Module 1.

What Is Multimedia?

Multimedia is a computer-based interactive communications process that incorporates text, graphics, sound, animation, and video.

Multimedia can have a many definitions these include:

Multimedia means that computer information can be represented through audio, video, and animation in addition to traditional media (i.e., text, graphics drawings, and images).

A good general definition is:

Multimedia is the field concerned with the computer-controlled integration of text, graphics, drawings, still and moving images (Video), animation, audio, and any other media where every type of information can be represented, stored, transmitted and processed digitally.

A ***Multimedia Application*** is an Application which uses a collection of multiple media sources e.g. text, graphics, images, sound/audio, animation and/or video.

Hypermedia can be considered as one of the multimedia applications.

Multimedia Systems

A *Multimedia System* is a system capable of processing multimedia data and applications.

A *Multimedia System* is characterized by the processing, storage, generation, manipulation and rendition of Multimedia information.

Characteristics of a Multimedia System

A Multimedia system has four basic characteristics:

- Multimedia systems must be ***computer controlled*.**
- Multimedia systems are ***integrated*.**
- The information they handle must be represented ***digitally*.**
- The interface to the final presentation of media is usually ***interactive*.**

Hypermedia

- Based on cognitive theories of how people structure knowledge and how they learn

- Links to navigate
- Non-sequential navigation

Hypermedia Applications

- **Instructional courseware**
  - Appropriately introduced
  - Follow-up activities
  - **Teacher and students' own creations**

Multimedia Advantages

- Engrossing – deep involvement
- Multi-sensory
- Creates knowledge connections
- Individualized
- Teacher and student creation

Multimedia Disadvantages

- "Lost in cyberspace"
- Lack of structure
- Non-interactive – if one-way, no feedback
- Text intensive content
- Complex to create
- Time consuming
- Cognitive overload
- Linear content

Multimedia Growth

- Marketing Standpoint
- User Standpoint
  - **User control**
    - No longer only lectures and/or printed materials
    - Any sequence of the material, any time, anywhere, any modality
  - **Individualization**
    - Address different learning styles and needs
    - User decides how material is presented: visual, audio, textual
    - Adjusting level of difficulty
  - **Action**
    - Active processes: simulations, acting out a play, testing knowledge and feedback

Major Categories of Multimedia Titles

- Entertainment
  - Games: action and graphics
  - Action + storytelling
  - Physical coordination + mental outwitting
- Education
  - Accommodates different learning styles: association vs. experimentation; auditory vs. visual
  - Provides feedback, levels of difficulty, evaluates skills, nonlinear presentations
- Corporate communications
  - Attract attention to a message
  - Product catalogs, published magazines, touch-screen kiosks, online shopping, …
  - Stockholder's meeting, sales rep pitch, conference speaker, employee orientation and training, …
- Reference
  - CD: encyclopedias, census data, directories, dictionaries

Multimedia Components and Applications

Components

Now let us consider the Components (Hardware and Software) required for a multimedia system:

- **Capture devices**
  - -- Video Camera, Video Recorder, Audio Microphone, Keyboards.
- **Storage Devices**
  - -- Hard disks, CD-ROMs, Zip drives, DVD, *etc*
- **Communication Networks**
  - -- Ethernet, Token Ring, FDDI, ATM, Intranets, Internets.
- **Computer Systems**
  - -- Multimedia Desktop machines, Workstations, MPEG/VIDEO/DSP Hardware
- **Display Devices**
  - -- CD-quality speakers, HDTV,SVGA, Hi-Res monitors, Colour printers *etc.*

Applications

Examples of Multimedia Applications include:

- World Wide Web
- Hypermedia courseware
- Video conferencing
- Video-on-demand
- Interactive TV
- Groupware
- Home shopping
- Games
- Virtual reality

- Digital video editing and production systems
- Multimedia Database systems

Benefits of Multimedia

Improves Learning

Numerous studies over the years have shown that interactive multimedia learning takes less time, is enjoyed more and increases learning. In a review of numerous meta-analysis studies Najjar (1996:30) found that "learning was higher when information was presented via computer-based multimedia systems than traditional classroom lectures".

Interactive

Interactivity is mutual action between the learner, the learning system, and the learning material. Numerous studies have found that interactivity has a strong positive effect on learning (Bosco, 1986, Fletcher, 1989, 1990, Stanfford, 1990). For example, Bosco (1986) reviewed 75 learning studies and found that learners learn faster, and have better attitudes toward learning when using interactive multimedia.

Flexible

Multimedia courseware on CD-ROM can be used at work on the desktop or at a learning centre, at home, while travelling, or to enhance facilitated management development programs. Multimedia courseware can also be used on networks, Intranets or the Internet. These distributed learning approaches allow for even more flexibility, but in the cases of Internets will involve much lower quality images and will preclude the use of video, at least in the near future. Multimedia courseware off-loads repetitive training tasks and frees facilitators to focus on company-specific, department-specific, or even team-specific issues.

Modular

Each topic or section can stand alone, so managers or trainers can delve deeply into the topic areas they need to learn, and skip over the ones they don't. In many cases applications include the option to custom build the application for your specific use where you can choose modules, and even edit the content in some fields.

Practical

It is capable of presenting true-to-life situations that learners face every day. Adults are very practical learners—they learn best when faced with real problems that have real consequences. Decision tree simulation, video simulations or simple animations allow learners to learn-by-viewing, learn-by-doing or learn-by-coaching. All are effective methods for developing practical skill and increasing information retention.

Consistent

All learners learn the same principles and skills. Computer-based courseware typically forces instructional designers to better organise and structure learning materials, and this alone can result in learning advantages.

Timely

Learners can turn to the program when situations arise on the job, or when they are faced with new or increased responsibilities. This is critical, since research has shown that learning is enhanced and better retained when the topic is relevant to current needs.

Engaging

Interactive learning with live-action video, audio, graphics, feedback, expert advice, and questions and answers keep learners interested and reinforces skills. Because it is exciting, challenging, and fun to use, it encourages learners to return to the program again and again. Through continual practice, learning is absorbed and integrated into daily performance.

Cost-effective

Multimedia courseware may have higher up-front development costs, but overall studies have shown that it is less expensive and more effective than traditional classroom learning only. There can also savings on expensive and time-consuming travel, lodging, facility rentals, the loss of productivity caused by sending learners away, and other expenses. The ability to practice new concepts in a risk-free environment improves learners' skills and ability. When using a built in course management system which collects and analyses learner delivery and performance data substantial administrative time savings result.

The Elements of Multimedia in Education

- It is very tempting to use the latest computer wizardry to represent information and develop computer enhanced learning materials.
- However, the instructional design of these systems should be based on a careful examination and analysis of the many factors, both human and technical, relating to visual learning.
- When is sound more meaningful than a picture?
- How much text is too much?
- Does the graphic overwhelm the screen?
- For a student, this allows them to test all of their skills gained in every subject area.
- Students must be able to select appropriate multimedia tools and apply them to the learning task within the learning environment in order for effective learning to take place.
- A Multimedia Learning environment involves a number of components or elements in order to enable learning to take place.

- Hardware and software are only part of the requirement. As mentioned earlier, multimedia learning integrates five types of media to provide flexibility in expressing the creativity of a student and in exchanging ideas (See Figure 1).

Text

- Out of all of the elements, text has the most impact on the quality of the multimedia interaction.
- Generally, text provides the important information.
- Text acts as the keystone tying all of the other media elements together.
- It is well written text that makes a multimedia communication wonderful.

Sound

- Sound is used to provide emphasis or highlight a transition from one page to another.
- Sound synchronized to screen display, enables teachers to present lots of information at once.
- This approach is used in a variety of ways, all based on visual display of a complex image paired with a spoken explanation (for example, art – pictures are 'glossed' by the voiceover; or math – a proof fills the screen while the spoken explanation plays in the background).
- Sound used creatively, becomes a stimulus to the imagination; used inappropriately it becomes a hindrance or an annoyance.
- For instance, a script, some still images and a sound track, allow students to utilize their own power of imagination without being biased and influenced by the inappropriate use of video footage.
- A great advantage is that the sound file can be stopped and started very easily.

Video

- The representation of information by using the visualization capabilities of video can be immediate and powerful.
- While this is not in doubt, it is the ability to choose how we view, and interact, with the content of digital video that provides new and exciting possibilities for the use of digital video in education.
- There are many instances where students, studying particular processes, may find themselves faced with a scenario that seems highly complex when conveyed in purely text form, or by the use of diagrams and images.
- In such situations the representational qualities of video help in placing a theoretical concept into context.
- Video can stimulate interest if it is relevant to the rest of the information on the page, and is not 'overdone'.
- Video can be used to give examples of phenomena or issues referred to in the text.

- For example, while students are reading notes about a particular issue, a video showing a short clip of the author/teacher emphasizing the key points can be inserted at a key moment; alternatively, the video clips can be used to tell readers what to do next.
- On the other hand, it is unlikely that video can completely replace the face-to-face lecture: rather, video needs to be used to supplement textual information.

Animation

- Animation is used to show changes in state over time, or to present information slowly to students so they have time to assimilate it in smaller chunks. Animations, when combined with user input, enable students to view different versions of change over time depending on different variables.
- Animations are primarily used to demonstrate an idea or illustrate a concept. Video is usually taken from life, whereas animations are based on drawings.
- There are two types of animation: Cel based and Object based. Cel based animation consists of multiple drawings, each one a little different from the others.
- When shown in rapid sequence, for example, the operation of an engine's crankshaft, the drawings appear to move.
- Object based animation (also called slide or path animation) simply moves an object across a screen. The object itself does not change.
- Students can use object animation to illustrate a point – imagine a battle map of Gettysburg where troop movement is represented by sliding arrows.

Graphics

- Graphics provide the most creative possibilities for a learning session.
- They can be photographs, drawings, graphs from a spreadsheet, pictures from CD-ROM, or something pulled from the Internet. With a scanner, hand-drawn work can be included.
- Standing commented that, "the capacity of recognition memory for pictures is almost limitless".
- The reason for this is that images make use of a massive range of cortical skills: color, form, line, dimension, texture, visual rhythm, and especially imagination.

Multimedia in CBT

What is CBT?

- CBT, or Computer Based Training is the presentation of training and education materials via the computer.
- CBT can take many forms, from simple presentation of information in a text based format, much like the printed page in a textbook, all the way to a full-blown multimedia courseware presentation complete with text, images, video, audio, interaction and user feedback.

Examples of CBT

Examples of where CBT may be utilized for training or education include:

- New Service Procedures
- Interactive Study Guides for Textbooks
- Math Tutorials
- Mandated Health and Safety Training
- Customer Relations Training
- New Product Introduction
- Introduction to new Company Policies and Procedures

It should be understood that CBT in itself, does not always constitute a total training solution. CBT should be considered a component of your complete training system, but for total effectiveness, other mediums are also often employed, such as print based support materials, stand-up presentation and reference materials.

Use of Multimedia in CBT

Multimedia in CBT can be used as follows:

- Access, Delivery, Scheduling and Recording
- Interactivity
- Improves Learning
- Flexible
- Modular
- Practical
- Consistent
- Timely
- Cost-effective

Authoring and Presentation

- The "Intelligent tutoring system" research community uses the term **authoring systems** to refer to a computer based system that allows a general group (including non-programmers) to create (i.e., author) content for intelligent tutoring systems. While a few intelligent tutoring systems have been successfully created, they are very costly to construct.

- Authoring and presentation systems are the software programs that allow people to create and deliver an experience for an end user.

- This can take many forms, from computer based training course to a room sized presentation or a virtual reality environment.

- The experience is an interactive one.

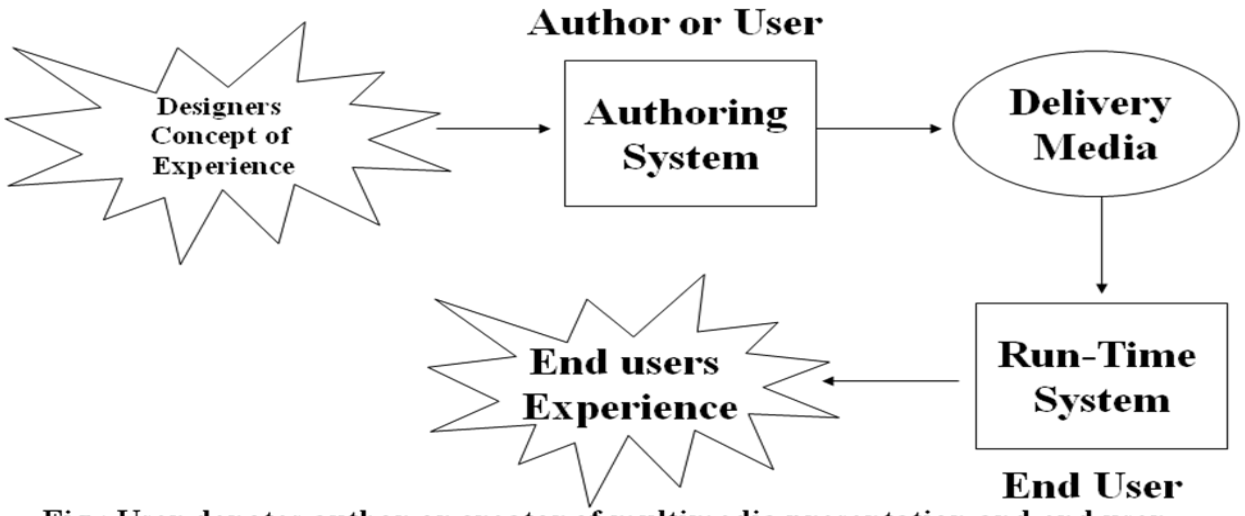


Fig.: User denotes author or creator of multimedia presentation and end user denotes consumer of the delivered presentation.

- Authoring and presentation systems are needed to create and present information on the computer because they provide an alternative to the custom programming of each end user experience.
- A Process that is usually slow, complicated and expensive.

- Authoring systems provide ways to generate common interactions through the use of reusable templates or software modules, which can be customized by the designers for a particular objective.

Example: Many training programs use a multiple choice question format. Authoring systems provide that format to a designer as a standard part of the system, which can be modified to produce many variations on the format.

Differences between Authoring and Presentation packages

- Authoring systems are designed to provide the tools for creating and organizing the data for a variety of media elements in order to produce an interactive application.

- Typically these applications are for education, professional training, public information kiosk, or retail marketing.

- The intended users of the software are usually instructional designers, professionals who develop educational or marketing presentations.

- Authoring software is designed to support the creation of an interactive non linear experience.

- The end user can make choices about where to go in the presentation, as well as how long to view each screen, the end users choices are refereed to as navigating.

- Authoring software for training supports testing of the end user, maintaining individual scores, and tracking the paths that users take through the material, known as courseware.

- From a commercial standpoint, authoring systems tend to be more expensive than presentation systems and have one price for the full authoring environment plus a per copy or site licence for a run time playback only module for each end user application.

- **Presentation** is the practice of showing and explaining the content of a topic to an audience or learner. A presentation program, such as Microsoft PowerPoint, is often used to generate the presentation content.

- A **presentation program** is a computer software package used to display information, normally in the form of a slide show. It typically includes three major functions: an editor that allows text to be inserted and formatted, a method for inserting and manipulating graphic images and a slide-show system to display the content.

- Presentation packages are designed to support the same media types, but without support for testing, scorekeeping, or tracking of end users.

- Some packages are intended for creation of simple linear presentations, which do not offer multiple pathways through the information.

- Presentation packages usually have a single price and simply offer different modes for creation and playback.

- Presentations are typically linear sequences of information, so the interfaces for users have often been organized along the time dimension.

- Current presentation packages allow users to construct interactive i.e. nonlinear, presentations that more closely resemble those produced by conventional authoring systems

Barriers to Widespread Use

In spite of recent advances in hardware and software technology, there are still substantial barriers to the widespread use and success of authoring and presentation systems. These issues are:

- Cost of acquisition, development, and delivery of multimedia material.
- Difficulties with production quality.
- Enforcement of intellectual property rights.

- Cost, availability, and ease of use tools.
- Lack of standards for delivery and interchange.
- Lack of clear vision for multimedia applications.

Multimedia Conferencing System

- Multimedia Conferencing System, MCS is the first of its kind to offer virtually unlimited multipoint-to-multipoint interactivity for notebook, desktop, boardroom and wireless in Boardroom or Enterprise.

- MCS is also already making a name for itself in the global marketplace with its other attractive features such as no call costs, low additional infrastructure needs, open-system hardware requirements and wireless capability.

- To enhance its unique multipoint-to-multipoint feature, MCS has add-on capabilities to cover special needs like multimedia collaboration (Microsoft Word, Excel and PowerPoint file-sharing), multiple-party file transfer, global roaming, document conferencing, background accounting and usage tracking. These modules are easily integrated into MCS as the needs of users change.

- MCS is well suited for intra-corporate meetings, distance learning, telemedicine and long-distance/ international desktop conferencing.

- At the same time, its relatively low system procurement and usage costs make MCS an excellent value investment for a far wider range of clientele.

Where to Use Multimedia

Multimedia in Business

- Business applications for multimedia include presentations, training, marketing, advertising, product demos, databases, catalogs, instant messaging, and networked communications.
- Voice mail and video conferencing are provided on many local and wide area networks using distributed networks and internet protocols.
- A multimedia presentation make an audience come alive.
- Most presentation software packages provide you the facility to add audio and video clips to the usual slide show of graphics and text material.
- Multimedia generally used in businesses, offices for various purposes.
- E.g. Image capture hardware is used for building employee ID, for video annotation, and for real time teleconferencing.
- Presentation documents attached to email and video conferencing is widely available.
- Laptop computers and high resolution projectors are commonplace for multimedia presentations on the road.
- Cell phones and personal digital assistants (PDAs) utilizing Bluetooth and Wi-Fi communications technology make communication and the pursuit of business more efficient.
- As companies and businesses catch onto the power of multimedia, the cost of installing multimedia decreases, meaning that more poser applications can be developed both in-house and third parties, which allows businesses to run more smoothly and efficiently.

Multimedia in Schools

- Teachers primarily require access to learning resources, which can support concept development by learners in a variety of ways to meet individual learning needs.
- The students become the core of the teaching, and teacher acts only as a guide.
- ITV (Interactive TV) is widely used among campuses to join students from different locations into one class with one teacher.

- In the online version of school, students can enroll at schools all over the world and interact with particular teachers and other students. Classes can be accessed at the convenience of the student's life style and the teacher may be relaxing on a beach and communicating via wireless system.

Multimedia at Home

- Multimedia entered into the home by providing an information from gardening, cooking, home design

Multimedia in Public Places

- Multimedia is used in hotels, train stations, shopping malls, museums, libraries, and grocery stores.
- Multimedia is available at stand-alone terminals or kiosks, providing information and help for customers.
- Multimedia is piped to wireless devices such as cell phones and PDAs. Such installations reduce demand on traditional information booths and personnel, add value and are available around the clock, even in the middle of the night, when live help is off duty.
- Kiosks in public places can make everyday life simpler.
- Supermarket kiosk provides services ranging from meal planning to coupons, purchasing items etc.
- Hotel kiosks list nearby restaurants, maps of the city, airline schedules, and provide guest services such as automated checkouts.
- Museum kiosks used to guide patrons through the exhibits, but when installed at each exhibit, providing great added depth, allowing visitors to browse through richly detailed information specific to that display.

Multimedia on Web

- Powerful multimedia tools can be used to create well designed web pages.
- We can develop and present the basic elements of multimedia within the constraints of HTML and the World Wide Web.
- Requirements:

- ❖ HTML: You should have a basic understanding of HTML before you begin developing multimedia for the web.

- ❖ HTML provides tags for inserting media into HTML documents:

For Example, <IMG> tag, <EMBED> tag, <BGCOLOR> tag, <BGSOUND> tag, <BACKGROUND>tag etc.

Educational Requirements

- Employing multimedia tools into the learning environment is a rewarding, but complex and challenging task.

- All of the multimedia formats available: text, sound, video, animation and graphics, already exist in one form or another in most libraries.

- Students can explore an almost infinite variety of information.

- All these explorations can certainly lead to new discoveries, but unless consumption is followed by production, the story ends.

- Without a chance to use their new discoveries and demonstrate what they have learned, the knowledge gained soon becomes the knowledge forgotten.

- Giving students an opportunity to produce multimedia documents of their own provides several educational advantages.

- Students work with the same information from four perspectives:

- 1) as researcher, they must locate and select the information needed to understand the chosen topic;

- 2) as authors, they must consider their intended audience and decide what amount of information is needed to give their readers an understanding of the topic;

- 3) as designers, they must select the appropriate media to share the concepts selected; and

- 4) as writers, they must find a way to fit the information to the container including the manner of linking the information for others to retrieve.

- When defining the appropriate medium to use it is vital to 'know' the audience and the technical specification of users' machines.

- There may be technical reasons for choosing which multimedia element will best communicate certain concepts.

- Whatever medium is chosen, to apply a principle mentioned above to all digital media elements, visuals must be congruent, relevant, and consistent with other information presented in order to be effective.

- Whatever the latest technological advance, instructional design principles apply.

- For example, care needs to be taken when using visuals for aesthetic reasons.

- The misuse of a single visual element can cause misrepresentation of information and become a barrier to content and impede learning, even if the program overall may, in all other aspects, follow the principles of instructional design.

- It is important to bear in mind the nature of the audience, especially their age group and culture mix.

Human – Computer Interface

- Multimedia applications like any other application, appliance or tool, benefit from being easy to use, with minimal training or self-learning.

- The need for a well designed human – computer interface, which may be screen or audio based is well accepted.

- The standards for computer- based publications are set by the publishers of books, music, Walt Disney cartoons and television producers.

- With the development of High Definition TV and beyond, it is likely that there will be a continual increase in the demands placed on computer based multimedia systems.

Access, Delivery, Scheduling and Recording

- On demand access times to computer information need to be below one second to be usable in real time.

- Alternatively the delivery of information at a later time is acceptable if it can be scheduled, as in a TV broadcast schedule. Scheduling can have advantages for users over on demand delivery.

- In open learning situations learners can control their program by requesting a multimedia unit at a convenient time.

- Computer users will wish to record a film, session, or learning experience for future reference.

Interactivity

- Computer based multimedia needs the same degree of interactivity that a school exercise book, or a laboratory experiment has in order to remain credible as a learning medium.

- Educationists have shown that certain forms of learning becomes easier, and is retained more permanently if the learner participates in some way with the learning material.

- The generation of computer based virtual reality is an extension of this process.

- The incorporation of interactivity is really the job of the application designer.

- The incorporation of interactivity is assisted if the network is capable of two-way communication, and for some applications the sense of interactivity is aided by the ability to deliver a moving picture, or a sound very quickly, so that a sense of two-way human participation can be generated. Real time video conferencing is an example.

Classroom Architecture and Resources

- The technology needed to support classroom teaching has increased in complexity.

- Until only a few years ago all that a lecture room needed were some seats for the students, and a blackboard and a lectern or table for the teacher.

- Then came the overhead projector, slide projector and the return of TV with video player.

- Now there is the computer, networks and related display tools.

- From having a next to zero maintenance cost, the teaching room is becoming not only costly to equip, but costly to run and maintain, including the escalating costs of security.

- Figure 2 shows a typical multimedia based educational environment.

- The main teaching spaces are equipped with a standard set of presentation equipment, and full details of what is, and is not, available in each room.

- The live lecture in the digital theater is concurrently broadcast to the remote distance-learning site.

- Even home-based students may join the live session.

- The ways in which users or participants in multimedia sessions access multimedia or connect with others have important consequences for the storage and transmission systems. For instance multimedia learning material can be accessed directly from a server during a class or downloaded to student machines prior to a session.

- The demands on a connecting network are very different in each access mode. Students learn to make use of multimedia as an aid to retrieving information from multiple sources such as digital libraries and multimedia servers that could support computer-assisted learning environments.

- Students learn to develop multimedia materials, especially as a component of project-based learning that is rooted in constructivism and in cooperative learning.

- Multimedia offers the lecturer many benefits including: satisfying educational objectives, increasing students understanding, demonstrating events, showing places, conducting experiments which would otherwise be impossible.

- Sharing of multimedia outputs is done carefully such that it will not disturb other learners working in the same classroom!

- Not only may a number of students be performing similar activities at the same time on a network, the lecturer must decide whether to control the activities via the media of the computer.

- The use of multi-party desktop conferencing with the lecturer chairing the running of the conferencing session, showing selected parts of a video is a case in point.

- Many school reform models focus on a significant restructuring of the classroom. They propose a shift from a teacher-centered didactic model to a learner-centered constructivist model. While details of these constructivist models vary, they typically include an emphasis on cooperative learning and on the use of project-based learning. Most types of school reform models recognize that multimedia brings a new dimension to reading and writing, and the need for students to develop basic skills in information retrieval in multimedia environments.

Training and Staff Development

- Of course all of these teaching innovations require a new methodology to support the technology. It requires a change of direction in terms of academic planning and lectures need to be carefully structured to maximize the benefits that interactive systems bring to teaching.

- The installation of any new technology inevitably brings with it the need for staff development courses, and the costs of such staff development should not be overlooked. With regards to presentation equipment within teaching spaces there are two main groups

of people who require training, the lecturers and the support staff, though increasingly students also seek training in presentation skills. The availability of standards for multimedia networking, particularly for inter-working between applications, the development of networked applications, and interworking between networks are essential to reduce the complexity and level of skill required in using multimedia.

Resources – WWW and Virtual Environments

- The World-Wide Web was created to support remote collaborative research, but it has developed primarily as a means of providing information that is linked to other information sources. It is an essential medium for accessing, delivering and exchanging information. The WWW provides a number of opportunities for teachers and students. Resources can be accessed which might otherwise have been unavailable. These include virtual libraries and museums. Other resources can be built up and used by students, for example questions and answers that can be searched or routed through to an expert if it is a new query and then the answer logged for future use. Teaching programs can be accessed and used by students as part of their modules.

- The Web can be thought of as a digital global multimedia library (See Figure 2). With the steadily increasing classroom use of multimedia resources, students are required to develop the skills needed to locate information contained in this format. Developing skills for locating and evaluating information requires learning to distinguish good multimedia from poor multimedia materials.

- Multimedia in education has the potential to go beyond the boundaries of interaction and explorative learning. The actors in the education community could establish a 'Virtual Education Space' (VES). A student can 'create' artifacts that reflect his/her understanding of concepts by combining text, voice and animation utilities. A teacher could customize lesson plans that can be individualized. Literally it is setting up an education lab to innovate and create.

Concerns

- The fusion of all types of media in a digital world captures the ethos of the new technological age. Multimedia: a combination of video, text, still images and sound can provide an effective learning aid. But the adage, "Putting computers into schools will directly improve learning," is negated by the reality that, "all this expensive technology will yield little educational return until schools and districts address the need for professional development, technical support, the availability of appropriate software, classroom management, and curriculum integration."

- The full potential of using multimedia technologies for learning in primary and secondary schools can only be realized after there has been some re-engineering of the way learning experiences are offered in the traditional schools and colleges. A critical element is for

teachers to be familiar with multimedia technologies in order for them to know how to use them within their curriculum areas.

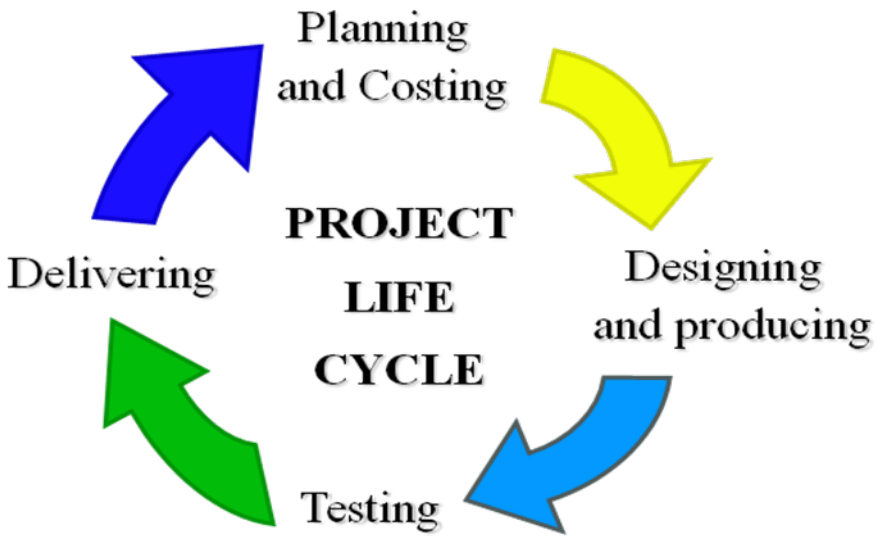
- Moreover, the freedom of the Internet has some disadvantages. There is too much information on the Internet. Students must decide what information they need and what they do not need. The quality of the information can also be misleading. Students must be taught how to distinguish between quality and unimportant information. Since no rules exist on the Internet in terms of what can and cannot be disclosed, anyone can put any material on the Internet.

Multimedia Project Life Cycle

The Stages of a Project

- A project life cycle is simply a series of orderly, interrelated activities leading to a successful completion of a project.
- A periods of time during which these activities takes place are called phases/ stages.
- Following are the four basic stages in a multimedia project:

    1. Planning and costing
    2. Designing and producing
    3. Testing
    4. Delivering



Stages of Multimedia Project

What we need

To build up a multimedia project, we need,

1. Hardware
2. Software
3. Creativity

Multimedia Skills

- To produce a good multimedia, you will need a good set of skills – detailed knowledge of computers, text, graphic arts, sound and video.

- These skills i.e. multimedia skills set, may be available in a single individual or more likely, in a composite of individuals working as a team.

Individual Skill Sets:

1. Project Manager:

- Responsible for the overall development and implementation of project as well as day-to-day operations.

- Budgets, schedules, creative sessions, time sheets, illness, invoices, and team dynamics - the project manager is the person that holds these together.

- A subject matter expert

2. Multimedia Designer:

The look and feel of a multimedia project should be pleasing and aesthetic, as well as inviting and engaging. Screens should present an appealing mix of color, shape, and type. The project should maintain

1. Visual consistency
2. Navigation clues should be clear and consistent
3. Icons should be meaningful
4. Screen elements should be simple and straightforward.

