Fundamentals of Multimedia

2020-2021

المرحلة الرابعة / الفصل الدراسي الاول

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Lecture one: Introduction to Multimedia

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VIEDEO LECTURES

Dr Suhaila Najim

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Welcome to Multimedia Course

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Pattern Recognition and Intelligence Systems

Image Processing Engineering

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College of Science

Computer Science Department

In this course of Multimedia

- Students will be introduced to the concept of multimedia.
- Students will learn what multimedia is and why it has become so pervasive.
- Students will learn about the elements that make up multimedia and how interactivity is a necessary part of multimedia.
- Students will learn how multimedia elements programmed using different programming languages (VB.Net, C# and Java.)

Course objective:

Student will be able to

- Demonstrate knowledge of technology and processes employed in the use and integration of digital multimedia and have knowledge of technical terminology used in the multimedia domain.
- Demonstrate an understanding of the capabilities of current technology and the challenges posed to businesses and society.
- Demonstrate an understanding of managing a small multimedia project using different computer programming languages (VB.Net, C# and Java.). And use some of the current multimedia software packages.
- finally understanding digital multimedia elements and **multimedia related technology**

Overview of Multimedia Software Tools

- Software tools available for carrying out tasks in multimedia are:
  1. Music Sequencing and Notation
  2. Digital Audio
  3. Graphics and Image Editing
  4. Video Editing
  5. Animation
  6. Multimedia Authoring

Return

Course Description:

Visual information plays an important role in almost all areas of our life. Today, much of this information is represented and processed digitally. Main topics to be covered in this course are :

Multimedia an overview: Defining Multimedia , multimedia elements, mm components representing in computer, multimedia interactivity, Typical multimedia computer playback system, Exploring MM on the web , Classification of media , software tools available for carrying out tasks in multimedia. Definition and properties of a multimedia system, Multimedia related technology, MM applications fields, Global structure of MM ,Multimedia Storage CD and , the five multimedia components (text, image, sound , video, animation) formats. MIDI (Musical Instrument Digital Interface) Basic concepts and devices, comparison between MIDI and Audio files

Multimedia storage CD and CD-ROM technology. Also, in the LAB introducing MM components programming and introduction to accessing the websites using in different computer programming language such as VB.net and C# .

Textbook:

- Fundamentals of Multimedia.by Ze-Nian Li, and Mark S. Drew. 2014, prentice Hall. *Electronic version is available*
- **supported refs:**
- *Ralf Steinmetz and Klara Nahrstedt ; Multimedia fundamental :vol.1 media coding and contents processing .IMSC Pewss Multimedia Series, Prentice Hall, 2002.*
- *find the book at the first website below:*

useful websites:
The following are the Collection of Web sites on multimedia

- **http://www.slideshare.net/fareedurrahman/multimedia-technologies-introduction**

  https://my.safaribooksonline.com/book/electrical-engineering/9780132442435/firstchapter
- **http://www.authorstream.com/Presentation/nandinivij1-1757565-lecture-01-introduction-multimedia/** .

Course book

Week no.	Lecture No	Topic
1 1-8-10-2019	1	Multimedia an overview: defining Multimedia , multimedia elements, mm components representing in computer, multimedia interactivity
	2	Typical multimedia computer playback system
	3	Exploring MM on the web
	4	Classification of media (the perception medium, the presentation medium, …)
2 8-15-10-2019	1	Multimedia Software tools :Quick scan, Definition and Properties of a multimedia system,
	2	Multimedia related technology
	3	Lab
	4	MM applications fields: education, business, entertainment
3 15-22-10-2019	1	Global structure of MM ,Multimedia Storage CD and
	2	CD-ROM technology,
	3	Lab
	4	Continue
4 22-29-10-2019	1	MM components: Digital image concepts, types, formats in internet
	2	Colors, image compression…..
	3	Lab
	4	
5 29- 10/5-11-2019	1	Understanding multimedia computer playback systems
	2	A typical multimedia computer development system
	3	Lab
	4	continue
6 12-19-11-2019	1	CD ROM and DVDs ,
	2	Understanding multimedia computer development systems
	3	Lab
	4	Continue
7 19-26-11-2019	1	Numerical System and color system
	2	Digital Camera
	3	Lab
	4	

8 26- 11-3-12-2019	1	Sound Fundamentals: Basic Sound Concepts (Basic Concept Of Audio)
	2	Continue 1st lecture
	3	Lab
	4	Continue
3-10- 12-2019		Mid exam
9 11-18- 12-2019	1	Computer representation of sound (sampling rate, quantization)
	2	Examples
	3	Lab
	4	
10 19-24-12-2019	1	MIDI Basic concepts
	2	MIDI Devices
	3	Lab
	4	
11 24-31-12-2019	1	Comparison between MIDI and Audio files.
	2	Comparison between MIDI and Audio files.
	3	Lab
	4	
12 1-7-1-2020	1	Video Fundamentals; programming video
	2	Programming video data
	3	Lab
	4	
13 8-15-2020	1	Introduction to accessing the websites using VB- programming, or VB.Net
	2	Examples writing VB code/C#
	3	Lab
	4	
14 15-1- 22-1-2020	1	Power Point Application in MM
	2	MM in Power Point
	3	Lab
	4	
22-1 – 31-1-2020	1	Final Examination of 1st sem.

Definition of Multimedia

- **Multimedia : is the simultaneous use of two or more different forms of media (text, graphics, animation, sound and video) for effective information communication and deliver these information using computer**

- **Media in digital form includes**

- **Text,**
- **Images,**
- **Graphics,**
- **Audio,**
- **Video,**
- **Animation**

- **With computer processing:**
  - **Medium –a means of distribution and presentation of information** using the computer.

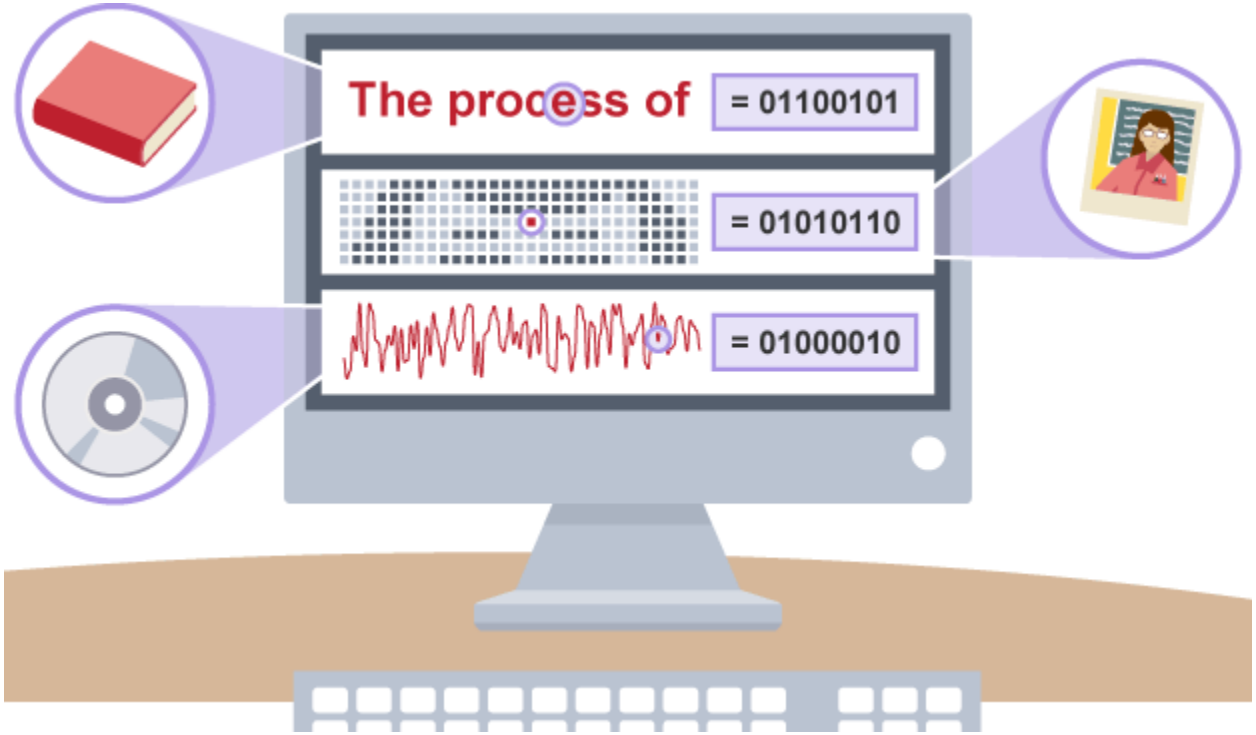
- **Multimedia elements (text, graphics, sound, video, animation, and virtual reality) are broad categories that can be subdivided further. For example, the graphics multimedia element includes drawings and photos; the animation multimedia element includes 2-D as well as 3-D.**
- **In most cases, a combination of two or more multimedia elements provides the best results when developing multimedia.**
- **For instance, using sound narration with a video clip may be more effective in helping someone learn a new concept than using sound or video alone.**

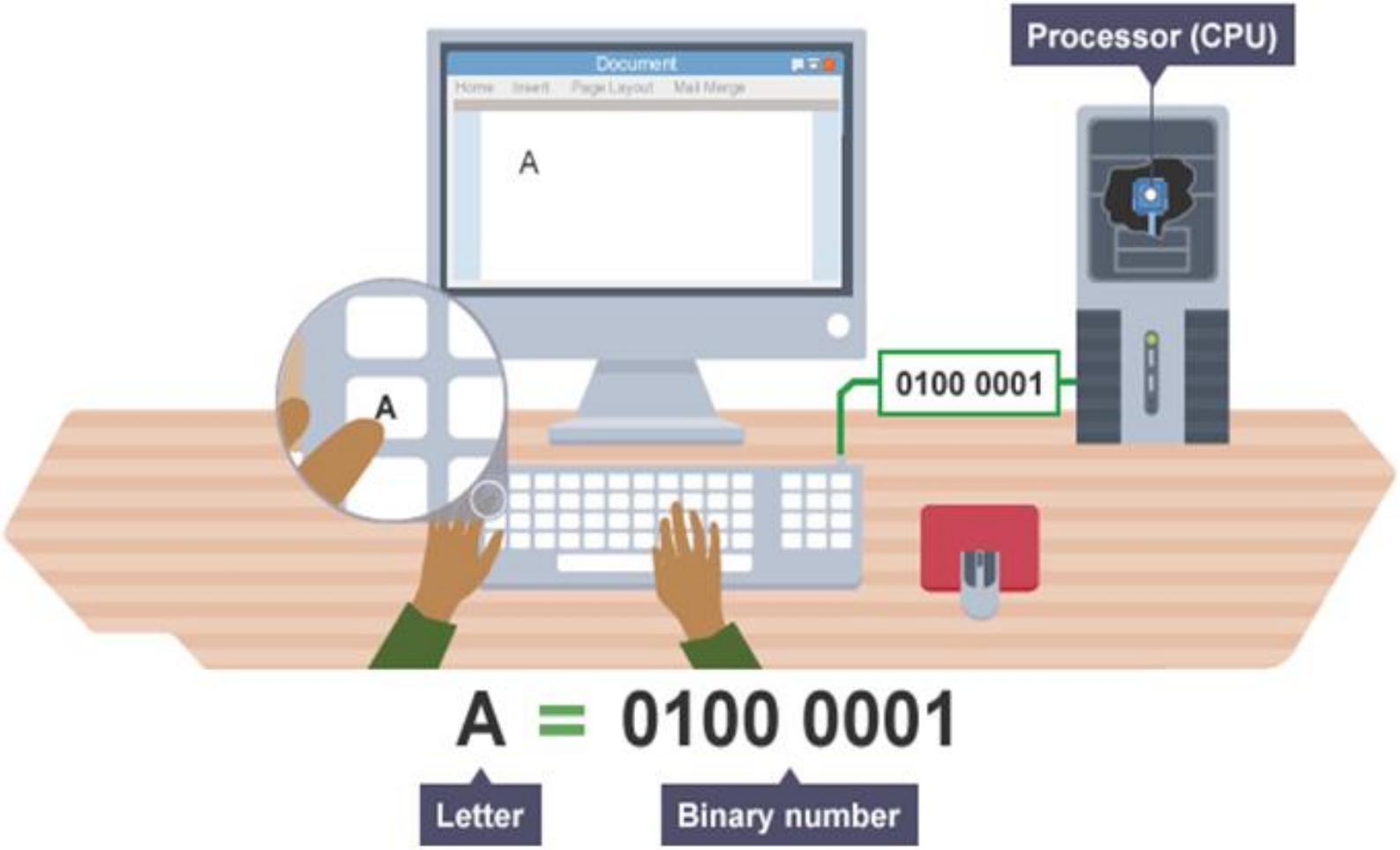
How to represent digital multimedia components

- access the following link
- http://www.bbc.co.uk/education/guides/zpfdwmn/revision

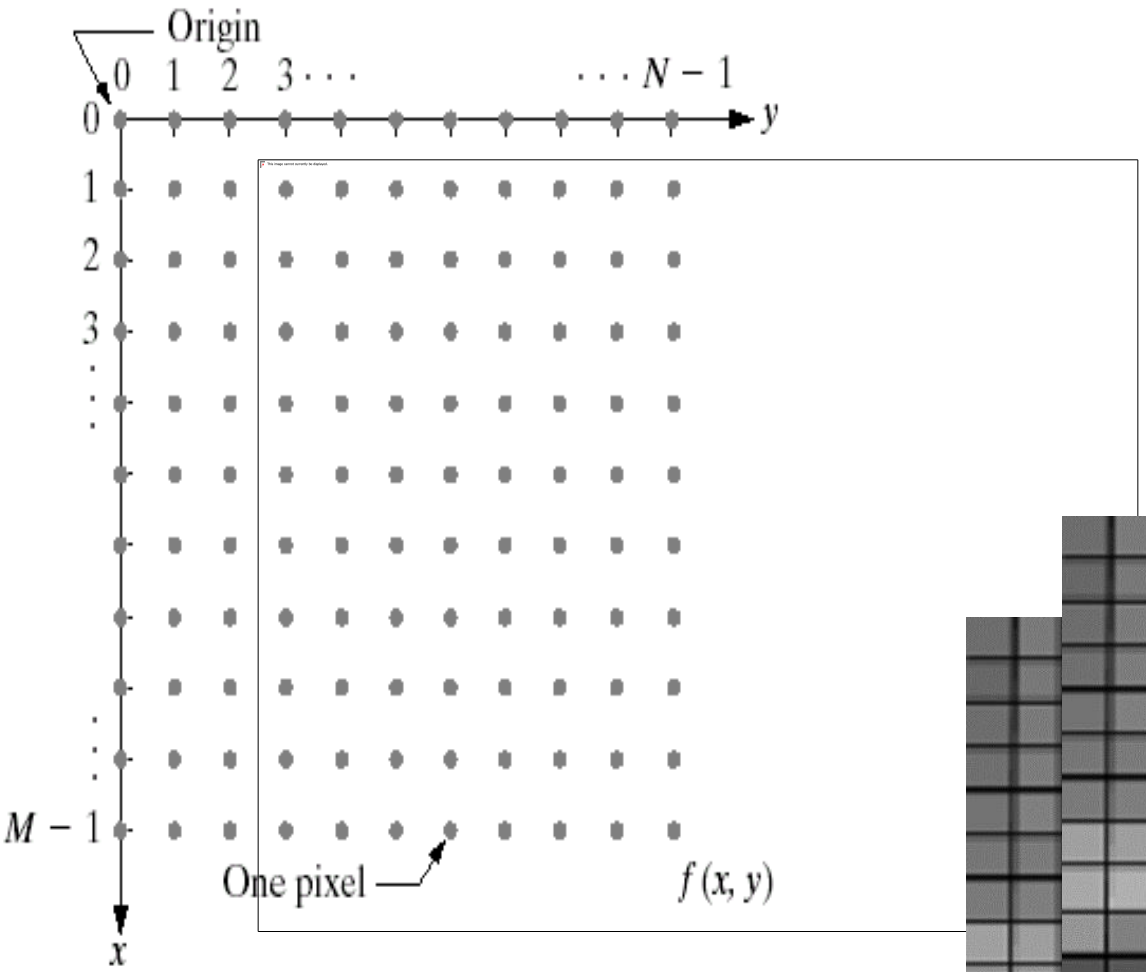
Representing data

text, images and sound are converted into binary so they can be processed by a computer and how images and sound are compressed to create smaller files.

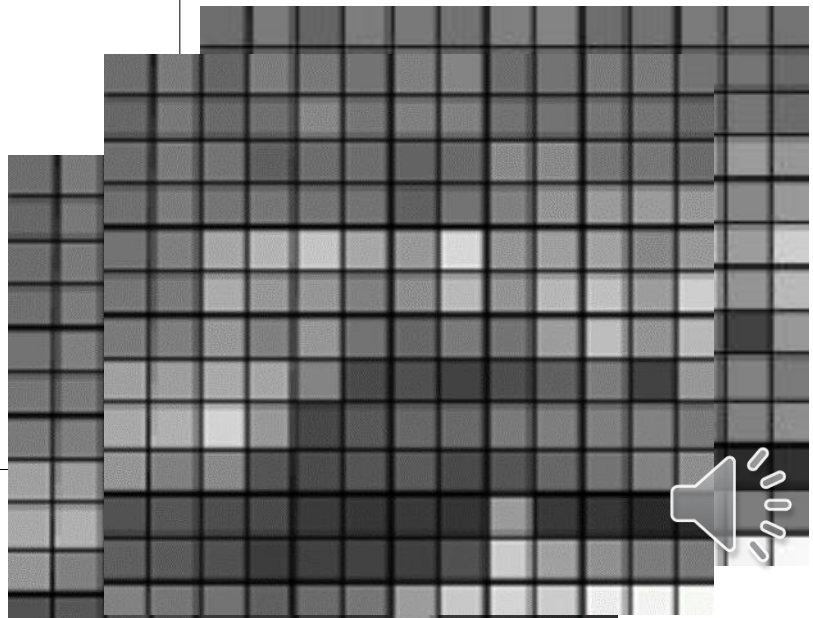



Processor (CPU)
Document
Home
Insert
Page Layout
Mail Merge
A
A
0100 0001
A = 0100 0001
Letter
Binary number

Digital image representation



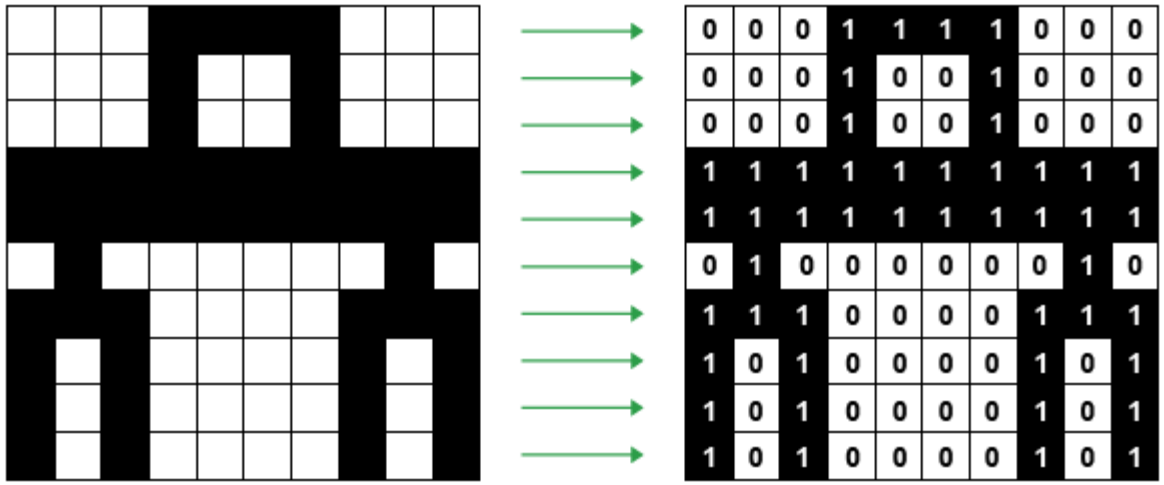
54	48	48	52	67	111	144	160	162	158
54	48	48	49	61	106	141	160	164	158
48	45	48	49	56	97	138	160	167	160
50	51	57	56	61	101	135	161	170	162
59	60	61	55	60	103	134	162	172	164
62	61	55	44	49	96	133	163	174	165
56	45	53	54	41	99	137	163	171	160
55	45	55	56	42	94	136	164	173	163
53	45	58	59	44	86	134	162	173	165
54	47	61	60	46	79	131	160	172	165
57	51	63	58	49	75	133	162	174	167
63	57	62	54	52	74	138	166	176	168
70	62	61	49	54	77	139	166	174	164



No. of colors and image file size

$$colors \quad number = 2^{color\ resolution}$$

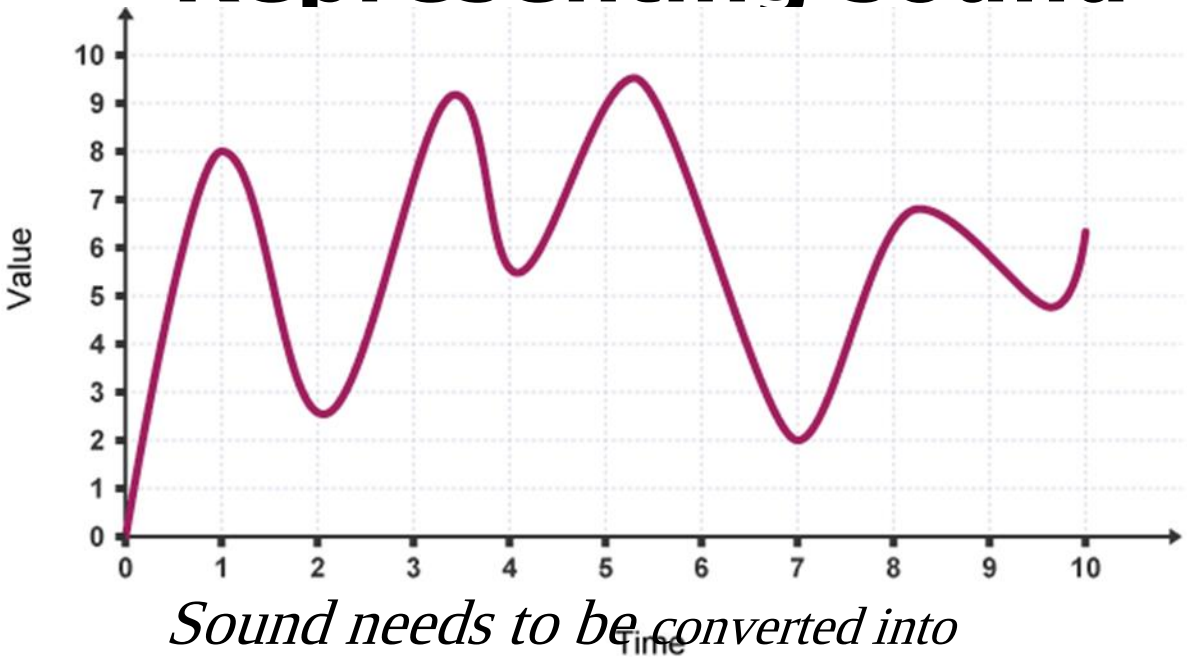
$$image \quad size = image \quad resolution \quad x \quad color \quad resolution$$



1 bit resolution image

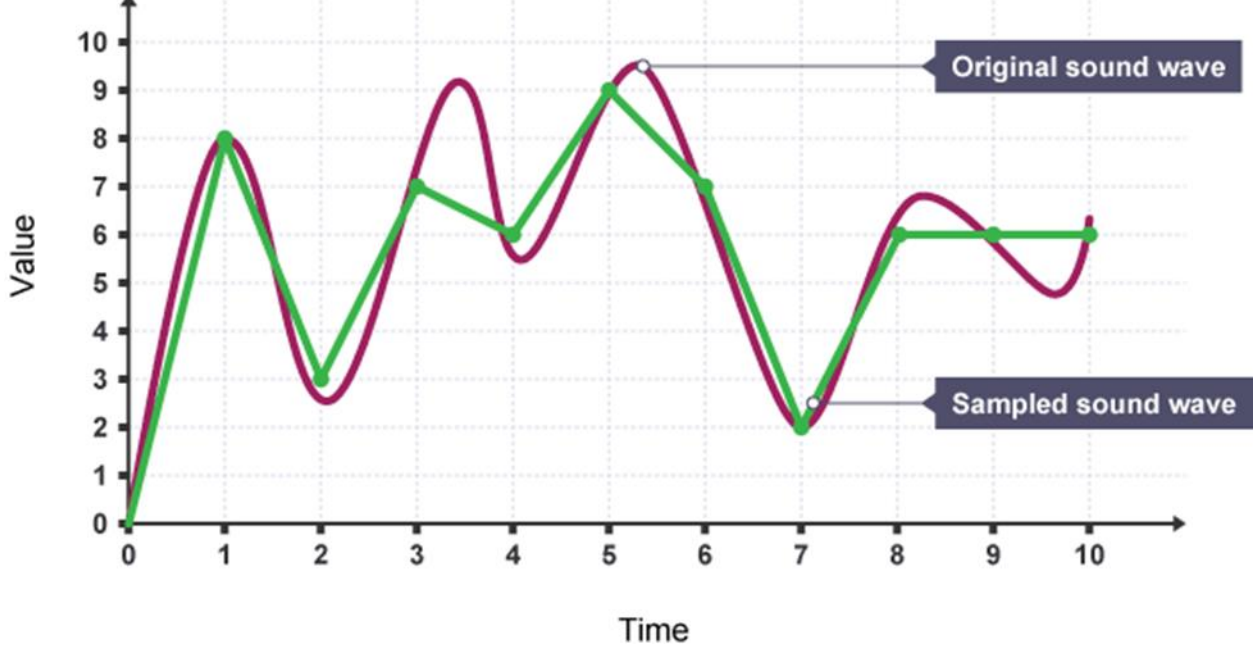
- *1 bit per pixel (0 or 1): two possible colours ;no. of color is equal to 2 to the power no. of bits*
- *2 bits per pixel (00 to 11): four possible colours*
- *3 bits per pixel (000 to 111): eight possible colours*
- *4 bits per pixel (0000 – 1111): 16 possible colours*

Representing sound



Sound needs to be converted into binary for computers to be able to process it. To do this, sound is captured - usually by a microphone - and then converted into a digital signal.

An analogue to digital converter will sample a sound wave at regular time intervals. For example, a sound wave like this can be sampled at each time sample point:



Time sample	1	2	3	4	5	6	7	8	9	10
Denary	8	3	7	6	9	7	2	6	6	6
Binary	1000	0011	0111	0110	1001	0111	0010	0100	0110	0110

The way to increase the quality and store the sound at a quality closer to the original, is to have more time samples that are closer together. This way, more detail about the sound can be collected, so when it's converted to digital and back to analogue again it does not lose as much quality.

The frequency at which samples are taken is called the sample rate, and is measured in Hertz (Hz). 1 Hz is one sample per second. Most CD-quality audio is sampled at 44 100 or 48 000 KHz.

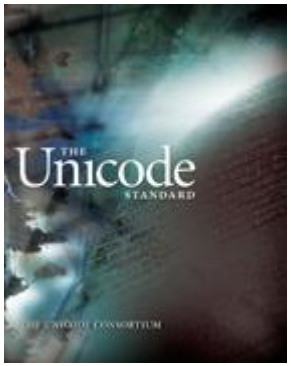
- **Why compress files?**
- Processing power and storage space is very valuable on a computer. To get the best out of both, it can mean that we need to reduce the file size of text, image and audio **data** in order to transfer it more quickly and so that it takes up less storage space.In addition, large files take a lot longer to **download** or **upload** which leads to web pages, songs and videos that take longer to load and play when using the internet.
- **Compression** addresses these issues.
- Any kind of data can be compressed. There are two main types of compression: lossy and lossless.
- **Lossy compression**
- Lossy compression removes some of a file's original data in order to reduce the file size. This might mean reducing the numbers of colours in an image or reducing the number of samples in a sound file. This can result in a small loss of quality of an image or sound file.
- A popular lossy compression method for images is the **JPEG**, which is why most images on the internet are JPEG images. A popular lossy compression method for sounds is **MP3**. **Once a file has been compressed using lossy compression, the discarded data cannot be retrieved again**.

Lossless compression

- Lossless compression doesn’t reduce the quality of the file at all. No data is lost, so lossless compression allows a file to be recreated exactly as it was when originally created.
- There are various algorithms for doing this, usually by looking for patterns in the data that are repeated. **WinRAR** files are an example of lossless compression.
- The space savings of lossless compression are not as good as they are with lossy compression.

What is Unicode?

Unicode provides a unique number for every character,
no matter what the platform,
no matter what the program,
no matter what the language.



Characters Before Unicode

Fundamentally, computers just deal with numbers. They store letters and other characters by assigning a number for each one. Before Unicode was invented, there were hundreds of different systems, called character encodings, for assigning these numbers. These early character encodings were limited and could not contain enough characters to cover all the world's languages. Even for a single language like English no single encoding was adequate for all the letters, punctuation, and technical symbols in common use.

Early character encodings also conflicted with one another. That is, two encodings could use the same number for two *different* characters, or use different numbers for the *same* character. Any given computer (especially servers) would need to support many different encodings. However, when data is passed through different computers or between different encodings, that data runs the risk of corruption.

Unicode has changed all that!

The Unicode Standard provides a unique number for every character, no matter what platform, device, application or language. It has been adopted by all modern software providers and now allows data to be transported through many different platforms, devices and applications without corruption. Support of Unicode forms the foundation for the representation of languages and symbols in all major operating systems, search engines, browsers, laptops, and smart phones—plus the Internet and World Wide Web

يشكل دعم Unicode الأساس لتمثيل اللغات
والرموز في جميع أنظمة التشغيل الرئيسية
ومحركات البحث والمتصفحات

- The End

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lecture 2: Interactivity and Multimedia Classification

Dr. Nassir H. Salman & Dr Suhaila Najim

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Lect. 2 Interactivity

- A fundamental feature of multimedia is **interactivity**—that is, the ability of the user to interact with an application.
- Multimedia allows the content to be presented in a nonlinear way, which allows the user to be active rather than passive. **The user determines what content is delivered, when it is delivered, and how it is delivered.**

- User interactivity comes in many forms, including **keyboard input**, mouse point-and-click, mouse rollovers, voice activation, and touch screens. Figure (1) shows some of the interactivity that a user might encounter when accessing an online encyclopedia.

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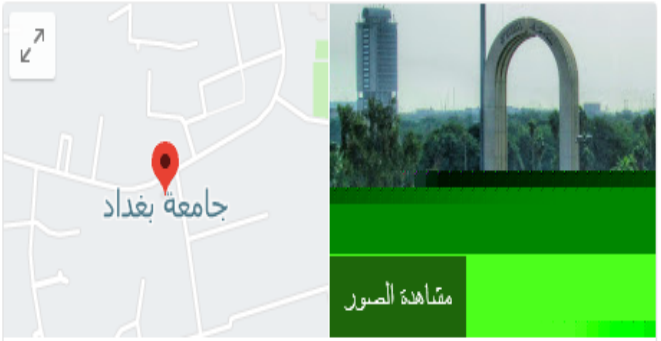
جامعة بغداد - ويكيبيديا، الموسوعة الحرة

https://ar.wikipedia.org/wiki/جامعة_بغداد

جامعة بغداد هي أكبر الجامعات العراقية، وتقع في وسط العاصمة العراقية بغداد. أسست وشيدت بتمويل .... انظر أيضا[عدل] مكتبة **جامعة بغداد** · **جامعة بغداد** - طب الاسنان



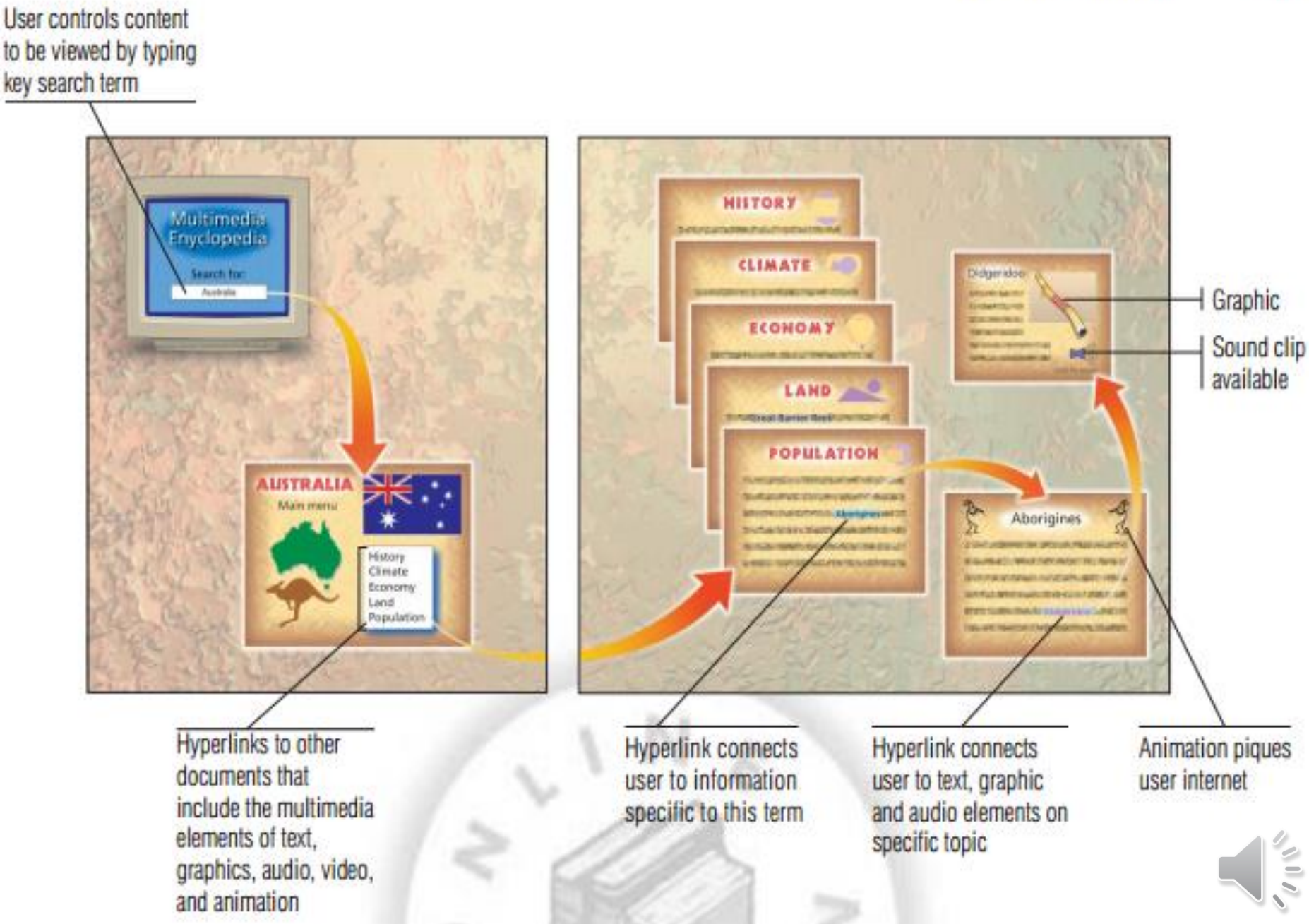
جامعة بغداد

موقع ويب | اتجاهات السير | حفظ

جامعة

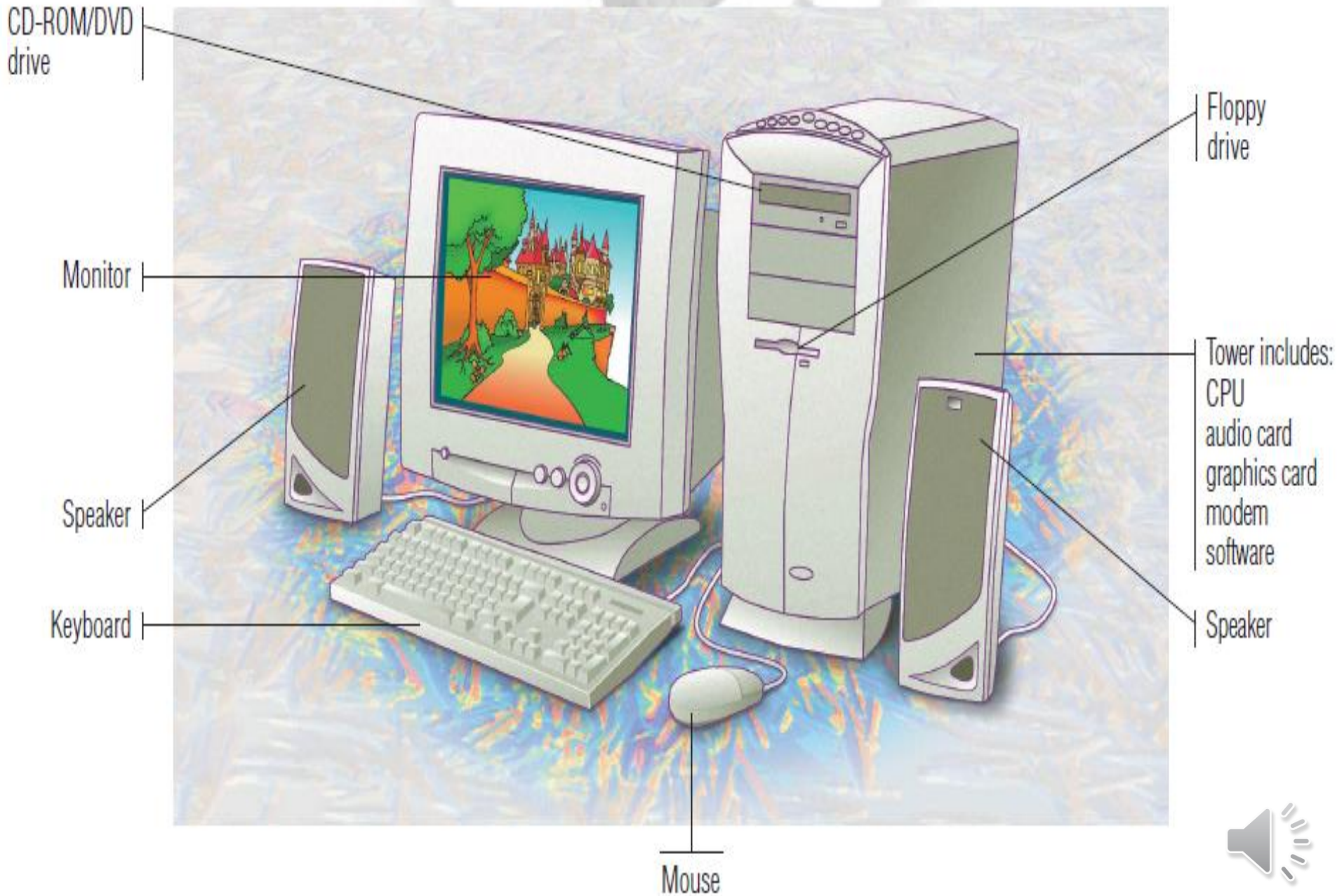
جامعة بغداد هي أكبر الجامعات العراقية، وتقع في وسط العاصمة العراقية بغداد. أسست وشيدت بتمويل من قبل الحكومة العراقية في أواخر عقد الخمسينيات. ولكن لبناتها الأولى تعود إلى سنة 1908 حيث تأسست كلية الحقوق، وما تبعها بسنوات قليلة من كليات أخرى مثل دار المعلمين العالية، والطب في سنة 1927 والصيدلة والهندسة. ويكيبيديا

FIGURE A-1: *Multimedia interactivity*



- Fundamental to the development and delivery of multimedia is **a computer system capable of incorporating multimedia elements such as sound and animation.** It also must support an environment in which the user can interact with the program. Figure(2) shows a typical computer playback system capable of delivering multimedia.
- Today most computer systems are equipped with the **hardware and software needed to deliver multimedia. The typical configuration includes** CD-ROM or DVD drives, audio cards, graphics cards, speakers, and sufficient speed and processing power to deliver multimedia.
- Most multimedia computer playback systems include an **Internet connection**, a browser, and a modem that allows the user to access multimedia applications from the Web.

FIGURE A-2: *Typical multimedia computer playback system*



Media Classification

- **Media can be classified with different criteria. We can classify media according to:**
  - **Perception,**
  - **Representation,**
  - **Presentation,**
  - **Storage,**
  - **Transmission,**
  - **Information exchange**

Perception medium

Perception media help the humans to sense their environment; **The central question is:**

How do human perceive information in a computer?

It is mostly through *seeing* and *hearing*,.

- **For the perception of seeing, we have visual media such as text, image, and video are used.**

- **For the perception of hearing, we have auditory media such as music, noise, and speech.**

The Representation Medium

Representation media are characterized by internal computer representations of information. The central question is:

How is computer information coded?

There are various formats used to represent media information in a computer, For example:

- **Text is coded in ASCII code (America Standard Code for Information Interchange). Which is** Text is coded in ASCII code (America Standard Code for Information Interchange). Which is A code that assigns numbers to the letters

  0-127 of the alphabet,

  the digits 0 through 9, and punctuation marks.

  For example, the capital letter A is coded as 65.

  (In the binary number system used by computers, 65 is written 1000001.)
  By standardizing the code used in representing written text, ASCII enables computers to exchange information.

- When any key on a keyboard is pressed, it needs to be converted into a binary **number** so that it **can** be processed by the **computer** and the typed character **can** appear on the screen.
- A code where each **number represents** a character **can** be used to convert **text** into binary. One code we **can** use for this is called ASCII.
- So The Text is the most common multimedia element. Text expresses the information the developer is trying to get across to their viewers. Even though pictures grab the viewers' attention, text is a good idea to include, as well, just in case the picture does not load.

continue The five multimedia elements formats

- The second multimedia element is image. An image catches the viewers' attention much more quickly than just plain, old text.

- Almost every multimedia application contains images. The most common images are JPEGS and PNGs. Also, Photoshop and Paint.NET create high tech visual effects which are common with images.

- Images that are generated by a **computer** are called **computer graphics**. Examples are photographs, drawings, Line art, graphs, diagrams, ...

Continue

JPEG, GIF, and PNG Formatting

- GIF and PNG are two different formats which images are available in. GIF simply means Graphics Interchange Format and is typically used for animations and sometimes single images as well. The images are compressed or made smaller; they are using what is called loss-less data compression. This compression makes it so that the image does not lose quality even if it is compressed due to its ability to have uniformed color with well-defined edges.

- A GIF is not the best quality format for images because of its limit of colors, which is one of the reasons that PNG was created. PNG are Portable Network Graphics. Their ability to compress is higher quality and allows for alpha transparency, which is basically creating the image with a background so that it looks transparent either partially or fully. They can store more color depth but also take up more space than GIFs in some cases..

Continue

- The fourth multimedia element is video. The web is the most common place where videos are seen concerning multimedia elements. A few digital video formats are Flash, MPEG, AVI, WMV, and QuickTime. Streaming digital videos can increase the speed of the playback. Developers use videos to hold on to the viewers' attention.
- A codec is a way of compressing the file to decrease file size, while maintaining quality.Some of the most common video file formats are Audio-Video Interleave (.avi), Flash Video Format (.flv), Moving Picture Experts Group 2 (.mp2), Moving Picture Experts Group 4 (.mp4), QuickTime (.mov), and Windows Media Video (.wmv). **Video sequences can be coded in different TV standard formats (e.g. PAL, SECAM, NTSC) and can be stored in MPEG format (Motion Picture Experts Group) standard for video and associated audio.**

- In multimedia applications, the digital video is gaining popularity because the video clips can be edited easily, it can be stored like any other files in the computer and the quality of the video can still be maintained, and the video can be transferred within a computer network which allows non-linear editing in any part of the video. Just like in audio, in streaming video the traveling information is a stream of data from a server. In 2006, people watched more than a million streaming videos a day on YouTube
- The fifth multimedia website is animation. Animation draws in the younger crowd. AdobeFlash is the most common tool for creating these animations. Animations are the most creative and fun multimedia element! .

- **The Presentation Medium**

Presentation media refer to tools and devices for the input and output of information. The central question is:

Through which medium is information delivered by the computer, or introduced into the computer?

The media to deliver information by computer (output media) includes paper, screen, speaker, whereas the input media are keyboard, mouse, camera, and microphone.

- **The Storage Medium**

Storage media refer to a data carrier which enables storage of information. The central question is: *Where will the information be stored?* Examples of storage media are Hard disk, CD-ROM, Magnetic Tapes, Removable Disk, Microfilm and even paper.

- **The Transmission Medium**

The transmission medium characterises different information carriers that enable continuous data transmission. The central question is: *Over what will the information be transmitted?* The answer is that information is transmitted over networks, which

use wire and cable transmission such as coaxial and fiber optics, as well as free air space transmission for wireless transmissions(Radio tower ,satellite.

- **The Information Exchange Medium**

The information exchange medium includes all information carriers for transmissions, i.e. all storage and transmission media. The central question is: *Which information carrier will be used for information exchange between different places?* Information can flow through *intermediate* storage media, where storage media is transported outside through computer networks to the destination, through d*irect* transmission using computer networks, or through c*ombined* usage of storage and transmission media (e.g. e-mail).

- **3. Representation of Media**

The media is characterised as information to be processed in computer systems. Each medium defines the following:

- **Representation Values**
- **Representation Space**

The user will perceive the content through these representations

- **Representation Values**

Representation values are the actual information representation of the media. A sentence can be represented by text, which is a sequence of characters, or by speech, which is in a waveform.

Representation values can be considered either as a continuum or a sequence of discrete values.

- **Representation Space**

Paper or computer monitors are examples of a visual presentation spaces. Each representation space consists of one or more *representation dimensions*. A computer screen has 2 spatial dimensions; stereophony require an additional spatial dimension. Time can occur in representation space as an additional dimension (audio and video; information is expressed not only in its individual values but also by its time of occurrence), as it has central meaning to multimedia systems.

What are Multimedia Systems?

- Multimedia systems are computer-based systems that support the delivery of multimedia content and is a system capable of processing multimedia data and applications.

- A few examples of multimedia systems are: Video on demand, Electronic book, Interactive cinema, Internet Bookshop, and Games.

Characteristics of a Multimedia System

- A Multimedia system has four basic characteristics:

- Multimedia systems must be *computer controlled*. that support the delivery of multimedia content.
- Multimedia systems are *integrated*. These systems are the results of the integration of multimedia computing and communications
- The information they handle must be represented *digitally*. Handle discrete and continuous media
- The interface to the final presentation of media is usually *interactive*.

Components of a Multimedia System

- Now let us consider the Components (Hardware and Software) required for a multimedia system:
- **Capture devices** -- Video Camera, Video Recorder, Audio Microphone, Keyboards, mice, graphics tablets, 3D input devices, VR devices. Digitising/Sampling Hardware

- **Storage Devices** -- Hard disks, CD-ROMs , DVD, *etc*
- **Communication Networks** -- Ethernet, 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.*

- Internet: Is now the World Wide Web (WWW) network of computers that is dispersedly managed with minimal restriction.
  Intranet: Operates much the same as the Internet but is restricted to a single corporate entity that has full control and management over it. Able to maximize restrictions over users.
  Extranet: is an extension of an Intranet over the Internet for remote users. Typically it is heavily restricted for security reasons to a virtual private network (VPN) connection for Telecommuters or other offsite users.
  Ethernet is the standard cable for computers to hook up to the network. It is also used for network devices (Routers, modems & switches) to interface with each other.

7. Multimedia-Related Technologies

- **Multimedia systems is the integration of many components of different technologies. The development of multimedia technology is related to the evolution of the following technologies:**
- **Computer Technology**

  With faster processing power, larger memory and storage capacities, the multimedia capabilities of the computer has increased significantly in the last decade. This has enabled the development of multimedia intensive applications in many areas.
- **Telecommunications**

  Digital networks with higher bandwidths increased the development of distributed multimedia applications, especially through the internet.
- **Consumer Electronics**

  Improvements in devices such as display units and optical storage contributed to new and better multimedia facilities. In addition, mass production reduced the prices significantly for consumers.

- **Entertainment and Broadcasting**

Professional audio and video production has significantly improved the technical capabilities and multimedia contents. These are adapted to multimedia systems for better quality products.

- **Publishing**

Many large publishing houses already offer their publications in electronic form. More and more multimedia information can be offered.

- Multimedia applications is a broad term that covers all uses of multimedia. Examples of multimedia include:
- an online college course Web site that uses 3-D animation to explain how earthquakes occur or
- an e-commerce Web site that shows video clip demonstrations of its products. Multimedia titles refer to specific products, including CD-ROM-based games.