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- Graphic designers, illustrators, animators, and image processing specialists deal with the visuals.

- Instructional designers are specialists in education or training and making sure that the subject matter is clear and properly presented for the intended audience.

- Interface designers devise the navigation pathways and content maps.

- Information designers structure content, determine user pathways and feedback, and select presentation media based on awareness of the strength of the many separate media that make up multimedia.

3. Writer:

- Writing proposals
- They script voice overs and actors narrations
- They write text screens to deliver messages
- They develop character designed for an interactive environment.
- They collect information from content experts, synthesize it, and then communicate it in a clear and concise manner.
- Writers of text screens are sometimes referred to as content writers.

4. Video Specialists:

- Responsible for an entire team of videographers, sound technicians, lightening designers, set designers, script supervisors, gaffers, grips, production assistants, and actors.
- A video specialist may shoot and edit all of the footage without outside help.

5. Audio Specialists:

- Audio specialists are the wizards who make a multimedia program come alive, by designing and producing music, voice-over narrations and sound effects.
- They perform a variety of functions on the multimedia team and may help from one or many others, including composers, audio engineers, or recording technicians.
- They are responsible for locating and selecting suitable music and talent, scheduling recording sessions, and digitizing and editing recorder material into computer files.

6. Multimedia Programmer:

- A multimedia programmer or software engineer integrates all the multimedia elements of a project into a seamless whole using an authoring system or programming language.
- Codes may be written in JavaScript, Java, C++ or any programming language. They mus have a programming skill.
- Multimedia programming functions range from coding simple displays of multimedia elements to controlling peripheral devices such as CD or DVD players.
- They are responsible for complex timing, transitions and record keeping

Module 2

- Multimedia Elements

Images

- Images may in black and white, full of sharp angles, or softened with gray scale.
- The computer screen may consists of images, audio, videos, graphics and animations in cluding text.
- It contains much more than your message.
- Multimedia screen is the viewers primary connection to all of your projects contents.

How to Start to Create Images

1. Plan Your Approach : Work out your graphic approach before you begin, either in your head or during creative sessions with your client or colleagues.
2. Organize your Tools: Most authoring systems provide the tools with which you can create the graphic objects of multimedia (text, interactive buttons, bitmaps, sound, animations etc.)
3. Using Monitors: Using high resolution monitor.

Bitmaps:

- A bit is the simplest element in the digital world, an electronic digit that is either on or off, black or white, or true(1) or false (0). This is referenced to as binary, since only two states (on or off) are available.
- A map is a two-dimensional matrix of these bits.
- A bitmap, then, is a simple matrix of the tiny dots that form an image and are displayed on a computer screen.
- A bitmap is a simple information matrix describing the individual dots of an image, called pixels.
- The image's bit-depth determines the number of colors that can be displayed by an individual pixel.

- A one dimensional (1-bit depth) is used to display monochrome images – a bitmap where each bit is most commonly set to black or white.

- We can represent images with varying shades of color (4 bits for 16 colors; 8 bits for 256 colors; 15 bits for 32,768 colors; 16 bits for 65,536 colors; 24 bits for 16,772,216 colors).

Vector Drawing

Most multimedia authoring systems provide for use of vector-drawn objects such as lines, rectangles, ovals, polygons, complex drawing created from those objects, and text.

- Computer aided design (CAD) programs have traditionally used vector-drawn object systems for creating the highly complex and geometric renderings needed by architects and engineers.

- Programs for 3-D animation also use vector-drawn graphics. For example, the various changes of position, rotation, and shading of the light required to spin an excluded corporate logo must be calculated mathematically.

How Vector Drawing Works

- A vector is a line that is described by the location of its two endpoints. A simple rectangle, for example, might be defined as follows,
  RECT 0, 0, 200, 200

- Using cartesian coordinates, your software will draw a rectangle (RECT) starting at the upper-left corner of your screen (0,0) and going 200 pixels horizontally to the right and 200 pixels downward (200,200) to mark the opposite corner.

- You may draw a same square with a red boundary line and fill the square with the color blue as follows,
  RECT 0,0,200,200,RED,BLUE

- Cartesian coordinates are a pair of numbers that describe a point in two-dimensional space as the intersection of horizontal and vertical lines (the x and y axes).They are listed in a order x,y.

- In three-dimensional space, a third dimension, depth, is described by the z axis (x,y,z).

Vector-Drawn Objects Vs Bitmaps

Bitmap Graphics:

- Bitmap graphics are the most common graphic format in use on the web and, indeed, on the computer. With the exception of Flash and the still relatively unsupported .svg (scalable vector graphic) format, every single graphic seen on the web is a Bitmap.

- Bitmap graphics are composed of pixels, each of which contains specific color information. A pixel is minutely small; a single image may be composed of hundreds of thousands of individual pixels. Much like cells revealed from a piece of tissue when seen under a microscope, these pixels are only clearly and individually visible when the image is magnified (fig 1).

- A graphic composed entirely of pixels each with its own color properties is ideal for photographic images where there are thousands, even millions of different colors. Complex fills, shading and gradient effects can easily be rendered. The Bitmap image offers as much freedom as an empty canvas.

- In Bitmap graphics, there is an immutable connection between pixels and the image they compose. When a Bitmap graphic is saved, the computer is really saving an exact visual picture of the image: this pixel goes here and is this color; this pixel goes there and is that color, and so on and so on.

- This connection is responsible for the effects seen when resizing a bitmap graphic. Given three image sizes - an original, one smaller, and one larger - each will naturally contain a different number of pixels. Pixels do not change sizes, but the image has. It takes more pixels to fill the volume of a larger space, fewer to fit into a smaller space. (fig 2)

- Making an existing Bitmap graphic smaller is a process of reduction; pixels are removed from the image until it fits the new size. Computers are well equipped to perform this task. An image can be sized smaller repeatedly and still maintain the same quality, up until the point where there are not enough pixels available to reproduce the image clearly.

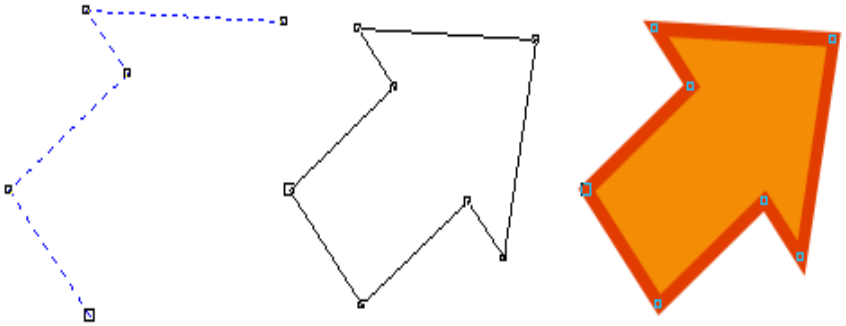
- At any given size, a Bitmap graphic contains exactly the amount of information (pixels) required to display it. No more and no less. Increasing the size of a Bitmap Graphic is akin to pouring a drink from a smaller glass to a larger one. For the drink to occupy the full volume of the larger glass, we must add additional fluid. The original concoction is diluted, the flavor weakened.

- In the same way, the computer must add additional information (pixels) to the original image to allow it to fill the new larger area. Since there is no source for this information, it must be interpolated based on what is currently available in the image. Because the computer is not especially skilled at guessing games, Bitmap images that have been scaled larger are frequently blurry. After extreme size increases, individual pixels

"blocks" are more apparent (as though we held a magnifying glass up to it) and the image is said to be pixilated. Slight blurriness can be combated by sharpening the image with the filters provided within many graphic programs, but an enlarged image will never be as clear as the smaller original. This blurriness also occurs for the same reason any time a Bitmap graphic is manipulated, by rotating, skewing or distorting.

Vector Graphics

- Rather than being composed of pixels, Vector graphics consist of points, lines, and curves which, when combined, can form complex objects (fig 3). These objects can be filled with solid colors, gradients, and even patterns.
  Figure 3



- Vector graphics are mathematical creations. For this reason, the programs that are used to create them save instructions on how the image should be drawn, rather than how it looks.

- A vector graphic resized to 5 times its original dimensions is simply reproduced, exactly, at the new size.

- It can also be freely manipulated without losing coherence, like a rubber band that can be stretched an infinite number of ways.

- The price of this scaling flexibility is that Vector images must remain relatively simple in comparison to Bitmap images.

- Vector graphics are ideal for producing artwork which frequently needs to be presented in different sizes or colors.

- Logos especially fall into this category. A logo produced with a vector application can be blown up to fit on a billboard or scaled down to adorn a letterhead with no loss of quality.

Summary:

- Vector drawn objects use a fraction of the memory space required to describe and store the same object in bitmap form whereas bitmap image require more memory space.

- The bitmap images loses clarity when resizing whereas a vector graphic resized to 5 times its original dimensions is simply reproduced, exactly, at the new size.

- Web pages uses vector graphics in plug ins Flash download faster and when used for animation, draw faster than pages displaying bitmaps.

- Vector objects are easily scalable without loss of resolution or image quality.

Converting Between Bitmaps and Drawn Images

- The only way to convert a Bitmap image to a Vector image is to trace the image using either a manual process or automatic program.

- The tracing process attempts to duplicate the shapes of a Bitmap image using Vector lines and curves.

- When Vector graphics are pasted or imported into Bitmap editors, however, the opposite is true. The editor converts the vector image to Bitmap as soon as it is brought in.

- Vector image is converted to Bitmap, there is no way to return to the original state. For this reason, Designers keep copies of the original vector artwork when converting an image to a bitmap file format.

- Converting bitmaps to objects is more difficult. Programs and utilities that will compute the bounds of a bitmapped image or the shapes of colors within an image and then derive the polygon object that describes the image. This procedure is called **autotracing.**

- This facility is available in vector drawing applications such as Illustrator or Freehand.
- Flash has a Trace Bitmap menu option that converts a bitmapped image into a vector image.

Image File Formats

Windows Formats

- The device independent bitmap (DIB) is windows common image file format, usually written as BMP files.

- DIBs can stand alone, or they can be buried within a Resource Interchange File Format (RIFF) file.

- RIFF is actually the preferred file type for all multimedia development in Windows, bacause this format was designed to contain many types of files, including bitmaps, MIDI scores and formatted text.

- The bitmap formats used most often by Windows developers are DIB, BMP, PCX, and TIFF.

Windows formats are classified into:

1. **Raster Formats**
2. **Vector Formats.**

1. Raster Formats

A raster graphics image or bitmap is a data structure representing a generally rectangular grid of pixels, or points of color, viewable via a monitor, paper, or other display medium.

BMP

- A BMP file is a windows bitmap file.
- Typically, BMP files are uncompressed, hence they are large; the advantage is their simplicity, wide acceptance, and use in Windows programs.

PCX (Personal Computer Exchange)

- PCX files are originally developed for use in Z-Soft MS-DOS paint packages.
- These files can be opened and saved by almost all MS-DOS paint software and desktop publishing software.

TIFF (Tagged Interchange File Format)

- TIFF was designed to be a universal bitmapped image format and is also used extensively in desktop publishing package.
- TIFF is a flexible format that normally saves 8 bits or 16 bits per color (red, green, blue) for 24-bit and 48-bit totals, respectively, using either the **TIFF** or the **TIF** filenames.

PSD (Photoshop Document)

- Adobe creates a PSD file for photoshop.
- PSD format is widely used, and it is supported to some extent by most competing software.

AIX

- Adobe creates AIX file for Illustrator.

CDR

- Corel creates a CDR file for CorelDraw

DSF and PPF

- Micrographics Designer and Picture Publisher applications use DSF and PPF files.

If you import your artwork into other programs, such as multimedia authoring systems, be sure you save your bitmaps in a format that can be imported by that application.

2. Vector Formats

Vector graphics is the use of geometrical primitives such as points, lines, curves, and shapes or polygons, which are all based on mathematical equations, to represent images in computer graphics.

CGM (Computer Graphics Metafile)

- CGM is a file format for 2D vector graphics, raster graphics, and text and is defined by ISO/IEC 8632.
- CGM provides a means of graphics data interchange for computer representation of 2D graphical information independent from any particular application, system, platform, or device.

SVG (Scalable Vector Graphics)

- is an open standard created and developed by the World Wide Web Consortium to address the need (and attempts of several corporations) for a versatile, scriptable and all-purpose vector format for the web and otherwise.

Cross-Platform Formats

- For handling drawn objects across many platforms, there are two common formats:
    1. DXF
    2. IGS

- DXF was developed by AutoDesk as an ASCII based drawing interchange file for AutoCAD, but the format is used today by many computer aided design applications.

- IGS or IGES, Initial Graphics Exchange Standard, was developed by an industry comitee as a broader standard for transfering CAD drawings. These formats are also used in 3-D rendering and animation programs.

- **JPEG (Joint Photographic Experts Group)** files are (in most cases) a lossy format; the DOS filename extension is **JPG** (other operating systems may use **JPEG**). Nearly every digital camera can save images in the JPEG format, which supports 8 bits per color (red, green, blue) for a 24-bit total, producing relatively small files.

- **GIF (Graphics Interchange Format)** is limited to an 8-bit palette, or 256 colors. This makes the GIF format suitable for storing graphics with relatively few colors such as simple diagrams, shapes, logos and cartoon style images.

JPEG and GIF are considered cross platform, as all browsers will display them.

- **PDF (Portable Document File)** file manages both bitmaps and drawn art as well as text and other multimedia content) and is commonly used to deliver a "finished product" that contains multiple assets

Macintosh Formats

- In Macintosh every application can import or export PICT files.

- PICT is complicated but versatile format developed by Apple as a common format always available to Macintosh users.

- In PICT file, both bitmaps and vector-drawn objects can live side by side, and programs such as revolution or canvas make use of these feature, providing editors for both drawn and bitmapped graphics.

- Many drawing programs for Macintosh, such as Illustrator or Freehand, will allow you to import a bitmap but offer no facility for editing it.

- Multimedia authoring programs that can import PICT images may not utilize the drawn objects that are part of the file, but will usually convert them to bitmaps for you.

Animation

- Animation makes static presentations alive.

- It is a visual change over time and can add great power to your multimedia.

- Animation is an object actually moving across or into or out of the screen.

- **Animation** is the rapid display of a sequence of images of 2-D or 3-D artwork or model positions in order to create an illusion of movement.

- Animation is possible because of a biological phenomenon known as **persistence of vision** and a psychological phenomenon called **phi.**

Principles of Animation

The 12 basic principles of animation is a set of principles of animation introduced by the **Disney animators Ollie Johnson and Frank Thomas** in their **1981** book **The Illusion of Life: Disney Animation**

Basic Principles of Animation

1. Squash and stretch
2. Anticipation
3. Staging
4. Straight Ahead Action and Pose to Pose
5. Follow Through and Overlapping Action
6. Slow In and Slow Out
7. Arcs
8. Secondary Action
9. Timing
10. Exaggeration
11. Solid Drawing
12. Appeal

1. SQUASH AND STRETCH

This action gives the illusion of weight and volume to a character as it moves. Also squash and stretch is useful in animating dialogue and doing facial expressions. How extreme the use of squash and stretch is, depends on what is required in animating the scene. Usually it's broader in a short style of picture and subtler in a feature. It is used in all forms of character animation from a bouncing ball to the body weight of a person walking. This is the most important element you will be required to master and will be used often.

2. ANTICIPATION

This movement prepares the audience for a major action the character is about to perform, such as, starting to run, jump or change expression. A dancer does not just leap off the floor. A backwards motion occurs before the forward action is executed. The backward motion is the anticipation. A comic effect can be done by not using anticipation after a series of gags that used anticipation. Almost all real action has major or minor anticipation such as a pitcher's wind-up or a golfers' back swing. Feature animation is often less broad than short animation unless a scene requires it to develop a characters personality.

3. STAGING

A pose or action should clearly communicate to the audience the attitude, mood, reaction or idea of the character as it relates to the story and continuity of the story line. The effective use of long, medium, or close up shots, as well as camera angles also helps in telling the story. There

is a limited amount of time in a film, so each sequence, scene and frame of film must relate to the overall story. Do not confuse the audience with too many actions at once. Use one action clearly stated to get the idea across, unless you are animating a scene that is to depict clutter and confusion. Staging directs the audience's attention to the story or idea being told. Care must be taken in background design so it isn't obscuring the animation or competing with it due to excess detail behind the animation. Background and animation should work together as a pictorial unit in a scene.

4. STRAIGHT AHEAD AND POSE TO POSE ANIMATION

Straight ahead animation starts at the first drawing and works drawing to drawing to the end of a scene. You can lose size, volume, and proportions with this method, but it does have spontaneity and freshness. Fast, wild action scenes are done this way. Pose to Pose is more planned out and charted with key drawings done at intervals throughout the scene. Size, volumes, and proportions are controlled better this way, as is the action. The lead animator will turn charting and keys over to his assistant. An assistant can be better used with this method so that the animator doesn't have to draw every drawing in a scene. An animator can do more scenes this way and concentrate on the planning of the animation. Many scenes use a bit of both methods of animation.

5. FOLLOW THROUGH AND OVERLAPPING ACTION

When the main body of the character stops all other parts continue to catch up to the main mass of the character, such as arms, long hair, clothing, coat tails or a dress, floppy ears or a long tail (these follow the path of action). Nothing stops all at once. This is follow through. Overlapping action is when the character changes direction while his clothes or hair continues forward. The character is going in a new direction, to be followed, a number of frames later, by his clothes in the new direction. "DRAG," in animation, for example, would be when Goofy starts to run, but his head, ears, upper body, and clothes do not keep up with his legs. In features, this type of action is done more subtly. Example: When Snow White starts to dance, her dress does not begin to move with her immediately but catches up a few frames later. Long hair and animal tail will also be handled in the same manner. Timing becomes critical to the effectiveness of drag and the overlapping action.

6. SLOW-OUT AND SLOW-IN

As action starts, we have more drawings near the starting pose, one or two in the middle, and more drawings near the next pose. Fewer drawings make the action faster and more drawings make the action slower. Slow-ins and slow-outs soften the action, making it more life-like. For a gag action, we may omit some slow-out or slow-ins for shock appeal or the surprise element. This will give more snap to the scene.

7. ARCS

All actions, with few exceptions (such as the animation of a mechanical device), follow an arc or slightly circular path. This is especially true of the human figure and the action of animals. Arcs give animation a more natural action and better flow. Think of natural movements in the terms of a pendulum swinging. All arm movement, head turns and even eye movements are executed on an arcs.

8. SECONDARY ACTION

This action adds to and enriches the main action and adds more dimension to the character animation, supplementing and/or re-enforcing the main action. Example: A character is angrily walking toward another character. The walk is forceful, aggressive, and forward leaning. The leg action is just short of a stomping walk. The secondary action is a few strong gestures of the arms working with the walk. Also, the possibility of dialogue being delivered at the same time with tilts and turns of the head to accentuate the walk and dialogue, but not so much as to distract from the walk action. All of these actions should work together in support of one another. Think of the walk as the primary action and arm swings, head bounce and all other actions of the body as secondary or supporting action.

9. TIMING

Expertise in timing comes best with experience and personal experimentation, using the trial and error method in refining technique. The basics are: more drawings between poses slow and smooth the action. Fewer drawings make the action faster and crisper. A variety of slow and fast timing within a scene adds texture and interest to the movement. Most animation is done on twos (one drawing photographed on two frames of film) or on ones (one drawing photographed on each frame of film). Twos are used most of the time, and ones are used during camera moves such as trucks, pans and occasionally for subtle and quick dialogue animation. Also, there is timing in the acting of a character to establish mood, emotion, and reaction to another character or to a situation. Studying movement of actors and performers on stage and in films is useful when animating human or animal characters. This frame by frame examination of film footage will aid you in understanding timing for animation. This is a great way to learn from the others.

10. EXAGGERATION

Exaggeration is not extreme distortion of a drawing or extremely broad, violent action all the time. It¹s like a caricature of facial features, expressions, poses, attitudes and actions. Action traced from live action film can be accurate, but stiff and mechanical. In feature animation, a character must move more broadly to look natural. The same is true of facial expressions, but the action should not be as broad as in a short cartoon style. Exaggeration in a walk or an eye movement or even a head turn will give your film more appeal. Use good taste and common sense to keep from becoming too theatrical and excessively animated

11. SOLID DRAWING

The basic principles of drawing form, weight, volume solidity and the illusion of three dimension apply to animation as it does to academic drawing. The way you draw cartoons, you draw in the classical sense, using pencil sketches and drawings for reproduction of life. You transform these into color and movement giving the characters the illusion of three-and four-dimensional life. Three dimensional is movement in space. The fourth dimension is movement in time.

12. APPEAL

A live performer has charisma. An animated character has appeal. Appealing animation does not mean just being cute and cuddly. All characters have to have appeal whether they are

heroic, villainous, comic or cute. Appeal, as you will use it, includes an easy to read design, clear drawing, and personality development that will capture and involve the audience¹s interest. Early cartoons were basically a series of gags strung together on a main theme. Over the years, the artists have learned that to produce a feature there was a need for story continuity, character development and a higher quality of artwork throughout the entire production. Like all forms of story telling, the feature has to appeal to the mind as well as to the eye.

Animation Types and Techniques

The three general types/ techniques of Animation are:

1.) Cell Animation

Drawings are made on transparent sheets (celluloid) which may then be laid on top of each other to combine characters and backgrounds

2.) Stop Motion Animation

A model or puppet (shadow puppets were used in early stop motion) is shot a frame at a time, with tiny changes in position being made between each frame

3.) Computer Animation

Computers can be used to entirely create the shapes and colors of animated action, working from a series of mathematical codes, or they can be used to enhance hand-drawn characters.

1. **TRADITIONAL ANIMATION / CELL ANIMATION / HAND-DRAWN ANIMATION**

- Traditional animation was the process used for most animated films of the 20th century.
- The individual frames of a traditionally animated film are photographs of drawings, which are first drawn on paper.
- To create the illusion of movement, each drawing differs slightly from the one before it.
- The animators' drawings are traced or photocopied onto transparent acetate sheets called cels, which are filled in with paints in assigned colors or tones on the side opposite the line drawings.
- The completed character cels are photographed one-by-one onto motion picture film against a painted background by a rostrum camera.

- Cell animation artwork begins with **keyframes** (the first and last frame of an action)
- The series of frames in between the keyframe are drawn in a process called **tweening.**
- Tweening is an action that requires calculating the number of frames between keyframes and the path the actions takes, and then actually sketching with pencil the series of progressively different outlines.

2. STOP ANIMATION

Stop Motion Animation

- Stop motion (or frame-by-frame) is an animation technique to make a physically manipulated object appear to move on its own.
- The object is moved in small increments between individually photographed frames, creating the illusion of movement when the series of frames is played as a continuous sequence.
- These animations are,used to describe animation created by physically manipulating real-world objects and photographing them one frame of film at a time to create the illusion of movement.
- There are many different types of stop-motion animation, usually named after the type of media used to create the animation.
- Computer software is widely available to create this type of animation.

Clay Animation

- **Clay animation**, or Plasticine animation often abbreviated as *claymation*, uses figures made of clay or a similar malleable material to create stop-motion animation.
- The figures may have an armature or wire frame inside of them, similar to the related puppet animation (below), that can be manipulated in order to pose the figures.

3. COMPUTER ANIMATION

- Computer animation encompasses a variety of techniques, the unifying factor being that the animation is created digitally on a computer.

2D Animation

- 2D animation figures are created and/or edited on the computer using 2D bitmap graphics or created and edited using 2D vector graphics.

- This includes automated computerized versions of traditional animation techniques such as of kinematics, tweening, morphing and onion skinning

Kinematics:

- Kinematics is the study of the movement and motion f structures that have joints, such as walking man.
- Animating a walking step is tricky; you need to calculate the position, rotation, velocity, and acceleration of all joints and articulated parts involved (knees bend, shoulders swing).
- Inverse kinematics, available in high-end 3D programs such as Lightwave, and Maya, is the process by which you link objects such as hands to arms and define their relationships and limits.

Morphing:

- Morphing is a popular effect in which one image transforms into another
- Morphing applications and other modeling tools that offer this effect can transition not only between still images but often between moving images as well

Tweening:

- ***Tweening*** is the process of generating intermediate frames between two images to give the appearance that the first image evolves smoothly into the second image.

Onion skinning

- Onion skinning is a 2D computer graphics term for a technique used in creating animated cartoons and editing movies to see several frames at once. This way, the animator or editor can make decisions on how to create or change an image based on the previous image in the sequence.

3D Animation

- 3D animation digital models manipulated by an animator. In order to manipulate a mesh, it is given a digital skeletal structure that can be used to control the mesh. This process is called rigging. Various other techniques can be applied, such as mathematical functions (ex. gravity, particle simulations), simulated fur or hair, effects such as fire and water and the use of Motion Capture to name but a few, these techniques fall under the category of 3d dynamics. Many 3D animations are very believable and are commonly used as Visual effects for recent movies.

Animation File Formats

Some files formats are designed specifically to contain animations, so they can be ported among applications and platforms with the proper translators. Those Formats include:

1. Director (.dir and .dcr)
2. AnimatorPro (.fli using 320 x 200 pixel images and .flc)
3. 3D Studio Max (.max)
4. SuperCard and Director (.pics)
5. CompuServe GIF89a (.gif) and
6. Flash (.fla and .swf)

- As file size is a critical factor when downloading animations to play on web pages, file compression is an essential part of preparing animations files for the web.
- A Director's native file (.dir) must be preprocessed and compressed into proprietary Shockwave animation file (.dcr) for the web.
- Compression for Director movies is much as 75% or more with this tool, turning 100K files into 25K files, and significantly speeding up download/ display times on the internet.
- Flash, widely used for web-based animation, makes extensive use of vector graphics to keep the post-compression file size at absolute minimums.
- The flash files, .fla must be converted to Shockwave Flash files (.swf) in order to play on the web. To view these animations within a web page, special plug-ins or players are required.
- In some cases, especially with 3D animations, the individual rendered frames of an animation are put together into one of the standard digital video format, such as the Windows Audio Video Interleaved format (.avi), QuickTime (.qt, .mov), or Motion Picture Experts Group video (.mpeg or .mpg).
- These can be played using the media players shipped with computer operating systems.

Text

In this module we will discuss:

1. The importance of text in a multimedia presentation
2. Discuss the attributes of text, for example, font, typeface, kerning, leading and color.
3. Describe the difference between Sarif/Sans Sarif.
4. List different design factors with text.
5. Describe how to convert a Word document to HTML for importing into Blackboard CE6.

The Power of Text

- Reading and writing are expected and necessary skills within most modern cultures.

- Text and the ability to read it are doorways to power and knowledge.

- With the World Wide Wed, text has become more important than ever. The native language for the web is HTML (Hypertext Markup Language)

In multimedia it is important to cultivate accuracy in words you choose. Words will appear in:

- Titles
- Menus
- Navigation aids
- Narrative or content

Text Attributes

1. Font
2. Typeface
3. Tracking
4. Kerning
5. Leading
6. Color

1. Font

- A collection of characters of a single size and style belonging to a particular typeface family.

- Expressed in point; one point is .0138 inch.

2. Typeface

- Typeface is a family of graphic characters that usually includes many type sizes and styles.

3. Tracking

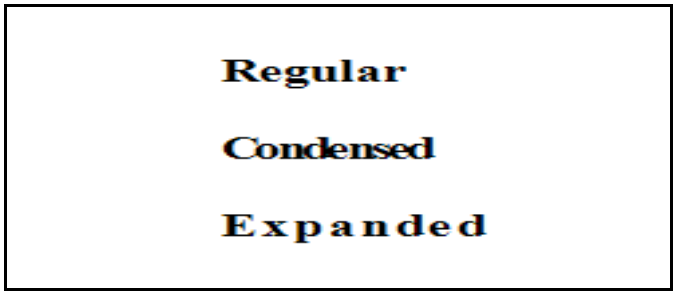
- Tacking: Spacing between the characters.

Tighter Track

L o o s e r T r a c k

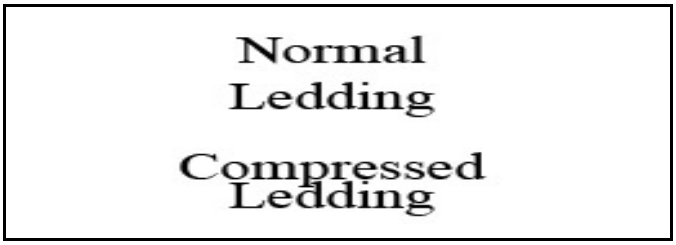
4. Kerning

- Kerning: The spacing between character pairs.



5. Leading

- Leading: The space between lines of text sometimes called the line spacing.



6. Color

- Consider using color to make your type stand out or be more legible. Use black on white whenever possible. Avoid conflicting colors like red on purple.

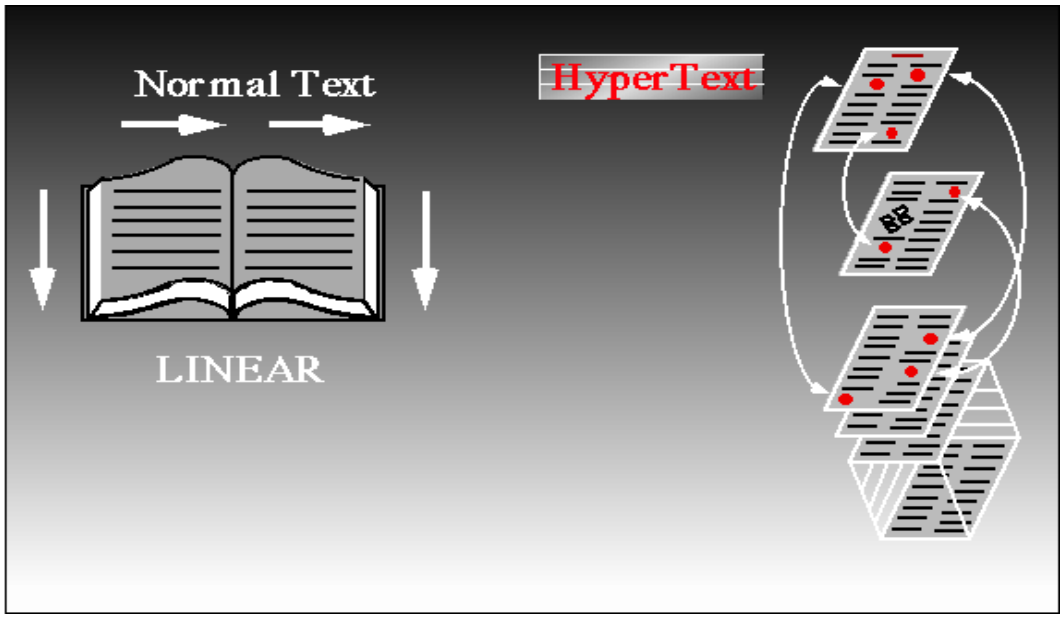
- Don't use color to convey a message – your user might be color blind.