- The end

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lecture 3: Multimedia Applications and Development

Dr. Nassir H. Salman & Dr Suhaila Najim

VIEDEO LECTURES

Welcome to Multimedia Course

Dr. Nassir H. Salman

Pattern Recognition and Intelligence Systems

Image Processing Engineering

Dr. Suhail Najim Mohammed

University of Baghdad

College of Science

Computer Science Department

Lect. 3

-Hypermedia and Multimedia
- Applications of MM
- Global structure of MM
- Exploring MM on the web

- A **hypertext** system: meant to be read nonli
- nearly, by following links that point to other parts of the document, or to other documents
- **HyperMedia:** not constrained to be text-based, can include other media, e.g., graphics, images, and especially the continuous media | sound and video.
  - The World Wide Web (WWW) | the best example of a hypermedia application.
- **Multimedia** means that computer information can be represented through audio, graphics, images, video, and animation in addition to **traditional media**(Any form of mass communication available before the advent of digital **media**. This includes television, radio, newspapers, books, and magazines).

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

- **Courseware** is a term that combines the words 'course' with 'software'. It was originally used to describe additional **educational** material intended as kits for teachers or trainers or as tutorials for students, usually packaged for use with a computer.

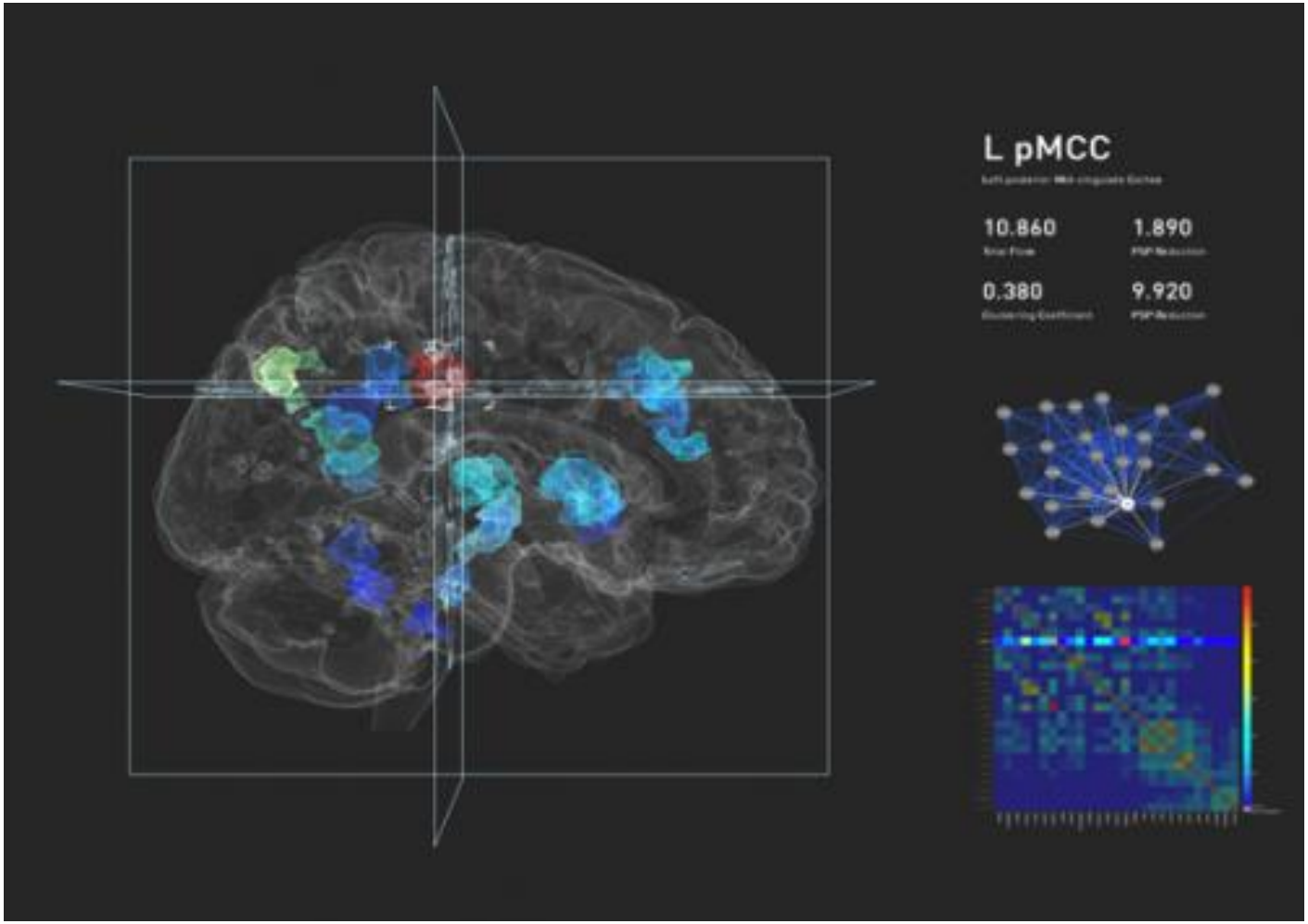
Interactive TV (ITV or iTV) is an approach to television advertising and programming that creates the opportunity for viewers to communicate with advertisers and programming executives by responding to a call to action.

Continue **Where to Use MM:**

- Residential Services
  - **video-on-demand**
  - **video phone/conferencing systems**
  - **multimedia home shopping (MM catalogs, product demos and presentation)**
  - **self-paced education (التعليم الذاتي)**
- Business Services
  - **Corporate training**
  - **Meeting (meet.google.com, or zoom)**
  - **Desktop MM conferencing, MM e-mail**

- Education
  - **Distance education - MM repository of class videos, google class room**
  - **Access to digital MM libraries over high speed networks**
- Science and Technology
  - **computational visualization and prototyping**
  - **astronomy, environmental science**
- Medicine
  - **Diagnosis and treatment - e.g. MM databases that provide support for queries on scanned images, X-rays, assessments, response etc.**

Brain visualization prototype holds promise for precision medicine



Medicine continue

- Also In Medicine, doctors can get trained by looking at a virtual surgery or they can simulate how the human body is affected by diseases spread by viruses and bacteria and then develop techniques to prevent it.

•*Engineering*

- Software engineers may use multimedia in Computer Simulations for anything from entertainment to training such as military or industrial training. Multimedia for software interfaces are often done as a collaboration between creative professionals and software engineers.

•*Industry*

- In the Industrial sector, multimedia is used as a way to help present information to shareholders, superiors and coworkers (المساهمين والرؤساء وزملاء العمل).
- Multimedia is also helpful for providing employee training, advertising and selling products all over the world via virtually unlimited web-based technology.

Mathematical and scientific research

- In mathematical and scientific research, multimedia is mainly used for modelling and simulation. For example, a scientist can look at a molecular model of a particular substance and manipulate it to arrive at a new substance. Representative research can be found in journals such as the Journal of Multimedia

•*Document imaging*

- Document imaging is a technique that takes hard copy of an image/document and converts it into a digital format (for example, scanners).

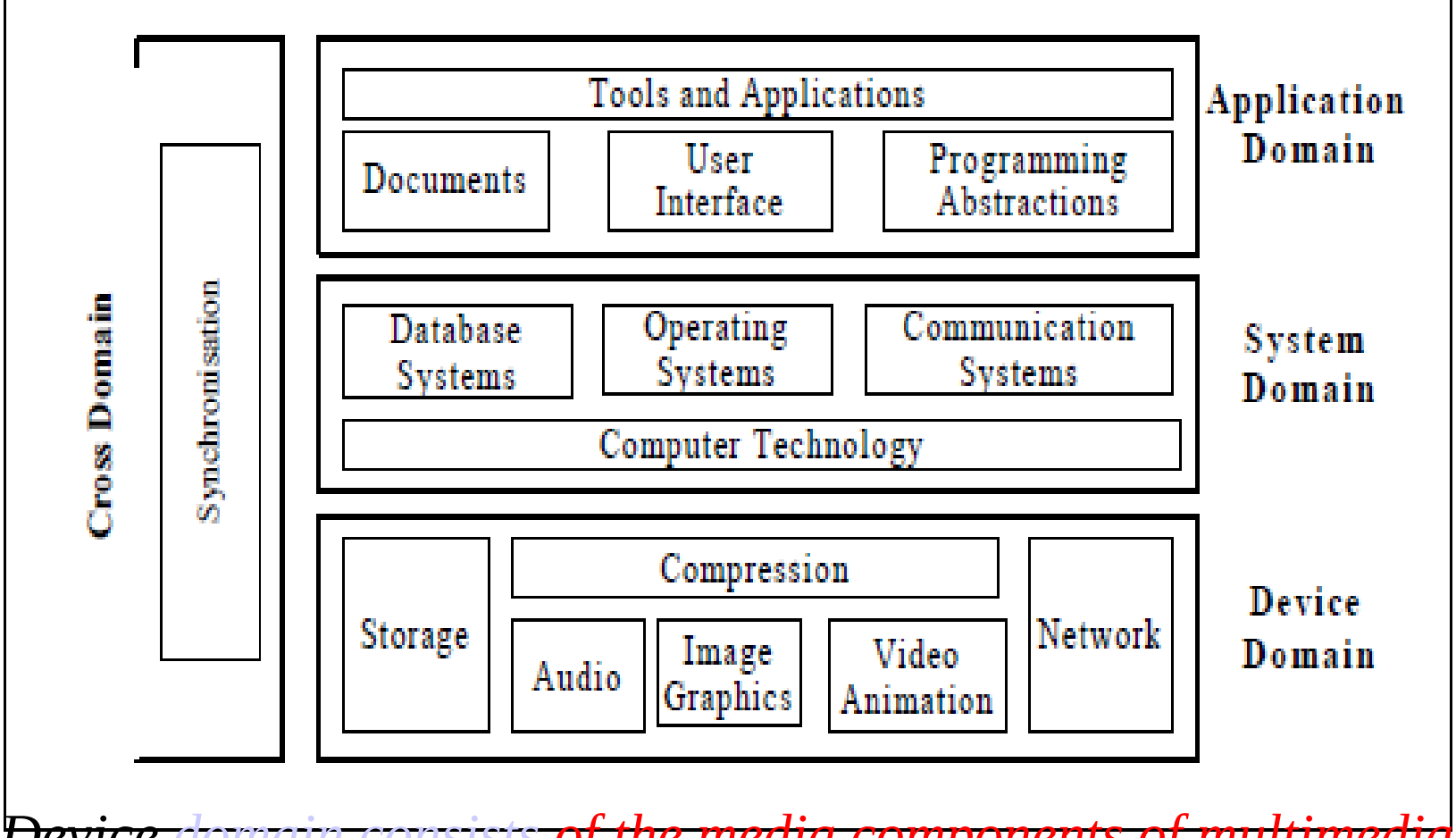
- **MM in Business: Presentation, Training, Marketing, Advertising, DB, Catalog, Network communication voice mail, Video conference will be soon provided on many local and wide area network.**

- **MM is School : connect every Class room ,Library ,Clinic and Hospital**

- **MM at Home :TV set or monitor with built in interactive user input or use computer with CD-ROM** device
- **MM in public place : Hotels, Train station, shopping malls,….to provide information and help.**

Global Structure

- Figure 1.1 illustrates the **different areas of multimedia systems**. The different areas interacts to provide the functionality of the multimedia systems.



Device domain consists of the media components of multimedia systems. The media includes audio, image graphics and video and animation, is delivered through devices controlled by computer systems. Compression methods determine the quality of delivery based on the data rates for the media. The diminishing cost of optical storage space contributes to the development of multimedia systems. And higher bandwidths and capacity of networks led to development of networked multimedia systems.

Device Domain

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System Domain

- Computer technology provides interface services to utilise the devices. Operating system provides interface between hardware/system software and other software. Database system allows structured access to data and management of large databases. Communication system is responsible for data transmission according to the timing and reliability requirements of the networked multimedia applications

Application Domain

- Services of system domain are offered through programming abstractions. In object oriented programming theory, **abstraction** involves the facility to define objects that represent abstract "actors" that can perform work, report on and change their state, and "communicate" with other objects in the system. Also Abstraction is one of the most important techniques in software engineering and is closely related to two other important techniques -- *encapsulation* and *information hiding*. All three techniques are used to reduce complexity.
- **Documents provide structured information, represented in different media, and generated or recorded at the time of presentation.**
- **User interface presents documents and applications to the user**.

Cross Domain

- Some aspects involve components in two or more domains. **Synchronization** is the temporal relationship among various media, and relates to many components across all domains.

Exploring multimedia on the Web

- The **Internet is a vast communications system linking computers around the world.** the Internet became widely popular after the development of **browsers**
- **A browser is a visual interface that interprets Web documents and allows** for the display of graphics

internet. A browser is an application program that provides a way to look at and interact with all the information on the World Wide Web. Browsers, such as Netscape Navigator and Internet Explorer, enable graphics, sound, movies, and animation to be delivered to the user.The development of browsers helped spawn the **World Wide Web, which supports** delivery of multimedia, and provides for hyperlinking of content over the Internet.Together, browsers and the Web give the Internet multimedia capabilities

- The fastest-growing area for multimedia delivery is online, including delivery via telecommunications and the Internet.
- Telecommunications involving phone line, satellite, wireless, and cable transmission is being used by educational institutions to deliver multimedia courseware to rural areas and by companies for teleconferencing and training.
- The use of the Internet is growing exponentially. Many companies are developing home pages for the Web that allow customers to access product data including video demonstrations, to purchase products, and even to subscribe to news services.

- One of the most compelling features of the Web is its immediacy. Events such as conference keynote speeches can be Webcast—that is, broadcast, in real time over the Web. All Webcasts are audio and some include video

بث مباشر على شبكة الانترنيت

- Animations, as simple as rotating text or as sophisticated as 3-D settings, are an exciting part of multimedia on the Web. They have proved especially useful for attracting attention and creating virtual learning environments.
- Animations can be created using simple HTML tags, animation software such as Macromedia Flash, or programming languages such as Virtual Reality Modeling Language (VRML).

- The “coding language” for Web documents is called HyperText Markup Language (HTML). Multimedia developers know that as long as their programs are written using HTML, the user should be able to run the application on the Web. Unfortunately, no standard hardware configuration exists for computers linked to the Internet. For example, the user’s computer may or may not include a sound card. If it lacks a sound card, then the user cannot hear sound used in the multimedia application.

- HTML allows Web page developers to include **hyperlinks**, which consist of text or graphics that are coded to "jump" to another location. Hyperlinks give users the ability to "navigate" from place to place in a document or across documents.
- HTML uses HTML tags to mark text. For example, ***Welcome***! would be coded as Welcome! in HTML. The HTML tags and display all text contained within the tags in italic.

- While HTML is used to create basic Web pages, other programming languages and development software are more appropriate for creating multimedia events. Programming languages, like Java, are used to produce sophisticated features such as animations and database searches. Applets are Java programs that are developed for a specific purpose and can be used in more than one application. For example, an applet might track stock prices and periodically display

• Web development considerations

Significant considerations when developing multimedia applications for the Web include file sizes and the playback system configuration (hardware and software). Today, most home computers connect to the Internet through modems and phone lines. A standard modem transfers data at a maximum rate of only 56 KB per second; by comparison, a CD may have a transfer rate as high as 7200 KB per second. Thus large files—especially video clips, sounds, and animations—can take an inordinately long time to move from the Web to a home or office computer. Certain techniques, such as ***file compression****, can be used to speed up the transfer process and/or give the developer some control over the process.*

- *File size and play back system consideration (software and hardware)*
- *Internet transfer rate and CD*
- *Compression techniques*

Studying the growth of multimedia

- Multimedia seems to be everywhere.so; There are :
- entertainment sites on the Web,
- children’s computer games,
- training materials with video clips, and educational material such as the textbook, which has both a CD-ROM and Web site with multimedia applications.
- The growth in multimedia has followed expansion of the use of computers, technological

- Technical advances in hardware such as audio cards capable of playing CD-quality sound, and development of software that allows video to be delivered to the desktop computer.

- This lecture examines factors contributing to the growth of multimedia

1-One indication of the growth of MM is the number of households that own MM computer playback systems

2-The growth in the use of the web and MM technologies used on the web

3-Developement of the programs that allow audio and video to be deliver over the web, example is Real player

4-The widespread distribution of MM CD titles.

5-Marketing by computer companies: consumer would spend billions of $ on hardware components such as CD/DVD drivers, Audio cards, video cards ,speakers , software programs

- The end

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Lecture 4: Multimedia Software Tools

Dr. Nassir H. Salman & Dr Suhaila Najim

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lect. 4 continue
Fundamentals of Multimedia

2nd Edition 2014
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Mark S. Drew
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Chapter 1 : Introduction and Multimedia Data Representations

Components of Multimedia

- Multimedia involves multiple modalities of text, audio, images, drawings, animation, and video.
- Examples of how these modalities are put to use:

1. Video teleconferencing.
2. Distributed lectures for higher education.
3. Tele-medicine.
4. Co-operative work environments.

5. Searching in (very) large video and image databases for target visual objects.
6. " Augmented" reality: placing real-appearing computer graphics and video objects into scenes.
7. Making multimedia components editable

1.3 Overview of Multimedia Software Tools

- software tools available for carrying out tasks in multimedia are:

1. Music Sequencing and Notation
2. Digital Audio
3. Graphics and Image Editing
4. Video Editing
5. Animation
6. Multimedia Authoring

1.Music Sequencing and Notation

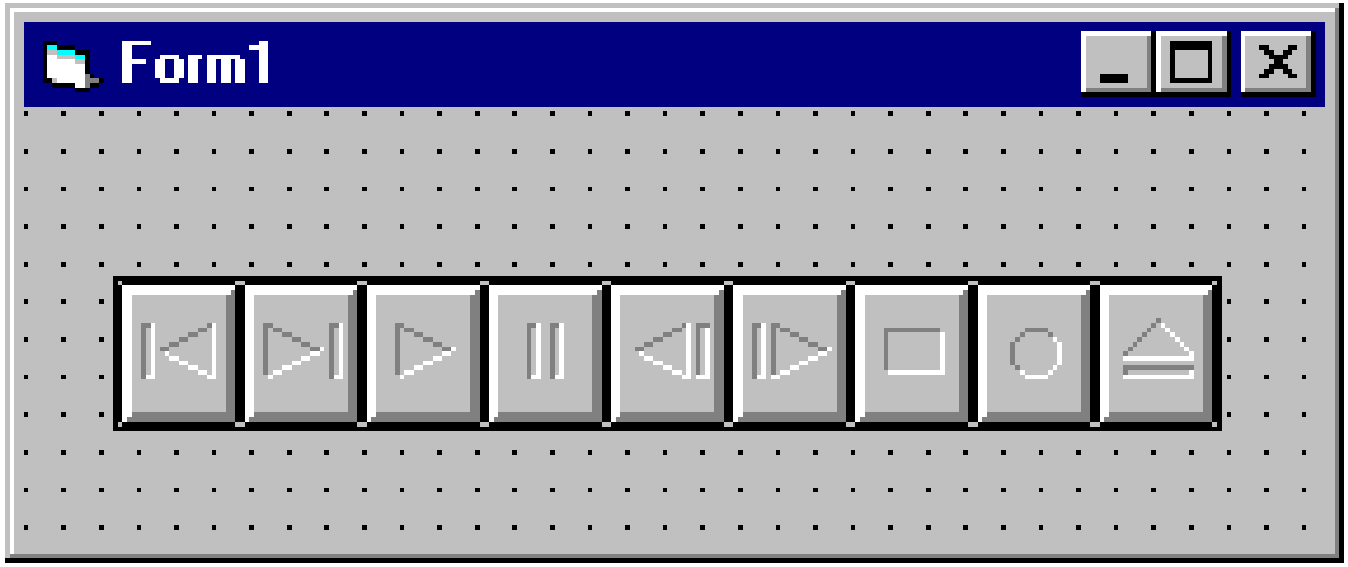
- ***Cakewalk:*** *now called Pro Audio.*
- https://www.youtube.com/watch?v=N6dYPsGsBMQ

  - The term sequencer comes from older devices that stored sequences of notes ("events", in MIDI [**Musical Instrument Digital Interface**]).
  - It is also possible to insert WAV files and Windows MCI commands (for animation and video) into music tracks (MCI is a ubiquitous component of the Windows API.)
- ***Cubase:*** another sequencing/editing program, with capabilities similar to those of Cakewalk. It includes some digital audio editing tools.
- ***Macromedia Soundedit:*** mature program for creating audio for multimedia projects and the web that integrates well with other Macromedia products such as Flash and Director.


Music Creator 7 is a fun, easy,
and fast way to create original music
or remix your favorite songs.
0:13 / 3:21

MIDI allows multiple instruments to be played from a single controller (often a keyboard, as pictured here), which makes stage setups much more portable. This system fits into a single rack case, but prior to the advent of MIDI, it would have required four separate full-size keyboard instruments, plus outboard mixing and effects units.

Multimedia Control Interface



The buttons are defined as Prev, Next, Play, Pause, Back, Step, Stop, Record, and Eject, respectively.

2.Digital Audio

- tools deal with accessing and editing the actual sampled sounds that make up audio:

- **Adobe Audition** (formerly **Cool Edit**) is a powerful, popular digital audio toolkit that emulate a professional audio studio, including multitrack productions and sound file editing, along with digital signal processing effects.
- **Sound Forge** Like Audition, Sound Forge is a sophisticated PC-based program for editing WAV files.

- **Pro Tools: a** high-end integrated audio production and editing environment . It offers MIDI creation and manipulation; powerful audio mixing, recording, and editing software.

3. Graphics and Image Editing

- **Adobe Illustrator**: a powerful publishing tool from Adobe. Uses vector graphics; graphics can be exported to Web.
- **Adobe Photoshop**: the standard in a graphics, image processing and manipulation tool.
  - Allows layers of images, graphics, and text that can be separately manipulated for maximum flexibility.
  - Filter factory permits creation of sophisticated lighting-effects filters
- **Macromedia Fireworks**: software for making graphics specifically for the web.
- **Macromedia Freehand**: a text and web graphics editing tool that supports many bitmap formats such as GIF, PNG, and JPEG.

Vector graphics

- **Vector graphics** is the creation of digital images through a sequence of commands or mathematical statements that place lines and shapes in a given two-dimensional or three-dimensional space
- **Vector graphics** is the use of polygons to represent images in computer graphics. Vector graphics are based on vectors, which lead through locations called control points or nodes. Each of these points has a definite position on the *x*- and *y*-axes of the work plane and determines the direction of the path

4. Video Editing

- **Adobe Premiere**: an intuitive, simple video editing tool for nonlinear editing, i.e., putting video clips into any order:

- Video and audio are arranged in "tracks".
- Provides a large number of video and audio tracks, super-impositions and virtual clips.
- A large library of built-in transitions, filters and motions for clips => effective multimedia productions with little effort.

- **Adobe After Effects:** a powerful video editing tool that enables users to add and change existing movies. Can add many effects: lighting, shadows, motion blurring; layers.

4. Video Editing

- **Final Cut Pro**: a video editing tool by Apple; Macintosh only.
- **CyberLink PowerDirector**: PowerDirector produced by CyberLink Corp.
  - is by far the most popular nonlinear video editing software.
  - It provides a rich selection of audio and video features and special effects
  - easy to use.
  - It supports all modern video formats (AVCHD 2.0, 4K Ultra HD, and 3D video)
  - It supports 64-bit video processing
  - it is not as "programmable" as Premiere.

AVCHD (Advanced Video Coding High Definition) is a file-based format for the digital recording and playback of high-definition video. Developed jointly by Sony and Panasonic, the format was introduced in 2006 primarily for use in high definition consumer camcorders(digital video cameras)

A programmable logic device (PLD) is an electronic component used to build reconfigurable digital circuits. Unlike a logic gate, which has a fixed function, a PLD has an undefined function at the time of manufacture. Before the PLD can be used in a circuit it must be programmed, that is, reconfigured

Reconfigurable computing is a computer architecture combining some of the flexibility of software with the high performance of hardware by processing with very flexible high speed computing fabrics like field-programmable gate arrays (FPGAs). The principal difference when compared to using ordinary microprocessors is the ability to make substantial changes to the datapath itself in addition to the control flow

5. Animation

- **Multimedia APIs: Application Programming Interface**

- **Java3D:** API used by Java to construct and render 3D graphics, similar to the way in which the Java Media Framework is used for handling media files.

  1. Provides a basic set of object primitives (cube, splines, etc.) for building scenes. مضلعات

  2. It is an abstraction layer built on top of OpenGL or DirectX (the user can select which).

- **DirectX** :Windows API that supports video, images, audio and 3-D animation
- **OpenGL**: the highly portable, most popular 3-D API.

What is Multimedia.api?
Multimedia.api is part of Adobe Acrobat and developed by Adobe Systems Incorporated according to the Multimedia.api version information.

Multimedia.api's description is "Adobe Acrobat Multimedia Plug-in"

Multimedia.api is usually located in the 'C:\Program Files\Adobe\Reader 8.0\Reader\plug_ins\' folder.

5. Animation

- **Animation Software (Rendering Tools):**

- **3D Studio Max:** rendering tool that includes a number of very high-end professional tools for character animation, game development, and visual effects production.
- **Softimage XSI:** a powerful modeling, animation, and rendering package used for animation and special effects in films and games.
- **Maya**: competing product to Softimage; as well, it is a complete modeling package.
- **RenderMan**: rendering package created by Pixar.

5. Animation

- **GIF Animation Packages :**

- simpler approach to animation, allows very quick development of effective small animations for the web.

- GIFs can contain several images, and looping through them creates a simple animation.

- Linux also provides some simple animation tools, such as **animate**.

6. Multimedia Authoring

- Tools that provide the capability for creating a complete multimedia presentation, including interactive user control, are called **authoring** programs.

- **Macromedia Flash:** allows users to create interactive movies by using the score metaphor, i.e., a timeline arranged in parallel event sequences.

- **Macromedia Director**: uses a movie metaphor to create interactive presentations. It is very powerful and includes a built in scripting language, **Lingo**, that allows creation of complex interactive movies.

6. Multimedia Authoring

- **Authorware:** a mature, well-supported authoring product based on the **Iconic/Flow-control** metaphor.

- **Quest:** similar to Authorware in many ways, uses a type of flowcharting metaphor. However, the flowchart nodes can encapsulate information in a more abstract way (called **frames**) than simply subroutine levels.

End of Chapter 1

Introduction and Multimedia Data Representations

Lect 5. Introduction

- Basic Sound Concepts
- Computer Representation of Sound

Audio

- Most modern audio signals are stored in digital form (for example MP3s and CDs) and in order to be heard through speakers they must be converted into an analog signal.
- DACs are therefore found in:
- CD players,
- digital music players, and PC sound cards.
- Specialist standalone DACs can also be found in high-end hi-fi systems. These normally take the digital output of a compatible CD player or

High fidelity (often shortened to hi-fi or hifi) is a term used by listeners, audiophiles and home audio enthusiasts to refer to high-quality reproduction of sound.

- dedicated transport (which is basically a CD player with no internal DAC) and convert the signal into an analog line-level output that can then be fed into an amplifier to drive speakers.
- Similar; digital-to-analog converters can be found in digital speakers such as USB speakers, and in sound cards.
- In VoIP (Voice over IP) applications, the source must first be digitized for transmission, so it undergoes conversion via an Analog-to-Digital Converter, and is then reconstructed into analog using a DAC on the receiving party's end.

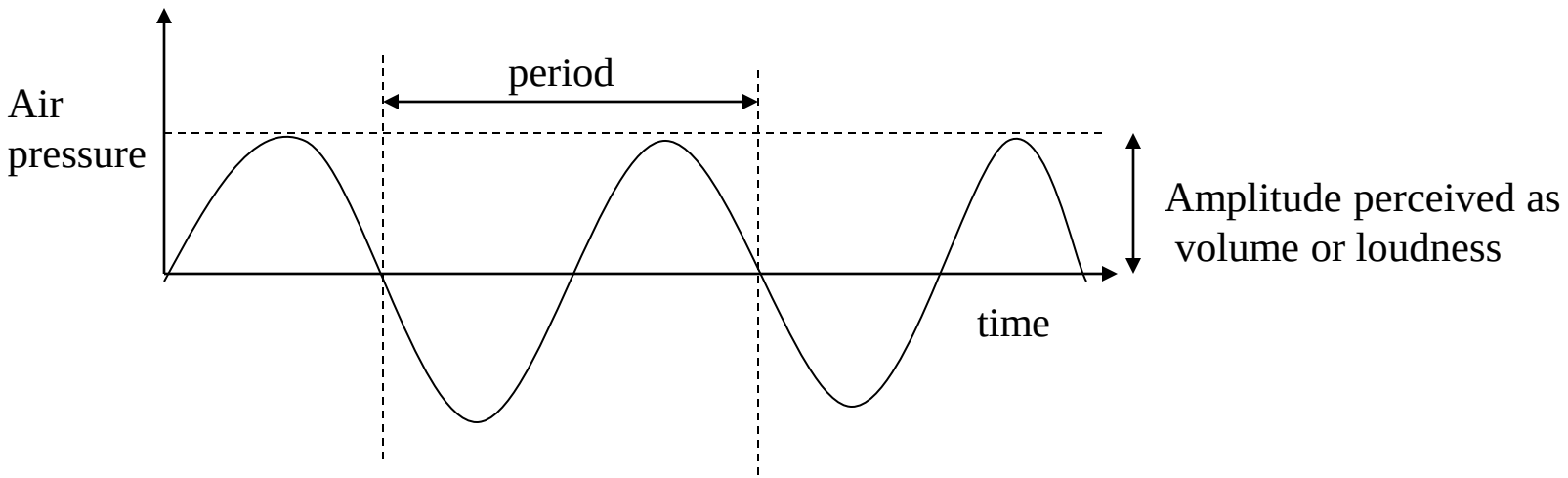
- AUDIO :
- A multimedia application may require the use of speech, music and sound effects. These are called audio or the sound elements.
- There are two basic types of audio or sound: analog and digital audio.
- **Analog audio refers to the original sound signal** .
- **Digital audio refers to the digital sampling of the actual sound** . ***The sound used in multimedia is digital audio.***

Sound

- **2.1 Classes of Sound**
- · Voice
- · Music
- · Sound Effects
- **2.2 Characteristic of Sound Waves**
- **Amplitud**e - Power or intensity of sound, the louder the sound, the larger the amplitude
- **Frequency** - The rate which sound is measured, the higher the frequency, the clearer and sharper the sound

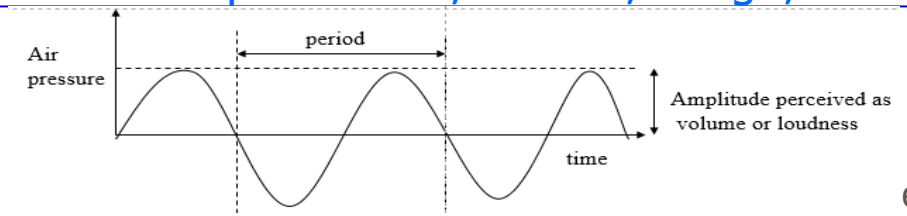
Frequency of a sound wave

Frequency is the reciprocal value of the period., or represents the number of periods/sec .it measures by hertz (Hz) or cycle/sec. a common abbreviation is KHz which describes 1,000 oscillation per second



Basic Sound Concepts

- Acoustics :is the science of the sound, which is energy , "sound is energy"
  - study of sound - generation, transmission and reception of sound waves.
- Sound is produced by vibration of matter.
  - During vibration, pressure variations are created in the surrounding air molecules.
  - Pattern of oscillation creates a waveform
    - the wave is made up of pressure differences.
  - Waveform repeats the same shape at intervals called a *period*.
    - Periodic sound sources - exhibit more periodicity, more musical –Generated by musical instruments .
    - Non-periodic sound sources - less periodic - unpatched percussion, sneeze, cough,drums

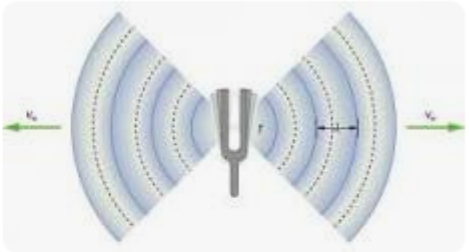


Basic Sound Concepts

- Sound Transmission
  - Sound is transmitted by molecules bumping into each other.
  - Sound is a continuous wave that travels through air.
- Sound is detected by measuring the pressure level at a point.
- Receiving
  - Microphone in sound field moves according to the varying pressure exerted on it.
  - Transducer converts energy into a voltage level (i.e. energy of another form - electrical energy)
- Sending
  - Speaker transforms electrical energy into sound waves.

Wavelength **is the distance travelled in one cycle**
20Hz is 56 feet, 20KHz is 0.7 in.

The **relationship of the** speed of **sound**, its **frequency, and wavelength** is the same as for all waves: $v_w = f\lambda$, where v_w is the speed of **sound**, f is its **frequency**, and λ is its **wavelength**. ... The **frequency** is the same as that **of the** source and is the number of waves that pass a point per unit time.



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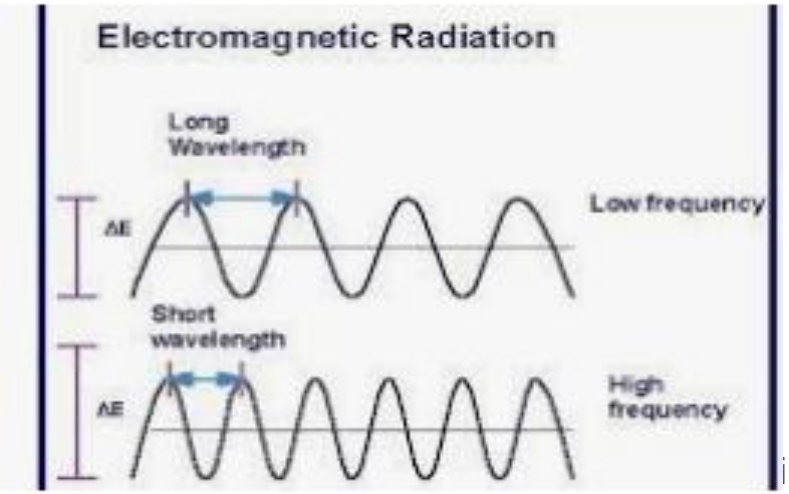
Speed of Sound, Frequency, and Wavelength | Physics



$$\text{Wave velocity} = \frac{\text{Distance}}{\text{Time}}$$

$$\Rightarrow \quad v = \frac{\lambda}{T}$$

$$\Rightarrow \quad u = v\lambda \qquad \left[\because \frac{1}{T} = \text{frequency}\,(v)\right]$$

$$\therefore \text{ Wave velocity} = \text{Frequency} \times \text{Wavelength}$$

Basic Sound Concepts

- *Frequency* represents the number of periods in a second (measured in hertz, cycles/second). Acommon abbreviation is KHz which describes 1000 oscillations per second
  - Frequency is the reciprocal value of the period.
  - Human hearing frequency range: 20Hz - 20Khz, voice is about 500Hz to 2Khz.

Infrasound	from 0 - 20 Hz	(Infrasonic)
Human range	from 20Hz - 20KHz	(Audio sonic) music
Ultrasound	from 20kHz - 1GHz	(Ultrasonic)
Hypersound	from 1GHz - 10THz	

Basic Sound Concepts

- ***Amplitude*** of a sound is the measure of the displacement of the air pressure wave from its mean or quiescent state.
- Subjectively heard as **loudness**. Measured in decibels.(وحدة قياس شدة الصوت)

0 db	-	essentially no sound heard
35 db	-	quiet home
70 db	-	noisy street
120db	-	discomfort

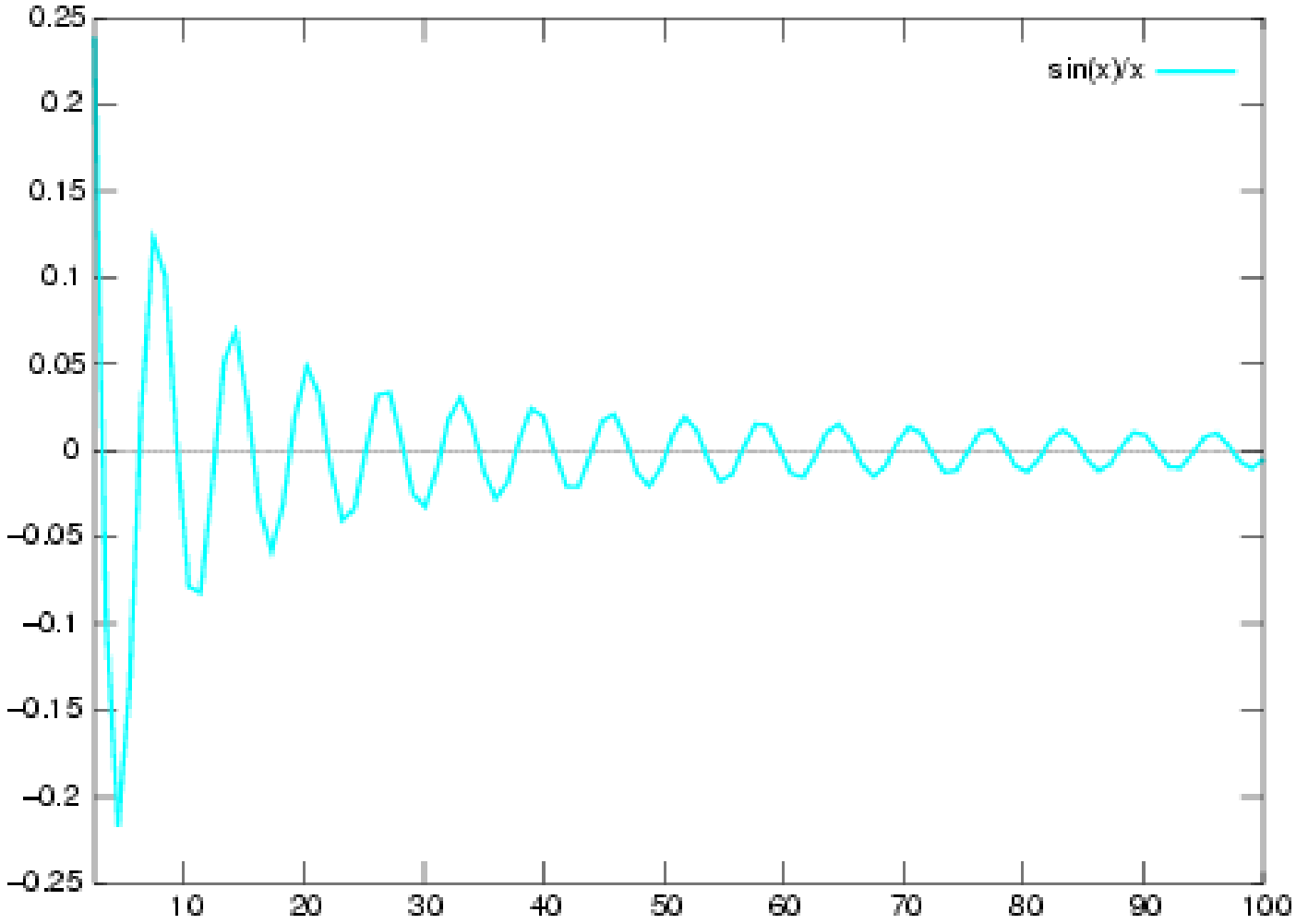
db(decibels measurements is actually the ratio between a chosen reference point on a longitude scale and the level that actually experienced.

- **Audiology** :is the discipline interested in manipulating a caustic signals that can be perceived by humans. most MM applications use audio in **the form of music and /or speech.**
- The **sound** in audiosonic frequency range is primarily important for MM systems ,music signals have frequencies in the 20Hz- 20KHz range.
- The waves in the audiocostic frequency range are called acoustic signals .
- To play sound with **windows** ,you need to have a sound board (card) with the correct drivers installed in your pc and from control panel choose sound icons to find some sound in the sound control panel.
- In windows system sounds are **.WAV** files

From Sound to Signals

- As was mentioned above, **a device such as a microphone can be used to sense the changes in air pressure--the peaks and through--at a particular point in space, just as the human ear does**. The result is an **electrical signal**, known as an ***audio signal***, which describes the local changes in air pressure at the microphone as a function of time. Figure 10.1 shows an example of an audio signal that is an idealization of one that would be created by **a transient sound source, such as that from a book striking the floor and recorded with a microphone.**

Figure 10.1: A signal such as would be created by a transient audio source upon transformation by a microphone into an electrical signal. The horizontal scale represents time in tenths of milliseconds



- **In this figure, the measurement of pressure has been converted into an electrical voltage, and the waveform shown depicts the voltage as it changes in time.**
- **The vertical axis shows the voltage (proportional to air pressure) at any instant, and the horizontal axis represents time in tenths of milliseconds.**
- **Louder sounds will create a greater vertical displacement; that is, the swings in air pressure due to loud sounds are greater.**

Frequency Content of Audio Signals

- **Because all audio signals are comprised of a sum of different pure tones**, each at a different frequency, we can describe a given audio signal in two different ways. One way we have already seen-
- **-we can use the waveform that describes how the audio signal varies with respect to time. This waveform is sometimes referred to as the**
- ***time-domain description* of the signal.**
- **The second way to describe an audio signal is by its *frequency spectrum*--that is, by specifying which frequency components the signal contains, and in what amount each frequency or pure tone occurs. This description of a signal is referred to as the *frequency-domain description*.**

Figure 10.12: A male saying ``information.''

Figure 10.13: The frequency spectrum of a male saying ``information.''

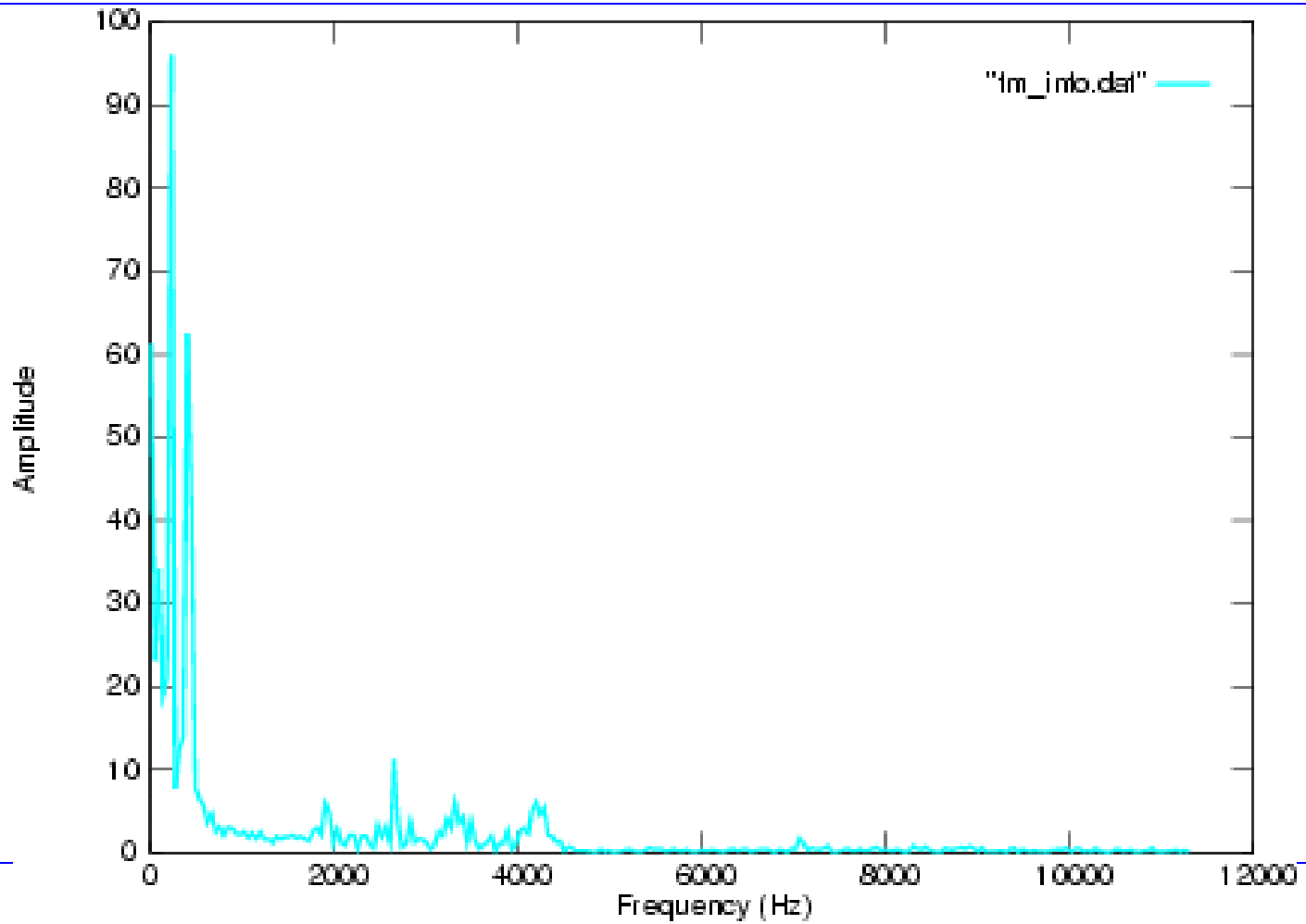


Figure 10.14: A female saying ``information.''

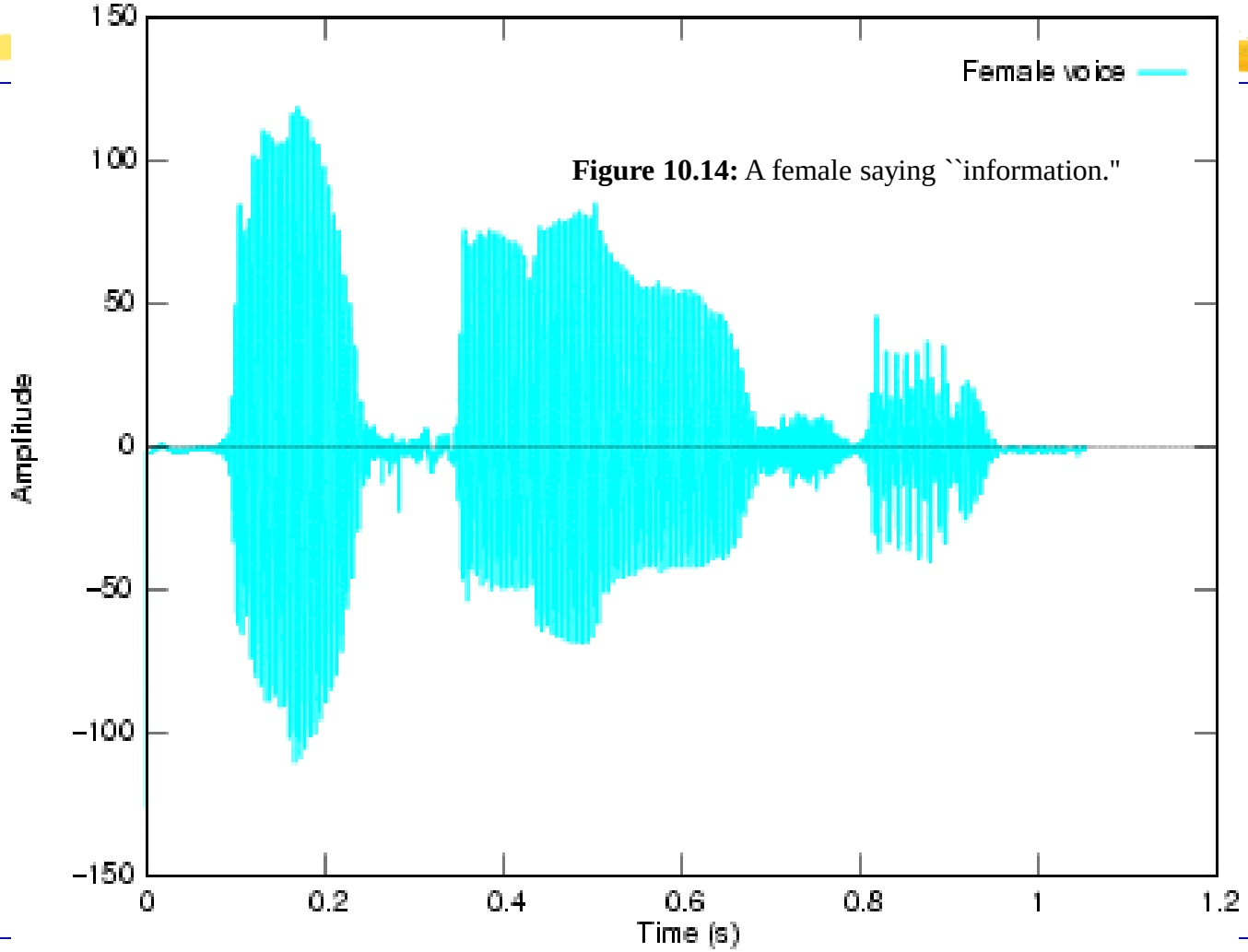
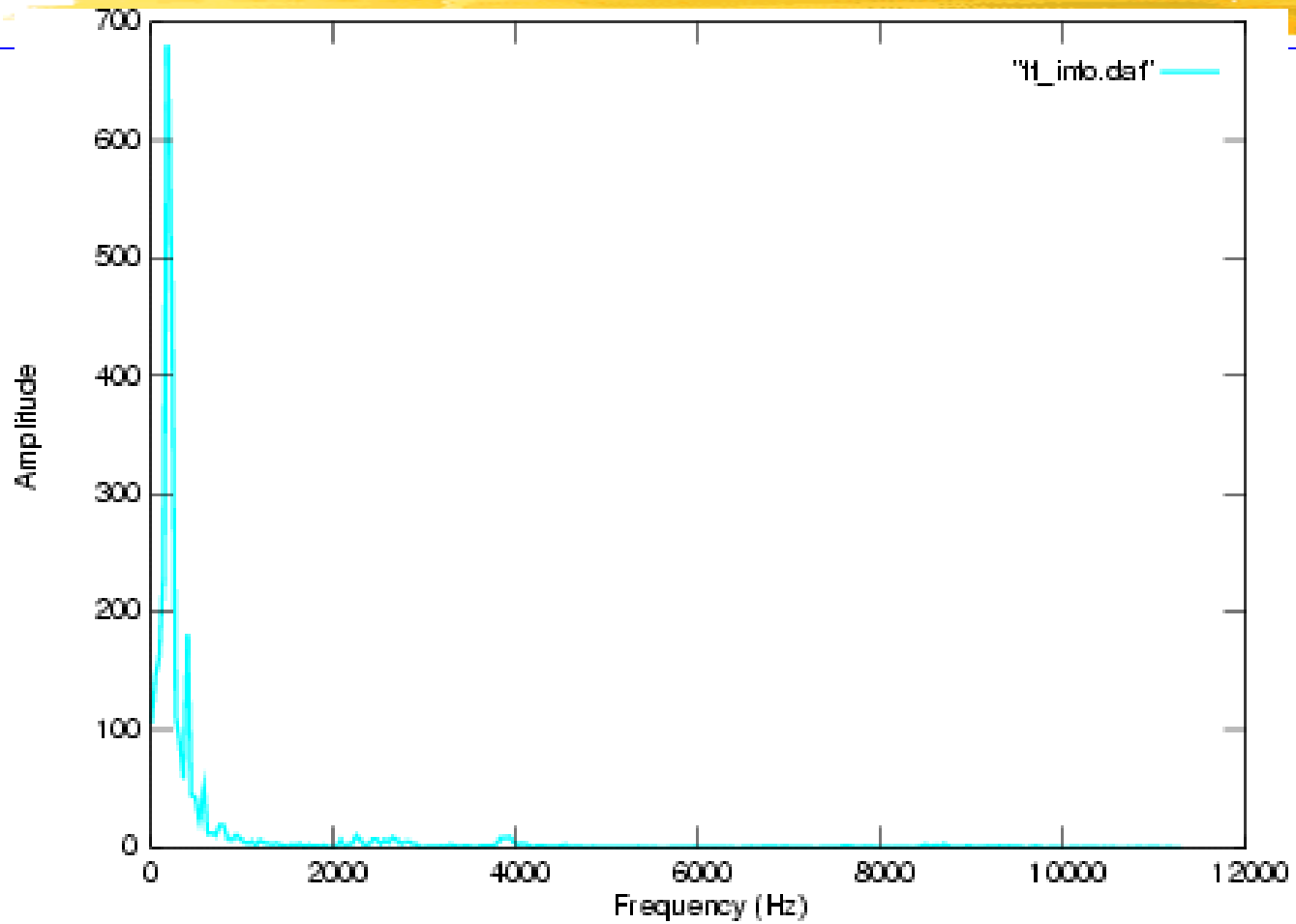