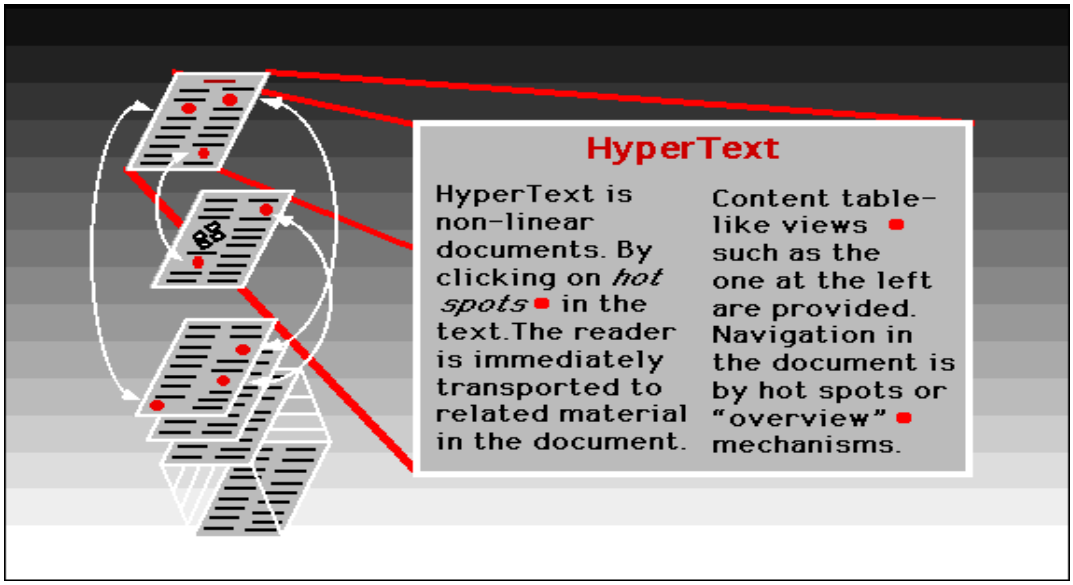
Hypermedia and Hypertext

Hypertext

- *Hypertext* is a text which contains links to other texts. The term was invented by Ted Nelson around 1965.

- Hypertext is therefore usually non-linear (as indicated below).

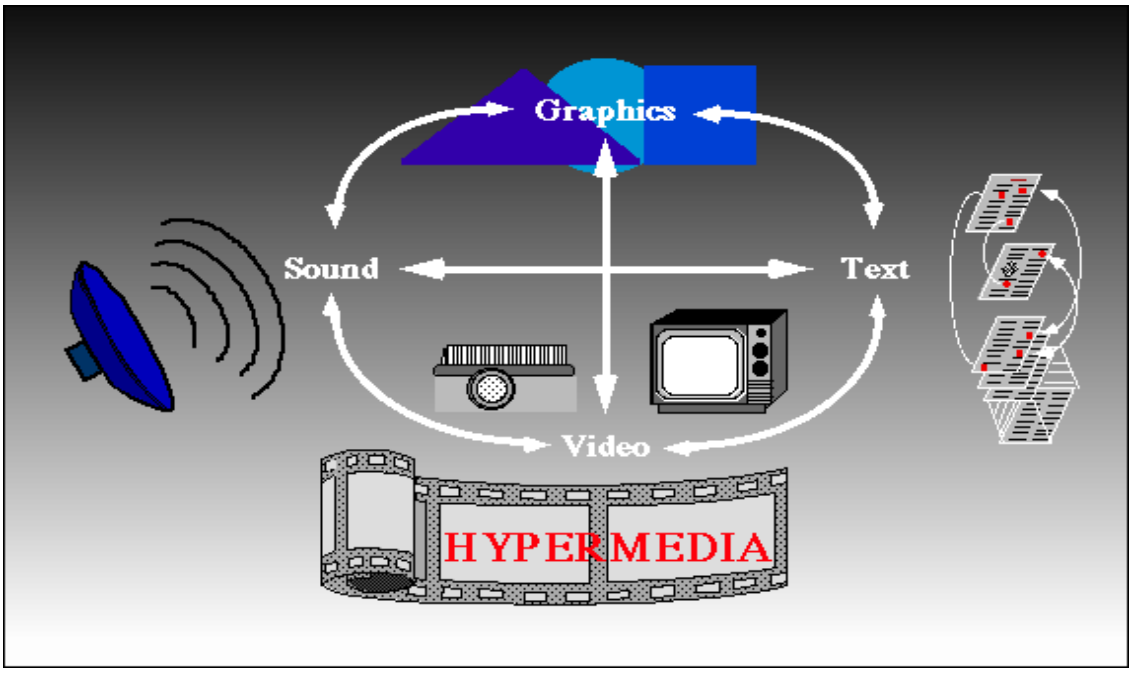




Hypermedia

- *HyperMedia* is not constrained to be text-based. It can include other media, e.g., graphics, images, and especially the continuous media - sound and video. Apparently, Ted Nelson was also the first to use this term.

- The World Wide Web (WWW) is the best example of hypermedia applications.



Hypermedia Applications

- **Instructional courseware**
  - Appropriately introduced
  - Follow-up activities
  - Teacher and students' own creations

Module 3

- Sound, Audio and Video

System Sounds

- **Sound** is a traveling wave which is an oscillation of pressure transmitted through a solid, liquid, or gas, composed of frequencies within the range of hearing and of a level of sufficiently strong to be heard, or the sensation stimulated in organs of hearing by such vibrations.

- When something vibrates in the air by moving back and forth, it creates waves of pressure. These waves spread, and when they reach your eardrums, you experience the vibration as sound.

- Acoustics is the branch of physics that studies sound.

- Sound pressure levels (loudness or volume) are measures in decibels (dB).

- Sounds are pressure waves of air. If there wasn't any air, we wouldn't be able to hear sounds. There's no sound in space.

- We hear sounds because our ears are sensitive to these pressure waves.

- **Example:** the easiest type of sound wave to understand in a short, sudden event like a clap.

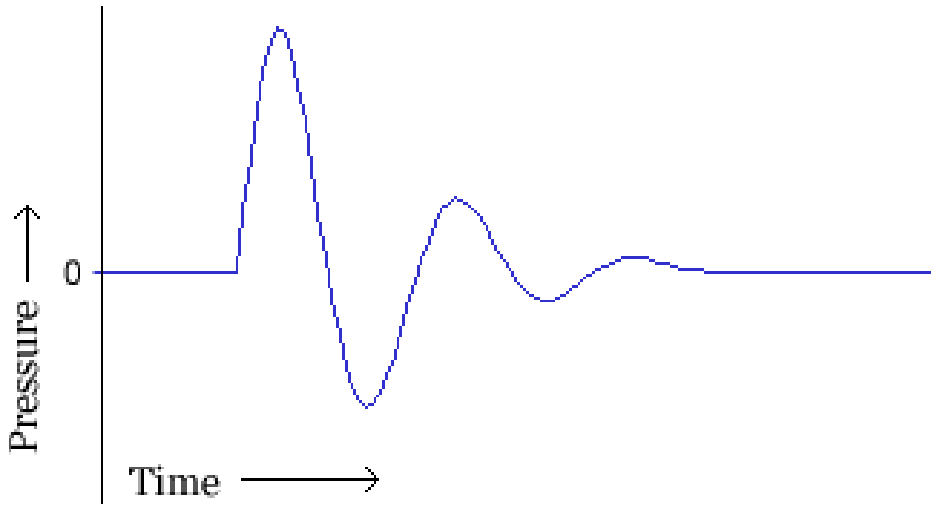
- When you clap your hands, the air that was between your hands is pushed aside.

- This increases the air pressure in the space near your hands, because more air molecules are temporarily compressed into less space.

- The high pressure pushes the air molecules outwards in all directions at the speed of sound, which is about 340 meters per second.

- When the pressure wave reaches your ear, it pushes on your eardrum slightly, causing you to hear the clap.

- A hand clap is a short event that causes a single pressure wave that quickly dies out.



- The image above shows the waveform for a typical hand clap.
- In the waveform, the horizontal axis represents time, and the vertical axis is for pressure.
- The initial high pressure is followed by low pressure, but the oscillation quickly dies out.

Multimedia System Sounds

- We can hear sounds in a multimedia PC running Windows, from the installation of the operating system, like beeps, and warning sounds.
- You can adjust the computer sound volume if you have a hearing impairment, work in a noisy environment, or for other reasons. The ability to clearly hear the sounds made by a computer is important to people who rely on sounds to get information from the computer—especially people who are blind or vision impaired. The volume of add–on computer speakers can often be adjusted independently. This procedure tells you how to adjust the computer sound volume through **Sounds and Audio Devices Properties in Control Panel**.

Setting System Sounds:

- On the Start menu:
  Select Control Panel
- In Control Panel:
  Be sure you are in Classic View (all Control Panel icons are showing). If not, under Control Panel in the left pane, select Switch to Classic View.
- Select Sounds and Audio Devices.
- In the Sounds and Audio Devices Properties dialog box, on the Volume tab:

Adjust the sound volume by moving the Device volume slider. Select OK.

- To close Control Panel: •Select the Close button.

Digital Audio

- Digital audio is created when you represent a sound wave using numbers, a process referred to as **digitizing**.
- We may digitize sound from a microphone, a synthesizer, existing tape recordings, live radio, and television broadcasts.
- In short, you can digitize sounds from any source, natural or prerecorded.
- Digitized sound is a samples sound. Every nth fraction of a second, a sample of sound is taken and stored as digital information in bits and bytes.
- The quality of digital recording depends upon how often the samples are taken, (i.e. sampling rate or frequency, measured in kilohertz, or thousands of samples per second) and how many numbers are used to represent the value of each sample (bit depth, sample size, resolution, or dynamic range).
- As we take more samples, and more data we store about that sample, the finer is the resolution and quality of the captured sound.
- The quality of sound is based on the quality of recording and not on the device on which you play the audio, digital audio is said to be **device independent**.

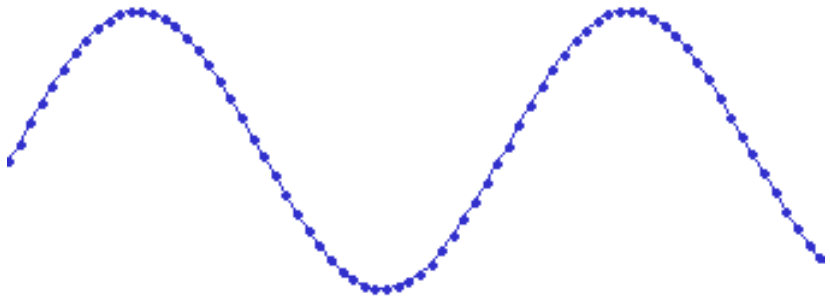
How Sound is recorded digitally? / Preparing Digital Audio Files

- Recording onto a tape is an example of analog recording.
- Digital recordings that have been sampled so that they can be used by a digital computer, like the one you're using now.
- Benefits:

    1. Digital files can be copied as many times as you want, with no loss in quality, and they can be burned to an audio CD or shared via the Internet.
    2. Digital audio files can also be edited much more easily than analog tapes.
    3. The main device used in digital recording is a Analog-to-Digital Converter (ADC).

4. The ADC captures a snapshot of the electric voltage on an audio line and represents it as a digital number that can be sent to a computer.

5. By capturing the voltage thousands of times per second, you can get a very good approximation to the original audio signal.



- Each dot in the figure above represents one audio *sample*. There are two factors that determine the quality of a digital recording.

- **Sample rate**: The rate at which the samples are captured or played back, measured in Hertz (Hz), or samples per second. An audio CD has a sample rate of 44,100 Hz, often written as 44 KHz for short. This is also the default sample rate that Audacity uses, because audio CDs are so prevalent.

- **Sample format** or **sample size**: The amount of information stored about each sample is the sample size and is determined by the number of bits used to describe the amplitude of the sound wave when the sample is taken.

- The three sampling frequencies most often used in multimedia are CD quality 44.1 kHz, 22.05 kHz, and 11.025 kHz.

- Higher sampling rates allow a digital recording to accurately record higher frequencies of sound.

- The sampling rate should be at least twice the highest frequency you want to represent.

- Humans can't hear frequencies above about 20,000 Hz, so 44,100 Hz was chosen as the rate for audio CDs to just include all human frequencies.

- Sample rates of 96 and 192 KHz are starting to become more common, particularly in DVD-Audio, but many people honestly can't hear the difference.

- Higher sample sizes allow for more dynamic range - louder louds and softer softs. If you are familiar with the decibel (dB) scale, the dynamic range on an audio CD is

theoretically about 90 dB, but realistically signals that are -24 dB or more in volume are greatly reduced in quality.

- Audacity supports two additional sample sizes: 24-bit, which is commonly used in digital recording, and 32-bit *float*, which has almost infinite dynamic range, and only takes up twice as much storage as 16-bit samples.

- Playback of digital audio uses a Digital-to-Analog Converter (DAC).

- This takes the sample and sets a certain voltage on the analog outputs to recreate the signal, that the Analog-to-Digital Converter originally took to create the sample.

- The DAC does this as faithfully as possible and the first CD players did only that, which didn't sound good at all.

- Nowadays DACs use Oversampling to smooth out the audio signal.

- The quality of the filters in the DAC also contribute to the quality of the recreated analog audio signal. The filter is part of a multitude of stages that make up a DAC.

- **Preparing digital audio files** :

  - If you have analog source materials music or sound effects that have recorded on analog media such as cassette tapes, the first step is to digitize the analog material by recording it onto computer readable digital media.

  - In most cases this means, playing sound from one device (such as tape recorder) right into your computer, using appropriate audio digitizing software.

Two crucial aspects of preparing digital audio files

- Balancing the need for sound quality against file size. Higher quality usually means larger files, requiring longer download times on the Internet and more storage space on a CD or DVD.

- Setting proper recording levels to get a good, clean recording.

File Size vs. Quality

- Sampling rate determines the frequency at which samples will be drawn for the recording.

- Sampling at higher rates (such as 44.1 kHz or 22.05 kHz) more accurately captures the high-frequency content of your sound.

- Audio resolution (such as 8 or 16 bit) determines the accuracy with which a sound can be digitized.

Introduction to MIDI

MIDI – Musical Instrument Digital Interface

Introduction:

- There is one thing that all musical instruments do. All musical instruments make a sound under the control of a musician. In other words, at any time, the musician can cause an instrument to start making a sound. For example, a musician can push down a key on a piano to start a sound.

- Most instruments also allow the musician to stop the sound at any given time. For example, the musician can release that piano key, thus stopping the sound.

- There are other things that many musical instruments may have in common, for example, most instruments can make sounds at various volumes. (ie, They can sound notes at volumes ranging from very soft to very loud). For example, if the pianist pushes down a key with great force, the resulting note will be louder than if he were to gently press down the key.

Introduction:

- It is impossible for a single musician to play several instruments together.

- Musicians often want to be able to control electronic instruments remotely or automatically.

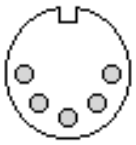
- sometimes a musician wants to use only one physical keyboard to control several, separate sound modules.

- So, musicians had a need to remotely or automatically control their musical instruments, and they wanted a method that wasn't tied to one particular manufacturer's product, nor one particular type of instrument. (ie, They wanted a method that worked as well with an electronic piano as it did with a drum box, for example). They wanted a standard that could be useful in controlling <u>any</u> electronic musical device. To satisfy this need, a few music manufacturers got together in mid 1983 and created **MIDI**, which **stands for Musical Instrument Digital Interface**.

Hardware/ Connections:

- The visible **MIDI connectors** on an instrument **are 5-pin DIN jacks**. There are separate jacks for incoming MIDI signals (received from another instrument that is sending MIDI

signals), and outgoing MIDI signals (ie, MIDI signals that the instrument creates and sends to another device). The jacks look like these:



MIDI Messages:

- But MIDI is much more than just some jacks on an electronic instrument. In fact, **MIDI is a lot more than just hardware. Mostly, MIDI is an extensive set of "musical commands" which electronic instruments use to control each other**. The MIDI instruments pass these commands to each other over the cables connecting their MIDI jacks together.

- But MIDI is more than just "Note On" and "Note Off" messages. There are lots more messages. There's a message that tells an instrument to move its pitch wheel and by how much. There's a message that tells the instrument to press or release its sustain pedal. There's a message that tells the instrument to change its volume and by how much. There's a message that tells the instrument to change its patch (ie, maybe from an organ sound to a guitar sound). And of course, these are only a few of the many available messages in the MIDI command set.

- And just like with Note On and Note Off messages, these other messages are automatically generated when a musician plays the instrument.

MIDI Audio

What is MIDI?

- **MIDI** (**Musical Instrument Digital Interface**) is an industry-standard protocol that enables electronic musical instruments such as keyboard controllers, computers, and other electronic equipment to communicate, control, and synchronize with each other.

- **MIDI** is a music industry standard communications protocol that lets MIDI instruments and sequencers (or computers running sequencer software) talk to each other to play and record music.

- **MIDI** is an acronym for musical instrument digital interface, a standard adopted by the electronic music industry for controlling devices, such as synthesizers and sound cards, that emit music.

- MIDI data is not digitized sound; it is a shorthand representation of music stored in numeric form.

- MIDI files tend to be significantly smaller than equivalent digitized waveform files.
- MIDI data is device dependent; its playback depends on the capabilities of the end users system.
- Because they are small, MIDI files embedded in web pages load and play more quickly than their digital equivalents.
- You can change the length of a MIDI file (by varying its tempo) without changing the pitch of the music or degrading the audio quality. MIDI data is completely editable.
- MIDI cannot easily be used to play back spoken dialog.
- Working with MIDI requires familiarity with musical scores, keyboards, and notation as well as audio production.

Making MIDI Score

- To make MIDI scores, you will need,

1. A Sequencer software
2. A Sound synthesizer
3. A MIDI keyboard

1. A Sequencer Software:

- A **music sequencer** (also **MIDI sequencer** or just **sequencer**) is software or hardware designed to create and manage computer-generated music.
- Most modern sequencers now featured with audio **editing and processing** capabilities as well.
- Sequencer software also **creates data about each note** as it is played on a MIDI keyboard (or another MIDI device) i.e. how much pressure was used on the keyboard to play the note, how long it was sustained, and how long it takes for the note to decay or fade away.
- As the quality of the playback depends upon the end users MIDI device rather than the recording, MIDI is **device dependent.**

2. A Sound Synthesizer:

- A **synthesizer** (or **synthesizer**) is an electronic instrument that is capable of producing a variety of sounds by generating and combining signals of different frequencies.

- Synthesizers are typically, but not exclusively, controlled with a piano-style keyboard, leading the instruments to occasionally be referred to simply as "keyboards".

3. A MIDI Keyboard:

- A **MIDI keyboard** is a piano-style digital keyboard device used for sending MIDI signals or commands to other devices connected to the same interface as the keyboard.

Advantages of MIDI

MIDI is:

- **Compact -** Hours of music can fit on a single 3 1/2" floppy disk, thousands of songs on a CD
- **Editable -** It is an easily edited / manipulated form of data.
- **Efficient -** Just about any computer can handle it
- **Powerful -** A whole orchestra is at your command
- **Quality** – Its of high quality and sound better than digital audio files.
- **Size** – As they are small, MIDI files embedded in web pages, load and play more quickly than their digital equivalents.
- **Versatile -** A click of a button is all it takes to change key, tempo, instrument, etc.
- **Intuitive -** a MIDI file is just an electronic version of a player piano roll for many instruments
- **Portable Industry Standard -** Any MIDI instrument can talk to any other

Disadvantages of MIDI

- As MIDI data does not represent sound but musical instruments, you can be certain that playback will be accurate only if the Midi playback device is identical to the device used for production.
- MIDI cannot easily be used to play back spoken dialog, although expensive and technically tricky digital samplers are available.

Reasons to work with Digital Audio

- A wider selection of application software and system support for digital audio is available for both the Macintosh and Windows platform.
- The preparation and programming required for creating digital audio do not demand knowledge of music theory, whereas while working with MIDI data usually require atleast the familiarity with music scores, keyboards as well as audio production

Comparing and contrasting the use of MIDI and digitized audio in Multimedia

- MIDI is analogous to structured or vector graphics, while digitized audio is analogous to bitmapped images.
- MIDI is device dependent, meaning the quality of the playback is dependent upon the hardware installed on the users machine, while digitized audio is device independent.
- Use MIDI only when you have control over the playback hardware and know your users will be using high quality MIDI device for playback.
- MIDI files are much smaller than digital audio, so they may be used for delivery of music under the right circumstances.
- Use digital audio for spoken dialog.

Choosing between MIDI and Digital Audio

Use MIDI data in following circumstances:

- Digital audio won't work because you don't have enough RAM, hard disk space, CPU processing power or bandwidth.
- You have a high quality MIDI sound source.
- You have a complete control over the machines on which your program will be delivered, so you know that your users will have high-quality MIDI playback hardware.
- You don't need spoken dialog.

Use Digital Audio in following circumstances:

- You don't have control over the playback hardware.
- You have the computing resources and bandwidth to handle digital files.
- You need spoken dialog.

Audio File Formats

- An **audio file format** is a file format for storing audio data on a computer system.
- A sound file format is simply a recognized methodology for organizing the digital sounds data bits and bytes into a data file.

Types of Audio File Formats

- It is important to distinguish between a file format and a codec. A codec performs the encoding and decoding of the raw audio data while the data itself is stored in a file with a specific audio file format. Most of the publicly documented audio file formats can be created with one or two or more encoders or codecs. Alhough most audio file formats support only one type of audio data (created with audio coder), a multimedia container format (as MKV or AVI) may support multiple types of audio and video data.

  There are three major groups of audio file formats:
  1. Uncompressed audio formats, such as WAV, AIFF, AU.

  2. Formats with lossless compression, such as FLAC, Monkey's Audio (filename extension APE), WavPack (filename extension WV), TTA, Apple Lossless and Windows Media Audio Lossless (WMA Lossless).

  3. Formats with lossy compression, such as MP3, Vorbis, Musepack, AAC, ATRAC and lossy Windows Media Audio (WMA).

Free and open file formats

- wav – standard audio file container format used mainly in Windows PCs. Commonly used for storing uncompressed (PCM), CD-quality sound files, which means that they can be large in size — around 10 MB per minute. Wave files can also contain data encoded with a variety of codecs to reduce the file size (for example the GSM or mp3 codecs). Wav files use a RIFF structure.

- aiff – the standard audio file format used by Apple. It is like a wav file for the Mac.

- au – the standard audio file format used by Sun, Unix and Java. The audio in au files can be PCM or compressed with the μ-law, a-law or G729 codecs.

- mid - an industry-standard protocol that enables electronic musical instruments, computers, and other equipment to communicate, control, and synchronize with each other

- ogg – a free, open source container format supporting a variety of codecs, the most popular of which is the audio codec Vorbis. Vorbis offers compression similar to MP3 but is less popular.

- mpc - Musepack or MPC (formerly known as MPEGplus, MPEG+ or MP+) is an open source lossy audio codec, specifically optimized for transparent compression of stereo audio at bitrates of 160–180 kbit/s. Musepack and Ogg Vorbis are rated as the two best available codecs for high-quality lossy audio compression in many double-blind listening tests. Nevertheless, Musepack is even less popular than Ogg Vorbis and nowadays is used mainly by the audiophiles.

- flac – a lossless compression codec. This format is a lossless compression as like zip but for audio. If you compress a PCM file to flac and then restore it again it will be a perfect copy of the original. (All the other codecs discussed here are lossy which means a small part of the quality is lost). The cost of this losslessness is that the compression ratio is not good. Flac is recommended for archiving PCM files where quality is important (e.g. broadcast or music use).

Open file formats

- gsm – designed for telephony use in Europe, gsm is a very practical format for telephone quality voice. It makes a good compromise between file size and quality. Note that wav files can also be encoded with the gsm codec.

- aac – the Advanced Audio Coding format is based on the MPEG2 and MPEG4 standards. aac files are usually ADTS or ADIF containers.

- mp4/m4a – MPEG-4 audio most often AAC but sometimes MP2/MP3

- mmf - a Samsung audio format that is used in ringtones.

Proprietary formats

- mp3 – MPEG Layer-3 format is the most popular format for downloading and storing music. By eliminating portions of the audio file that are essentially inaudible, mp3 files are compressed to roughly one-tenth the size of an equivalent PCM file while maintaining good audio quality.

- wma – the popular Windows Media Audio format owned by Microsoft. Designed with Digital Rights Management (DRM) abilities for copy protection.

- atrac (.wav) – the older style Sony ATRAC format. It always has a .wav file extension. To open these files simply install the ATRAC3 drivers.

- ra – a Real Audio format designed for streaming audio over the Internet. The .ra format allows files to be stored in a self-contained fashion on a computer, with all of the audio data contained inside the file itself.

- mxp4 – a Musinaut proprietary format allowing play of different versions (or skins) of the same song. It allows various interactivity scenarios between the artist and the end user.

- 3gp - multimedia container format can contain proprietary formats as AMR, AMR-WB or AMR-WB+, but also some open formats

- m4p – A proprietary version of AAC in MP4 with Digital Rights Management developed by Apple for use in music downloaded from their iTunes Music Store.

Adding Sound to Your Multimedia Project

- To **add sounds / audio recording / digital audio** into your multimedia project, you need to consider the following **steps / process:**

1. Determine the file formats that are compatible with your multimedia authoring software and the delivery mediums you will be using (for file storage and bandwidth capacity).

2. Determine the sound playback capabilities (codecs and plug-ins) that the end users system offers.

3. Decide what kind of sound is needed (such as background music, special sound effects, and spoken dialog). Decide where these audio events will occur in the flow of your project. Fit the sound cues into your storyboard, or make up a cue sheet.

4. Decide where and when you want to use either digital audio or MIDI data.

5. Acquire source material by creating it from scratch or purchasing it. Edit the sound to fit your project.

6. Test the sounds to be sure they are timed properly with the project's images.

7. This may involve repeating steps 1 through 4 until everything is in sync.

Considerations involved in managing Audio files and integrating them into Multimedia Projects

- Because **sounds are time based**, you may need to consider what happens to sounds that are playing in your project when the user goes to a different location.

- Appropriate use of sound requires **technical considerations** of disk space or bandwidth as well as the abilities of the authoring system to use various file formats and compression algorithms.

- **Do not use equipment and standards** that exceed what your project requires.

- **Keep track of your audio files**, and be sure to back them up.

- **Regularly test** the sound-and-image synchronization of your project.
- **Evaluate** your sounds RAM requirements as well as your users playback setup.
- Be sure you understand the implications of using **copyrighted material**. You are breaking the law if you record and use copyrighted material without first securing the appropriate rights from the owner or publisher.
- You can **purchase and use digitized clip sounds** with an unlimited-use, royalty-free license.

Analog Display standards

- The following analog broadcast video standards are commonly used around the world:

  1. NTSC
  2. PAL
  3. SECAM
  4. ATSC DTV

NTSC (National Television Standards Committee)

- The United States, Canada, Mexico, Japan, and many other countries used a system for broadcasting and displaying video that is based upon the specifications set forth by the 1992 National Television Standards Committee.
- These standards defined a method for encoding information into the electronic signal that uultimately created a television picture.
- As specified by the NTSC standard, a single frame of video was made up of 525 horizontal scan lines drawn onto the inside face of a phosphor-coated picture tube every $1/30^{th}$ of a second by a fast-moving electron beam.
- The drawing occurred so fast that your eye would perceive the image as stable.
- The electron beam actually made two passes as it drew a single video frame- first it laid down all the odd-numbered lines, and then all the even-numbered lines.
- Each of these passes, which happens at the rate of 60 per second, or 60 Hz.) painted a field, and the two fields were then combined to create single frame at a rate of 30 frames per second (fs). Technically the speed is actually 29.97 Hz. This process of building a single frame from two fields was called **interlacing.**

- **Interlacing** is a technique that helps to prevent flikker on television screens.

- Computer monitors used a different **progressive-scan** technology, and drew the lines of an entire frame in a single pass, without interlacing them and without fliker.

PAL (Phase Alternate Line)

- The PAL system was used in United Kingdom, Western Europe, Australia, South Africa, China and South Africa.

- PAL increased the screen resolution to 625 horizontal lines, but slowed the scan rate 25 frames per second.

- As with NTSC, the even and odd lines were interlaced, each field taking 1/50 of a second to draw (50 Hz).

SECAM (Sequential Color and Memory)

- The SECAM system was used in France, Eastern Europe, the former USSR, and a few other countries.

- Although SECAM is a 625 line, 50 Hz system, it differed greatly from both the NTSC and the PAL color systems in its basic technology and broadcast method.

- However, TV sets sold in Europe utilized dual components and could handle both PAL and SECAM systems.