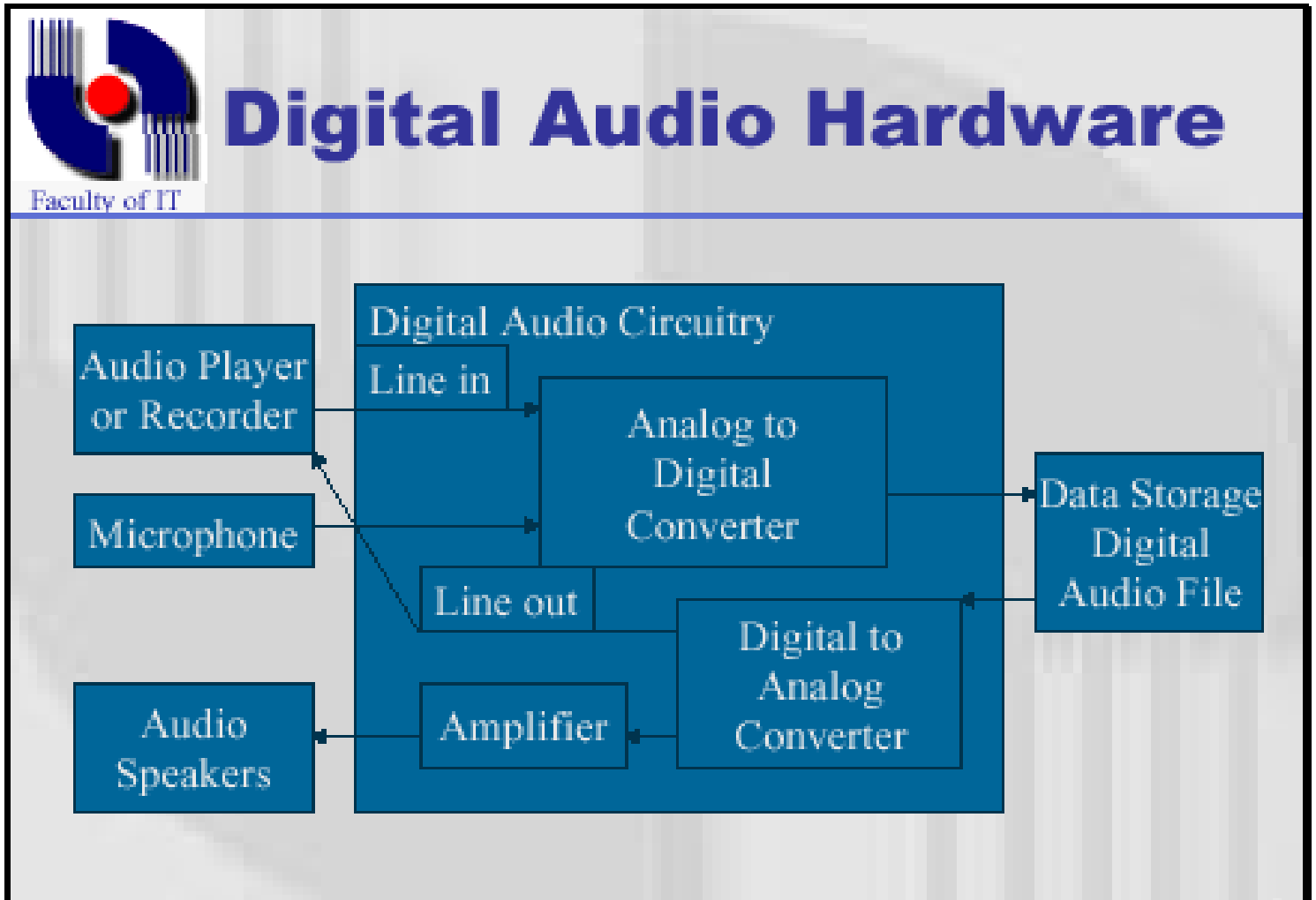
Figure 10.15: The frequency spectrum of a female saying ``information.''



Lect 6: Sound in Multimedia

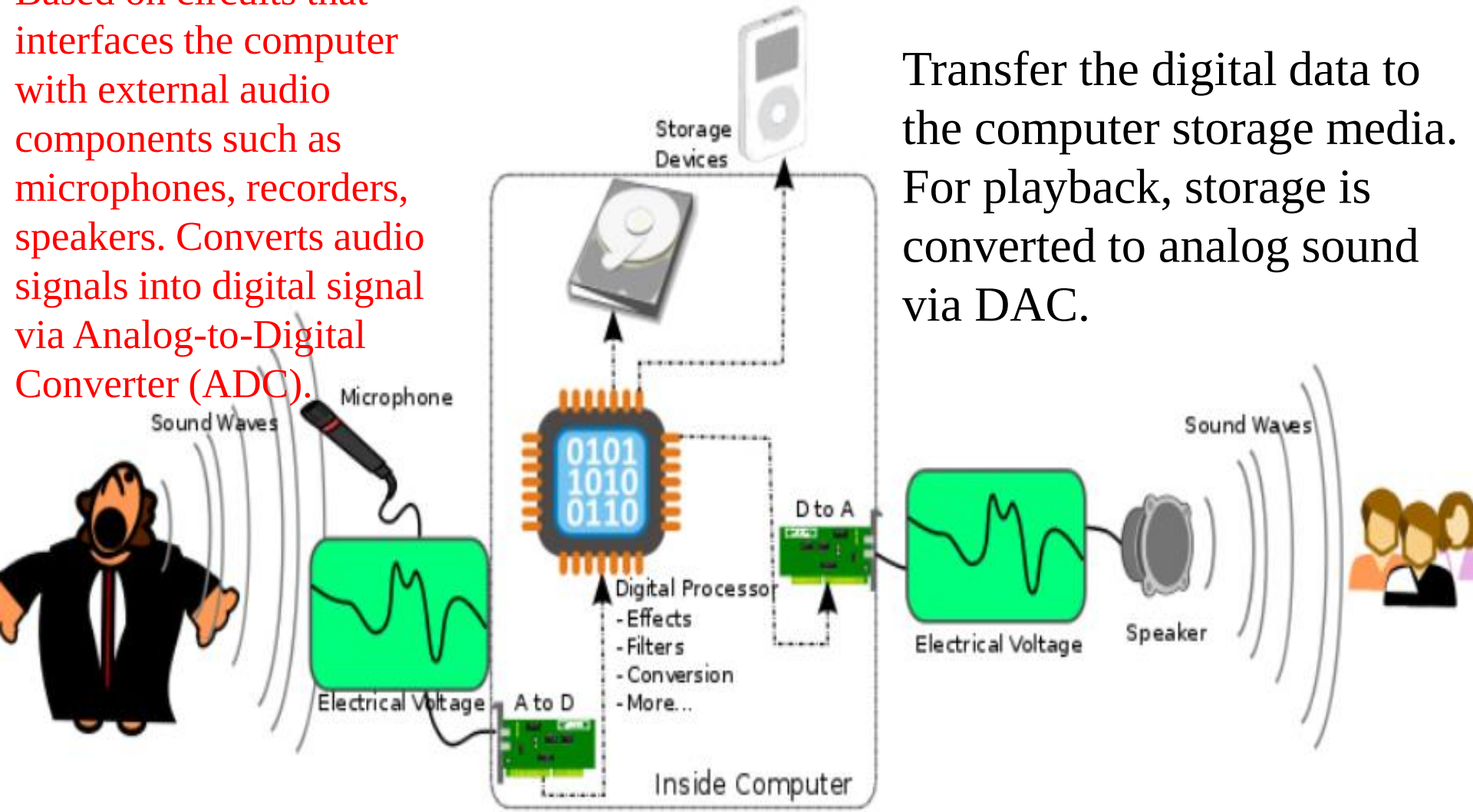
- Digital Audio

Based on circuits that interfaces the computer with external audio components such as microphones, recorders, speakers. Converts audio signals into digital signal via Analog-to-Digital Converter (ADC). Transfer the digital data to the computer storage media. For playback, storage is converted to analog sound via DAC



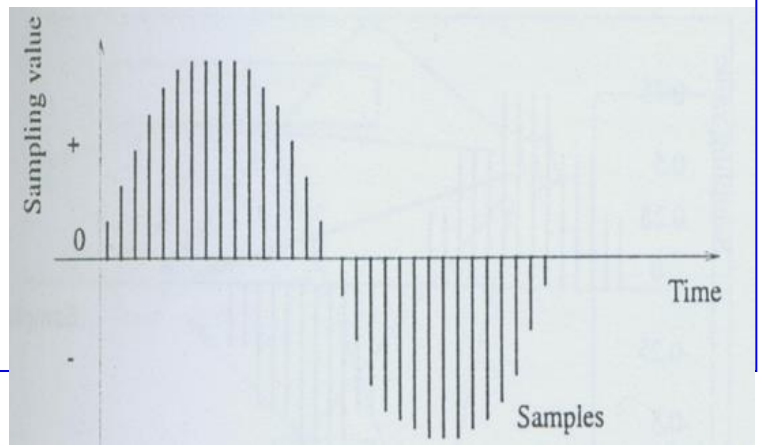
Based on circuits that interfaces the computer with external audio components such as microphones, recorders, speakers. Converts audio signals into digital signal via Analog-to-Digital Converter (ADC).

Transfer the digital data to the computer storage media. For playback, storage is converted to analog sound via DAC.



3 Computer Representation of Sound

- Computer measures the amplitude of waveform at regular intervals to produce a series of numbers. Each measurement is a sample. Sampling rate is the rate which a continuous waveform is sampled. Quantization is the possible (range of) values of the sample



Audio representation on computers

- Before the continuous curve of a sound wave can be represented on a computer , the computer has to measure the wave's amplitude in regular time intervals. it then takes the result and generates a sequence of sampling values. or samples for short. figure 3.4 shows the period of a digitally sampled wave. The mechanism that converts an audio signal into sequence of digital samples is called an analog –to-digital converter (ADC) and a digital to-analog converter (DAC) is used to achieve the apposite conversion

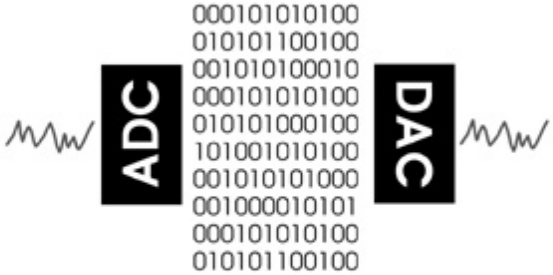
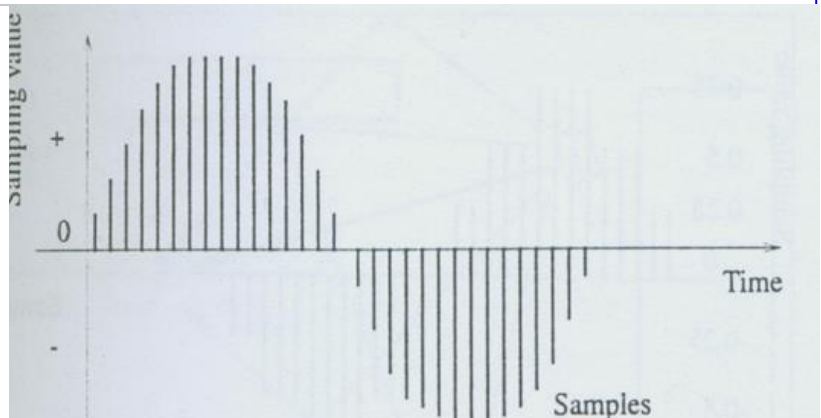


Figure 2.2 A pictorial description of the recording and playback of sounds through an ADC/DAC.



Sampling wave

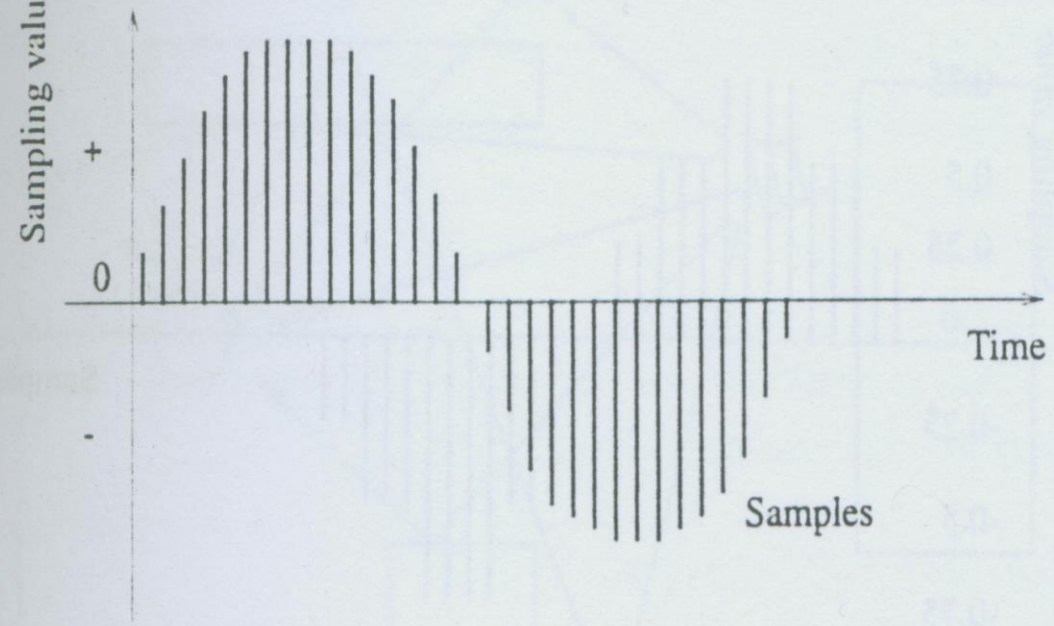


Figure 3-4 Sampling a wave.

sampling rate:

- the rate at which a continuous wave form is sampled (see fig below) is called the sampling rate.
- like frequency ,the sampling rate is measured in Hz .for example , CDs are sampled at a rate of 44100 Hz , which may appear to be above the frequency range perceived by human .however the bandwidth in this case ,20000 Hz-20 Hz=19980 Hz.-that can represent digitally sampled audio signal is only about half as big as a CD's sampling rate ,
- because CDs use the Nyquist sampling theorem (which states that the signal being sampled cannot contain any frequency components that exceed half the sampling frequency) .This means that a sampling rate of 44100 Hz covers only frequencies in the range from 0 Hz to 22050 Hz. this limit is very close to the human hearing capability.

QUANTIZATION:

- The digitization process requires two steps:
- first the analog signal must be sampled .this means that only a discrete set of values is retained at (generally regular) time or space intervals.
- The second step involves quantization .the quantization process consists of converting a sampled signal into a signal that can take only a limited number of values. an 8-bit quantization provides 256 possible values ,while a 16-bit quantization in CD quality results in more than 65,536 possible values. The figure below shows a 3-bit quantization

3-bit quantization

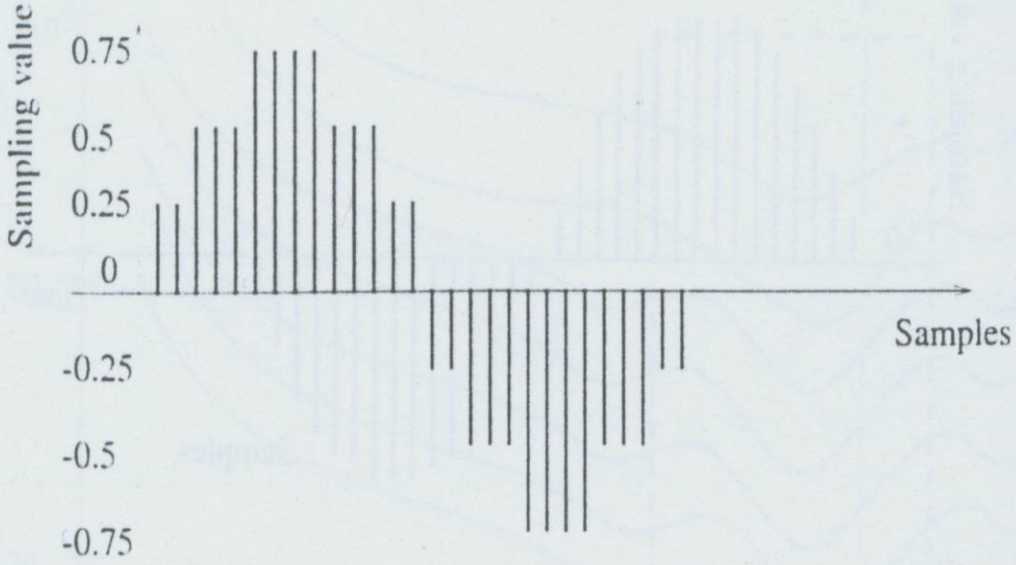
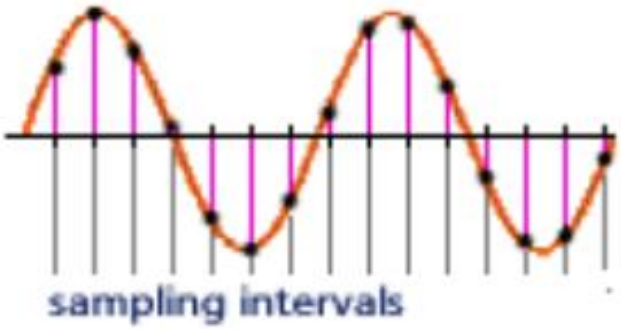


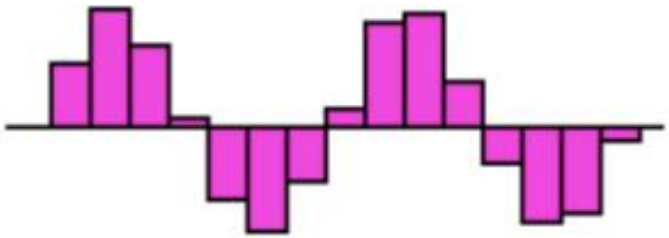
Figure 3-5 3-bit quantization.

- **The values transformed by a 3-bit quantization process can accept eight different characteristics :0.75,0.5,0.25,0,-0.25,-0,5, -0.75, and -1 so that we obtain an "angular shape" wave. This means that the lower the quantization (in bit) ,the more the resulting sound quality deteriorates**

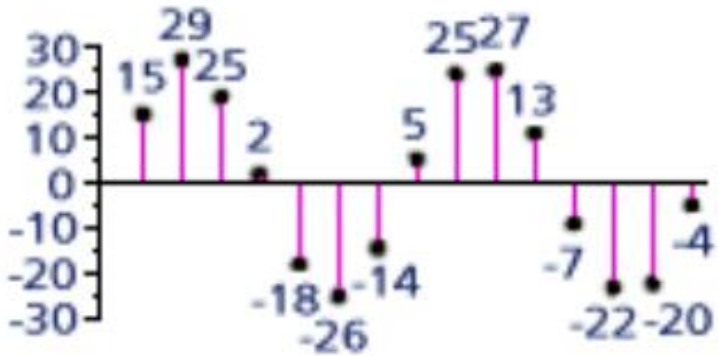
analogue signal



digital signal



digital representation of signal



15 29 25 2 -18 -26 -14
5 25 27 13 -7 -22 -20 -4

3.2 Digital Audio Representations

- · Sampling frequency (rate) - sampling freq is at least twice the highest freq present in original signal
- ·
- · Number of channels (tracks) - stereo have 2 channels, some products have 4, 16, 32
- · Negative samples - analog signals alternate between positive and negative
- · Encoding - common methods are Pulse Code Modulation (PCM) and Adaptive Delta Pulse Code Modulation (ADPCM).

File size versus quality

- Remember that the sampling rate determines the frequency makeup of the recording. Sampling at higher rates more accurately captures the high frequency content of your sound. Resolution determines the accuracy with which a sound can be digitized. Using more bits yields a recording that sounds more like its original.

***Warning*: the higher the sound quality, the longer your file will be.**

- Stereo recording are more lifelike and realistic, because human being have two ears. *mono recordings are fine, but tend to sound a bit "flat" and uninteresting when compared with stereo recordings*. Stereo sound files require twice as much storage space as mono files.

Here are the formulas for determining the size (in bytes) of a digital recording.