ATSC DTV (Digital Television)

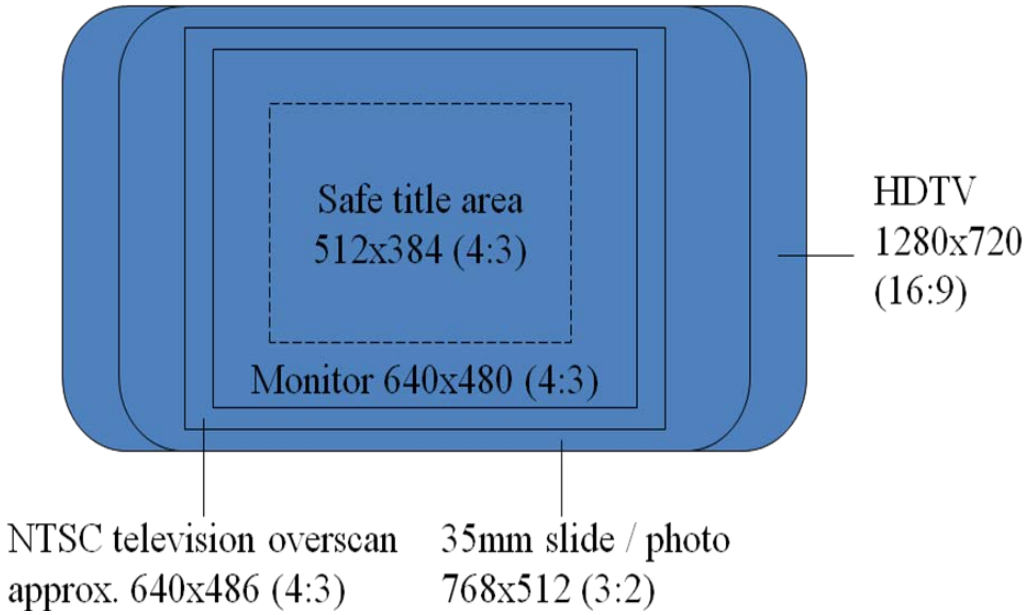
- **High-Definition Television** (or **HDTV**) is a digital television broadcasting system with higher resolution than traditional television systems (standard-definition TV, or SDTV). HDTV is digitally broadcast; the earliest implementations used analog broadcasting, but today digital television (DTV) signals are used, requiring less bandwidth due to digital video compression.

- This standard, which was slightly modified from both the Digital Television Standard (ATSC Doc. A/53) and the digital Audio Compression Standard (ATSC Doc. A/52), moved U.S. television from an analog to digital standard.

- It also provided TV stations with sufficient bandwidth to present four or five Standard Television (STV, providing the NTSC's resolution of 525 lines with a 3:4 aspect ratio, but in a digital signal) or on HDTV signals (providing 1,080 lines of resolution with a movie screens 16:9 aspect ratio).

ATSC DTV (Advanced Television Systems Committee – Digital Television)

- For multimedia producers , this emerging standard allowed for transmission of data to computers and for new ATV interactive services.
- HDTV provides high resolution in a 16:9 aspect ratio.
- This aspect ratio allows the viewing of Cinemascope and Panavision movies.
- The broadcast industry has promulgated an ultra high resolution, 1920x1080 interlaced format to become the corner stone of a new generation of high end entertainment centers, but the computer industry would like to settle on a 1280x720 progressive scan system for HDTV.
- As the 1920x1080 format provides more pixels than the 1280x720 standard, the refresh rates are quite different.
- The higher resolution interlaced format delivers only half the picture every 1/60 of a second, and because of the interlacing, on highly detailed images there is a great deal of screen fliker at 30 Hz.
- The computer people using only 1280x720 standard, saying that the picture quality is superior and steady.
- Both formats have been included in the HDTV standard by the Advanced Television Systems Committee (ATSC).



Digital Display standards

- The following digital video standards are commonly used around the world:

    1. ATSC (Advanced Television System Comittee)
    2. DVB (Digital Video Broadcasting)
    3. ISDB (Integrated Services Digital Broadcasting)

ATSC (Advanced Television System Comittee)

- ATSC is the digital television standard for the United States, Canada, Mexico, Taiwan, and South Korea and others.

- It supports wide screen aspect ratio of 16:9 with images upto 1920x1080 pixels in size and number of other images sizes, allowing upto six, standard-definition-television "virtual channels" to be broadcast on a single TV station using the existing 6 MHz channel.

- It provides "theatre quality" because it uses Dolby Digital AC-3 format to provide 5.1 channel surround sound.

DVB (Digital Video Broadcasting)

- DVB is used mostly in Europe where the standards define the physical layer and the data link layer of a distribution system.

- **Digital Video Broadcasting** (**DVB**) is a suite of internationally accepted open standards for digital television.

- DVB systems distribute data using a variety of approaches, including by satellite (DVB-S, DVB-S2); also for distribution via cable (DVB-C); terrestrial television (DVB-T, DVB-T2) and via microwave using DTT(), MMDS(), and / or MVDS standards.

- These standards define the physical layer and data link layer of the distribution system.

ISDB (Integrated Services Digital Broadcasting)

- ISDB is used in Japan to allow radio and television stations to convert to digital format.

- The core standards of ISDB are ISDB-S (satellite television), ISDB-T (terrestrial) ISDB-C (cable) and 2.6 GHz band mobile broadcasting which are all based on MPEG-2 video and audio coding as well as the transport stream described by the MPEG-2 standard, and are capable of high definition television (HDTV).

Considerations in converting from digital video to television

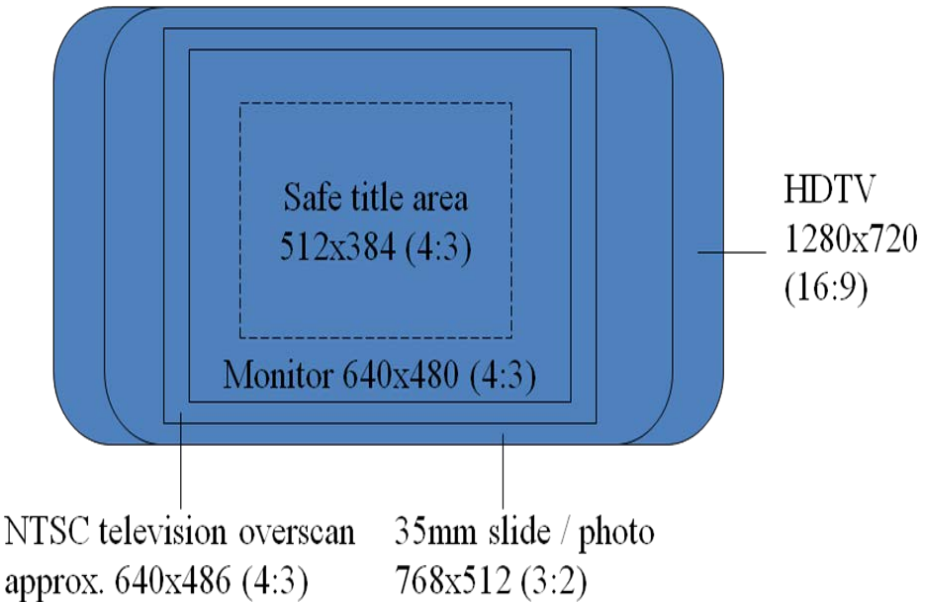
Overscan and the Safe Title Area

- It is a common practice in a television industry to broadcast an image larger than will fit on a standard TV screen so that the "edge" of the image seen by the viewer is always bounded by the TV's physical frame, This is called **overscan**.

- In contrast computer monitors display a smaller image on the monitors picture tube, leaving a black border inside the physical frame, called as **underscan.**

- When a digitized video image is displayed on an RGB screen, there is a border around the image; and when a computer screen is converted to video, the outer edges of the image will not fit on a TV screen.

- Only about 360 of the 480 lines of the computer screen will be visible.



Video Color

- Computer use RGB component video.

- Computers split colors into red, green and blue signals. There colors are more purer and more accurate than those seen on a television set that is using a composite input.

- Also colors used in a graphic image created for computers video may display differently when that image is transformed into NTSC television video.

- Television uses a limited color pallete, restricted luminance levels and black levels.

- Properly adjusted color can have as much effect on video quality as an increase in size. The process of basic color correction is simple; adjust the range of black to white (tonality), and the color balance (hue and saturation) so that the image (pick any of the following)
    1. shows clear and vivid details.
    2. matches a good standard sample (like a commercial dvd).
    3. looks the way you want it.

- Digital video is represented in either ***RGB*** or in ***YCbCr*** (often called ***YUV***) ***colorspace***. A color space is simply a way of representing a color.

- Both the RGB and the YCbCr colorspace formulas contain three variables, also known as components or channels.

- RGB's are red, green and blue. YCbCr's are Y = ***luma*** (or black and white or lightness) and CbCr = ***chroma*** (or color), where Cb = Blue minus 'black and white', and Cr = Red minus 'black and white'.

- ***Bit depth*** describes the number of bits used to encode each color channel of the video signal. 8 bits is the consumer standard. This provides for 256 (= 2^8) shades of a given color. When you adjust a given channel (such as red or luma) of a given pixel, you are simply changing the value within a range of 0-255.

Subsampling

- ***Subsampling*** is a reference to keeping less detail for the color components in digital Video. Subsampling is only used in the YCbCr colorspace. 4:2:2 subsampling describes keeping color information (CbCr) for only every other pixel, on every line. YUY2 is a PC storage reference to YCbCr 4:2:2. 4:1:1 is keeping color for every 4th pixel on every line. NTSC DV is 4:1:1 YCbCr. 4:2:0 is keeping color for every other pixel on the odd lines, and no color for the pixels on the even lines. MPEG and PAL DV use YCbCr 4:2:0. YV12 is a PC storage reference to 4:2:0 YCbCr.

- Subsampling is used to reduce the storage and broadcast bandwidth requirements for digital video. This is effective for a YCbCr signal because the human eye is more sensitive for changes in black and white than for changes in color.

Adjusting Colors

- A ***waveform monitor (wfm) graph***, keeps the horizontal (width) position of every pixel, and replaces its vertical (height) position with the pixels ***intensity value*** (or ***luma value***) (0-255). With this graph, one can determine the range of intensity values in a given picture, and pinpoint the specific objects that have those values.

- A ***vector scope graph***, shows the color portion of a video picture mapped around a circle. It can be used to determine the ***hue*** and ***saturation*** of a color. Going clock wise around the circle, red falls at about 11:30, next comes magenta, blue, cyan, green, and yellow. As the hue of a color changes, it moves around the circle.

Interlacing Effects

- The electron beam actually made two passes as it drew a single video frame- first it laid down all the odd-numbered lines, and then all the even-numbered lines.

- Each of these passes, which happens at the rate of 60 per second, or 60 Hz.) painted a field, and the two fields were then combined to create single frame at a rate of 30 frames per second (fs). Technically the speed is actually 29.97 Hz. This process of building a single frame from two fields was called **interlacing.**

- **Interlacing** is a technique that helps to prevent flikker on television screens.

Calibration

- calibration is a comparison between measurements-one of known magnitude or correctness made or set with one device and another measurement made in as similar a way as possible with a second device.

- The device with the known or assigned correctness is called the standard. The second device is the unit under test (UUT), test instrument (TI), or any of several other names for the device being calibrated.

Text and Titles for Television

- Fonts for titles be plain, san serif, and bold enough to be easily read.

- When you are laying text onto a dark background, use white or a light color of text.

- Use a drop shadow to help separate the text from the background image.

- Never use black or colored text on a white background.

- Do not kern your letters too tightly.
- If you use underlining or drawn graphics, always make your lines at least two pixels wide. If you use a one-pixel wide line, the line will flikker when transferred to video due to interlacing.
- Avoid colors that are too hot, because they will twinkle.
- Keep you graphics and titles within the safe area of the screen.
- Bring titles on slowly, keep them on screen for a sufficient interval, and then fade them out.

Digital Video

- **Digital video** is a type of video recording system that works by using a digital rather than an analog rather than an video signal.
- A video that has been digitized so that it can be controlled from a PC and displayed directly on a computer monitor.
- Video where all the instructions for the images are in computer data form, ie bits.

Digital Video Resolution

- A video image is measured in pixels for digital video and scan lines for analog video.
- HDTV televisions are capable of 1920x1080p60, also known as 1920 pixels per scan line by 1080 scan lines, progressive at 60 frames per second.

Digital Video Architecture

- A digital video architecture is made up of a format for encoding and playing back video files by a computer and includes a player that can recognize and play files created for that format.
- The major digital video architectures are Apple's QuickTime, Microsoft's Windows Media Format, and Real Networks RealMedia.

Digital Video Formats

- **.AVI** It stands for Audio Video Interleaved. This type of file is a sound and motion picture file that conforms to the standards set by Microsoft Windows Resource Interchange File Format (RIFF). You will be able to recognize this type of file by its extension .avi. This is a common file format. The video quality is good at smaller

resolutions; the only major drawback is that the files tend to be large. The most commonly used video codecs that use .avi are MJPEG and DivX. To play an .avi, you could use Windows Media Player, RealPlayer, or the DivX player.

- **.MOV** This file extension identifies an Apple QuickTime movie; .mov is an Apple QuickTime motion video file format. Developed by Apple Computer for viewing moving images, .mov is a method of storing sound, graphics and movie files. Originally QuickTime was developed for the Macintosh; it is now available for Windows as well. Such .mov files are created and played back on the Apple QuickTime player.

- **MJPEG** is short for Motion JPEG. It is a video codec where each video field is separately compressed into a JPEG image. It best suited for broadcast resolution interlaced video, such as NTSC or PAL. MJPEG is not good for movies that are smaller than TV resolutions. MJPEG is ill suited for progressive scan computer monitors. It is lso used for short files such as the short movies that can be made by a digital camera.
- **DivX** is a software application that uses MPEG-4 standard to compress digital video. The DivXNetworks and the open source community are developing DivX jointly. The DivX player is a powerful and stable player.

Basic properties of Digital Video

- Digital video comprises a series of orthogonal bitmap digital images displayed in rapid succession at a constant rate.

- These digital images are called **frames.**

- We can measure the rate at which frames are displayed in **frames per second (FPS).**

- Since every frame is an orthogonal bitmap digital image it comprises a raster of pixels. If it has a width of W pixels and a height of H pixels we say that the frame size is W*x*H.
  frame size = WxH

- Pixels have only one property, their color. The color of a pixel is represented by a fixed amount of bits. The more bits the more subtle variations of colors we can reproduce. This is called the **color depth (CD)** of the video.

- To compute the video size, we use the following formulas:
  pixels_per_frame = W * H
  pixels_per_second = W * H * FPS
  bits_per_frame = W * H * CD
  Bit Rate (BR) = W * H * CD * FPS
  Video Size (VS) = BR * T = W * H * CD * FPS * T

(units are: BR in bits/sec, W and H in pixels, CD in bits, VS in bits, T in seconds)

- **Example:** A video can have a **duration (T)** of 1 hour (3600sec), a frame size of 640x480 at a color depth of 24bits and a frame rate of 25fps. Calculate the Video size.

Solution:

- **pixels per frame** = W*H = 640 * 480 = 307,200
- **bits per frame** = W*H*CD = 307,200 * 24 = 7,372,800 = 7.37Mbits
- **bit rate (BR)** = W*H*CD*FPS = 7.37 * 25 = 184.25**Mbits/sec**
- **video size (VS)** = BR * T = W * H * CD * FPS * T **=** 184Mbits/sec * 3600sec = 662,400Mbits = 82,800Mbytes = 82.8**Gbytes**

Digital Video Compression Why?

- To digitize and store a 10 second clip of full motion video in your computer requires transfer of an enormous amount of data in a very short amount of time.

- Reproducing just one frame of digital video component at 24 bits requires almost 1 MB of computer data; 30 seconds of full screen, uncompressed video will fill a gigabyte of hard disk.

- Full size, full motion video requires that the computer deliver data at about 30 MB per second.

- This overwhelming technological bottleneck is overcome using digital video compression scheme or codecs (coders / decoders).

Digital Video Compression

- A codec is the algorithm used to compress (code) a video for delivery and then decode it in real time for fast playback.

- Different codecs are optimized for different methods of delivery, for example, from a hard drive, from a CD-ROM, or over the Web).

- Real time video compression algorithm such as MPEG, Indeo, JPEG, Cinepak, and Sorenson are available to coompress digital video information at rates that range from 50:1 to 200:1.

- In addition to compressing video data, **streaming** technologies such as Adobe Flash, Microsoft Windows Media, QuickTime and RealPlayer are being implemented to provide reasonable quality low bandwidth video on the web.

MPEG

- **MPEG** stands for Moving Picture Experts Group. MPEG was established in 1988 to develop standards for digital audio and video formats. There are 4 MPEG standards being used right now. Each compression standard was designed with a specific application and bit rate in mind.

- **MPEG-1** is designated for 1.5Mbit/sec standard for the compression of moving pictures and audio. This was based on CD-ROM video applications and is a popular standard for video on the Internet transmitted as an .mpg file. Level 3 of MPEG-1 is the most popular standard for digital compression of audio - known as MP3. VideoCD uses MPEG-1 as its standard compression method. It is not very complicated to create and will yield okay results.

- **MPEG-2** is designed for 1.5 to 15Mbit/sec standard on which digital TV set top boxes and DVD compression are based. It is based on MPEG-1 but designed for the compression and transmission of digital broadcast television. The most significant improvement over MPEG-1 is its ability to efficiently compress interlaced video.

- **MPEG-4** is the standard of multimedia and Web compression. MPEG-4 is based on object-based compression, similar to Virtual Reality Modeling Language. Individual objects within a scene are tracked separately and compressed together to create an MPEG-4 file. The end result is a very good and efficient compression that is very scalable, from low bit rates to very high ones. This format is the one most used today.

- It offers excellent video and audio quality. It is the most popular MPEG standard used right now.

- **MPEG-7,** called the Multimedia Content Description Interface, went a step further by integrating information about the image, sound, or motion video elements being used in composition. It's descriptive elements can be used to describe simple features such as color or motion using descriptors, or higher level contents such as facial expressions, personality characteristics, or any number of content-related variables using Description schemes.

- **MPEG-21,** which is under development. It will provide a "Right Expression Language" standard designed to communicate machine-readable license information and to do so in a secure manner. The idea here is that when you get a Digital Item, the file will let you know where to go to find who holds the rights to it.

Video Recording and Tape Formats

Composite Analog Video:

1. Composite video combines the luminance and chroma information from the video signal.

2. As a result, it produces the lowest quality video and is most susceptible to generation loss, the loss of quality that occurs as you move from original footage to edit master to copy.

3. This recording format was used for consumer analog video recording tape formats and was never adequate for most multimedia productions.

Component Analog Video:

Component video separates the luminance and chroma information in order to improve the quality of the video and to decrease generation loss.

S-Video (Y/C)

- In S-Video, color and luminance information are kept on two separate tracks (Y/C). The result is a definite improvement in picture quality over composite video.

- This standard is used in S-VHS.

- It provides sharper image and slightly less generation loss from master to copy

Three-Channel Component (Y/R-Y/B-Y, Y/U/V)

- Professional quality requires further separation in the video signal, usually divided between luminance (Y) and two channels of chroma, but sometimes divided between the Red/ Green/ Blue primary additive colors.

Composite Digital

- Composite digital recording formats combine the luminance and chrome information.

- They sample the incoming waveforms and encode the information in binary (0/1) digital code.

- It also improves color and image resolution, and having the recording in digital format eliminates generation loss when copies are made.

- The D-2 format was developed primarily by Ampex and Sony.

- The D-3 format was developed primarily by Panasonic.

- The major advantage over the component digital format is the lower cost in equipment.

- Although this equipment is expensive enough to find a market only at the professional level and has not been used much in multimedia production

Component Digital

- Sony released the first equipment in this category with its D-1 format.

- D-1 format is an uncompressed format, so it has very high quality image, and need large storage.

- Because of its high quality, D-1 is used for NTSC video and is the mastering standard of choice among high end editing facilities.

- This quality comes with an extremely high price tag.

- The result is that this format really only fits super-high-end broadcast projects and not your standard multimedia title.

- The other digital component formats, including **DCT** (from Ampex), **D-5** (from Panasonic), and **Digital Betacam** (from Sony) also used.

- Featuring four channels of CD-quality audio, **Digital Betacams** video quality is almost equal to **D-1** digital.

- Although another digital component format **DV** format provided a high quality level and price point that attracted and it compresses the video allowing for the use of smaller tape width.

- DVCPRO and DVCAM, professional formats that use the DV recording format, but provide professional features on the camcorders and tape decks..

ATSC Digital TV

- These standards provide for both digital standard TV (STV) and High Definition TV (HDTV) recordings that can be broadcast by digital TV transmitters to digital TV receivers.

- ATSC standards also provide for Enhanced TV (ETV), potentially bringing the interactivity of multimedia and the web to broadcast television.

Comparing Formats:

- Following slides shows the basic information about the most commonly used video recording formats. Formats are listed in the chronological order of their release as “industry standards”.

Format (Year Introduced)	Analog/Digital	Tape Size	Video Standard for Input/Output	Description
NTSC Videotape				
Betamax (1975)	Analog	½ inch	Composite	This Sony format was the first consumer videotape format to find a market. The original format had a resolution of 260 lines. Although considered to be superior in quality to VHS, the format stalled in the marketplace when longer playing time and a price war among the many VHS competitors attracted more consumers. Nonetheless, machines recording in this format continued to be manufactured by Sony until 2002.
VHS (1976)	Analog	½ inch	Composite	Popular consumer format developed by Sony's competitor JVC, but unsuitable for video production because of low-quality image (250 lines of resolution) and quick generation loss. Also available in a compact cassette size, VHS-C.
Betacam (1982)	Analog	½ inch	Component	A professional version of Sony's consumer Betamax format. Only 300 lines of, but resolution maintained higher image quality through its use of true component I/O.
MII (1985)	Analog	½ inch	Component	Developed by Panasonic to compete with Sony's Betacam and Betacam SP. Provided 340 lines of resolution.
Betacam SP (1986)	Analog	½ inch	Component	An improvement of the original Betacam equipment, offering 340 lines of resolution. Became a broadcast industry standard for better than a decade, when digital alternatives began to take over.
D-2 (1986)	Digital	¾ inch (19mm)	Composite	Ampex uncompressed 8-bit, composite digital format. Since it is composite, it produces a lower quality signal than D-1, which is a component format.
D-1 (1987)	Digital	¾ inch (19mm)	Component	Sony-developed digital format providing uncompressed 8-bit 4:2:2 component video.
S-VHS (1988)	Analog	½ inch	S-Video (Y/C)	An improvement over VHS, since the video signal was divided into two parts and and resolution increased to 400 lines. Less generation loss than VHS, but still relatively low image quality.
Hi-8 (1989)	Analog	8mm	S-Video (Y/C)	Similar qualities as S-VHS, but smaller tape size. Resolution of 415 lines.
D-3 (1991)	Digital	½ inch	Composite	Panasonic 8-bit composite digital format developed to compete with D-2 and with about the same image quality. 450 lines of resolution.

Format (Year Introduced)	Analog/Digital	Tape Size	Video Standard for Input/Output	Description
NTSC Videotape				
Digital Betacam (1994)	Digital	½ inch	Component	Very high quality 10-bit 4:2:2 digital format with little compression (2:1). Continued Sony's commitment to the ½-inch Betamax-type cassette, while moving its popular Betacam line to digital recording.
D-5 (1994)	Digital	½ inch	Component	A high-quality, uncompressed 10-bit 4:2:2 component digital format developed by Panasonic. Provides a full 525 lines of resolution for NTSC and 625 for PAL.
DV (1995)	Digital	¼ inch	Component	First consumer digital format, providing 8-bit recording and 4:1:1 color sampling with 5:1 compression. Provides 500 lines of resolution. Created by a consortium of electronics companies, it is widely available in many consumer and prosumer models, replacing the analog S-VHS and Hi-8 formats. MiniDV is not a separate recording format; it uses the DV format and just uses a smaller cassette. The DV format is the basis for the professional DVCPRO and DVCAM lines of products, which add professional features to camcorders and VCRs.
D-7 (1995)	Digital	¼ inch	Component	Panasonic's DVCPRO format. A digital 8-bit 4:1:1 format, compressed at 5:1. It provides 525 lines of resolution for NTSC and 625 lines for PAL. Competes with Sony's DVCAM. (See note on use of the format under the DVCAM listing.)
D-9 (1995)	Digital	½ inch	Component	Uses 8-bit processing and 4:2:2 color sampling with 3.3:1 compression. Developed by JVC to compete with Sony's Digital Betacam, it is also called Digital-S and uses an S-VHS-type cassette. It provides 540 lines of resolution.
DVCAM (1996)	Digital	¼ inch	Component	Sony format to compete with Panasonic's DVCPRO. It uses 8-bit component digital recording and 4:1:1 color sampling. It provides 530 lines of resolution for NTSC. The high quality and low price of the DVCPRO and DVCAM lines have made them popular for industrial and prosumer video. They are also used as a "disposable" format for Electronic News Gathering (ENG) as, for example, in coverage of the 2003 war in Iraq.

Format (Year Introduced)	Analog/Digital	Tape Size	Video Standard for Input/Output	Description
NTSC Videotape				
Betacam SX (1996)	Digital	½ inch	Component	Records a compressed 8-bit, 4:2:2 component digital signal. Provides backward compatibility for analog Betamax formats. Its MPEG-2 compressed data provides fast transmission of data, a feature targeted to the ENG market.
DVCPRO 50 (1998)	Digital	¼ inch	Component	A variation of Panasonic's D-7 format, providing 4:2:2 sampling and only 3.3:1 compression.
DVCPRO P (1998)	Digital	¼ inch	Component	Another variation of the D-7 format, the "P" indicating it uses progressive scan with 4:2:0 sampling. Its resolution is 480 lines.
Digital 8 (1999)	Digital	8mm	Component	The DV format used by Sony, continuing its 8mm line. It is backward compatible with Sony's analog 8mm and Hi-8 tapes.
ATSC Videotape				
D-5 HD (1995)	Digital	½ inch	Component	Version of D-5 that provides either 1,080- or 720-line HDTV resolution.
D-11 (1997)	Digital	½ inch	Component	HDCAM format, providing compressed HDTV.
D-9 HD (2000)	Digital	½ inch	Component	Version of D-9 for HDTV, also using S-Video-type cassettes.
DVCPRO HD (2000)	Digital	¼ inch	Component	HDTV version of D-7 (DVCPRO), but backward compatible with NTSC DVCPRO, DV, and DVCAM tapes.

Shooting and Editing Video Considerations in shooting and editing video for use in Multimedia

- Import video and sound at the highest resolution and with the least amount of compression possible; reduce the resolution and compress footage later according to your needs.

Storyboarding

- Preplanning is a factor that cannot be ignored while designing the multimedia project.
- It's a place to plan out your digital story in two dimensions.
- The first dimension is time: what happens first, next, and last.
- The second is of interaction: how does the voiceover (your story) interact with the images, how do visual transitions and effects help tie together the images, how does the voiceover interact with the musical soundtrack?
- Any element can interact with any other one, and the storyboard is the place to plan out the impact you intend to make on the audience.
- A story board can get everyone on one page quickly.

Some ways to make your storyboard

1. Get a piece of posterboard, preferably large (22” x 17”), and a packet of Post-it notes. Sort out the image material you plan to use and label each of the Post-its with the name and, if needed, a phrase describing the image.
2. Create 5 or 6 rows horizontally across your posterboard, leaving room for writing text below each post-it. Fill in the text of your script in pencil, and place the appropriate images above the appropriate words. The Post-its will allow you to move things around or take them out as need be, and you can erase the text if you want to move it around.
3. Instead of labeling Post-its with the name of each image, you could go to a copy place and photocopy your photos. (Shrink them a bit.) Tape or glue your copied images to the Post-its, and lay out your storyboard. The advantage here is that, just as on the computer, you can easily move things around.
4. If you know desktop publishing software like Adobe’s Pagemaker or Quark Express, and you're familiar with how to scan images, you can make your storyboard right on the computer.

Shooting Platform

- Always shoot using a steady shooting platform.
- Try to use a camera with an electronic image stabilization feature for static shots, a "steady-cam" balancing attachment.

Lighting

- Use proper lighting (low light levels and high light levels) .
- Daylight may improve the image.
- Onboard battery lights for camcorders can be useful, but only in conditions where the light acts as a "fill light" to illuminate the details of subject's face.

Chroma Keys

- Chrome keys allow you to choose a color or range of colors that become transparent, allowing the video image can be seen through the computer image.
- A useful tool easily implemented in most digital video editing applications is **blue screen, green screen, Ultimatte, or chroma key editing.**
- **Blue screen** is used for making multimedia titles. Incredible backgrounds can be generated using 3-D modeling and graphic software. The objects are neatly layered onto the background. Applications such as Videoshop, Final Cut Pro, and iMovie provide this capability.
- Use a proper screen backgrounds, for example, if the person has blue eyes, choose a **green screen**. Another handy hint while deciding the color is analyzing the color scheme of the video which will be inserted as the background.
- If the background you are going to insert contains images of the sea, then use a **blue screen.**
- If the background contains an image of a park or trees, use a green screen.

Composition

- Composition is an act or mechanism to combine simple functions to build more complicated ones.
- It is the plan, placement or arrangement of the elements of art in a work

- When shooting video for playback from CD-ROM or the web in a small computer window, it is best to avoid wide panoramic shots.

- Use close-ups and medium shots, head-and-shoulders or even tighter.

Considerations:

1. Always import video and sound at the higher resolution and with the least amount of compression possible; reduce the resolution and compress footage later according to your needs.

2. Always shoot using a steady shooting platform.

3. Good lightening is extremely important.

4. Expensive sets are not required when using blue screen or matte technique.

5. Avoid wide panoramic shots and camera motion when shooting for a small computer window on CD-ROM or the Web.

Optimizing Video for CD-ROM

- CD-ROMs provide an excellent distribution medium for computer based video, because they are inexpensive to mass produce, they can store grant quantities of information.

- CD-ROM players offer slow data transfer rates, but adequate video transfer can be achieved by taking care to properly prepare your digital video files.

Optimizing Video Files for CD-ROM

- Without great care, these digital files may display poorly in low-bandwidth / high-compression environments:

1. Limit the amount of synchronization required between the video and audio. With Microsoft's AVI files, the audio and video data are already interleaved, so this is not a necessity, but with QuickTime files, you should "flatten" your movie. Flattening means that you interleaved the audio and video segments together.

2. Use regularly spaced key frames, 10 to 15 frames apart, and temporal compression can correct for seek time delays. Seek time is how long it takes the CD-ROM player to locate specific data on the CD-ROM disc.