- **For a monophonic recording**

$$sampling\ rate * duration\ \ of\ \ recording\ \ in\ \ second * (bit\ \ resolution / 8) * 1$$

For a stereo recording:

$$sampling\ rate * duration\ \ of\ \ recording\ \ in\ \ second * (bit\ \ resolution / 8) * 2$$

Example

$$sampling\ rate * duration\ \ of\ \ recording\ \ in\ \ second * (bit\ \ resolution / 8) * 1$$

Thus the formula for 10-second recording at 22.05 KHz (sampling rate), 8-bit resolution would be:

$$22050 * 10 * 8 / 8 * 1 = 220{,}500\ \ bytes$$

A 10-second stereo recording at 44.1 KHz, 16-bit resolution(meeting the CD-quality red book audio standards-an international recording standards discussed later in this chapter) would be :

$$44100 * 10 * 16 / 8 * 2 = 1{,}764{,}000\ \ bytes$$

A 40-second mono recording at 11 KHz, 8-bit resolution would be:

$$44100 * 10 * 16 / 8 * 1 = 440{,}000\ \ bytes$$

■

Sampling Rate	Resolution	Stereo or Mono	Bytes Needed for 1 Minute	Comments
44.1KHz	16-bit	Stereo	10.5MB	CD-quality recording; the recognized standard of audio quality.
44.1KHz	16-bit	Mono	5.25MB	A good trade-off for high-quality recordings of mono sources such as voice-overs.
44.1KHz	8-bit	Stereo	5.25MB	Achieves highest playback quality on low-end devices such as most of the sound cards in Windows PCs.
44.1KHz	8-bit	Mono	2.6MB	An appropriate trade-off for recording a mono source.
22.05KHz	16-bit	Stereo	5.25MB	Darker sounding than CD-quality recording because of the lower sampling rate, but still full and "present" because of high bit resolution and stereo.
22.05KHz	16-bit	Mono	2.5MB	Not a bad choice for speech, but better to trade some fidelity for a lot of disk space by dropping down to 8-bit.
22.05KHz	8-bit	Stereo	2.6MB	A very popular choice for reasonable stereo recording where full bandwidth playback is not possible.
22.05KHz	8-bit	Mono	1.3MB	A thinner sound than the choice just above, but very usable. Any Macintosh or any MPC can play back this type of file. About as good as listening to your TV set.
11KHz	8-bit	Stereo	1.3MB	At this low a sampling rate, there are few advantages to using stereo.
11KHz	8-bit	Mono	650K	In practice, probably as low as you can go and still get usable results. Very dark and muffled.
5.5KHz	8-bit	Stereo	650K	Stereo not effective.
5.5KHz	8-bit	Mono	325K	About as good as a bad telephone connection.

3.3 Digital Audio Operations

- · Storage
- · Retrieval
- · Editing
- · Effects and filtering
- · Conversion
- 3.4 Audio Capacity of CD-ROM
- Based on 650 MB size of CD-ROM.
- 1. Voice quality (11 kHz, 8 bit, mono, about 600 kbyte/minute) : 1083 minutes.
- 2. High quality music (44 kHz, 16 bit, stereo, about 10 MB/minute): 61 minutes.
- 3. Good voice or acceptable music (22 kHz, 16 bit, stereo): 122 minutes.

650 Mbyte=44 x1000x Tx (16/8)x2; →T(sec)/60=61.55 Minutes

Digital Audio

Multimedia Systems (Module 1 Lesson 1)

Summary:

- Basic concepts underlying sound
- Facts about human perception of sound
- Computer representation of sound (Audio)
- A brief introduction to MIDI

Sources:

- My research notes
- Dr. Ze-Nian Li's course material at:
  http://www.cs.sfu.ca/CourseCentral/365/li/

CMPT 365 Multimedia Systems

Spring 2019

Teaching Assistants: Alan Mao and Shray Khanna

Lecture Time: MWF 1:30-2:20
Classroom: AQ3003

Lab: CSIL, Room ASB9700, 9804, etc.
For CSIL information, see http://www.sfu.ca/computing/about/support/csil.html,
for the PC workstation map in CSIL, see here.
To get an access card, see here.
For remote desktop access to the CSIL lab, see here.

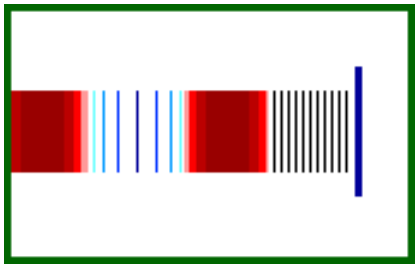
Text: Fundamentals of Multimedia, 2nd ed., Springer, 2014.

ISBN: 978-3-319-05289-2, Springer (*students can download via www.lib.sfu.ca*)
Table of Contents

http://www.cs.sfu.ca/mmbook (1st ed., plus student resources)

Sound Facts

- Sound is a continuous *wave* that travels through the air
- The wave is made up of pressure differences.
- Sound is detected by measuring the pressure level at a location
- Sound waves have normal wave properties (reflection, refraction, diffraction etc.)

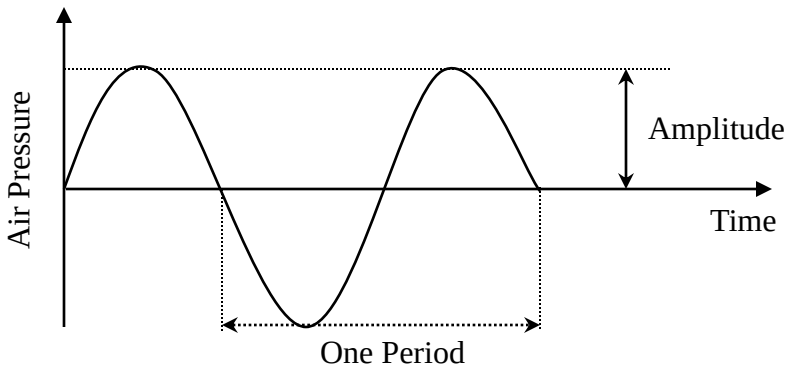


The human Ear detecting Sound

Sound Facts

Wave Characteristics

- *Frequency*: Represents the number of periods in a second and is measured in *hertz* (Hz) or *cycles per second*.
  Human hearing frequency range: 20Hz to 20kHz (audio)
- *Amplitude*: The measure of displacement of the air pressure wave from its mean. Related to but not the same as loudness



One particular frequency component

Principles of Digitization

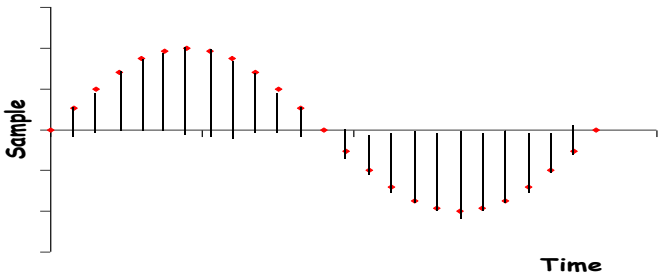
- Why Digitize?
  - Microphones, video cameras produce *analog signals* (continuous-valued voltages)
  - To store audio or video data into a computer, we must *digitize* it by converting it into a stream of numbers.

Sound as analog signal

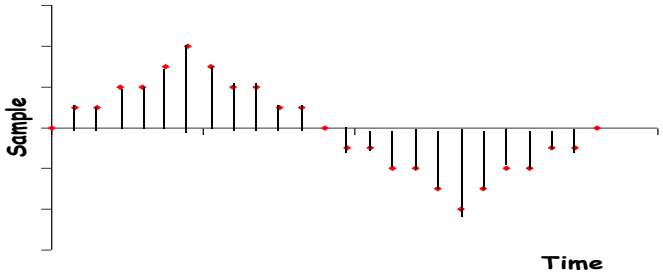
Principles of Digitization

- *Sampling*: Divide the horizontal axis (time) into discrete pieces
- *Quantization*: Divide the vertical axis (signal strength - voltage) into pieces. For example, 8-bit quantization divides the vertical axis into 256 levels. 16 bit gives you 65536 levels. Lower the quantization, lower the quality of the sound
  - Linear vs. Non-Linear quantization:
    - If the scale used for the vertical axis is linear we say its linear quantization;
    - If its logarithmic then we call it non-linear (μ-law or A-law in Europe). The non-linear scale is used because small amplitude signals are more likely to occur than large amplitude signals, and they are less likely to mask any noise.

Sampling and Quantization



Sampling

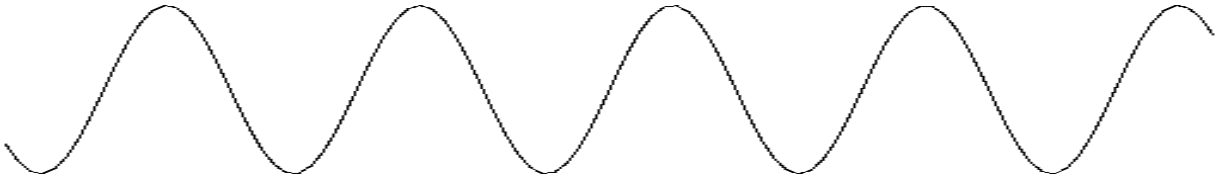


3-bit quantization

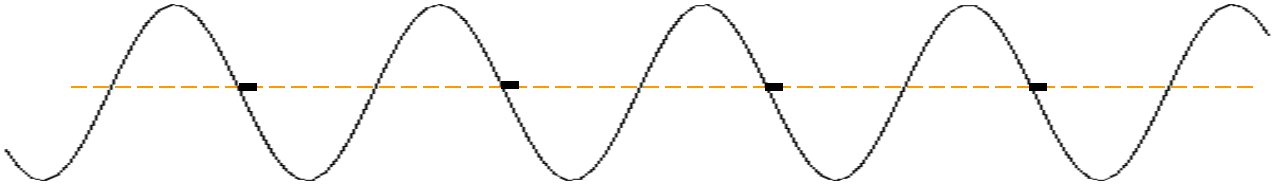
- Sampling rate: Number of samples per second (measured in Hz)
- E.g., CD standard audio uses a sampling rate of 44,100 Hz (44100 samples per second)

- 3-bit quantization gives 8 possible sample values
- E.g., CD standard audio uses 16-bit quantization giving 65536 values.
- Why Quantize?
  - To Digitize!

Nyquist Theorem

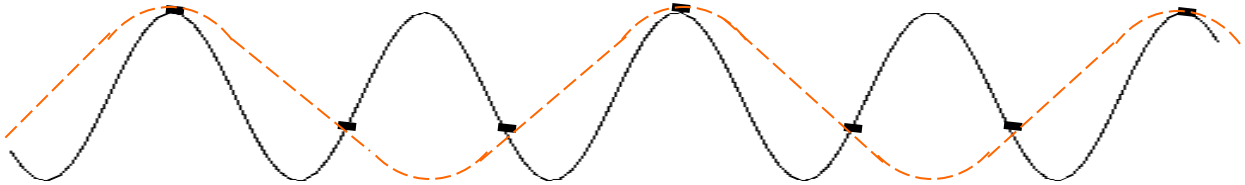


Consider a sine wave



Sampling once a cycle

Appears as a constant signal



Sampling 1.5 times each cycle

Appears as a low frequency sine signal

- For Lossless *digitization, the sampling rate should be* ***at least*** *twice the maximum frequency responses*

Application of Nyquist Theorem

- Nyquist theorem is used to calculate the optimum sampling rate in order to obtain good audio quality.
- The CD standard sampling rate of 44100 Hz means that the waveform is sampled 44100 times per sec.
- Digitally sampled **audio** has a bandwidth of (20 Hz - 20 KHz). By sampling at twice the maximum frequency (40 KHz) we could have achieved good audio quality.
- CD audio slightly exceeds this, resulting in an ability to represent a bandwidth of around 22050 Hz.

Quantization (Quality ->SNR)

- In any analog system, some of the voltage is what you want to measure (*signal*), and some of it is random fluctuations (*noise*).
- *SNR:* Signal to Noise ratio captures the quality of a signal (dB)

$$\mathrm{SNR} = 10 \log \frac{V^2_{signal}}{V^2_{noise}} = 20 \log \frac{V_{signal}}{V_{noise}}$$

- *Signal to Quantization Noise Ratio (SQNR)*
- The quantization error (or quantization noise) is the difference between the actual value of the analog signal at the sampling time and the nearest quantization interval value.
- *The largest (worst) quantization error is half of the interval?*

SQNR Calculation (WC)

- If we use N bits per sample, the range of the digital signal is: -2^{N-1} to 2^{N-1}
- The worst-case signal to quantization noise ratio is given by:

$$SQNR = 20 \log \frac{V_{signal}}{V_{quant\text{ - }noise}} = 20 \log \frac{2^{N-1}}{1/2} = N \times 20 \log 2 = 6.02N \text{ (dB)}$$

- Each bit adds about 6 dB of resolution, so 16 bits enable a maximum SQNR = 96 dB.

SQNR= N x 20 log 2 = 6.02N (dB) x 16 bit=96 dB

Miscellaneous Audio Facts

Typical Audio Formats

- Popular audio file formats include .au (Unix), .aiff (MAC, SGI), .wav (PC, DEC)
- A simple and widely used audio compression method is Adaptive Delta Pulse Code Modulation (ADPCM). Based on past samples, it predicts the next sample and encodes the difference between the actual value and the predicted value.

An audio file format is a file format for storing digital audio data on a computer system

DEC system was a line of server computers from Digital Equipment Corporation

SGI (Silicon Graphics) is a leading manufacturer of high-performance computing, data management, and visualization products.

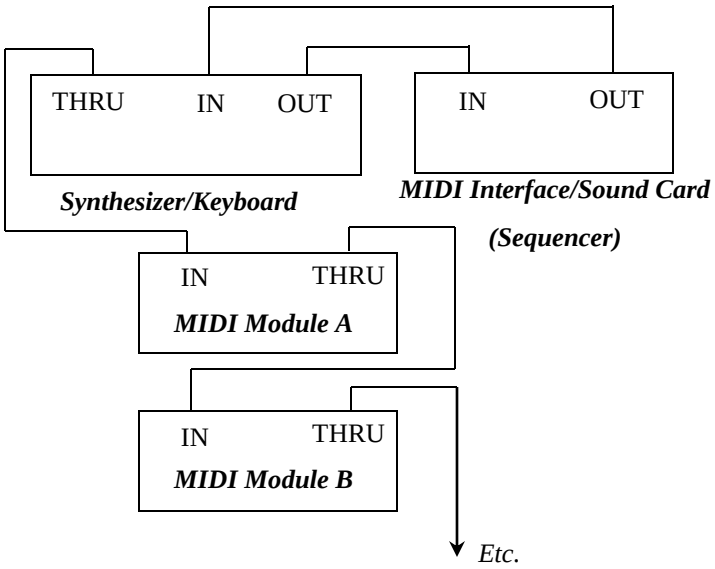
Audio Quality vs. Data Rate

Quality	*Sample Rate (kHz)*	*Bits per Sample*	*Mono/ Stereo*	*Data Rate (kBytes/sec) (uncompressed)*	*Frequency Band*
Telephone	8	8	Mono	8	200-3400 Hz
AM Radio	11.025	8	Mono	11.0	540-1700 KHz
FM Radio	22.050	16	Stereo	88.2	
CD	44.1	16	Stereo	176.4	20-20000 Hz
DAT	48	16	Stereo	192.0	20-20000 Hz

MIDI

- **Musical Instrument Digital Interface**

  a protocol that enables computer, synthesizers, keyboards, and other musical devices to communicate with each other.



Typical Sequencer setup

- *Setup:*
  - MIDI OUT of synthesizer is connected to MIDI IN of sequencer.
  - MIDI OUT of sequencer is connected to MIDI IN of synthesizer and "through" to each of the additional sound modules.
- *Working:*
  - During recording, the keyboard-equipped synthesizer is used to send MIDI message to the sequencer, which records them.
  - During play back, messages are sent out from the sequencer to the sound modules and the synthesizer which will play back the music.

MIDI THRU

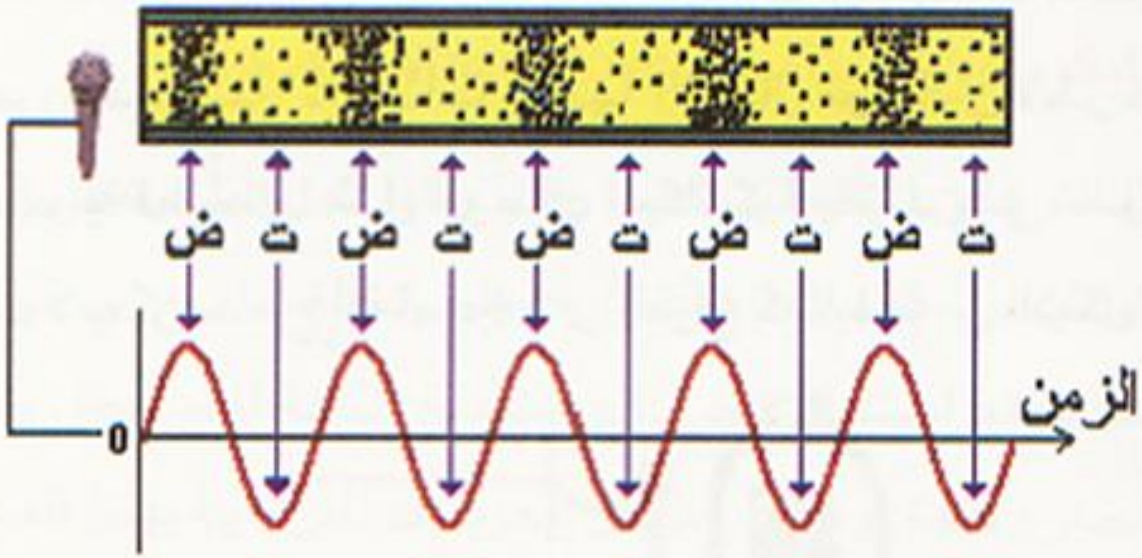
MIDI thru

The MIDI through is a connection available on many MIDI devices. ... It's purpose is to pass on (or through) an exact copy of the data present at the MIDI In of the device.

MIDI: Data Format

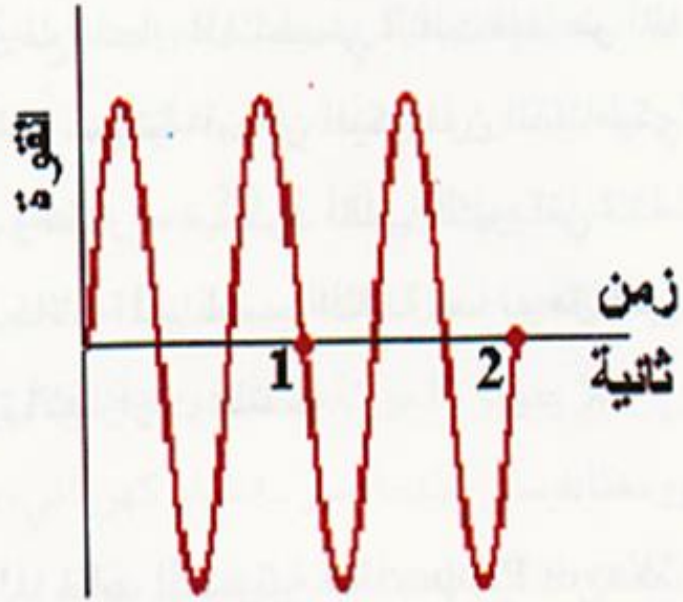
- Information traveling through the hardware is encoded in MIDI data format.
- The encoding includes *note* information like beginning of note, frequency and sound volume; upto 128 notes
- The MIDI data format is digital
- The data are grouped into MIDI messages
- Each MIDI message communicates one *musical event* between machines. An event might be pressing keys, moving slider controls, setting switches and adjusting foot pedals.
- 10 mins of music encoded in MIDI data format is about 200 Kbytes of data. (compare against CD-audio!)
- ***For audio see mono and stereo equations to calculate file size***

تسجيل الموجات الصوتية بالمايكرفون



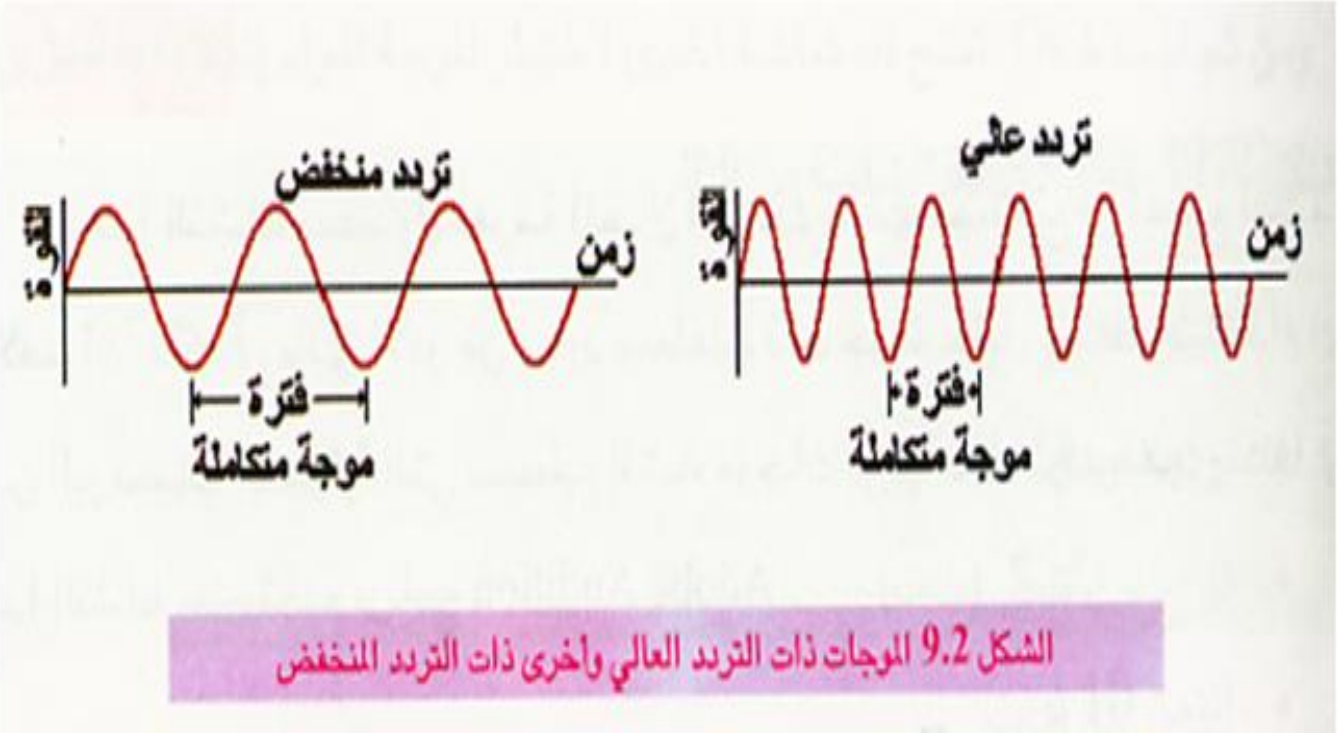
الشكل 2.2 إشارات كهربائية

ماهو تردد الصوت المبين في الشكل 8.2 ادناه ؟ الحل 1.5 هرتز لان عدد الموجات 3 خلال 2 ثانية , اذن 3/2=1.5 Hz

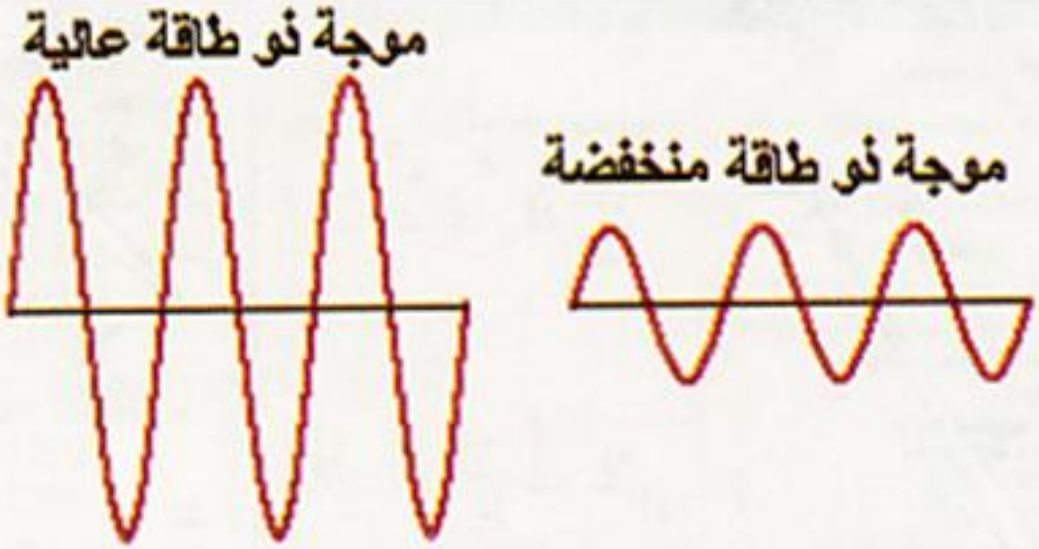


الشكل 8.2 موجة صوتية

موجات التردد العالي تجعل المسافة بين مناطق الضغط المتتالية او مناطق الرخاوة المتتالية صغيرة والعكس يحصل في موجات التردد المنخفض