3. The size of video window and the frame rate you specify dramatically affect performance. In QuickTime, 20 frames per second played in a 160 x 120 pixel window is

equivalent to playing 10 frames per second in 320 x 240 window. The more data that has to be decompressed and transferred from the CD-ROM to the screen, the slower the playback.

4. Although interleaving CD-quality audio into your video production will theoretically yield the highest-quality sound, the volume of data required may be too great to transfer from the CD-ROM in real-time. Try a lower sampling rate and sample size to reduce the quantity of audio data.

5. The software compression algorithm you specify will make a dramatic difference in performance. The Sorenson algorithm or codec, available within both AVI and QuickTime, is optimized for CD-ROM playback.

6. Defragment your files before burning the master.

7. If you are working with QuickTime, consider using a specialized application such as Media Cleaner Pro to automatically optimize your digital video file playback from CD-ROM.

DVD Recordable

- DVD recordable are used for consumer audio and video recording.

- Three formats were: -R/RW (dash), +R/RW (plus), -RAM (random access memory).

- Dual Layer recordings allows DVD-R and DVD+R discs to store more data, up to 8.5 GB per disc, compared with 4.7GB for single layer discs.

Considerations for preparing video for the Web and CD-ROM

Considerations:

1. Codecs are digital video and video compression schemes that compress a video for delivery and then decode it during playback.
2. Streaming audio and video starts playback as soon as enough data has transferred to the user's computer to sustain this playback.
3. The MPEG standards provide good media encoding abilities. MPEG-4 includes numerous multimedia capabilities and may become the preferred standard for video and audio in multimedia.
4. CD-ROMs provide an excellent distribution medium for computer-based video.
5. When preparing video for CD-ROM distribution, interleave the audio tracks with the video track, use key frames every 10 to 15 frames, and keep the size of the video window small. The Sorenson codec is optimized for CD-ROM playback.

Recording and Editing Digital Audio

Steps and considerations in recording and editing digital audio

- The file size (in bytes) of a digital recording is,
  sampling rate * duration of recording in seconds * (bit resolution / 8) * number of tracks (1 for mono, 2 for stereo).

- Consumer-grade audio compact discs are recorded in stereo at a sampling rate of 44.1 kHz and a 16 bit resolution. Other sampling rates include 22.05 and 11 kHz., at either 16 or 8 bits.

- When recording (digitizing) audio, its important to keep the recording level near the maximum without going over it.

- Important steps in digital sound editing include removing blank space from the start and end of a recording and normalizing the sound to bring all clips to approximately the same level.

- The native sound file formats for most Macintosh editing software are the SND and AIF formats, and most authoring systems will read these formats. In Windows, the native sound file format for most editing software is a WAV file.

- Many audio editors provide tools such as,

1. Multiple Tracks
2. Trimming
3. Splicing and Assembly
4. Volume Adjustments
5. Format Conversion
6. Resampling or Downsampling
7. Fade-ins and Fade-outs
8. Equalization
9. Time Stretching
10. Digital Signal Processing (DSP)
11. Reversing Sounds.

1. **Multiple Tracks:**

You may edit and combine multiple tracks (for sound effects, voice overs, music, etc.) and then merge the tracks and export them in a “final mix” to a single audio file is important.

2. Trimming:

Removing “dead air” or blank space from the front of a recording and any unnecessary extra time off the end. Trimming is typically accomplished by dragging the mouse cursor over a graphic representation of your recording and choosing a menu command such as Cut, Clear, Erase, or Silence.

3. **Splicing and Assembly:**
Removing extraneous noises that inevitably creep into a recording.

4. **Volume Adjustments:**
Provide a consistent volume level, select all the data in the file, and raise or lower the overall volume by a certain amount.

5. **Format Conversion:**
Most editing software, save files in your choice of formats, most of which can be read and imported by multimedia authoring system.

6. **Resampling or Downsampling:**
If you have recorded and edited your sounds at 16 bit sampling rates but are using lower rates and resolutions in your project, you must resample or downsample the file. Your software will examine the existing digital recording, and work through it to reduce the number of samples. This process may save considerable disk space.

7. Fade-ins and Fade-outs:
Most programs offer enveloping capability, useful for long sections that you wish to fade in or fade out gradually. This enveloping helps to smooth out the very beginning and the very end of a sound file.

8. Equalization:
Digital Equalization (EQ) allow you to modify a recordings frequency content so that it sounds brighter or darker.

9. Time Stretching:
You may alter the length (in time) of a sound file without changing its pitch.

10. Digital Signal Processing (DSP):
Some programs allow you to process the signal with reverberation, multitap delay, chorus, and other special effects using digital signal processing (DSP) routines.

11. Reversing Sounds:
Another simple manipulation is to reverse all or a portion of a digital audio recording. Sounds, particularly spoken dialog, can produce a surreal, otherworldly effect when played backword.

Module 4

Multimedia Authoring Tools

Making Instance Multimedia

- Multimedia projects are so simple to build where you can use organizing, planning, rendering and testing stages into a single effort, and make “instant” multimedia.
- In a Microsoft Word document, you can include various image formats, movies and digitized sound.
- Software's like Word processing, spreadsheets, graphing, drawing and presentation have added capabilities for sound, image, and animation to their products.
- You can generate spreadsheet to enhance its contents with graphic images, sounds and animations.
- Your database may include pictures, audio clips, and movies.
- Your presentation software can generate interesting titles, visual effects, and animated illustrations for you product demo.

Making of your Multimedia Project:

1. Use templates that people have already creates to set up your production**.** These can include appropriate styles for sorts of data, font sets, color arrangements, and particular page set ups that will save your time.
2. Use wizards when they are available. They may save you much time and pre-set-up work.
3. Use named styles, because if you take the time to create your own it will really slow you down. Unless your client specifically requests a particular style, you will save a great deal of time using something already created, usable, and legal.
4. Create tables, which you can build with a few keystrokes in many programs, and it makes the production look credible.
5. Help readers find information with tables of contents, running headers and footers and indexes.
6. Improve document appearance with bulleted and numbered lists and symbols.

7. Allow for a quick-change replacement using the global change feature.

8. Reduce grammatical errors by using the grammar and spell checker provided with the software. Do not rely on that feature, though, to set all things right, you still need to proofread everything.

9. Include identifying information in the file name so you can find the file later.

Multimedia Authoring Tools

A multimedia authoring tool is a program that helps you write multimedia applications. A multimedia authoring tool enables you to create a final application merely by linking together objects, such as a paragraph of text, an illustration, or a song. They are used exclusively for applications that present a mixture of textual, graphical, and audio data.

With multimedia authoring software you can make video productions including CDs and DVDs, design interactivity and user interface, animations, screen savers, games, presentations, interactive training and simulations.

Different Stages Of Authoring
There are five distinct stages of multimedia authoring:

1. **Analysis:** What do you need to do and what do you use to do it.
2. **Design:** Create storyboards to tell the story of the project.
3. **Development:** Incorporate data and set it up as a prototype or model.
4. **Evaluation:** When the prototype application works the way you want it to, test it again, fine-tune it and then review your work.
5. **Distribution:** When it is ready to go, make it real. Package and distribute it.

Types of Authoring Tools

- **Card- or Page-based Tools**
- **Icon-based Tools**
- **Time-based Tools**

Card- or Page-based Tools

- In these authoring systems, elements are organized as pages of a book or stack of cards.

- The authoring system lets you link these pages or cards into organized sequence and they also allow you to play sound elements and launch animations and digital videos.

- Page-based authoring systems are object-oriented: the objects are the buttons, graphics and etc.

- Each object may contain a programming script activated when an *event* related to that object occurs.

- EX: Visual Basic

Icon-based Authoring Tools

- *Icon-based, event-driven* tools provide a visual programming approach to organizing and presenting multimedia.

- First you build the flowchart of events, tasks and decisions by using appropriate icons from a library.

- These icons can include menu choices, graphic images and sounds.

- When the flowchart is built, you can add your content: text, graphics, animations, sounds and video movies.

- EX: Authoware Professional

Time-based Authoring Tools

- Time-based authoring tools are the most common of multimedia authoring tools. In these authoring systems, elements are organized along a time line.

- They are the best to use when you have message with the beginning and an end.

- Sequentially organized graphic *frames* are played back at the speed that you can set.

- Other elements (such as audio events) are triggered at the given time or location in the sequence of events.

- EX: Animation Works Interactive

Elemental Tools

Elemental tools help us work with the important basic elements of your project: its graphics, images, sound, text and moving pictures. An elemental tool includes:

- Painting And Drawing Tools
- Cad And 3-D Drawing Tools
- Image Editing Tools
- OCR Software

- Sound Editing Programs
- Tools For Creating Animations And Digital Movies
- Helpful Accessories

Module 5

- Designing and Producing

Designing

- The design part of your project is where your knowledge and skill with computers, your talent in graphic arts, video, and music and your ability to conceptualize logical pathways through information are all focused to create the real thing.
- Design is thinking, choosing, making and doing.
- Design is shaping, smoothing, reworking, polishing, testing, and editing.
- After designing a project, your ideas and concepts are moved one step closer to reality.

Designing the Structure of Multimedia

- A multimedia project is consisting of text, graphics, sound and video elements.
- The way you compose these elements into interactive experiences is shaped by your purpose and messages.
- You can organize you material for a project in such away that, it can provide a great impact on the viewer.
- There are various ways of designing the multimedia or we may categorize them depending on the purpose. They are given in next slides.

Designing the Structure of Multimedia / Types of Multimedia Structure

Navigation

- Mapping the structure of your project is a task that should be started early in the planning phase, because navigation maps outline the connections or links among various areas of your content and help you organize your content and messages.
- A navigation map (or site map) provides you with a table of contents as well as a chart of the logical flow of the interactive interface.
- In Websites, a site map is typically a simple a hierarchical table of contents with each links to a particular page.
- A more detailed design document is very useful to your project, listing your multimedia objects and describing what happens when the user interacts.

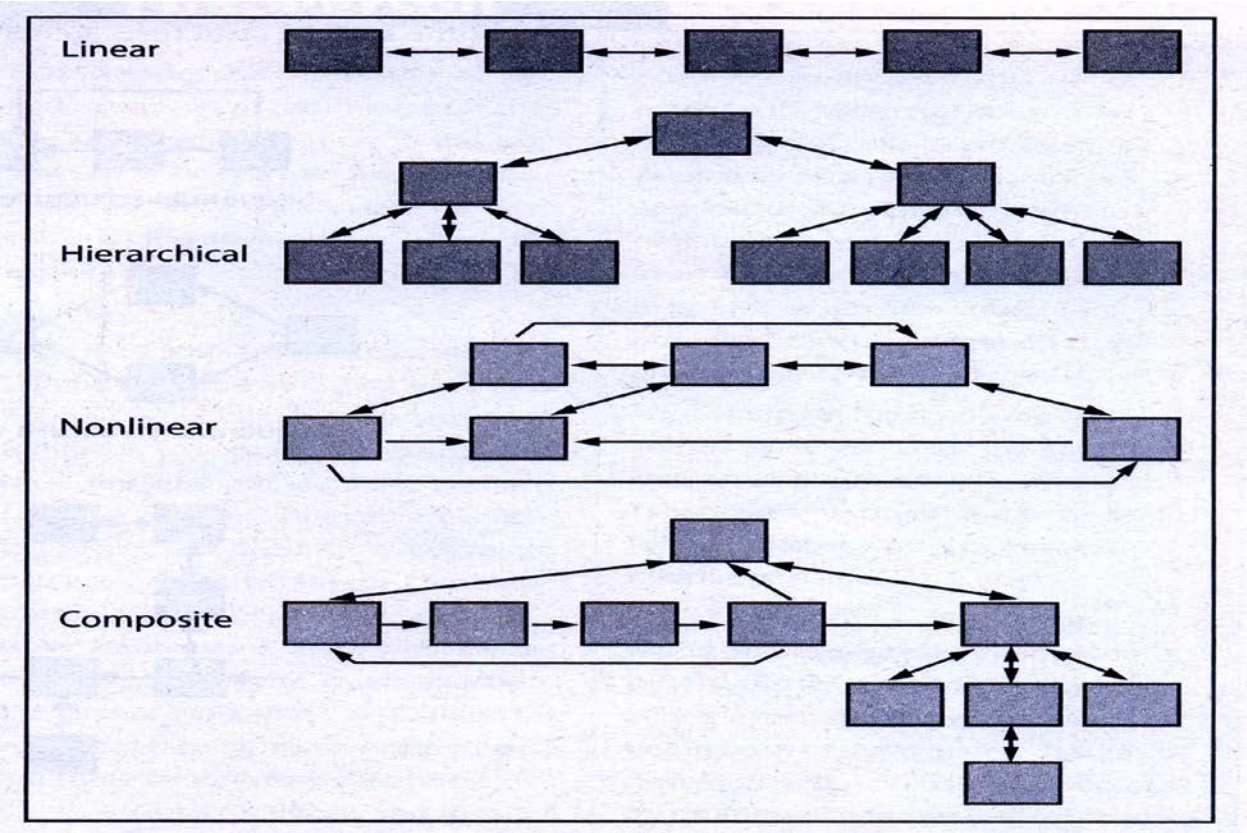
- The basic structures for Multimedia project covers the following cases: **Linear, Hierarchical, Nonlinear, and composite.**

- **Linear:** Users navigate sequentially, from one frame or byte of information to another.

- **Hierarchical:** It is also called "Linear with branching", since users navigate along the branches of a tree structure that is shaped by the natural logic of the content.

- **Nonlinear:** Users navigate freely through the content of the project, unbound by predetermined routes.

- **Composite:** Users may navigate freely (nonlinearly), but are occasionally constrained to linear presentations of movies or critical information's and/ or to data that is most logically organized in a hierarchy.



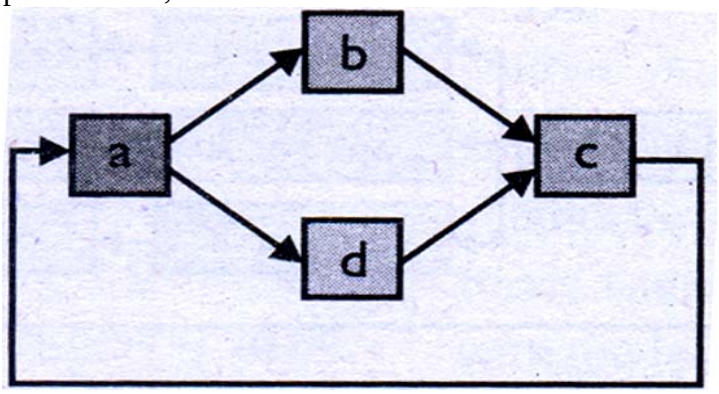
When you design your multimedia project you should work with **two types of structures:**

1. **Depth Structure**
2. **Surface Structure**

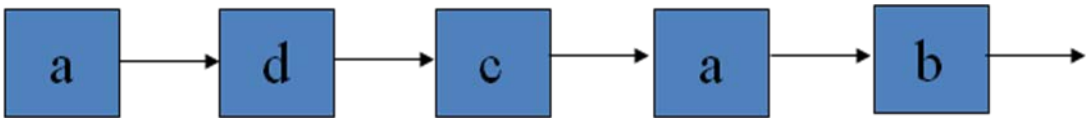
Depth Structure: It represents the complete navigation map and describes all the links between all the components of your project.

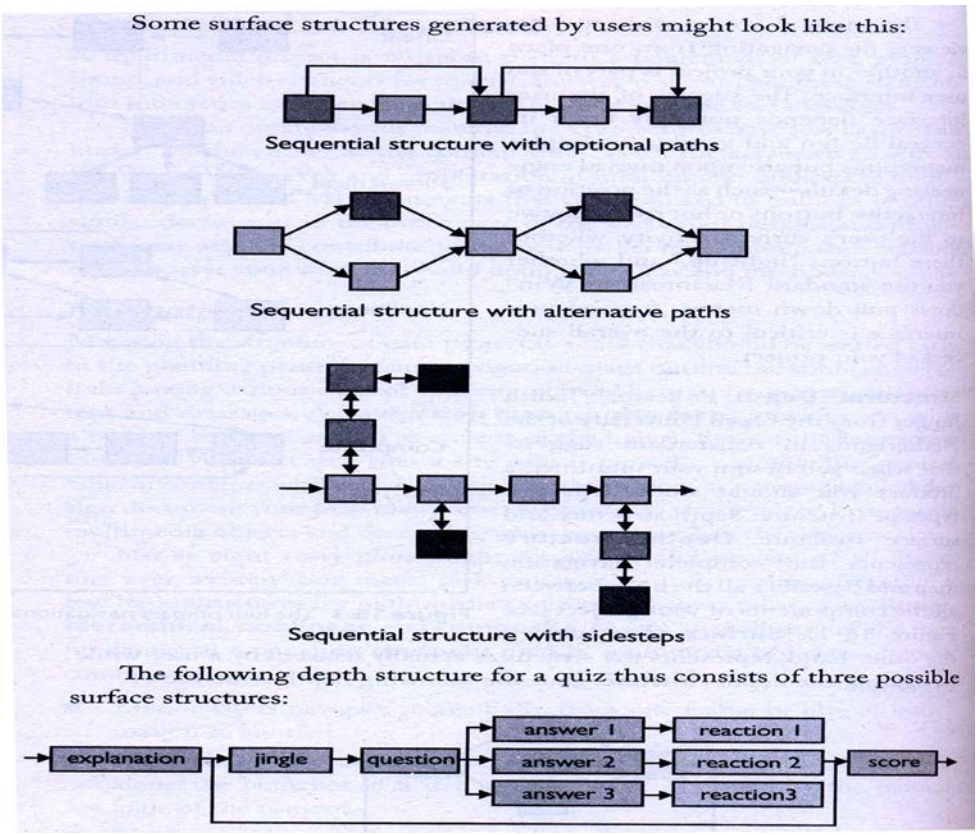
Surface structure: It represents the structures actually realized by a user while navigating the depth structure.

- The following depth structure,



might be realized as the following surface structure:



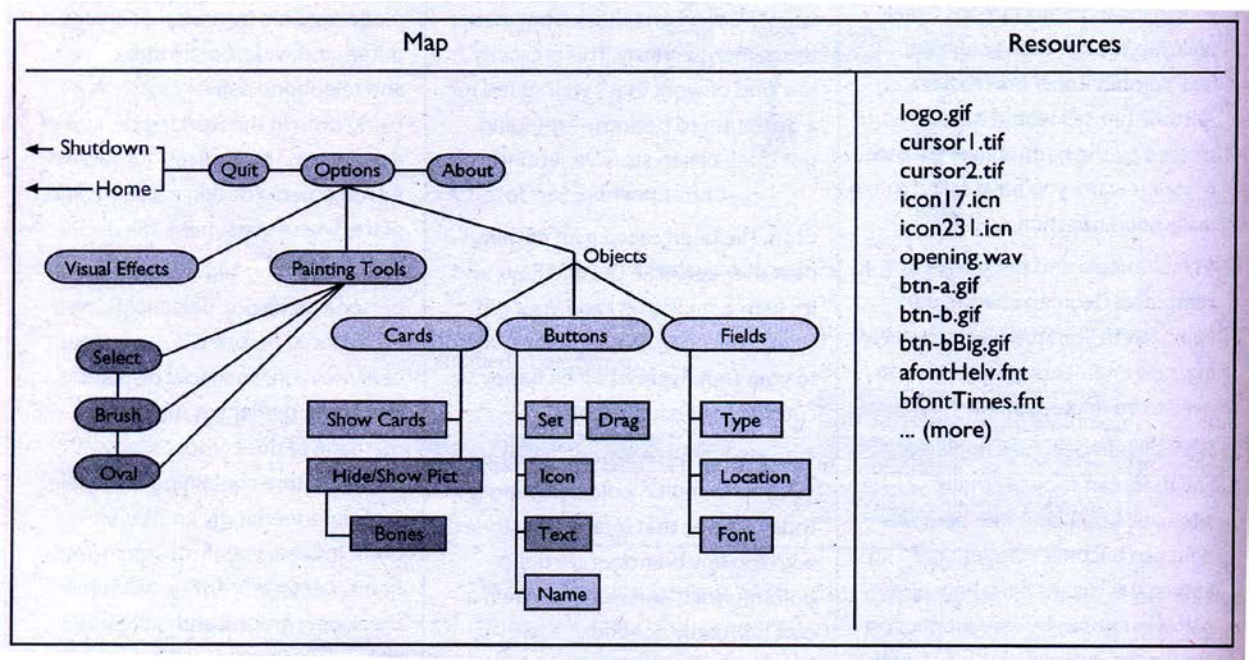


- **Surface structures** are of particular interest to marketing firms in tracking users routes through a website to determine the effectiveness of the sites design.

- Many navigation maps are **nonlinear**, where the viewers are always jump to an index, various menus or any sections.

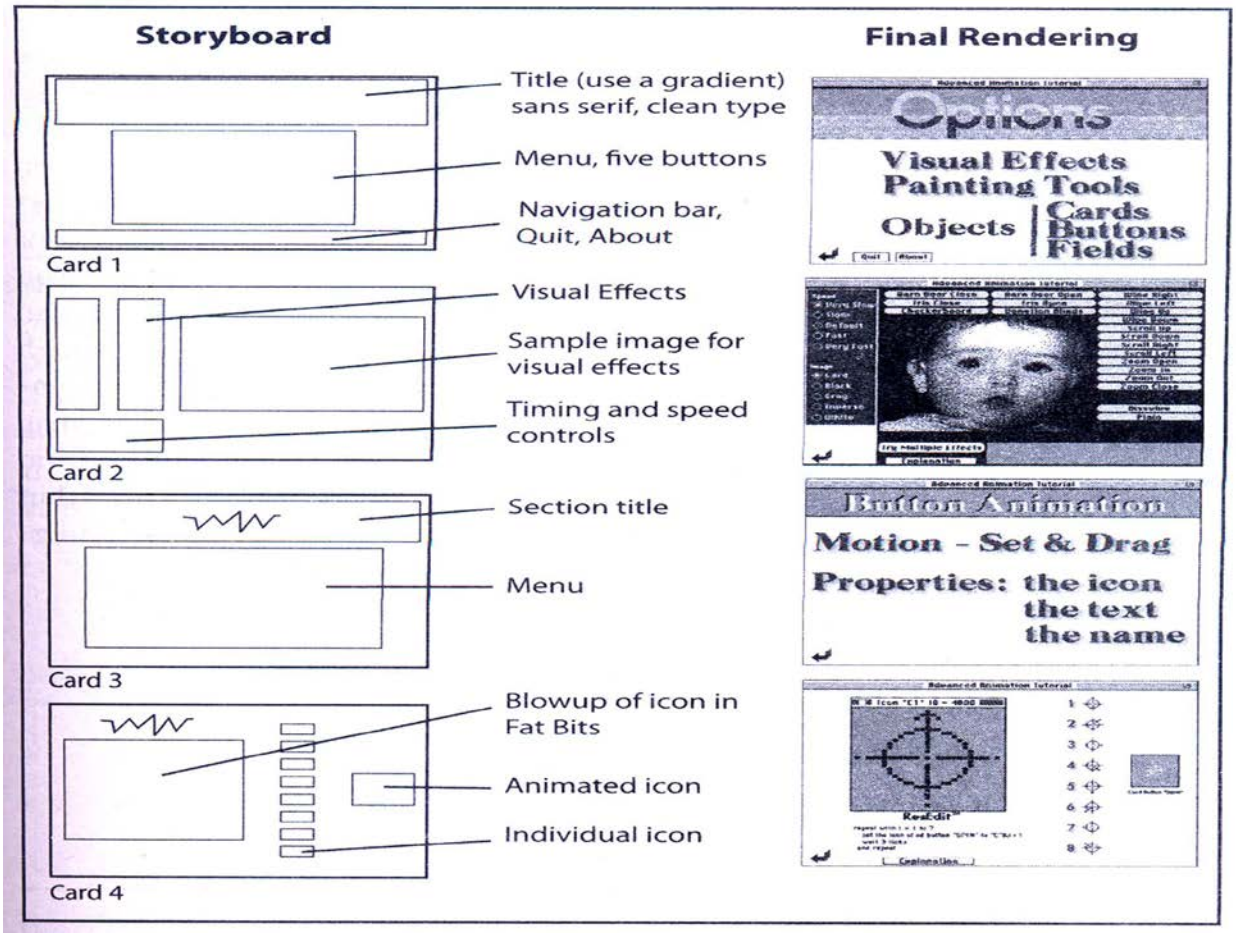
- The architectural drawings for your multimedia project are **storyboards** and **navigation maps**. Storyboards in combination with navigation maps are used in design process, to visualize the information architecture.

- A simple navigation map is shown in following slide:



- A storyboard for the same project, originally organized sequentially, screen by screen and each screen is sketched out with design notes and specifications before rendering.

- A simple storyboard is shown in the following slide:



Hot Spots, Hyperlinks, and Buttons

- **Hot spot** is a region of high or special activity within a larger area of low or normal activity.
- Most multimedia authoring systems allow you to make any part of the screen, or any object, into a **hot spot.**
- When user click a hot spot at that location, something happens, which makes multimedia not just interactive but also exciting.
- Hot spots can be given more specific names based upon either their function or form.
- If the hot spot connects the user to another part of the document or program or to a different program or web site, it is referred to as a **hyperlink.**
- If the hot spot is a graphic image designed to look like a push button or toggle switch, it is called a **button.**

- **A button** is more formally defined as a meaningful graphic image that you click to make something happens.
- The term **"tab"** is not a button but it's a **hot spot.** The clickable tab labels as the top of the illustration below are hot spots, but are not buttons. The real buttons are along the bottom:
- There are three categories of hot spots based upon the form in which they appear: **Text, graphic, or icon.**
- **Text:** A text is a hypertext. You may use hyperlink to other web pages.
- **Graphics:** You may create graphics, by using authoring tools, which should be used as a hot spot.
- **Icons:** Icons are graphic objects designed specifically to be meaningful buttons and are usually small.
- HTML do not directly support interactive buttons that follow the rules of good interface design.
- But you can make plain and animated buttons for your HTML documents on the web using plug-ins such as Flash or JavaScript.
- A JavaScript in an HTML document may be used to replace one image with another on mouseOver or hover.
- A simplest hot spots on the web are the text anchors that link a document to other document.
- Larger Images should may be sanctioned into hot areas with associated links, these are called image maps.
- Hyperlink to a **text, image, icon** is a hot spot.
- Examples of How text, image and Icon acts as hot spot.

Designing the User Interface

- The user interface of your multimedia product is a collection of multimedia elements and navigation system.
- While designing the user interface you need to consider several factors, i.e. designing the Graphical User Interface, Designing the Audio Interface.

Graphical User Interface (GUI)
Graphical Approaches:

- Designing excellent computer screens requires a special set of fine art skills.
- Graphic artist must upgrade his / her knowledge as the technology changes. They must stay informed about the rapidly changing canvas of new features, techniques, applications, and creative tools.

Following are **some graphical approaches that get good result:**
Things That Work:

- Neatly executed contrasts: big/ small, heavy/ light, bright/ dark, thin/ thick etc.
- Simple and clean screen with lots of spaces.
- Use shadows in various shapes.
- Gradients
- Reversed graphics to emphasize important text or images.
- Shaded objects and text in 2-D and 3-D.

Following are **some mistakes that you have to avoid:**
Things to Avoid:

- Clashes of color
- Using picture with a lot of contrast.
- Requiring more than two buttons to quit.
- Too many numbers.
- Too many words.

Audio Interface

- Sounds can be background music, special effects for button clicks, voice-overs, effects given to animations, or using video clips.
- Choose music that best fits the content and the atmosphere you wish to create.
- Always provide a toggle switch to disable sound.

- Always test a project that contain sound with potential users.

A Multimedia Design Case History

- The design process of multimedia project from planning to launch is given here as a case history:

1. **Storyboarding a Project:**

   a) Collect the available source material, practically sorted into logical groups: old photographs, a magazine article and newspaper clippings, engineering drawings, official documents and some cassettes with recorded sounds.

   b) The first storyboard was simple hierarchical structure with branches to each subject area.

2. **Putting It Together:**

   a) The most eye-catching photograph was chosen as a background for the main menu screen.

   b) Main screen clearly specify the mission, vision of the company and the objectives, with message boards.

   c) From every screen in the project, users would be able to return to the main menu.

   d) Clicking buttons on screens may play related sounds.

   e) Adding a Quit button was necessary, also on the main menu and sub menus.

   f) Photos were too small to be placed alone on a single screen.

   g) The sound bites were recorded, digitized, and added to the project wherever necessary. You may use the picture of loudspeaker to play the music.

3. **Reworking:**

   a) If any modification in any screen is necessary, then modify it.

   b) For Example, the buttons on the main menu were the wrong color, so they were changed.

   c) You may format the text by using several font styles, sizes and also several designing options like shadow effect and so on.

Producing

- Production is the phase when your multimedia project is actually rendered.
- During this phase you will contend with important and continuous organizing tasks.
- In production you have to consider several factors, they are described in following slides:

Starting Up

- Before you begin your multimedia project, it's important to check your development hardware and software and review your organizational and administrative setup, even if you are working alone.
- You must think about certain things, they are,

  a) Fastest CPU and RAM you can afford?

  b) Time-accounting and management system in place?

  c) Biggest monitors you can afford?

  d) Sufficient disk storage space for all work files?

  e) Communication pathways open with client?

  f) Financial arrangements secure?

  g) Expertise lined up for all stages of the project?

Working with Clients

- Be sure to keep good communication between you and client as well as among the people actually building the project.
- Many projects have turned out unhappily because of communication breakdowns.

Client Approval Cycles

- Manage production so that your client is continuously informed and formally approves by signing off on artwork and other elements as you build them.
- Develop a scheme that specifies the number and duration of client approval cycles, and then provide a mechanism for change orders when changes are requested after sign-off.

- For change orders, remember that the client should pay extra and the changes should be costly.

Data Storage Media and Transportation

- You may transport your multimedia project through web, so that the client can view the application via Internet at high bandwidth.

- The most cost and time-effective method for transporting your files is on CD-R, or DVD-ROM by an overnight courier service.

Copyrights

- You may copyright your project code, in open-code environment.
- The source code of HTML pages on web may also be easily viewed.
- In such an open-code environment, you may prepared to let others see your programming work. Your code must be neat and commented.
- You can insert a copyright statement in your project that clearly designates the code as your intellectual property, but the code, tricks, and programming technique remain accessible for study, learning.

Principles for successful project management of multimedia productions

1. Production is the phase when your multimedia project is actually rendered.

2. Provide a time-accounting system for everyone working on the project.

3. Check your development hardware and software and review your organizational and administrative setup.

4. Have a system for communication between you, the client, and the people actually building the project in place.

5. Provide management oversight and control the client review process to avoid endless feedback loops.

6. Establish a process in which your client is continually informed and formally approves the project as you develop it.

7. Organize a method for tracking the receipt of material that you will incorporate into your multimedia project.

8. Develop a file-naming conventions specific to your project's structure.

9. Version control of your file (tracking editing changes s is critically important, especially in large projects.

DELIVERING

- Once the project is finalized, and ready to release for public or client, it is delivered on a web or on a CD-ROM or on a DVD.
- Before delivering the multimedia project, you must have to **test** the project again and again to ensure that it is bug free, accurate, operationally and visually on a target, and that the client requirements have been met.
- Before delivering you must test your project **as many platforms as possible**.

Testing

- **Testing** is an investigation conducted to provide information about the quality of the product with respect to the context in which it is intended to operate.
- **Testing** can also be stated as the process of validating and verifying that a software program/application/product/ project (1) meets the business and technical requirements that guided its design and development; (2) works as expected; and (3) can be implemented with the same characteristics.

Alpha Testing

- **Alpha testing** is simulated or actual operational testing by potential users/customers or an independent test team at the developers' site.
- This test involved few developers, few testers, and some of customer site people etc.
- This test is suitable for applications.
- **Alpha releases** are typically for internal circulation only and testing is performed among the selected group of users.
- Alpha testing is often employed for off-the-shelf software as a form of internal acceptance testing, before the software goes to beta testing.

Beta Testing

- **"Beta"** is a nickname for software which has passed the alpha testing stage of development and has been released to users for software testing before its official release.

- **Beta Testing** is the process of giving the product to customers and let them do the testing at their environment.

- **Beta testing** allows the software to undergo usability testing with users who provide feedback, so that any malfunctions these users find in the software can be reported to the developers and fixed.

- A **"beta version"** is the first version released outside the organization or community that develops the software, for the purpose of evaluation

- The process of delivering a beta version to the users is called **beta release.** Beta level software generally includes all features, but may also include known issues and bugs of a less serious variety.

- The users of a beta version are called beta testers. They are usually customers or prospective customers of the organization that develops the software.

- Beta testing is conducted by model customer, in the customer site.

- This test is suitable for products.

Polishing to Gold

- Once alpha and beta test is finished, now your software is ready for release. You may use some terms that indicate the current version status of project.

- **Bronze**, when you are closed to being finished.

- **Gold**, when you have determined there is nothing left to change or correct, and ready to reproduce copies from your **golden master**. Some software developers may use the term **release candidate**.

- Going gold, announcing that the job is finished and ready to ship a product.

Preparing for Delivery

Considerations in preparing your project for delivery in the market place

- A bad reputation earned by premature product release can destroy an otherwise excellent piece of work.

- Your product performance will usually depend on specific hardware and system configurations and, in the case of the Internet, on end users connection speeds. Online performance also depends on the amount of traffic to the site and the internet route taken to the site.

- Fully test your project on as many platforms as possible.
- Budget for obtaining the hardware test platforms, as well as for the many hours of effort that testing will require.
- Your contract should clearly specify the intended delivery platform and its hardware and software configuration, and provide a clause that you will test only to that platform.
- If your project depends on QuickTime and will be delivered on Windows, be sure the end user can install QuickTime from your CD or can download the QuickTime plug-in.
- Once you finished your multimedia project, it will be delivered to the client who will install the project on many computers.
- You will need to prepare your files so they can be easily transferred from your media to the users platform.
- The end users must easily or automatically set up your project or application on their own computers, so you may need to provide a single program acts as an installer.
- You must have to provide the written documentation about the installation process so that users have a clear step-by-step procedure to follow.
- You must have to provide necessary information through documentation used while installing the project like,
  1. Must have atleast 256 MB of RAM
  2. Will not run unless QuickTime is installed.
  3. 4 MB available disk free space.
  4. Disable all screen savers before running.
  5. Backup older versions before installing this update etc.
- Always provide this documentation in the files, may be named as README.TXT, which provides the details on installing the product.
- The clearer and more detailed your installation instructions are, the fewer frustrated users queries you will receive.

File Archives

- One or more files in your project can be compressed into a single file called as **archive.**
- Use a shareware or commercial compression utility for creating program archives that can then be decompressed and “reconstituted” into the original file structure.

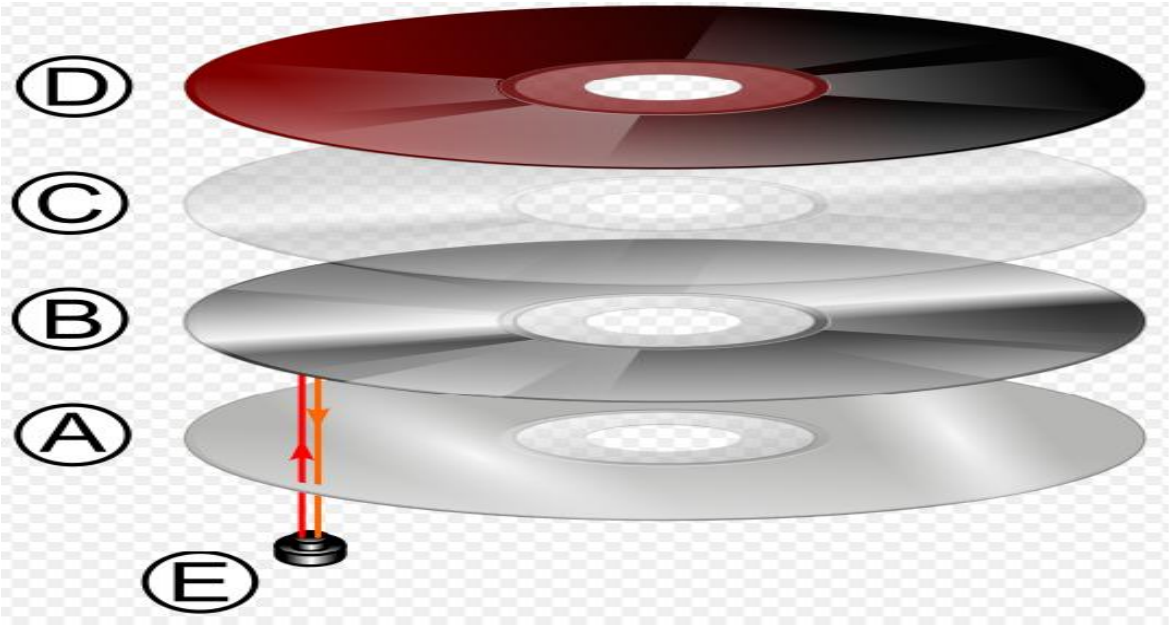
- **Self extracting files** allow the user to run the executable archive; compressed files are automatically decompressed and placed on the hard disk.

Delivering on CD-ROM

- The majority of multimedia products sold into retail and business channels are delivered on CD-ROMs.
- You can store a multimedia project and helpful documents in a CD-ROM or DVD.
- You must have to store the required software's for executing your project files e.g. WinZip.
- You also have to store the written documentation about the installation process so that users have a clear step-by-step procedure to follow.
- Now this full package, you have to deliver to the client using CD-ROM or DVDs.

Compact Disk Technology

-
- A Compact disk, or CD is a thin wafer of clear polycarbonate plastic and metal measuring 4.75 inches (120 mm) in diameter, with a small whole, or hub, in its center.
- Standard CDs have a diameter of 120 mm and can hold up to 80 minutes of uncompressed audio (700 MB of data).
- A **Compact Disc** (also known as a **CD**) is an optical disc used to store digital data. It was originally developed to store sound recordings exclusively, but later it also allowed the preservation of other types of data.
- A thin layer of aluminum or, more rarely, gold is applied to the surface to make it reflective, and is protected by a film of lacquer that is normally spin coated directly on top of the reflective layer, upon which the label print is applied.
- CD data are stored as a series of tiny indentations known as "***pits***", encoded in a spiral track molded into the top of the polycarbonate layer.
- The areas between pits are known as "lands". Each pit is approximately 100 nm deep by 500 nm wide, and varies from 850 nm to 3.5 µm in length.



- In the diagram of CD layers.

  A. A polycarbonate disc layer has the data encoded by using bumps.
  B. A reflective layer reflects the laser back.
  C. A lacquer layer is used to prevent oxidation
  D. Artwork is screen printed on the top of the disc.
  E. A laser beam reads the polycarbonate disc, is reflected back, and read by the player.

CD-R

- CD-R (Compact disk recordable) is an excellent method for distributing multimedia projects.

- CD-R blanks can hold as much as 700 MB of data are made up of polycarbonate core coated with layers of reflective metals and special photosensitive organic dyes.

- During the burning process, laser light hits the layer of dye, bakes it, and forms a pit.

- A 74-minute CD-R disc contains 333,000 sectors * 2048 bytes / sector for a capacity of 650.4 MB.

- An 80 minute disc contains 360,000 sectors * 2048 bytes / sector for a capacity of 703.1 MB.

Compact Disk Standards

- In 1979, Philips and Sony together launched CD technology as a digital method of delivering sound and music to consumers.
- This collaboration resulted in the **Red Book** standard, officially called the Compact Disc Digital Audio Standard. The Red Book standard defines the audio format for CDs available in music stores today.
- The **Yellow Book** is for CD-ROM.
- The **Green Book** is for CD-I (Interactive).
- The **Orange Book** is for write-once, read-only (WORM) CD-ROMs.
- The **White Book** is for Video CD (Karaoke CD).
- Red book remains the basis for standards that define more elaborate digital data formats for computers and other digital devices.
- A CD may contain one or more tracks. These are areas normally allocated for storing a single song in Red Book format.
- CDs also contain lead-in information and a table of contents.
- Each track on the CD may use a different format; this allows you to create a mixed-mode disc that combines.
- A CD contains tracks, the primary logical unit for data storage on a CD is a sector, which is 1/75 second in length.
- Each sector of a CD contains 2,352 bytes of data.
- After every sector are 882 bytes consisting of two layers of error-detecting and error-correcting information (EDC and ECC) and timing control data.
- A CD actually requires, then, 3,234 bytes to store 2,352 bytes of data.
- EDC and ECC allow a scratched or dirty data sector to reconstructed by software fast enough to avoid dropout of music.
- Timing codes are used to display song-playing time on an audio CD player.
- The disc spins at a constant linear velocity (CLV), so data can be read at a constant density and spacing.

- The rotational speed of the disc may vary from about 200 rpm when the read head is at the outer edge, to 530 rpm when it is reading near the hub.
- This translates to 1.3 meters (51 inches) of travel along the data track each second.
- The CDs rotational speed and density of the pits and lands on the CD allow data to be read at sustained rate of 150 Kbps in a single speed reader.
- Philips and Sony developed the Yellow Book to provide an established standard for data storage and retrieval.
- Yellow Book adds another layer for error checking to accommodate the greater reliability required of computer data, and it provides two modes: one for computer data and other for compressed audio and video/ picture data.

DVD

- Digital Versatile Discs (DVDs) stores 4.7 GB media on a Single-Sided, Single-Layered discs.
- You may store 15.9GB of storage on a single disc in the Double-Sided, Dual Layered format.
- There are three competing set of standards for recording DVD: DVD-R/DVD-RW, DVD+R/DVD+RW, and DVD-RAM.
- "R" stands for recordable and "RW" stands for rewritable.
- The standards, DVD-R/DVD-RW, DVD+R/DVD+RW are similar and can be played back on most DVD players and drives.
- The capacity of DVD is expressed in billion bytes or Giga bytes.
- Now you may record more than 4.37 GB onto a blank disc.

Wrapping It Up

- Packing is an important area where sales and marketing issues extend the process of making multimedia into the real world of end users.
- Like the cover of the book, people can judge your work based upon the impression it makes.
- Provide a title to the CD to be sold in a consumer market.

- Your package consists of a user manual, a registration card, quick reference guides.
- The fancier, bigger, and heavier the package is, the higher its perceived value.
- The art of your cover should reflect the content and function of the enclosed product.
- Your product with a proper documentation available for purchase is packaged in a well designed box.

Considerations Involved in selecting CD-ROM file standard, in packaging, and in delivering projects

- Select CD-ROM to store the multimedia project and the documentation files and also the necessary files depending on the size of your project.
- Digital Versatile Disc (DVD) CDs are made with a multilayer, high density manufacturing process that provides 4.7 gigabytes of storage.
- Packaging is an important consideration in marketing your project. Although users often equate quality with large boxes, high-caliber artwork, and fancy packaging, the current trend in software packaging is toward simplification.
- Delivering multimedia projects built for the World Wide Web can be as simple as renaming a directory or transferring a group of files on a Web Server.
- On the other hand, hosting your own server for delivering your project means tackling a variety of issues, including security, server-side configuration, and access.

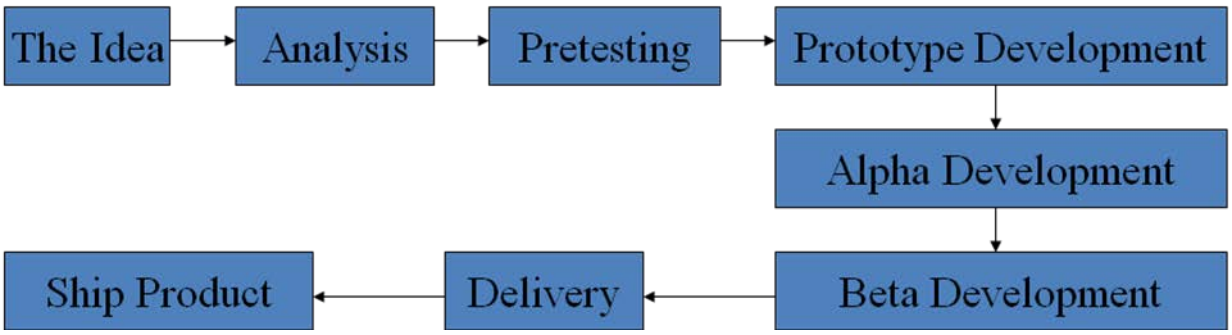
Module 6

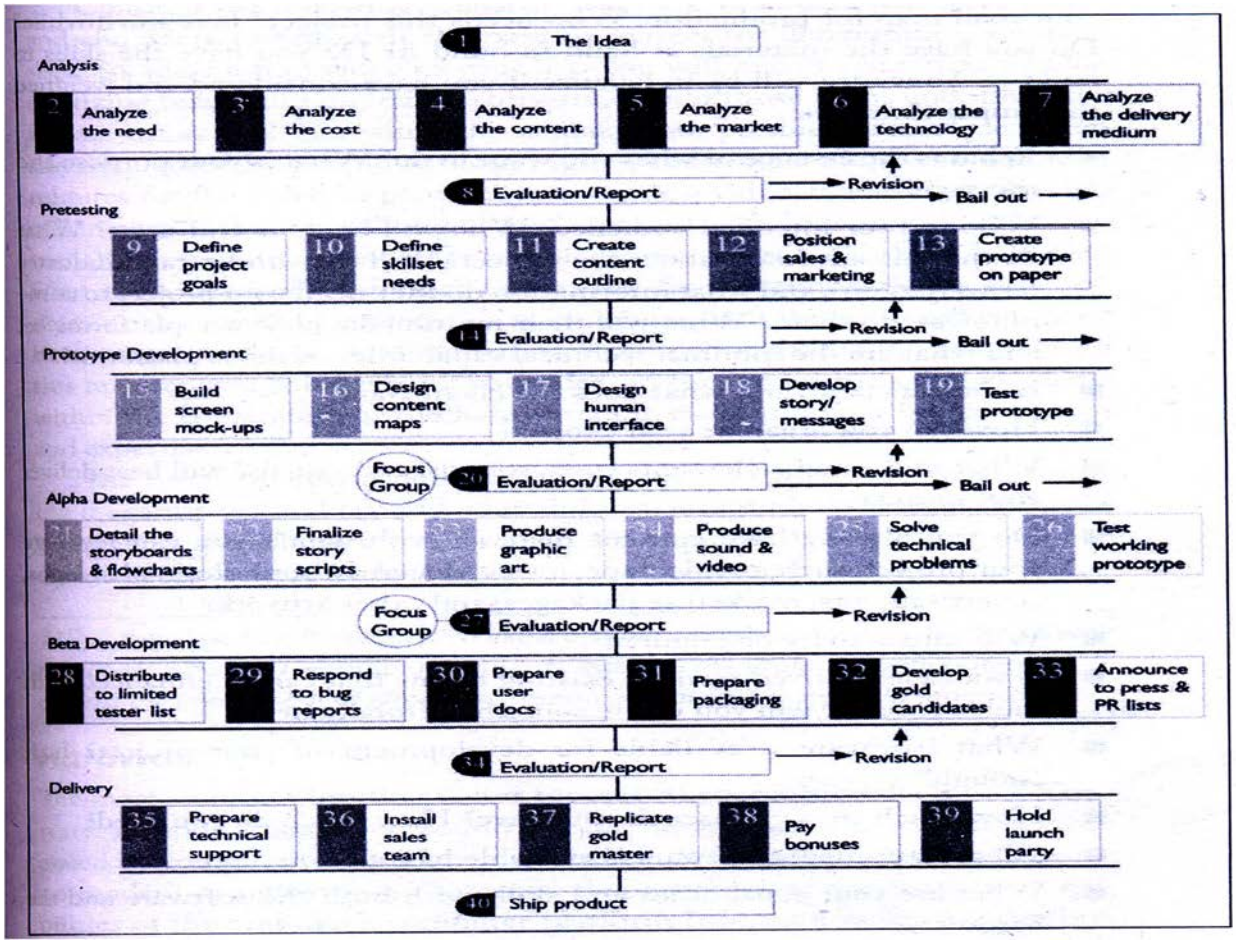
– Planning and Costing

- Before you start a Multimedia project, you first understand the requirements, scope and contents of the Multimedia design.
- Then you must develop an organized outline and a plan that is rational in terms of the skills, time, budget, tools, and resources you have.
- You may plan for the layout and contents.
- Your plans must be with you while rendering graphics, sounds, and other components, and you should refer to them throughout the projects execution.

The Process of Making Multimedia

- While making a Multimedia, you must have to make a plan, perform requirement analysis, and the planning from the beginning with your first ideas and ending with completion and delivery of a finished products.
- The Process of making multimedia is as follows:





Idea Analysis

- **Analysis** is the process of breaking a complex topic or substance into smaller parts to gain a better understanding of it.

- **Analysis** is the abstract separation of a whole into its constituent parts in order to study the parts and their relations.

- You will generate a plan of action that will become your roadmap for production, depending on, the following key questions,

    - Who needs this project?
    - Is it worthwhile?
    - Do you have the materials at hand to build it?
    - Do you have the skill to build it?

- Your idea will be in balance if you have considered and weighed the proper elements:

1. What is the essence of what you want to do?
2. Who is your intended audience?
3. Is there a client, and what does the client want?
4. How can you organize your project?
5. What multimedia elements will best deliver your message?
6. Do you already have content material with which you can leverage your project, such as music, documents, photographs, logos, advertisements etc? Will interactivity be required?
7. Will interactivity be required?
8. Is your idea derived from an existing theme that can be enhanced with multimedia, or will you create something totally new?
9. What hardware is available for development of your project? Is it enough?
10. How much storage space do you have? How much do you need?
11. What multimedia software is available to you?
12. What are your capabilities and skills with both the software and the hardware?
13. Can you do it alone?
14. How much time do you have?
15. How much money do you have?
16. How will you distribute the final product?
17. Will you need to update and / or support the final product?

- You can maintain balance between purpose and feasibility by dynamically adding and subtracting multimedia elements as you stretch and shape your idea.
- You can start small and build from minimum capabilities toward a satisfactory result in an additive way.

Hardware

- You must have to examine the existing hardware, available hardware for the development of the project as well as in the customers environment whether it is available or not.

- Begin by listing the hardware capabilities of the end user's computer platform (not necessarily the platform on which you will develop a project).

- If the capabilities are not enough, examine the cost of enhancing that delivery platform, and balance those results against your purpose and resources.

Idea Management Software

- The software's that is used for arranging your ideas, resources.

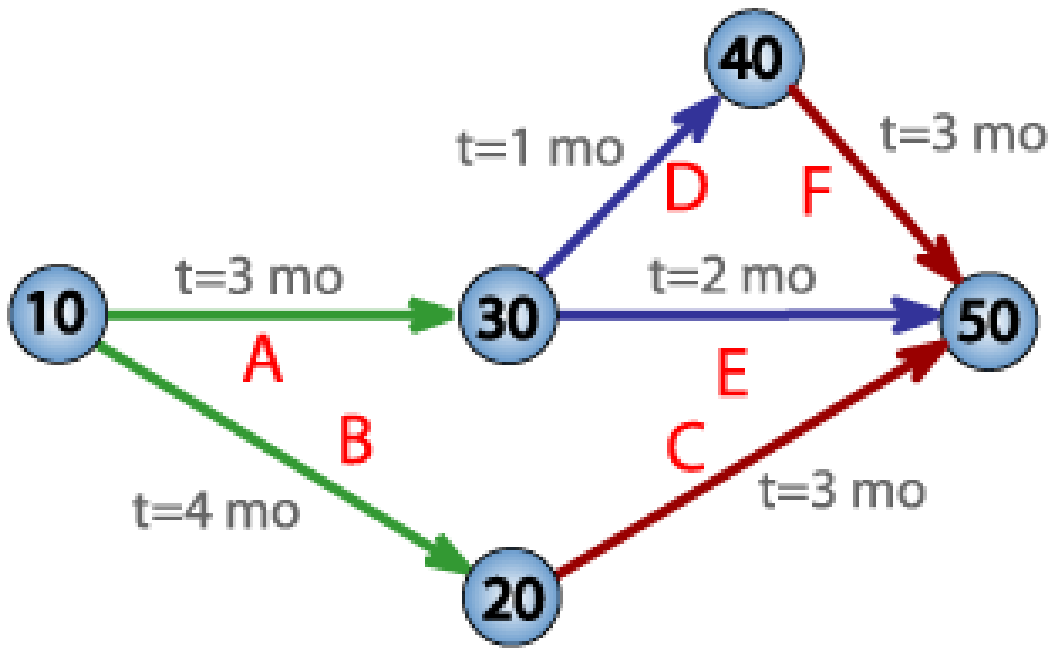
- Software such as Microsoft Project, Designer's Edge, spreadsheets such as Excel can be useful for arranging your ideas and the many tasks, work items, employee resources, and costs required of your multimedia project.

- Project management tools provide the added benefit of built-in analysis to help you stay within your schedule and budget during the rendering of the project itself.

- Project Management Software typically provides **Critical Path Method (CPM)** scheduling functions to calculate the total duration of a project based upon each identified task.

- Tasks that are critical and that if lengthened, will result in a delay in project completion.

- **Program Evaluation Review Technique (PERT) charts** provide graphic representations of task relationships, showing prerequisites, the tasks that must be completed before others can commence.



PERT chart for a project with five milestones (10 through 50) and six activities (A through F). The project has two critical paths: activities B and C, or A, D, and F – giving a minimum project time of 7 months with fast tracking. Activity E is sub-critical, and has a float of 2 months.

Pretesting

- Define your project goals in greater details and spell out what it will take in terms of skills, contents, and money to meet these goals.
- If you are building a commercial product, sketch out how you will sell it.
- Work up a prototype of the project on paper, with an explanation of how it will work.
- All these steps help you organize your idea and test it against the real world.

Task Planning

- You must plan tasks to be performed during developing Multimedia project.
- A checklist of action items for which you should plan ahead, you think through your project is given as follows:

-

1. Design Instructional Framework	10. Conduct User Test
2. Hold creative Idea Session	11. Revise Design
3. Determine Delivery Platform	12. Create Graphics and Animations
4. Determine Authoring Platform	13. Produce Audio and Video
5. Create Storyboards	14. Digitize Audio and Video

6. Design Interface	15. Program and Author
7. Design Information Containers	16. Test Functionality
8. Assemble Team	17. Conduct Beta Test
9. Build Prototype	18. Prepare Package, Deliver and Install.

Building a Team

- Multimedia is an emerging technology requires a set of skills, like graphics, animations, audio, video including programming languages.
- Multimedia developers come from all corners of the computer and art worlds as well as from a variety of other disciplines.
- If you need to assemble a team, you need to know the people and skills it takes to make multimedia.
- You should make the list of the skills and software capabilities available to you.
- You may build a matrix chart of required skills which is helpful to describe the makeup of your team.
- Staying at the leading edge is important. If you remain knowledgeable about what's new and expected, you will be more valuable to your own endeavors, your team, and to your employer or prospective clients.
- Don't neglect team morale as hours grow long, deadlines slip.

Prototype Development

- A working system to explore implementation or processing alternatives and evaluate results.

- The prototype is developed based on the currently known requirements. Development of the prototype obviously undergoes design, coding and testing.

Steps :

1. Identify the user's information and operating requirements.
2. Develop a working prototype that focuses on only the most important functions, using a basic database.
3. Allow the user to use the prototype, discuss requested changes and implement the most important changes.
4. Repeat the next version of the prototype with further changes incorporated until the system fully meets user requirements.

- Once you decided to develop a project, develop a working prototype on the basis of requirement specification and planning.

- Build a screen, mock-ups, and a human interface of menus and button clicks.

- Prototype is sometimes called a **proof-of-concept or feasibility study,** in which you have to build a small working model on which you have to work.

- In a prototyping, you might select a small portion of a large project and get that part working as it would in the final product.

- During this phase you can test ideas, mock up interfaces, exercise the hardware platform, and develop a sense about where the alligators live.

- Test your prototype along several fronts, technology, costs, market, and human interface.

- The purpose of any prototype is to test the initial implementation of your idea and improve on it based upon test result.

- By having a prototype or working model the user gets better understanding of the product being developed.

- Quicker user feedback is available leading to better solution.

Alpha Development

- As you go forward, you should aware of the requirements and passages that will appear along your course and prepare for them.

- The **alpha** build of the software is the build to the internal software testers, that is, people different from the software engineers, sometimes to the public, but usually internal to the organization or community that develops the software.

- With a prototype in hand and a commitment to proceed, the investment of effort will increase and at the same time, become more focused.

- More people may become involves as you begin to flesh out the project as a whole.

Beta Development

- "Beta" is a nickname for software which has passed the alpha testing stage of development and has been released to users for software testing before its official release.

- Beta testing allows the software to undergo usability testing with users who provide feedback, so that any malfunctions these users find in the software can be reported to the developers and fixed.

- A "beta version" is the first version released outside the organization or community that develops the software, for the purpose of evaluation

- The process of delivering a beta version to the users is called **beta release.** Beta level software generally includes all features, but may also include known issues and bugs of a less serious variety.

- The users of a beta version are called beta testers. They are usually customers or prospective customers of the organization that develops the software.

- By the time your idea reaches the beta stage of development, you will have committed serious time, energy, and money.

- At the Beta development stage, most of the features of the product are working, and you are distributing to a wider area of testers.

Delivery

- At this stage, you are having a final product.

- After the alpha and beta test passes, you are ready to deliver the product.

- Deliver the project for CD-ROM and the Web.

Scheduling

- To build a multimedia project you must define a timeline, for the completion of project.

- This may include **milestones** at which certain **deliverables** are to be done in a specified time.
-

- You must estimate the total time required for each task and then allocate this time among the number of persons who will be asynchronously working on the project.

- You must keep balance in distributing task to the workers.

- You can distribute the required hours to perform a task among several workers, completion should take proportionally less time.

Difficulties:

- Scheduling can be difficult for multimedia projects because so much of the making of multimedia is artistic trial and error.

- Scheduling multimedia project is also difficult because the technology of computer hardware and software is in constant flux, and upgrades while your project is under way may drive you to new installations and you may be in the learning curves.

- You must have to take the approval from customer at various stages of your work.

- In order to protect yourself from a customers arguments like non acceptance of project, you need to have points during the project for **client sign-off** on the work, meaning that he or she has approved the work to that point.

Estimating and Costing

- You must have to estimate the multimedia project in terms of costs and efforts.

- Estimate the costs for workers, machines and the other resources including hardware and software including the time constraints.

- Estimate the costs for advertisement, production of storyboards, Editing time, and for other elements of multimedia.
- Estimate depending on the complexity of the project, graphical screen and animations used.

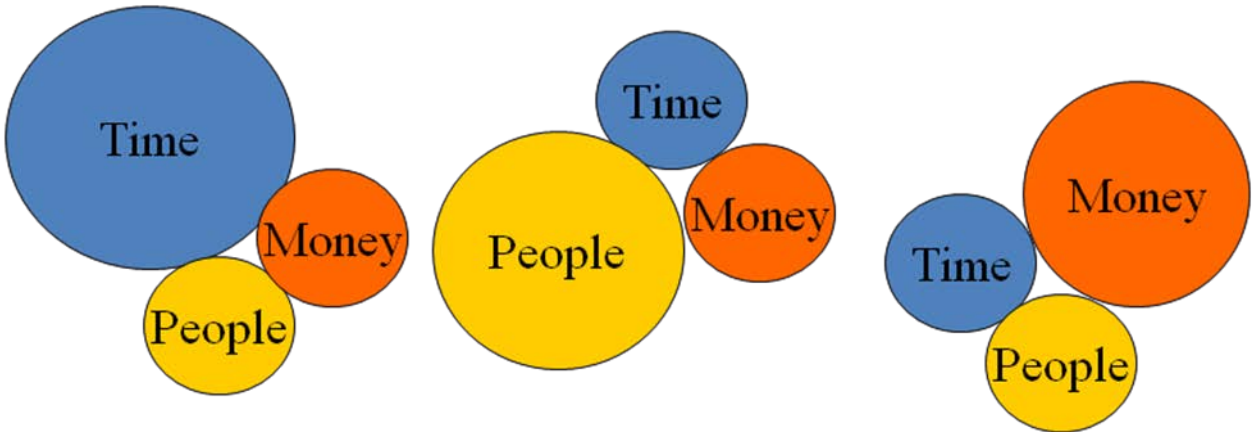
- Estimate the costs of your multimedia project by analyzing the tasks that it comprises and the people who build it.