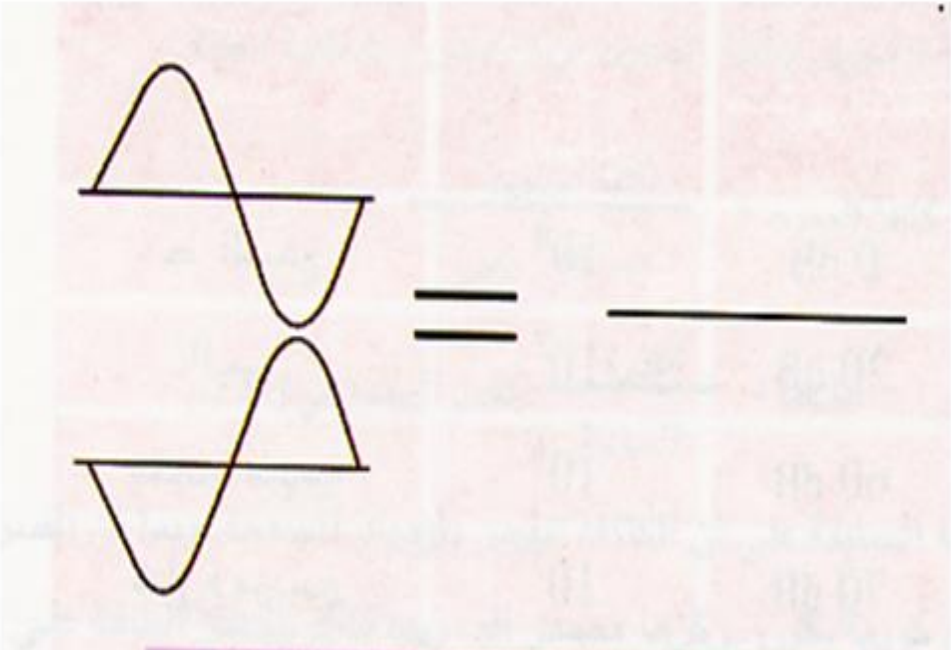
الشكل 9.2 الموجات ذات التردد العالي وأخرى ذات التردد المنخفض



الشكل 12.2 الموجات الصوتية ذات الطاقة المنخفضة والموجات الصوتية ذات الطاقة العالية

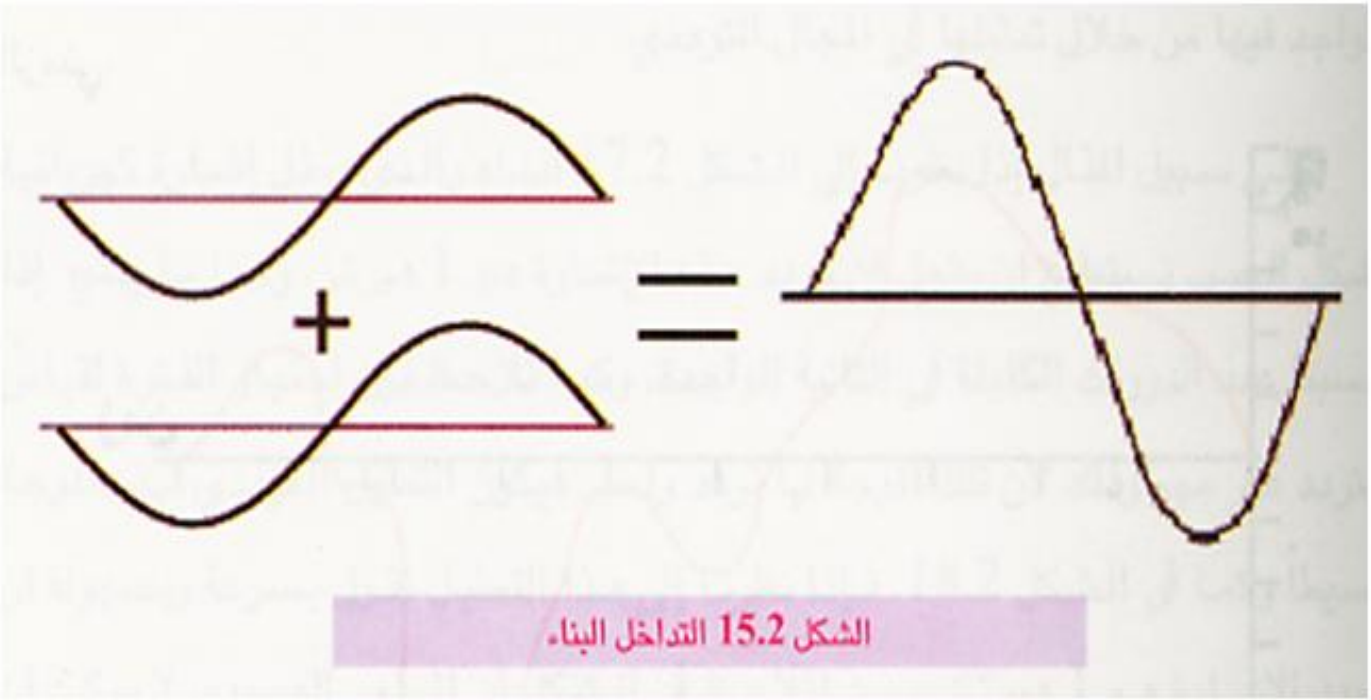
الزاوية او الطور Phase

1-Destructive Interference



الشكل 14.2 موجتان متقابلتان تماما

2-Constructive Interference



الشكل 15.2 التداخل البناء

The end

Lect. 8
The Video

الفيديو

Analog Video

Electronic sequence of still images displayed or projected (quickly) in succession to one another. Gives illusion of movement. Similar to movies and television.

- ==========

Analog is an adjective that describes a continuous measurement or transmission of a signal. It is often contrasted with digital, which is how computers store and process data using ones and zeros. *While computers are digital devices, human beings are analog*.

What is difference between analog and digital?

- **Digital video** is an electronic representation of moving visual images (**video**) in the form of encoded **digital** data.
- This is in contrast to **analog video**, which represents moving visual images with **analog** signals. ...

Video Capture

- **Sources**: Television, VCR, video cameras,mobile …. etc.
- Relies on **controllers** that enables computers to control video equipment
- Based on specialized **video capture hardware** that accepts video input and turn it into digital format
- Uses graphic **overlay** techniques that places video on top of other display items

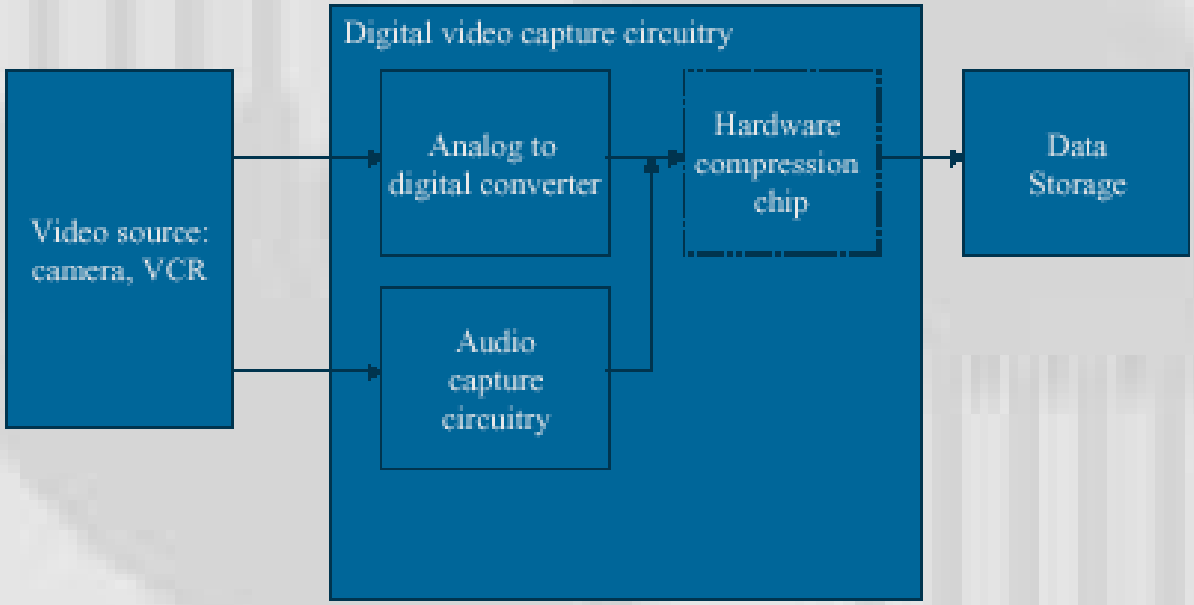
Video Capture Features

- Record videos as avi, wmv, flv, mpg, mp4, mov and more video formats
- Capture video from a webcam, network IP camera or video input device (e.g., VHS recorder)(Video Home System)
- Screen capture software records the entire screen, a single window or any selected portion

A digital video recorder (DVR) is an electronic device that records video in a digital format to a disk drive, USB flash drive, SD memory card, SSD or other local or networked mass storage device

Faculty of IT

Video Capture System



Important Characteristics of Video

- · **Frame rate** - how fast each picture is displayed
- · **Frame size** - how many elements create each picture in horizontal and vertical dimensions (normally in terms of pixels)
- · **Colour depth** - how many different colours the picture/pixel is made from
-

Frame Rate

- Images are displayed rapidly so that the brain processes the images collectively instead of as single images. Frame rate is measured in frames per second e.g. movies – 24 frames per second, others - typically 30 frames per second. Each frame is scanned:
- · Television - interlaced scan
- · Computer monitor - progressive scan

Frame Size

- Frame size determines the quality of the image and the processing involved. *Larger image improves resolution but requires more processing*. Common frame size - 640 x 480 (full screen VGA display) or smaller. When considering the frame size, look for acceptable quality and within processor performance capabilities.

Colour Depth

- *Number of colours displayed on the screen at one time*. Target: Highest quality image possible. Colour depth important to create a lifelike effect. Common strategies:
- · 24-bit colour (optimal colour reproduction)
- · 8-bit black-and-white (grayscale) or 256 colour (useful for Internet transmission)

- Several elements determine the file size; in addition to the **length of the video**, these include :
- Frame Rate
- Image Size
- Color Depth
- In most cases, a quarter-screen image size **(320 x 240)**, an **8-bit color depth (256 colors)**, and a frame rate of 1**5 fps** is acceptable for a multimedia title. And even this minimum results in a very large file size.

How to calculate raw uncompressed video sizes

- This short text will tell you **how to calculate the size of a video** in memory and on disk. This short text is really an introduction. It will give you basic terminology and tools to give you an idea of the numbers we are working with. If you work with video you probably already know this and can skip through to the video size calculator. If you do not know this well just read on...

Video frame pixel size

- When we talk about the video frame size we talk about how many pixels we see on the video screen. A larger frame size gives better quality and a larger file.
- To determine how many pixels each frame is you simply multiply the width in pixels by the height in pixels to get the total number of pixels. A typical 640x480 TV frame (not HD) is 307200 pixels or about 0.3 MPixels. If you would save one such file in an uncompressed image format, like BMP, you would get a file at least 300kb large (307200/1024).

Video frame byte size

- If we want to show our video in colour we need to use three colour channels to represent the one pixel. Today we almost always use one byte per colour channel, and although we use different color spaces we most often need three color channels. *To get the raw uncompressed size of the video frame you then need to multiply the number of pixels in the video frame by 3 to get the number of bytes each video frame will take.* You now have the size of the uncompressed video frame, in our example 0.9 Megabyte.

Raw video size

- We now know everything we need to calculate how large an uncompressed video file will be. We know how large one video frame is and we know how many frames are used every second. *Let us continue out example of a video in 640x480 where each frame took 0.9 Megabyte running at 25 frames per second.*
- The size of one second video footage would then require 25*0.9=22.5 Mb. A normal movie running one and a half hour would require 90*60*22.5 = 121500 MB/1024 = 118 Gb or about 26 single layer DVDs. The obvious conclusion is that when you work with videos you *require a lot of free disk space and you need take make it smaller with compression when you have finished creating a video.*

Definition: video clip

- *A video clip is a small section of a larger video presentation. A series of video frames are run in succession to produce a short, animated video. This compilation of video frames results in a video clip*.
- Definition: **Video or Movie Frame**
- A video or movie frame is a single picture or still shot, that is shown as part of a larger video or movie. Many single pictures are run in succession to produce what appears to be a seamless piece of film or videotape. Each frame can be selected on its own to print out a single photograph.
- Also Known As: frame, movie frame, single frame

High-definition

- **High-definition** refers to an increase in display or visual resolution such as in:
- High-definition television (HDTV), television formats that have a higher resolution than their contemporary counterparts
- High-definition video, used in HDTV broadcasting, as well as digital film and computer HD video file formats
- High-Definition Multimedia Interface (HDMI), all-digital audio/video interface capable of transmitting uncompressed streams
- HDV, format for recording high-definition video onto magnetic tape
- HD DVD, discontinued optical disc format
- Blu-ray Disc, a high resolution video optical disc format

continue

- High definition sound effects are artificially created or enhanced sound effects that are recorded at 24-bit/48kHz or above
- Intel High Definition Audio (HD Audio), device driver interface (DDI) for audio and modem drivers developed by Intel
- DVD-Audio, optical DVD standard that focuses on high-definition and surround audio, published by the DVD Forum
- HiDef, 24 frames-per-second digital video format

4.3 International Standards for Video and TV

- **<u>1. NTSC</u> (National Television Standards Committee**)
- · Used in US and Japan
- · 525 scan lines, 30 frames per second
- · Interlaced scanning - 2 passes, even lines followed by odd lines at the rate of 60 cycles per second

- Interlacing is the practice of displaying a single frame of video as two 'half' frames. Each frame is split into alternating lines, so that the first frame displays lines 1,3,5 and so on, while the second frame of the pair displays lines 2,4,6 and so on.

2. PAL (Phase Alternate Line)

- · Used in UK, much of Europe, Australia, South Africa
- · 625 scan lines, 25 frames per second
- · Interlaced scanning
- **3. SECAM (Sequential Colour with Memory)**
- · Used in France
- · 625 scan lines, 25 frames per second
- · Interlaced scanning

4.4 Analog Video Representations

- · **Frame rate** – number of frames per second
- · **Number of scan lines** – Each frame is divided into scan lines, scan rate is the number of lines scanned per second
- · **Aspect ratio** – ratio of the width of an image to its height, current 4:3
- · **Interlacing** – odd-number scan lines followed by even-numbered scan lines results in 2:1 interlacing for most video
- · **Quality** – measured by signal-to-noise ratio and image resolution
- · **Component vs composite** – video broadcasts uses colour information (chrominance) and intensity information (luminance), composite video combines the signals whereas component video have multiple signals

4.5 Analog Video Operations

- · Storage
- · Retrieval
- · Synchronisation
- · Editing
- · Mixing
- · Conversion

4.6 Digital Video Representations

- · Analog formats sampled – analog video formats influence quantities such as sampling rate and sample size:
- · Sampling rate – sampling frequency should be twice the highest frequency in the original signal
- · Sample size and quantization – sample size is the number of bits used to represent sample values, quantization is the mapping from the continuous range of analog signal to discrete sample values

Digital Video Representations

- · **Data rate** – important consideration for transmission, can be reduced using compression or reducing the frame rate
- · **Frame rate** – match to analog frame rates (25 or 30 frames per second)
- · **Compression** – lossy vs lossless compression, real-time compression, interframe vs intraframe
- · **Support for interactivity** – random access to video frames, ability to playback at different rates and in reverse, ability to cut and paste video segments
- · **Scalability** – transmit scalability (encoded data rate is chosen at compression time) and receive scalability (decoded data rate is chosen at decompression time to match playback requirements

4.7 Digital Video Operations

- · Storage
- · Retrieval
- · Synchronisation
- · Editing
- · Effects
- ·Conversion

Animation

- Animation is the use of computer generated images to convey motion, created one frame at a time by the computer. Graphic artist or animator uses tools to create the series of images.
- **Creating Animation**
- · Creating a series of still images that can be shown rapidly creating a sense of motion
- · Manipulating and moving an object along a vector or path
- · Storing animation information in a data file for later playback

5.2 Animation Operations

- · Graphics operations
- · Motion and parameter control
- · Rendering
- · Playback

Digital video continue

Lect. 9

Video

The term video refers to the moving picture, accompanied by sound such as a picture in television. Video element of multimedia application gives a lot of information in small duration of time.

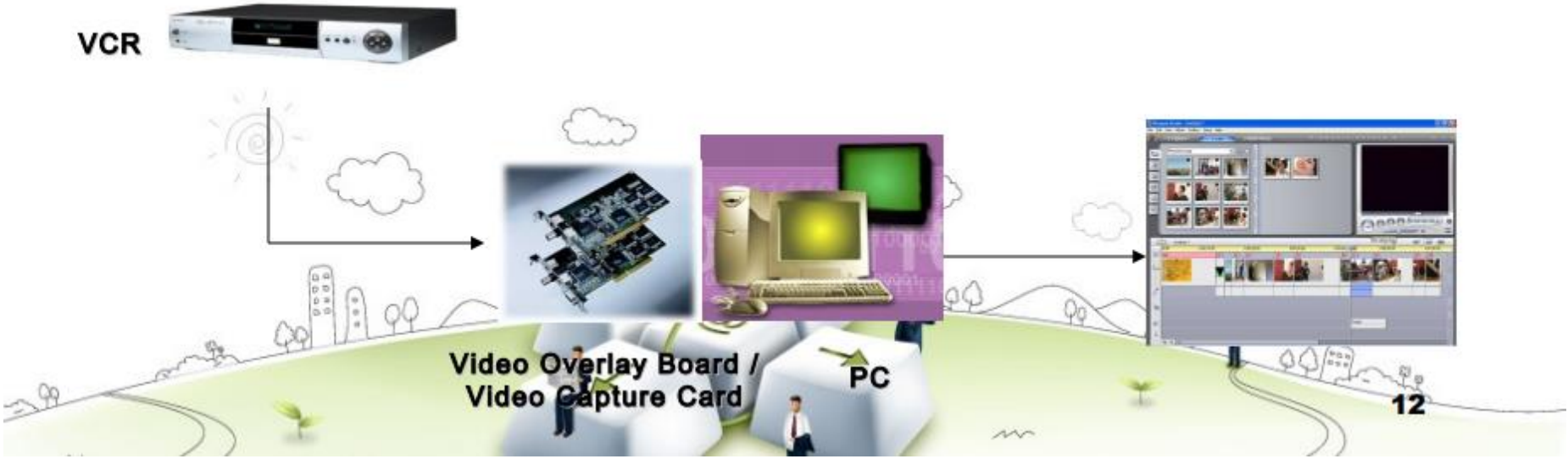
Digital video is useful in multimedia application for showing real life objects. Video have highest performance demand on the computer memory and on the bandwidth if placed on the internet. Digital video files can be stored like any other files in the computer and the quality of the video can still be maintained. The digital video files can be transferred within a computer network. The digital video clips can be edited easily.

Digital video combines features of graphics and audio to create dynamic content for multimedia products.

- Video is simply moving pictures.
- Digitized video can be edited more easily.
- Digitized video files can be extremely large.

Digital video is often used to capture content from movies and television to be used in multimedia.

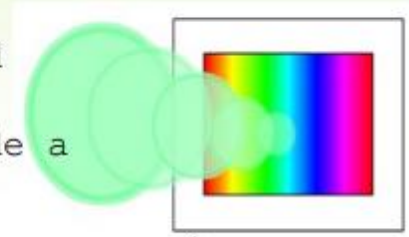
- A video source (video camera ,VCR, TV or videodisc) is connected to a video capture card in a computer.
- As the video source is played, the analog signal is sent to the video card and converted into a digital file (including sound from the video).



• A video source (video camera ,VCR, TV or videodisc) is connected to a video capture card in a computer.
• As the video source is played, the analog signal is sent to the video card and converted into a digital file (including sound from the video).

Analogue signal from VCR
Converted to DIGITAL
by VIDEO CAPTURE CARD

The converted signal is entered inside a computer

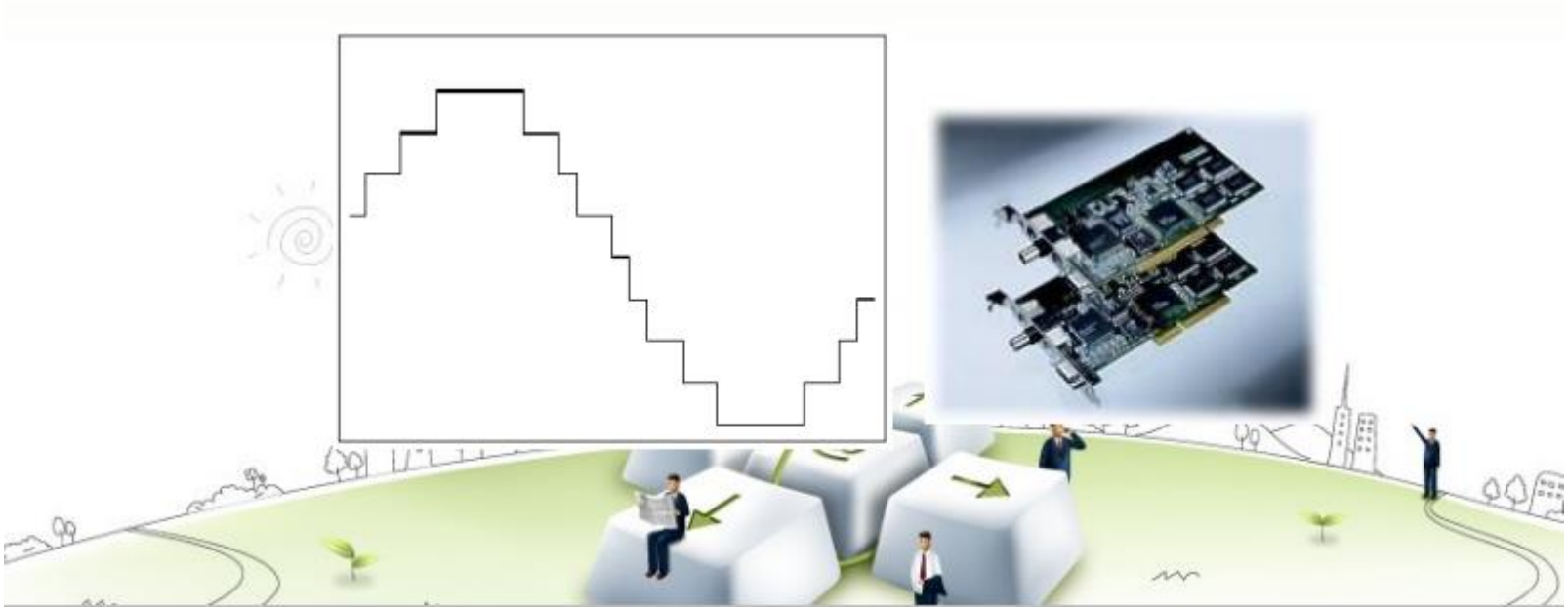


Signal is processed

Video is edited using video editing software software

Digital video is the digitization of analogue video signals into numerical format

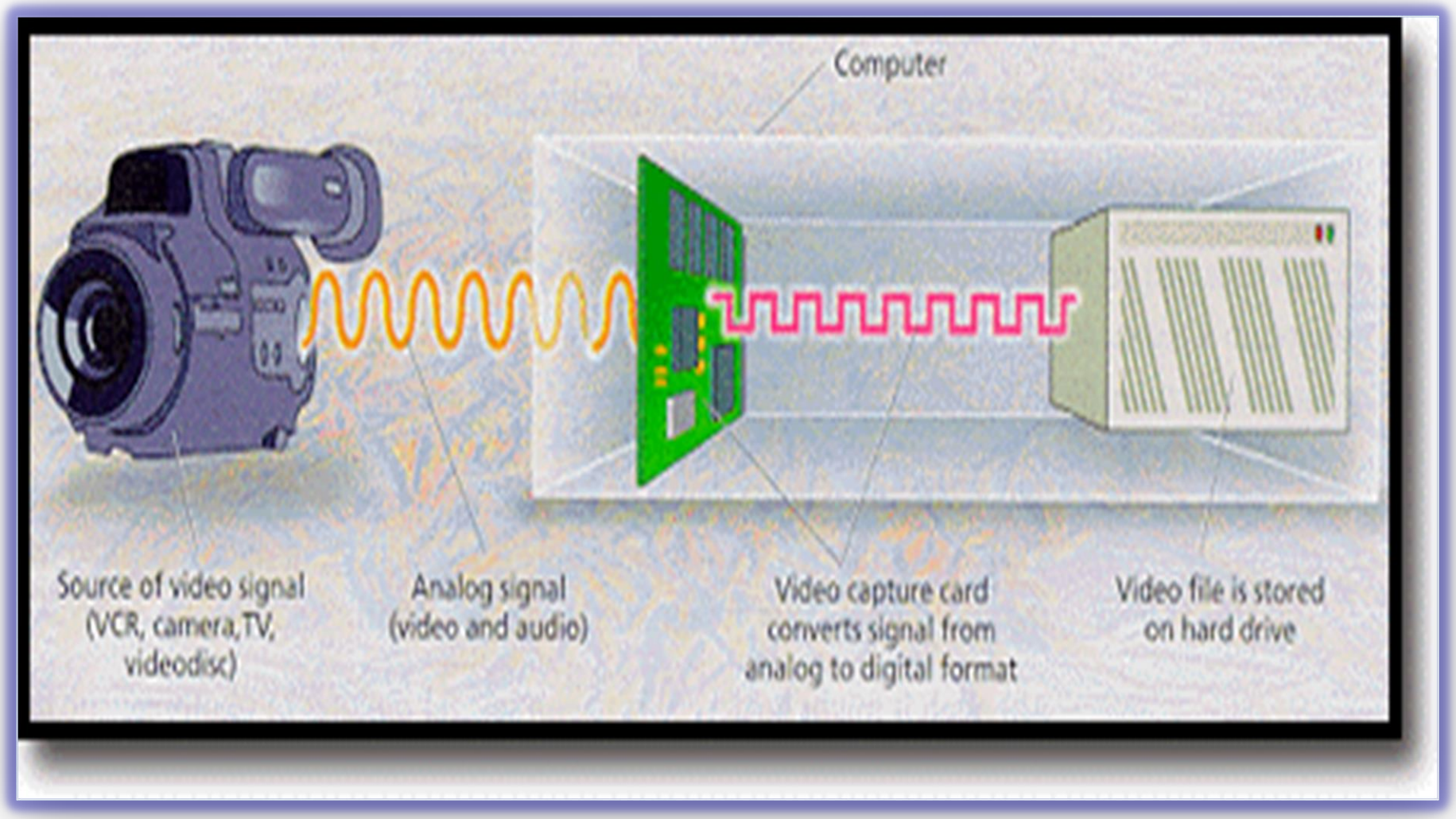
- It creates the illusion of full motion by displaying a rapid sequence of changing images on a display device.
- Conversion from analogue to digital format requires the use on an ADC(Analogue to Digital Converter)
- A Digital to Analogue Converter (DAC) can be used to output digital video on analogue equipment



Digitizing video signals

- There are two basic approaches to delivering video on a computer screen – analogue and digital video.
- Analogue video is essentially a product of the television industry and therefore conforms to television standards.
- Digital video is a product of the computing industry and therefore conforms to digital data standards.