- Be sure to include the hidden costs of administration and management.

- You must have to include the costs of other factors also like, a graphic artists, musician, instructional designer, and writer.

- Also remember to include a line item in your budget for **contingencies**, as a little extra padding to cover the inevitable unexpected costs.

- As a general rule, there are three elements that can vary in project estimates: time, money and people. If you decrease any one of these elements, you will generally need to increase one or both of the others.



- If you are working for an outside client, you will also need to determine a payment schedule.

- Payments are often divided into thirds: one-third upfront upon the signing of the contract, one-third as work products are delivered and approved during alpha and beta development phases, and one-third upon final approval of the completed production.

Billing Rates

- Billing rates should be set according to your cost of doing business plus a reasonable profit margin.

- Billing rate depends on the various factors, like hardware, software, technology, skills, time constraints etc.

- Typical billing rate for multimedia production companies and web designers range from $60 to $150 and hour, depending upon the work done and the person doing it.

- If consultants or specialists are employed on a project, the billing rate can go much higher.

Cost Sheets

- Different costs associated in developing a multimedia project, described in a sheet called **Cost Sheet.**

- Many costs are associated with a multimedia projects that are shown in following cost sheet example:

PROJECT DEVELOPMENT COSTS

- Salaries
- Client meetings
- Acquisition of content
- Communications
- Travel
- Research
- Proposal & contract prep
- Overhead

PRODUCTION COSTS

- Management
  - Salaries
  - Communications
  - Travel
  - Consumables
- Content Acquisition
  - Salaries
  - Research services
  - Fees for licensing content
- Content Creation
  - All content categories
    - Salaries
    - Hardware/software
    - Consumables
- Graphics Production
  - Fees for licensing images or animation clips
- Audio Production
  - Studio fees
  - Talent fees
  - Fees for licensing music rights
  - Data storage
- Video Production
  - Studio fees
  - Talent fees
  - Fees for licensing stock footage
  - Location fees
  - Equipment rental
  - Digital capture & editing
- Authoring
  - Salaries
  - Hardware/software
  - Consumables

TESTING COSTS

- Salaries
- Focus groups
  - Facility rental
  - Printing costs
  - Food and incentives
  - Coop fees (payment for participation)
- Editing
- Beta program

DISTRIBUTION COSTS

- Salaries
- Documentation
- Packaging
- Manufacturing
- Marketing
- Advertising
- Shipping

Module 7

- CODING AND COMPRESSION

Compression in General: Why Compress?

So Many Bits, So Little Time (Space)

- CD audio rate: 2 channels * 44100 samples per second per channel * 16 bits per sample = 1,411,200 bps

- CD audio storage (for monophonic recording):
  sampling rate * duration of recording in seconds * (bit resolution / 8) * 1

- CD audio storage (for stereo recording):
  sampling rate * duration of recording in seconds * (bit resolution / 8) * 2

Example: CD audio storage for 1 minute stereo (standard) recording = 10,584,000 bytes / minute

- A CD holds only about 70 minutes of audio
- An ISDN line can only carry 128,000 bps

Security: Best compressor removes all that is recognizable about the original sound

Graphics people eat up all the space

Compression

- **Data compression** or **source coding** is the process of encoding information using fewer bits (or other information-bearing units) than an unencoded representation would use, through use of specific encoding schemes.

- Compression is useful because it helps reduce the consumption of expensive resources, such as hard disk space or transmission bandwidth.

Compression principles

- The compression algorithms are based on the following principles:
  1. Source encoders and destination decoders
  2. lossless and lossy compression
  3. Entropy encoding

4. Source encoding.

1. **Source encoders and destination decoders**

   - The application is compressed by a compression algorithm, which is termed as the source encoder.

   - The application is decompressed at the destination by a decompression algorithm, termed as the destination decoders.

2. **Lossless and Lossy compression**

   - A lossless compression does not involve a loss of information and allows a perfect reconstruction of the original signal after the decompression.

   - In case of a lossless compression algorithm the aim is to reduce the amount of source information to be transmitted in such away that, when the compressed information is decompressed, there is no loss of information.

   - Lossless compression, is therefore, said to be reversible.

   - A lossy compression involves a loss of information compared to the original signal; therefore it is not possible to reconstruct the original signal from one that has been compressed by using a lossy compression algorithm.

   - In case of lossy compression algorithm the aim is normally not to reproduce an exact copy of the source information after decomposition but rather a version of it which is perceived by the recipient as a true copy.

   - Lossy compression is generally used in transmission of digitized images, and audio and video streams, because in such cases, the sensitivity of the human eye or ear is such that any fine details that may be missing from the original source signal after decompresion are not detectable.

Lossless Compression

- Lossless audio compression allows one to preserve an exact copy of one's audio files, in contrast to the irreversible changes from lossy compression techniques.

- Compression ratios are similar to those for generic lossless data compression (around 50–60% of original size), and substantially less than for lossy compression (which typically yield 5–20% of original size).

- Naturally wishes to maximize quality.

- Editing lossily compressed data leads to digital generation loss, since the decoding and re-encoding introduce artifacts at each generation.

Lossy Compression

- Greater compression than lossless compression (data of 5 percent to 20 percent of the original stream, rather than 50 percent to 60 percent), by discarding less-critical data.
- Use psychoacoustics to recognize that not all data in an audio stream can be perceived by the human auditory system.
- data is removed during lossy compression and cannot be recovered by decompression

3. Entropy Coding

- **Entropy encoding** is lossless and independent of the type of information that is being compressed.
- It is concerned solely with **how the information is represented.**
- **Entropy encoding (no loss / lossless):** Ignores semantics of input data and compresses media streams by regarding them as sequences of digits or symbols
    - Examples: run-length encoding, Huffman encoding , ...

Entropy Encoding run length / Run-length encoding

- This **encoding** type is used when the source information comprises long substrings of the same character or binary digit.
- **Run-length encoding** (**RLE**) is a very simple form of data compression in which *runs* of data (that is, sequences in which the same data value occurs in many consecutive data elements) are stored as a single data value and count, rather than as the original run.
- Instead of transmitting the source string in the form of independent codewords or bits, it is transmitted in the form of a different set of codewords which indicate not only the particular character or bit being transmitted but also an indication of the number of characters/ bits in the substring.
- At the **destination**, it provides the set of codewords being used, it simply interprets each codeword received and outputs the appropriate number of characters or bits.
- This is most useful on data that contains many such runs: for example, relatively simple graphic images such as icons, line drawings, and animations.

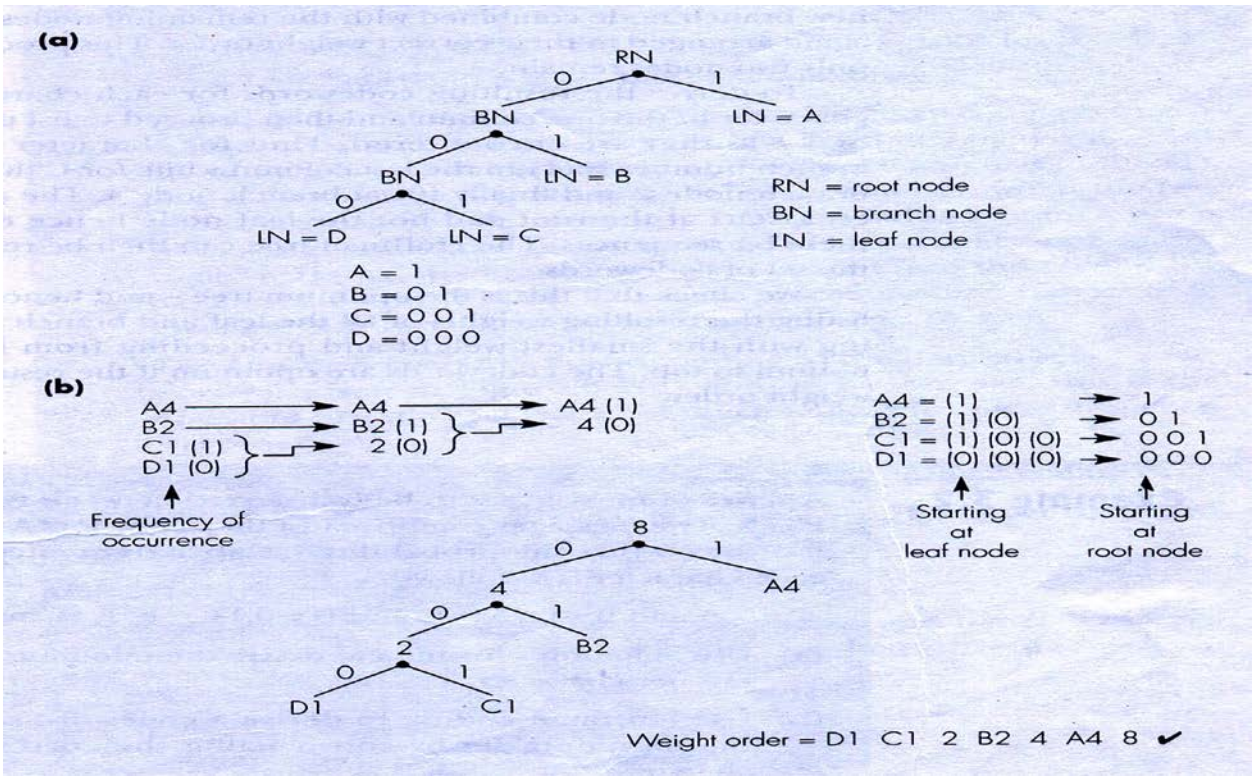
Example

-
- For example, consider a screen containing plain black text on a solid white background.
- There will be many long runs of white pixels in the blank space, and many short runs of black pixels within the text.
- Let us take a hypothetical single scan line, with B representing a black pixel and W representing white:
  - WWWWWWWWWWWWBWWWWWWWWWWWWBBBWWWWWWWW WWWWWWWWWWWWWWWWBWWWWWWWWWWWWWW
- If we apply the run-length encoding (RLE) data compression algorithm to the above hypothetical scan line, we get the following:
  - 12W1B12W3B24W1B14W
- Interpret this as twelve W's, one B, twelve W's, three B's, etc.
- The run-length code represents the original 67 characters in only 18.
- The actual format used for the storage of images is generally binary rather than ASCII characters like this, but the principle remains the same.
- After scanning a particular image, the output of the scanner is, 00000001111111110000011…
- This could be represented as, 0,7,1,10,0,5,1,2…
- Since only two binary digits are involved, if we ensure that the first substring always comprises binary 0s, then the string could be represented as, 7,10,5,2….
- To send this in a digital form, the individual decimal digits would be sent in their binary form and, assuming a fixed number of bits per codeword, the number of bits per codeword would be determined by the largest possible substring.
  - A compression technique that replaces consecutive occurrences of a symbol with the symbol followed by the number of times it is repeated
    - a a a a a => 5a
    - 00000000000000000000001111111 => 0x20 1x7
  - Most useful where symbols appear in long runs: e.g., for images that have areas where the pixels all have the same value, fax and cartoons for examples.

Huffman Coding (Lossless)

- Huffman coding has been shown to be one of the most efficient and simple variable length coding techniques used in high-speed data compression applications.
- Two important principles in Huffman coding is that no code is a prefix of another code which allows for a unique way to decode each word, and that no information is needed as a delimiter between codes.
- In the Huffman coding the character string to be transmitted is first analyzed and the character types and their relative frequency is determined.
- The coding operation involves creating an unbalanced tree with some branches shorter than others.
- The degree of imbalance is a function of the relative frequency of occurrence of the characters, the larger the spread, the more unbalanced is the tree.
- The resulting tree is known as the **Huffman code Tree.**
- A Huffman (code) tree is a **binary tree** with branches assigned the value **0 or 1.**
- The base of the tree, normally the geometric top, is known as the **root node.**
- The point at which the branch divides, is called a **branch node.**
- The termination point of a branch is known as a **leaf node.**
- Given a string, AAAABBCD. Generate Huffman code tree? Show Weight order and how many bits are required to transmit the complete string AAAABBCD.
- **Solution:**
  A binary values 0 and 1 are assigned to each branch

Huffman Coding (Lossless) Huffman code tree construction (a) Final tree with codes; (b) tree derivation



- Each branch divides, a binary value 0 or 1 is assigned to each branch.
- The codewords used for each character are determined by tracing the path from the root node out to each leaf and forming a string of the binary values associated with each branch traced.
- The set of codes associated with this tree would take,
  4 x 1 + 2 x 2 + 1 x 3 + 1 x 3 = 14 bits
  To transmit the complete string AAAABBCD.
- The characters must be encoded together with the probability of their occurrences, the Huffman coding algorithm determines the optimal code using minimum number of bits.
- To determine a Huffman code, it is useful to construct a binary tree.
- The leaves of this tree represent the characters that are to be encoded.
- Every node contains the occurrence probability of one of the characters that are to be encoded
- 0 and 1 are assigned to the branches (edges) of the tree.

- The Huffman code assignment procedure is based on a *binary tree* structure. This tree is developed *by a sequence of pairing operations* in which the *two least probable symbols* are joined at a node to form two branches of a tree. More precisely:

    - The list of probabilities of the source symbols are associated with the leaves of a binary tree.

    - Take the two smallest probabilities in the list and generate an intermediate node as their parent and label the branch from parent to one of the child nodes 1 and the branch from parent to the other child 0.

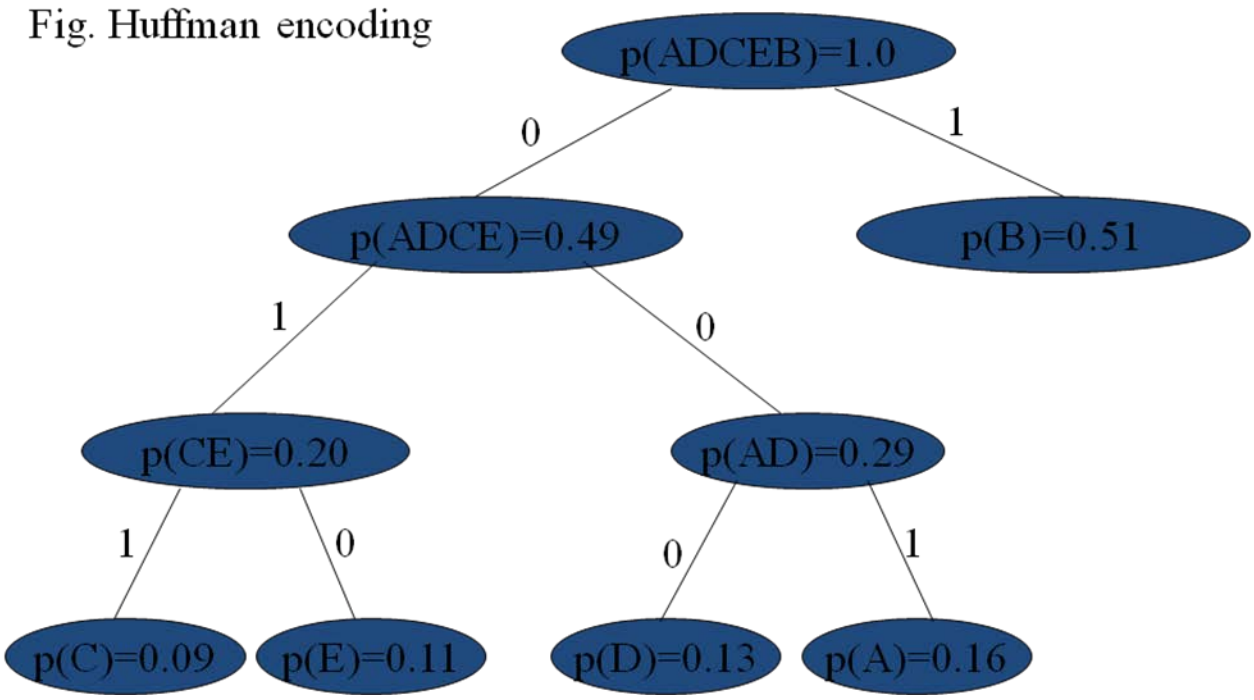
    - Replace the probabilities and associated nodes in the list by the single new intermediate node with the sum of the two probabilities. If the list contains only one element, quit. Otherwise, go to step 2.

Example:

- Given a string, ADCEB.
- Characters A, B, C, D and E have the following probability of occurrence:
  p(A) = 0.16
  p(B) = 0.51
  p(C) = 0.09
  p(D) = 0.13
  p(E) = 0.11

The Huffman encoding is generated as follows:

Fig. Huffman encoding



- The characters with the lowest probability are combined, in the first binary tree, thus C and E are leaves. The combined probability of the node CE is 0.20.

- The edge from CE to node C is assigned a 1 and the edge from CE to E becomes a 0. This is arbitrary assignment; therefore with the same data one can get different Huffman codes.

- Now the following nodes remain:
  p(A) = 0.16, p(B) = 0.51, p(CE) = 0.20, p(D) = 0.13

- Again the two nodes with the lowest probabilities are combined into a binary subtree; the nodes A and D are such leaves and the combined probability of their root is 0.29. The edge from AD to A is assigned a 1 and the edge from AD to D a 0.

- Now the following node remain:
  p(AD) = 0.29, p(B) = 0.51, p(CE) = 0.20

- The nodes with the smallest probabilities are AD and CE. They are combined into a binary tree; the combined probability of their root node ADCE is 0.49. The edge from ADCE to AD is assigned a 0 and the edge from ADCE to CE a 1.

- Now two node remain:
  p(ADCE) = 0.49, p(B) = 0.51

- They are combined to a binary tree with the root ADCEB. The edge from ADCEB to B is assigned a 1, and the edge from ADCEB to CEAD is assigned a 0.

- Figure shows, the resulting Huffman code in the form a of a binary tree.

- The result is the following code that is stored in a table:
  w(A) = 001
  w(B) = 1
  w(C) = 011
  w(D) = 000
  w(E) = 010
- If the information of an image can be transformed into a bit stream, such a table can be used to compress the data without any loss.

Huffman encoding:

- A popular compression technique that assigns *variable length codes* to symbols, so that the most frequently occurring symbols have the shortest codes

- Huffman coding is particularly effective where the data are dominated by a small number of symbols

- The theoretical **minimum average number of bits** that are required to transmit a particular source stream is known as the **entropy of the source** and can be computed using a formula attributed to **Shannon:**

The theoretical lowest average length (entropy)

$$H(P) = -\sum_{i=1}^{n} P(i)\log_2 P(i)$$

- Where n is the number of different symbols in the source stream and Pi is the probability of occurrence of symbol i.

- **Average number of bits per codeword is computed as,**

Average number of bits per codeword (Average length of Source),

$$L_{Huf} = \sum_{i=1}^{n} Ni\ Pi$$

- Where Ni is the number of bits per symbol and Pi is the probability of occurrence of symbol i.

- **The efficiency of this code is,**

- If we assign 3 bits per symbol *(N* =2^3=8), **the average length of the symbols is:**

$$\overline{L} = \sum_{i=1}^{8} 3P(i) = 3 \text{ bits/symbol}$$

Example:

- A statistical encoding algorithm is being considered for the transmission of a large number of text files over a public network. Analysis of the file contents has shown that each file comprises only the six different characters M, F, Y, N, 0, 1 each of which occurs with a relative frequency of occurrence of 0.25, 0.25, 0.125, 0.125, 0.125, and 0.125 respectively. If the encoding algorithm under consideration uses the following set of codewords:

- M = 10, F = 11, Y = 010, N = 011, 0 = 000, 1 = 001

- Compute:
  - the average number of bits per codeword with the algorithm,
  - the entropy of the source,
  - the minimum number of bits required assuming fixed-length codeword.

Answer:

Average number of bits per codeword

$$= \sum_{i=1}^{n} Ni\ Pi = (2\ (2 \times 0.25) + 4(3 \times 0.125))$$

$$= 2 \times 0.5 + 4 \times 0.375$$

$$= 2.5$$

Entropy of source

$$H(P) = -\sum_{i=1}^{n} P(i) \log2\ P(i) = -\ (2(0.25 \log2\ 0.25\ ) + 4(0.125 \log2\ 0.125))$$

$$= 1 + 1.5 = 2.5$$

Since there are 6 different characters, using fixed-length codewords require a minimum of 3 bits (8 combinations).

Example:

- A series of messages is to be transferred between two computers over a public network. The message comprise just the characters A through H. Analysis has shown that the probability (relative frequency of occurrence) of each character is as follows:
  A and B = 0.25, C and D = 0.14, E, F, G, H = 0.55

Compute:

(a) Use Shanon's formula to derive the minimum average number of bits per character.

(b) Use Huffman coding to derive a codeword set and prove this is the minimum set by constructing the corresponding Huffman code tree.

(c) Derive the average number of bits per character for your codeword set and compare this with:

(i) the entropy of the messages (Shanon's value),

(ii) fixed-length binary codewords,

(iii) 7-bit ASCII codewords.

Answer:

(a) Shanon's formula states:

Minimum average number of bits per character (Entropy),

$$H(P) = -\sum_{i=1}^{n} P(i) \log_2 P(i) = -(2(0.25 \log_2 0.25) + 2(0.14 \log_2 0.14) + 4(0.055 \log_2 0.055))$$

$$= 1 + 0.794 + 0.921 = 2.175 \text{ bits per codeword.}$$

(b) The derivation of the codeword set using Huffman coding is shown in the next slide (fig. a). The characters are first listed in weight order and the two characters at the bottom of the list are assigned to the (a) and (0) branches. Note that in this case, however, when the two nodes are combined, the weight of the resulting branch node (0.11) is greater than the weight of the two characters E and F (0.055). Hence the branch node is inserted into thesecond list higher than both of these. The same procedure then repeats until there are only two entries in the list remaining.

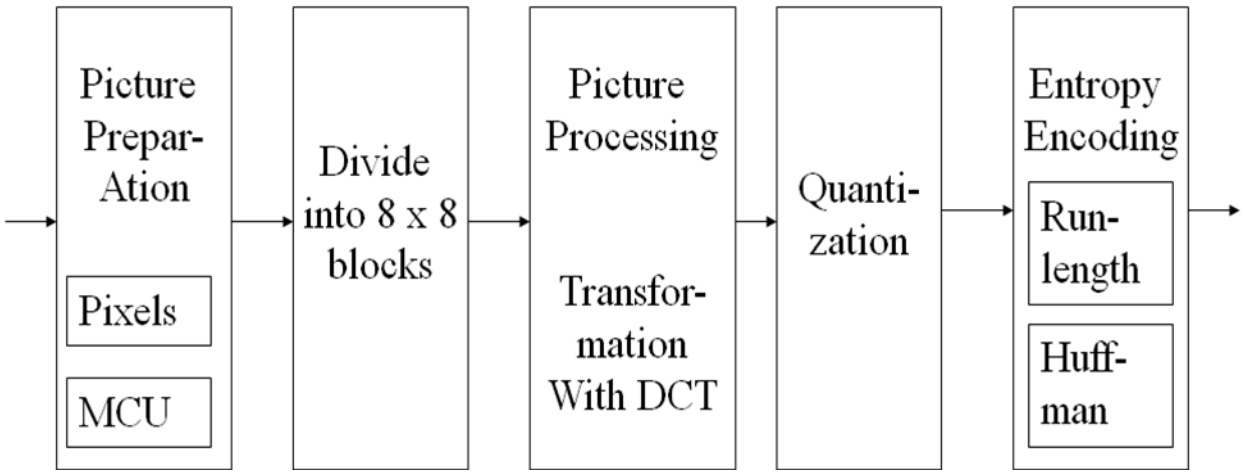
JPEG Compression

Fact about JPEG Compression

- JPEG stands for Joint Photographic Experts Group
- JPEG compression is used with .jpg and can be embedded in .tiff and .eps files.
- Used on 24-bit color files.
- Works well on photographic images.
- Although it is a lossy compression technique, it yields an excellent quality image with high compression rates.

Steps in JPEG Compression

1. (Optionally) If the color is represented in RGB mode, translate it to YUV.
2. Divide the file into 8 X 8 blocks.
3. Transform the pixel information from the spatial domain to the frequency domain with the Discrete Cosine Transform.
4. Quantize the resulting values by dividing each coefficient by an integer value and rounding off to the nearest integer.
5. Look at the resulting coefficients in a zigzag order. Do a run-length encoding of the coefficients ordered in this manner. Follow by Huffman coding.



Step 1a: Converting RGB to YUV

- YUV color mode stores color in terms of its luminance (brightness) and chrominance (hue).
- The human eye is less sensitive to chrominance than luminance.
- YUV is not required for JPEG compression, but it gives a better compression rate.

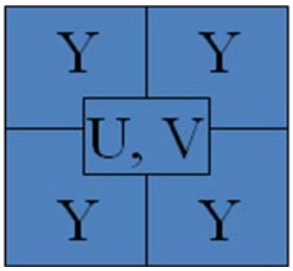
RGB vs. YUV

- It's simple arithmetic to convert RGB to YUV. The formula is based on the relative contributions that red, green, and blue make to the luminance and chrominance factors.
- There are several different formulas in use depending on the target monitor. For example:

$$Y = 0.299 * R + 0.587 * G + 0.114 * B$$
$$U = -0.1687 * R - 0.3313 * G + 0.5 * B + 128$$
$$V = 0.5 * R - 0.4187 * G - 0.813 * B + 128$$

Step 1b: Down sampling

- The chrominance information can (optionally) be downsampled.
- The notation 4:1:1 means that for each block of four pixels, you have 4 samples of luminance information (Y), and 1 each of the two chrominance components (U and V). MCU – minimum coded unit



Step 2: Divide into 8 X 8 blocks

- Note that with YUV color, you have 16 pixels of information in each block for the Y component (though only 8 in each direction for the U and V components).
- If the file doesn't divide evenly into 8 X 8 blocks, extra pixels are added to the end and discarded after the compression.
- The values are shifted "left" by subtracting 128.

Discrete Cosine Transform

- The DCT transforms the data from the spatial domain to the frequency domain.
- The spatial domain shows the amplitude of the color as you move through space
- The frequency domain shows how quickly the amplitude of the color is changing from one pixel to the next in an image file.

Step 3: DCT

- The frequency domain is a better representation for the data because it makes it possible for you to separate out – and throw away – information that isn't very important to human perception.
- The human eye is not very sensitive to high frequency changes – especially in photographic images, so the high frequency data can, to some extent, be discarded.

Step 3: Forward DCT

- The color amplitude information can be thought of as a wave (in two dimensions).
- You're decomposing the wave into its component frequencies.
- For the 8 X 8 matrix of color data, you're getting an 8 X 8 matrix of coefficients for the frequency components.

Fourier Transform

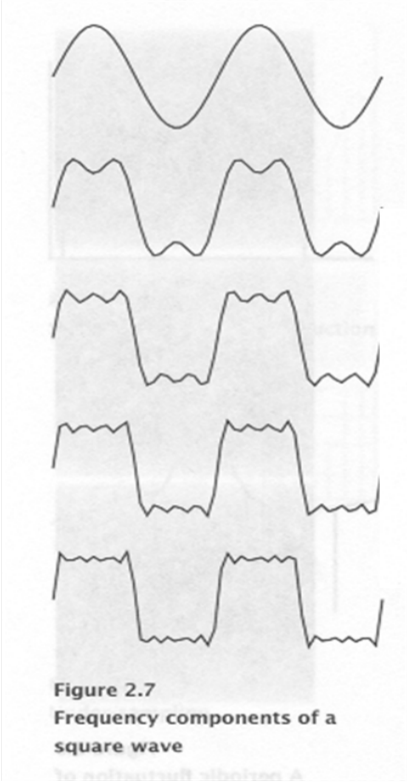


Figure 2.7
Frequency components of a square wave

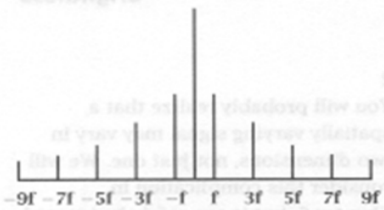
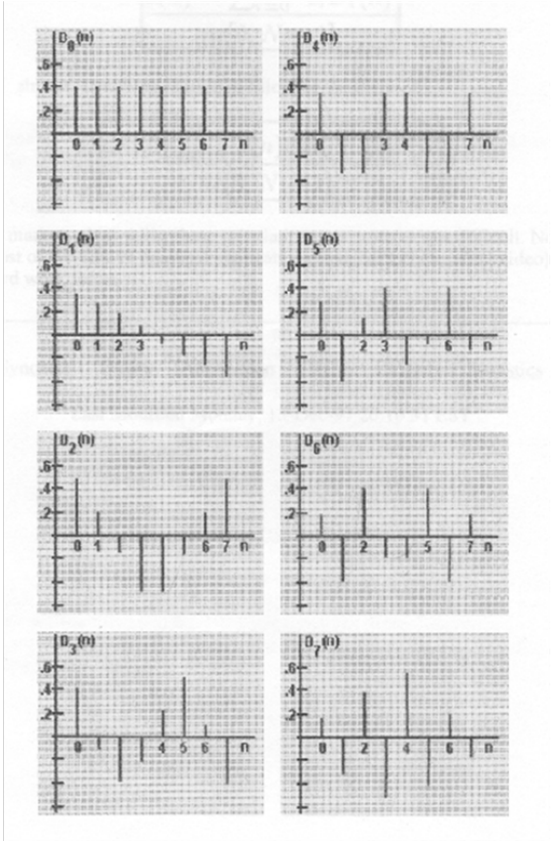


Figure 2.8
Square wave transformed into the frequency domain

Basic Functions for Discrete Cosine Transform



Step 4: Quantize the Coefficients Computed by the DCT

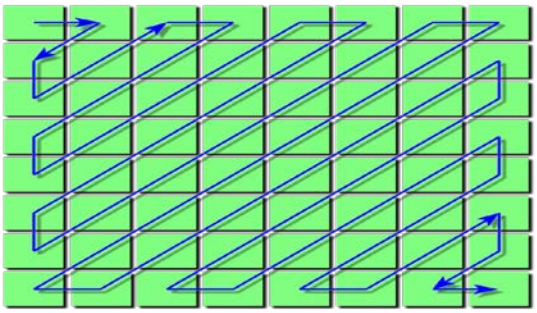
- The DCT is lossless in that the reverse DCT will give you back exactly your initial information (ignoring the rounding error that results from using floating point numbers.)
- The values from the DCT are initially floating-point.
- They are changed to integers by quantization.

Step 4: Quantization

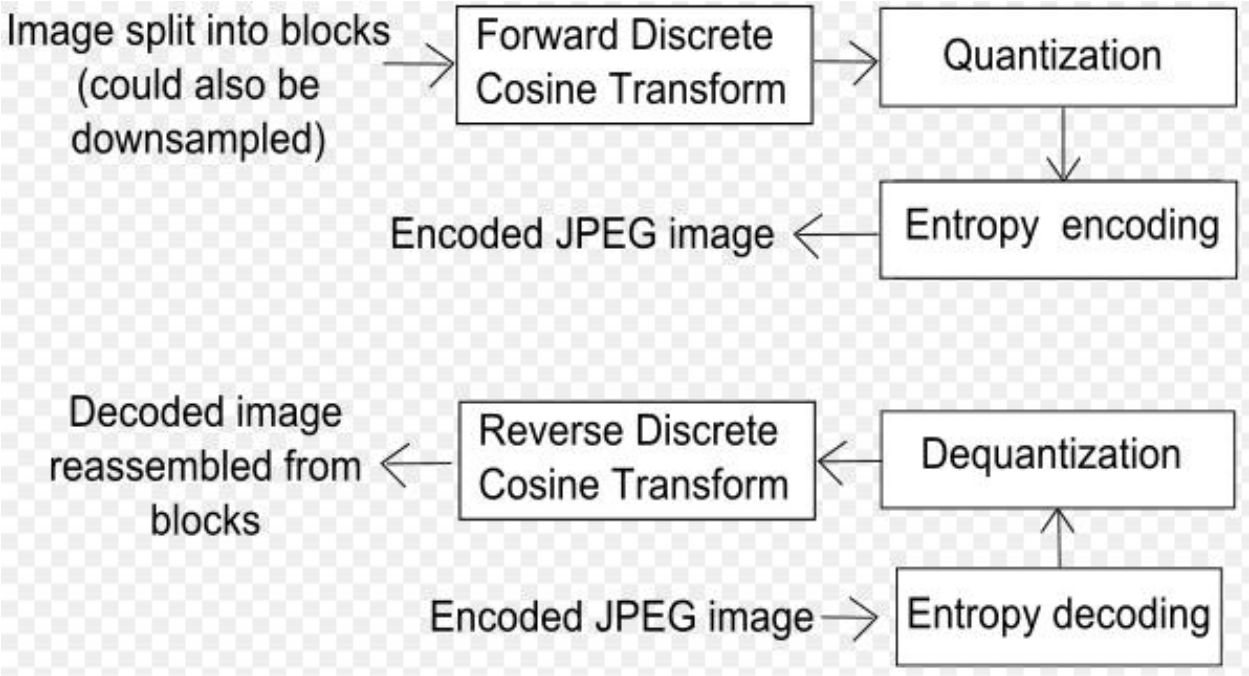
- Quantization involves dividing each coefficient by an integer between 1 and 255 and rounding off.
- The quantization table is chosen to reduce the precision of each coefficient to no more than necessary.
- The quantization table is carried along with the compressed file.

Step 5: Arrange in "zigzag" order

- This is done so that the coefficients are in order of increasing frequency.
- The higher frequency coefficients are more likely to be 0 after quantization.
- This improves the compression of run-length encoding.
- Do run-length encoding and Huffman coding.
- Entropy coding is a special form of lossless data compression. It involves arranging the image components in a "zigzag" order employing run-length encoding (RLE) algorithm that groups similar frequencies together, inserting length coding zeros, and then using Huffman coding on what is left.



JPEG encoding and decoding



JPEG encoding and decoding processing

- This encoding mode is called baseline *sequential* encoding.
- Baseline JPEG also supports *progressive* encoding. While sequential encoding encodes coefficients of a single block at a time (in a zigzag manner).
- progressive encoding encodes similar-positioned coefficients of all blocks in one go, followed by the next positioned coefficients of all blocks, and so on.
- So, if the image is divided into N 8×8 blocks {B0,B1,B2, ..., Bn-1}, then progressive encoding encodes Bi(0,0) for all blocks, i.e., for all i = 0, 1, 2, ..., N-1.
- This is followed by encoding Bi(0,1) coefficient of all blocks, followed by Bi(1,0)-th coefficient of all blocks, then Bi(2,0)-th coefficient of all blocks, and so on.
- It should be noted here that once all similar-positioned coefficients have been encoded, the next position to be encoded is the one occurring next in the zigzag traversal as indicated in the figure above.
- It has been found that Baseline Progressive JPEG encoding usually gives better compression as compared to Baseline Sequential JPEG due to the ability to use different Huffman tables (see below) tailored for different frequencies on each "scan" or "pass" (which includes similar-positioned coefficients), though the difference is not too large.

MPEG / Audio Compression

Facts about MPEG Compression

- MPEG stands for Motion Picture Experts Group
- This MPEG Audio compression algorithm was developed by the Motion Picture Experts Group (MPEG), as an International Organization for Standardization (ISO) standard for the high fidelity compression of digital audio. Used on 24-bit color files.

- While the MPEG/audio compression algorithm is lossy, often it can provide "transparent", perceptually lossless, compression even with compression factors of 6-to-1 or more.
- The algorithm works by exploiting the perceptual properties of the human auditory system.
- Much of the compression results from the removal of perceptually irrelevant parts of the audio signal.
- Removal of such parts results in inaudible distortions, thus MPEG/audio can compress any signal meant to be heard by the human ear.
- In keeping with its generic nature, MPEG/audio offers a diverse assortment of compression modes:
- The audio sampling rate can be 32, 44.1, or 48 kHz.
- The compressed bitstream can support one or two audio channels in one of 4 possible modes:

    1. **A monophonic mode** for a single audio channel,
    2. **A dual-monophonic mode** for two independent audio channels (this is functionally identical to the stereo mode),
    3. **A stereo mode** for stereo channels with a sharing of bits between the channels, but no joint-stereo coding, and
    4. **A joint-stereo** mode that either takes advantage of the correlations between the stereo channels or the irrelevancy of the phase difference between channels, or both.

- MPEG/audio offers a choice of three independent layers of compression. This provides a wide range of tradeoffs between codec complexity and compressed audio quality:

1. **Layer I** is the simplest and is best suited for bit rates above 128 Kbits/sec per channel. For example, Philips' Digital Compact Cassette (DCC) uses Layer I compression at 192 kbits/s per channel.
2. **Layer II** has an intermediate complexity and is targeted for bit rates around 128 Kbits/s per channel. Possible applications for this layer include the coding of audio for Digital Audio Broadcasting (DAB) , for the storage of synchronized video-and- audio sequences on CD-ROM, and the full motion extension of CD-interactive, Video CD.
3. **Layer III** is the most complex but offers the best audio quality, particularly for bit rates around 64 kbits/s per channel. This layer is well suited for audio transmission over ISDN.

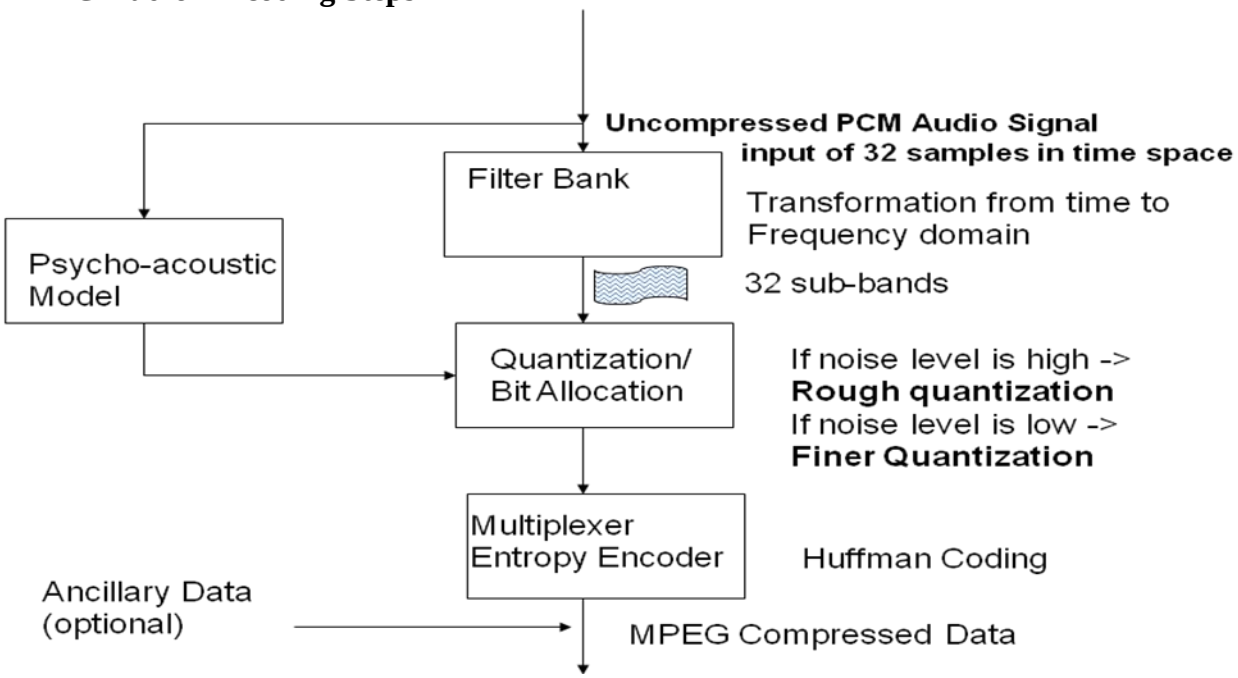
Features and Applications

- Generic lossy audio compression
- Diverse assortment of compression modes
- Possibilities of random access, audio FW, audio reverse
- Sampling rate: 33, 44.1 or 48 KHz
- Audio channel support:
    - Monophonic mode for a single audio channel
    - Dual-monophonic mode for two independent channels

- Stereo mode for stereo channels
- Joint-stereo model – takes advantage of correlations between stereo channels

- Predefined bit rate: 32-224 kbps
- Compression Layers:
  - Layer I: simplest, above 192 kbps
  - Layer II: intermediate complexity, 128 kbps
  - Layer III: most complex, but offers best audio quality for 64kbps

MPEG Audio Encoding Steps



MPEG/Audio Filter Bank

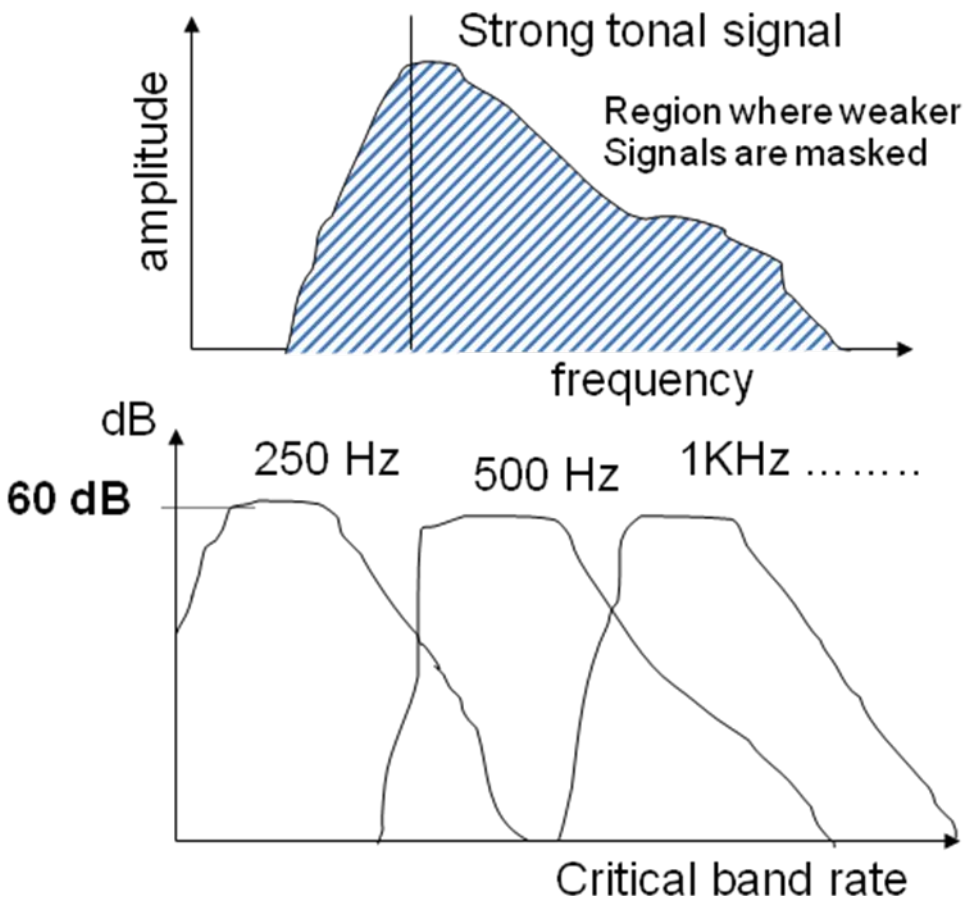
- Filter bank divides the PCM audio input into 32 equal-width frequency subbands
  - $S_t[i] = \Sigma_k \Sigma_j M[i][k] \times (C[k+64j] \times x[k+64])$, where
  - S[i] is the filter output sample for subband *i*, $i \epsilon [0,31]$;
  - *C[n]* is one of the 512 coefficients of the analysis window defined in standard
  - *X[n]* is the audio input sample read from a 512-sample buffer
  - *M[i][k]* are analysis matrix coefficients.
- Comments:
  - Equal widths of subbands do not reflect the human auditory system
  - Filter band and its inverse are lossy transformations (however the error introduced by the filter bank is small and inaudible)
  - Adjacent filter bands have a major frequency overlaps

MPEG/Audio Psychoacoustics

- The perception sensitivity, called **loudness**, is not linear across all frequencies and intensities.
- Some parts of an acoustic event can be measured but not heard. The reason is that part of a sound mixture masks another part. This **masking effect** can be observed in time and frequency domain.

- MPEG/Audio compresses audio by **removing acoustically irrelevant parts** of audio signal
- MPEG/Audio takes advantage of **human auditory system's inability** to hear quantization noise under auditory masking.
- **Auditory masking** is a perceptual property of human auditory system that occurs whenever the presence of a strong audio signal makes a temporal or spectral neighborhood of weaker audio signal imperceptible.

MPEG/Audio Psychoacoustic Model



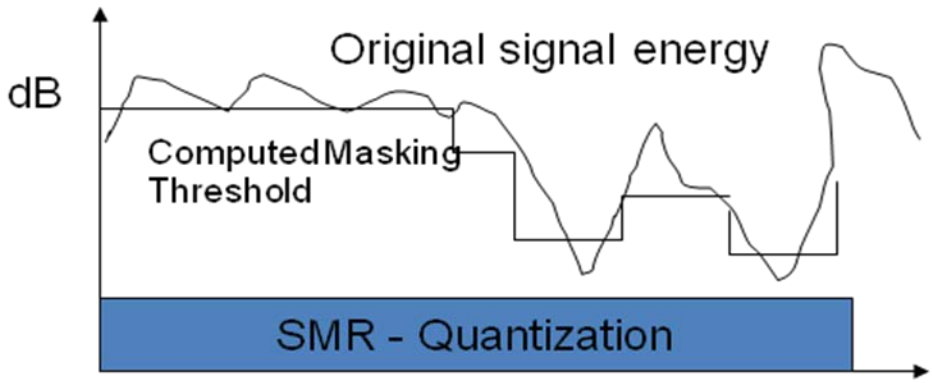
- Psychoacoustic model analyzes
- Audio signal and computes the amount of **noise masking**
- Masking depends on **signal frequency** And **loudness**
- **Width** of masking curves as a function Of frequency is a good indicator of human Auditory system's frequency-dependent Behavior

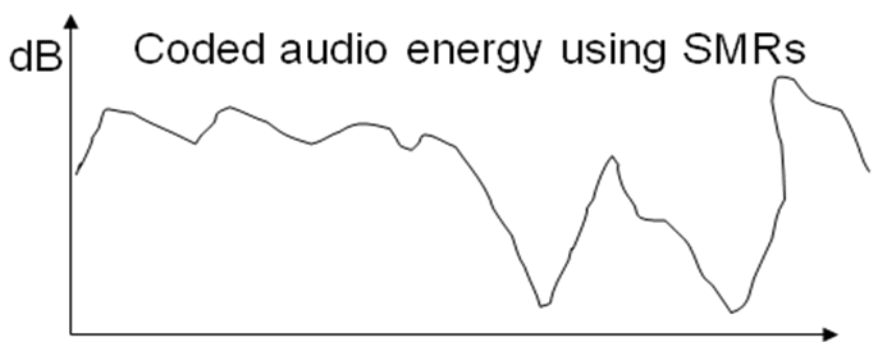
- Width is called the **size of critical band rate**

Psych. Model uses a separate, independent **time-to-frequency mapping** because it needs finer frequency resolution for an accurate calculation of masking thresholds

Quantization

- We quantize each sub-band according to the audibility of **quantization noise** within the band. Goal is to make the quantization noise **inaudible.**
- The model calculates **noise-masking thresholds** for each sub-band.
- The model computes **signal-to-mask** ratio (SMR) as the ratio of the signal energy within the sub-band to the minimum masking threshold for that sub-band.
- SMR is the quantization
- The model passes this value to the bit allocation component.





Bit Allocation

- Determines the number of code its allocated to each subband based on information from the psychoacoustic model
- Algorithm:
  - 1. Compute Mask-to-Noise Ratio (MNR)
    - $MNR_{dB} := SNR_{dB} - SMR_{dB}$

        - MPEG/Audio standard provides tables that give estimates for SNR resulting from quantizing to a given number of quantizer levels
    - 2. Get MNR for each sub-band
    - 3. Search for sub-band with the lowest MNR
    - 4. Allocate code bits to this sub-band. If subband gets allocated more code bits than appropriate, then look up new estimates of SNR and re-compute MNR, i.e., repeat step 1.

Layer Coding Options

- **Layer 1** codes audio in frames of 384 samples
    - Groups 12 samples from each of the 32 subbands
- **Layer 2** codes audio in frames of 1,152 samples
    - Groups three groups of 12 bytes for each subband
- **Layer 3** is derived from ASPEC (audio spectral perceptual entropy coding) and OCF (optimal coding in frequency domain)
    - Based on the same filter band as Layer 1 and 2, but compensates for filter bank deficiencies
    - Entropy coding used only in Layer 3

Layer1 Example

- Each group of 12 samples gets a **bit allocation** and if the bit allocation is not zero, a **scale factor**
- Layer 1 uses bit allocation of **0 to 15 bits** per subband
- Scale factor is a **multiplier** that sized the samples to fully use the range of the quantizer.
- Scale factor has a **6 bit** representation
- Decoder multiplies the decoded quantized output with scale factor to **recover** the quantized subband value.
- The **dynamic range** of scale factors alone exceeds **120 dB**
- The combination of bit allocation and scale factor provide potential for representing samples with dynamic range well over 120 dB.

Header (32)	CRC (0,16)	Bit Allocation (128-256)	Scale factors (0-384	Samples	Ancillary Data

Final MPEG/Audio Comments

- Real reason for precision of **16bits per sample** is to get a good signal-to-noise ratio
- Noise we are getting is **quantization noise** from the digitization process
- For each added bit in bit allocation process, we get **6dB** better SNR
- Masking effect means that we can **raise the noise floor** around a strong sound because the noise will be masked anyway
- Raising the noise floor is the same as using **less bits** and using less bits is the same as better compression
- Masking effect occurs also before and after strong sound (**pre/postmasking**).
    - Premasking: 2-5ms

- Postmasking: 100 ms

MPEG / Video Compression

Video Encoding/Compression

- Once video is in digital format, it makes sense to compress it
- Similarly to image compression, we want to store video data as efficiently as possible
- Again, we want to both maximize quality and minimize storage space and processing resources
- This time, we can exploit correlation in both space and time domains

Definitions

- **Bitrate**
  - Information stored/transmitted per unit time
  - Usually measured in Mbps (Megabits per second)
  - Ranges from < 1 Mbps to > 40 Mbps
- **Resolution**
  - Number of pixels per frame
  - Ranges from 160x120 to 1920x1080
- **FPS (frames per second)**
  - Usually 24, 25, 30, or 60
  - Don't need more because of limitations of the human eye

10 Parts of MPEG-2 / MPEG Technical Specification

- **Part 1**: Combine video and audio data into single/multiple streams
- **Part 2:** Offers more advanced video compression tools
- **Part 3:** Is a multi-channel extension of the MPEG-1 Audio standard
- **Part 4:** Describes procedures for testing compliance of MPEG-1
- **Part 5:** Describes systems for Software simulation.
- **Part 6:** Specifies protocols of managing MPEG-1 & MPEG-2 bitstreams
- **Part 7:** Specifies a multi-channel audio coding algorithm
- **Part 8:** (was discontinued because of obsolescence)
- **Part 9:** specifies the Real-time Interface (RTI) to Transport Stream decoders
- **Part 10:** the conformance part of Digital Storage Media Command and Control (currently under development)

MPEG-2 Video Compression Overview

Four Video Compression Techniques:

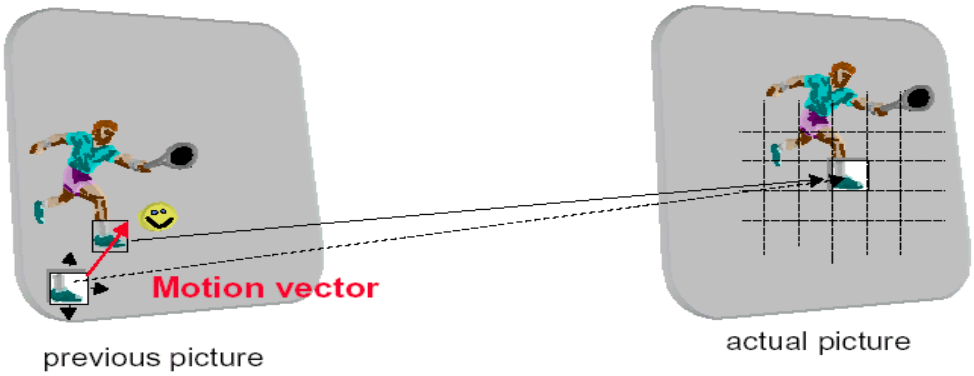
1. Pre-processing
2. Temporal Prediction
3. Motion Compensation
4. Quantization

- Pre-processing
  - Filters out unnecessary information
    - Information that is difficult to encode
    - Not an important component of human visual perception

- Temporal Prediction:
  - Uses the mathematical algorithm Discrete Cosine Transform (DCT) to:
    - Divide each frame into 8X8 blocks of pixels
    - Reorganize residual differences between frames
    - Encode each block separately

Motion Compensation

- Try to match each block in the actual picture to content in the previous picture. Matching is made by shifting each of the 8 x 8 blocks of the two successive pictures pixel by pixel each direction -> Motion vector
- Substract the two blocks -> Difference block
- Transmit the motion vector and the difference block



- Quantization:
  - Refers to DCT coefficients
  - Removes subjective redundancy
  - Controls compression factor
  - Converts coefficients into even smaller numbers

Where It Is Used:

- Multimedia Communications
- Webcasting
- Broadcasting
- Video on Demand
- Interactive Digital Media
- Telecommunications
- Mobile communications

CD Formats

- **CD-R:** CD-R discs can be formatted once -- the "R" stands for recordable. This means that once data is recorded onto the disc (or "burned," as techies like to say), it cannot be re-recorded, erased, or altered. CD-R discs, which are available in capacities of 650MB and 700MB, are good for burning music, backing up data, or transferring files between computers. Their use is limited by their inability to record more than once, however -- don't buy CD-Rs if you want to save successive versions of a document onto the same disc.

- **CD-RW:** CD-RW discs can be recorded multiple times -- the "RW" stands for rewritable. Unlike CD-R discs, which can only be burned once, the data on a CD-RW disc can be erased, altered, or re-written hundreds of times. This lets CD-RWs act just like floppy discs, as the information stored on them can be updated as many times as necessary. It is important to note that not all car and home stereos are compatible with CD-RW format -- if you intend to burn music onto CD-RWs, check that your player is compatible first.
- The table below is a basic compatibility reference chart for the various CD formats. Each column in the chart is a CD format, and each row in the chart is for a specific type of CD drive. The table should be read by looking at the left-most column for a type of drive, and then looking across the row to see which formats the drive will usually support. This table is a guideline only, since any specific drive can have differing capabilities depending on what the manufacturer decides to allow it to support.
- CD-R and CD-RW are included in the table, although they technically aren't "formats" of course--they write disks using the other formats listed. CD-R disks are supported by most drives as long as the CD-R created is in a format that the drive would read if it were a pressed CD. Some drives can be finicky about some types of CD-R disks, however. Each drive is rated as either "Single" or "Multi", with the former meaning only single-session disks are supported and the latter meaning multi-session disks are supported (which of course implies single-session is also supported).
- For CD-DA, each drive is specified as to whether it can play CD-DA or extract it in digital form.
- "Some" means that some of these drives support the format, and some don't.
-

Type of Drive	CD-DA	CD-ROM	CD-ROM XA	Bridge CD	CD-I	Video CD	Photo CD	CD-R	CD-RW
Audio CD Player	Play	No	No	No	No	No	No	Single	No
Standard (Older) CD-ROM Drive	Play, some extract	Yes	No	No	No	No	No	Single	No
(Newer) CD-ROM XA Drive	Play, some extract	Yes	Yes	Yes	No	Some	Some	Single	No
Multi-session CD-ROM XA Drive	Play, Extract	Yes	Yes	Yes	No	Yes	Yes	Multi	Some
CD-I Player	Play	No	No	Yes	Yes	Yes	Yes	Single?	No
CD-R Drive	Play, Extract	Yes	Yes	Yes	Yes	Yes	Yes	Multi	Some
CD-RW Drive	Play, Extract	Yes	Yes	Yes	Yes	Yes	Yes	Multi	Yes

DVD Formats

- **DVD-R:** DVD-R discs can be recorded on once -- as with CD-Rs, the "R" stands for recordable. DVD discs look just like CDs, but hold substantially more data -- 4.7GB or more. DVD-Rs cannot be rewritten or erased, so they are best suited for data backup, burning videos, or transferring large amounts of data that could not fit on a CD. DVD-R discs can be played in the vast majority of DVD players and drives.
- **DVD-RW:** DVD-RW discs can be recorded multiple times -- as with CD-RWs, the "RW" stands for rewritable. Like CD-RWs and floppy discs, DVD-RWs are great for users who will need to alter or erase the data they have burned onto disc, as these discs can be rewritten up to 1000 times. Many DVD players can play DVD-RW discs.
- DVD+R: Like DVD-R discs, DVD+RW discs can be recorded once. While their capabilities are the same as DVD-R discs, DVD+R media use a different technology and are supported by a different set of manufacturers than the DVD-R format. DVD+R drives are featured in products from Sony, Dell, Compaq, Hewlett-Packard, and other manufacturers; most of these drives are compatible with DVD-R and -RW discs as well.
- DVD+RW: DVD+RW discs are the rewritable version of DVD+R discs. Like other RW discs, the data on DVD+RWs can re-recorded, altered, or erased hundreds of times. Supported by the same manufacturers as DVD+R discs, DVD+RW media is the choice of many top computer makers.

Question Bank.

1. **Define Multimedia and briefly explain its classifications/components**.
2. Discuss in detail the components of multimedia.
3. Discuss in detail the elements that are used to design a multimedia project.
4. Explain the various devices needed for developing a multimedia application.
5. What are all the communication devices that are involved while developing multimedia project?
6. What are the input devices that are used to design the multimedia project? Explain any two.
7. Discuss in detail the applications of multimedia.
8. **What is CBT? Explain the use of multimedia in CBT?**
9. Explain Multimedia Presentation and Conferencing?
10. Explain the use of Multimedia in Public Place?
11. Explain the use of Multimedia on Web?
12. Explain the use of Multimedia in business?
13. **Explain the various stages of developing a multimedia project.**
14. List and define the skills in the multimedia skill set. Describe several ways of categorizing the skills. (Hint: skills related to project management, design, and programming).
15. **Explain briefly the image file formats?**
16. **Explain in detail Bitmap images and Vector drawing Images?**
17. **Differentiate between Vector drawn objects and bitmaps?**
18. If the bitmap graphic is opened or pasted into a vector editor, does it automatically become a vector? Explain in detail.
19. What is autotracing? Explain the process of converting between bitmaps and drawn images.
20. **Explain in detail various principles of animation?**
21. **Explain in detail various animation types / techniques?**
22. Explain briefly the animation file formats.
23. Explain the importance of Text in Multimedia? Discuss different design factors with text.
24. Discuss various attributes of Text.
25. **Explain the following:**
    a. **Kerning**
    b. **Leading**
    c. **Tracking**
    d. **Difference between Serif and Sans Serif.**
26. What is Hypermedia? Explain in detail.
27. What is Hypertext? What is the difference between a normal text and hypertext? Explain in detail.
28. How is a Multimedia product tested?
29. Discuss briefly the various video standards.
30. Discuss briefly where multimedia advanced authoring tools are used.
31. Explain the Internet basics.
32. What are the Basic Authoring Tools, which are used to design a multimedia project?
33. Explain in detail about the audio side of multimedia.