- Video, like audio. Is usually recorded and played as an analog signal. It must therefore be digitized in order to be incorporated into a multimedia title.
- The following figure shows the process for digitizing an analog video signal standards.


Computer
Source of video signal (VCR, camera, TV, videodisc)
Analog signal (video and audio)
Video capture card converts signal from analog to digital format
Video file is stored on hard drive

The figure shows:

- *A video source, such as video camera, VCR, TV, or videodisc, is connected to a video capture card in a computer*. As the video source is played, the analog signal is sent to the video card and converted into a digital file that is stored on the hard drive. *At the same time, the sound from the video source is also digitized*

- *Video data intended for use with computers is typically progressive, meaning that each frame is encoded as a single image*. Some devices, like televisions, do not display a frame all at once, but as two images. One of the images, or fields, contains all of *the even numbered rows.*
- The other field contains the data for all of the odd numbered rows. Video encoded with more than one field per frame is called interlaced, because it is rendered by switching between the even field and the odd field.

- Several elements determine the file size; in addition to the **length of the video**, these include :
- Frame Rate
- Image Size
- Color Depth
- In most cases, a quarter-screen image size **(320 x 240)**, an **8-bit color depth (256 colors)**, and a frame rate of 1**5 fps** is acceptable for a multimedia title. And even this minimum results in a very large file size.

Video clip stored on any mass-storage device can be played back on a computer's monitor without special hardware.

• Setting up a production environment for making digital video, requires some hardware specifications.

• Some specifications include computer with FireWire connection and cables, fast processor, plenty of RAM, fast and big hard disk.

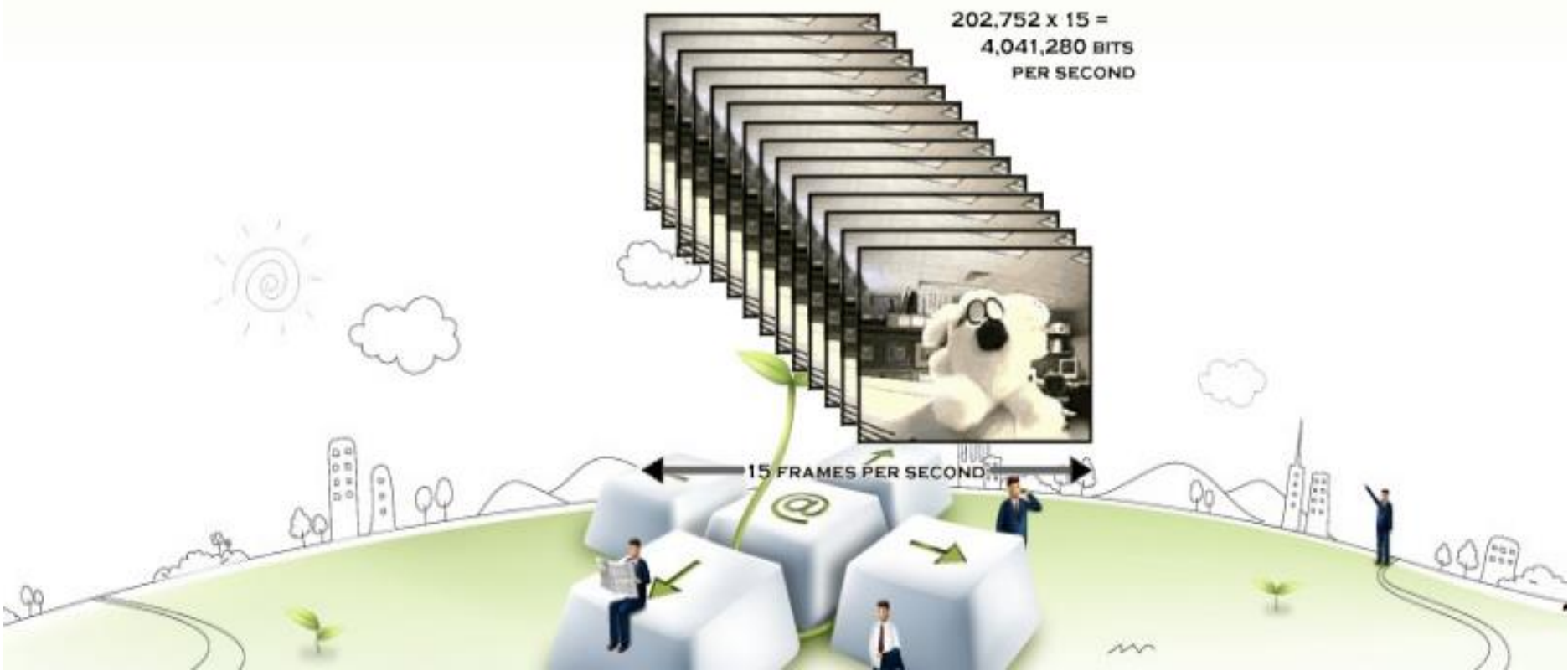
There is an important consideration:
– file size in digitized video which included
1. frame rate
2. image size
3. color depth.

FireWire, also called IEEE 1394 or i. LINK, high-speed computer data-transfer interface used to connect personal computers, audio and video devices, and other professional and consumer electronics.

FireWire is a serial bus, meaning that information is transferred one bit at a time

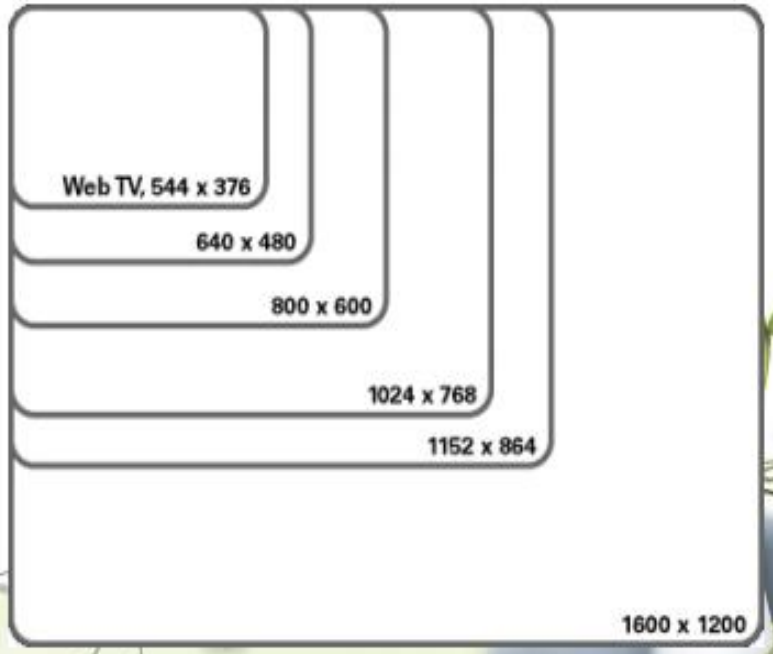
1. Frame Rate

- animation is an illusion caused by the rapid display of still images.
- **television and movies play at 30 fps** but acceptable **playback can be achieved with 15 fps.**



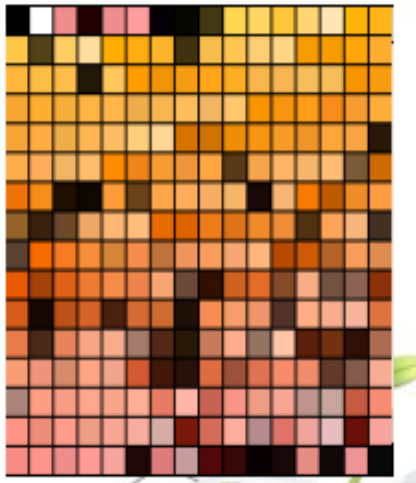
2. Image Size

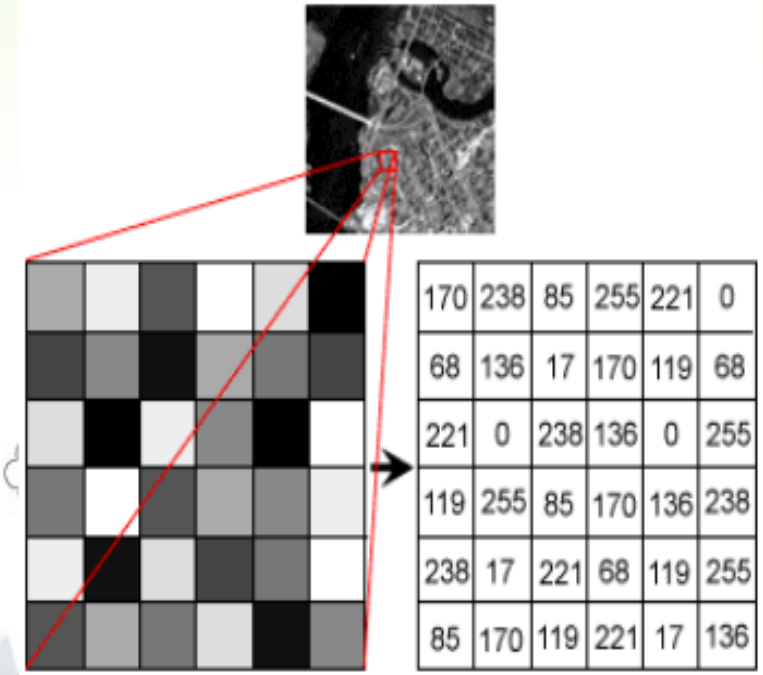
- A standard full screen resolution is 640x480 pixels but to safe storing space a video with 320x240 for a computer display is still acceptable.
- New high-definition televisions (HDTV) are capable of resolutions up to *1920×1080p60*,
  - 1920 pixels per scan line by 1080 scan lines, progressive, at 60 frames per second.



3. Color Depth

– The quality of video is dependent on the color quality (related to the number of colors) for each bitmap in the frame sequence.





3. Color Depth

- The **color depth** **below 256 colors is poorer-quality** image.
- The **frame rate** **to below 15 fps causes a noticeable and distracting jerkiness that unacceptable**.
- Changing the *image size* and *compressing* the file therefore become primary ways of reducing file size.

Video Compression

- **Two types of COMPRESSION:**
  - Lossless compression.
    - Preserves the exact image throughout the compression and decompression process.
    - **E.g:** text images is to identify repeating words and assign them a code.

- **Lossless Compression**
- Lossless compression preserves **the exact image throughout the compression** and decompression process. An example of when this is important is in the use of text images. Text needs to appear exactly the same before and after file compression. One technique for text compression is to identify repeating words and assign them a code.

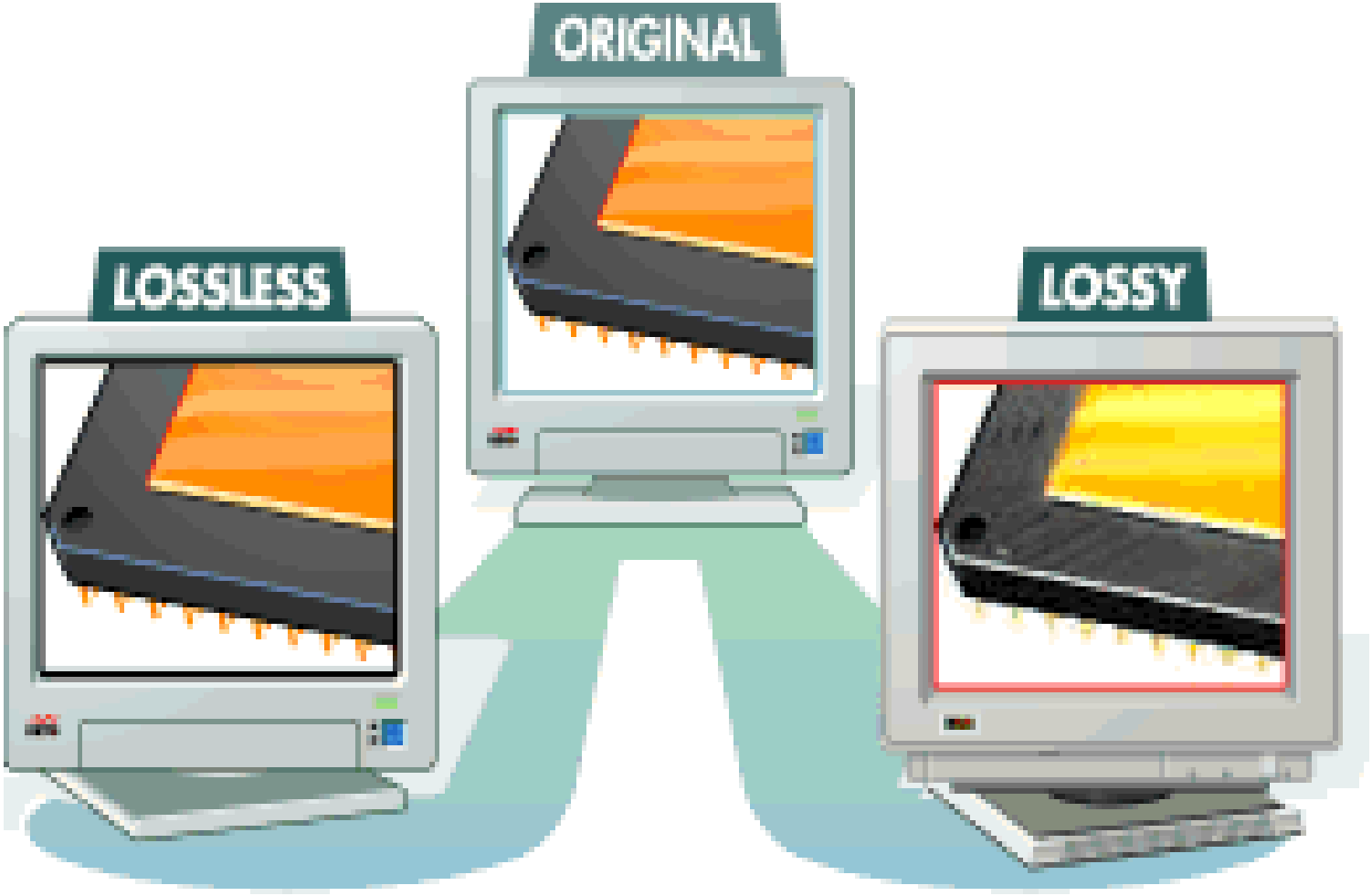
- For example, if the word **multimedia** appears several times in a text file, it would be assigned a code that takes up less space than the actual word. During decompression, the code would be changed back to the word multimedia.

– Lossy compression.

- Eliminates some of the data in the image and therefore provides greater compression ratios than lossless compression.
- Applied to video because some drop in the quality is not noticeable in moving images.

- **Lossy Compression**
- Lossy compression actually eliminates some of the data in the image and therefore provides greater compression ratios than lossless compression. The greater the compression ratio, however, the poorer the decompressed image. *Thus, the trade-off is file size versus image quality*.
- **Lossy compression is applied to video because some drop in the quality is not noticeable in moving images.**

The figure shows the difference in equality between lossy and lossless comprssion



Compression standard

- Certain standards have been established for compression programs, including
- JPEG
- MPEG(.MPEG)
- Microsoft's Video for Windows(.AVI)
- Apple's QuickTime(.MOV)

Motion JPEG (M-JPEG or MJPEG) is a video compression format in which each video frame or interlaced field of a digital video sequence is compressed separately as a JPEG image.

Video File Formats

- **AVI Format (.avi)**

  The AVI format, which stands for audio video interleave, was developed by Microsoft.

  The Some of the most common players that **support the avi format are**:

- Apple QuickTime Player (windows & Mac), Microsoft Windows Media Player (Windows & Mac), VideoLAN VLC media player (Windows & Mac) AND Nullsoft Winamp

File Formats

- **Quicktime Format (.mov)**
  The QuickTime format was developed by Apple and is a very common one. It is often *used on the internet, and for saving movie and video files*.

- The format contains one or more tracks storing video, audio, text or effects. . It is compatible with both Mac and Windows platforms, and can be played on an Apple Quicktime player.

File Formats

- **MP4 Format (.mp4)**

  This format is mostly used to store audio and visual streams online, most commonly those defined by MPEG. It Expands **MPEG-1 to support video/audio "objects", 3D content, low bit rate encoding and support for Digital Rights Management.**

- The **MPEG-4 video format uses separate compression for audio and video tracks; video is compressed with MPEG-4 video encoding**; audio is compressed using AAC compression, the same type of audio compression used in .AAC files.

- The mp4 can most commonly be played on the Apple QuickTime Player or other movie players. Devices that play p4 are also known as mp4 players.

P4 is a programming language for controlling packet forwarding planes in networking devices, such as routers and switches.

File Formats

STREAMING VIDEO

1. **Windows Media Video Format (.wmv)**
2. **3GP File Extension (.3gp)**
3. Apple QuickTime Player
4. RealNetworks RealPlayer
5. VideoLAN VLC media player
6. **Advances Streaming Format (.asf)**
7. **Real Media Format (.rm)**

Special effects

Advantages of digital video

- **One of the advantages of digitized video is that it can be easily** edited. Analog video, such as a videotape, is linear; there is a beginning, middle, and end. If you want to edit it, you need to continually rewind, pause, and fast forward the tape to display the desired frames.
- Digitized video on the other hand, allows random access to any part of the video, and editing can be as easy as the cut and paste process in a word processing program. In addition, *adding special effects* such as fly-in titles and transitions is relatively simple.

- Other advantages:
- The video is stored as a standard computer file. Thus it can be copied with no loss in quality, and also can be transmitted over standard computer networks.
- Software motion video does not require specialized hardware for playback.
- Unlike analog video, digital video requires neither a video board in the computer nor an external device (which adds extra costs and complexity) such as a videodisc player.

Video file consideration

- *Current technology limits digital video's speed of playback and the size of the window which can be displayed*. When played back from the computer's hard disk, videos are much less smooth than conventional television images due to the hard disk data transfer rate.

- Often compression techniques are used with digital video and as a result resolution is often compromised. Also, the storage of video files requires a comparatively large amount of hard disk space.

- Digitized video files can be extremely large. A single second of high-quality color video that takes up only one-quarter of a computer screen can be as large as 1 MB.

The common digital video formats are :

- **Motion Pictures Expert Group (.MPG)**
- **Quicktime (.MOV)**
- **Video for Windows (.AVI).**

Answer multiple choices

Practice : Video In Multimedia

1. The common digital video formats are :

a)	mpg, mov, and wav
b)	bmp, jpg, and wav
c)	mov, gif, and avi
d)	mov, mpg, and avi

CORRECT --> Excellent...!!! QuickTime (mov), Video for Windows (avi) and mpg are the common digital video formats.

2. Certain standards have been established for video compression programs, including _____; standards based on compression of still images.

a)	MPEG
b)	JPEG
c)	Quick Time
d)	Video for Windows

CORRECT --> Congratulations. Standards developed by Joint Photographic Experts Groups based on compression of still images. Motion JPEG treats each video frame as a still image.

3. Television and movies play at 30 fps, but for most multimedia applications acceptable playback can be achieved with _____ fps

○ **a)**	5
○ **b)**	10
◉ **c)**	15
○ **d)**	45

CORRECT --> 15 fps is the minimum Anything less results in a jerky motion, as the eye detects the changes from one frame to the next.

4.	**The file size of digitized video is not determined by :**	
	○ **a)**	frame rate
	○ **b)**	frame size
	◉ **c)**	video signal
	○ **d)**	color depth
		## CORRECT --> Excellent. Video signal doesn`t have any effects on the file size of digitized video.

5.	**A disadvantage of digital video is that it cannot be easily edited.**	
	○ a)	True
	◉ b)	False
		## CORRECT --> Digitized video allows random access to any part of the video, and editing can be as easy as the cut and paste process in a word processing program.

- The end

What is Optical Storage? Types of Devices, Examples, Advantage, Disadvantage

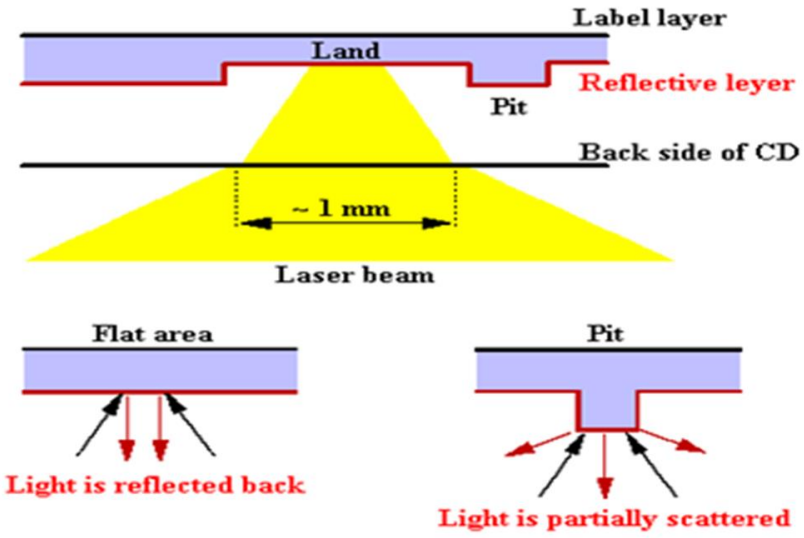
Lect. 10
Multimedia Storages

- **Definition of Optical Storage**
- **Definition** – In the **optical storage devices**, all read and write activities are performed by light. All recording information stores at an optical disk.
- As per the opinions of data scientist that compact space is most useful for huge data storage. Their big advantages are not more costly, light weight, and easy to transport because it is removable device unlike hard drive.

- ***Magnetic data storage such as floppy disks and hard disks have low average access time, adequate capacity and comes with reasonable prices.***
- Audio & video require higher storage capacity (compressed or uncompressed) for which optical storage media are more suitable, with comparatively lower cost for the capacity available.
-

Why to Use Optical Storage?

- In the **optical storage devices**, all data is saved like as patterns of dots which can be easily read with using of LIGHT. Laser Beam is used like as “Light Source”.
- The data is read while bouncing laser beam on the surface of storage medium. Laser beam creates the all Dots while reading process, but it is used with high power mode to mark the surface of storage medium, and make a dot. This entire process is also called the “Burning” data onto Disc.

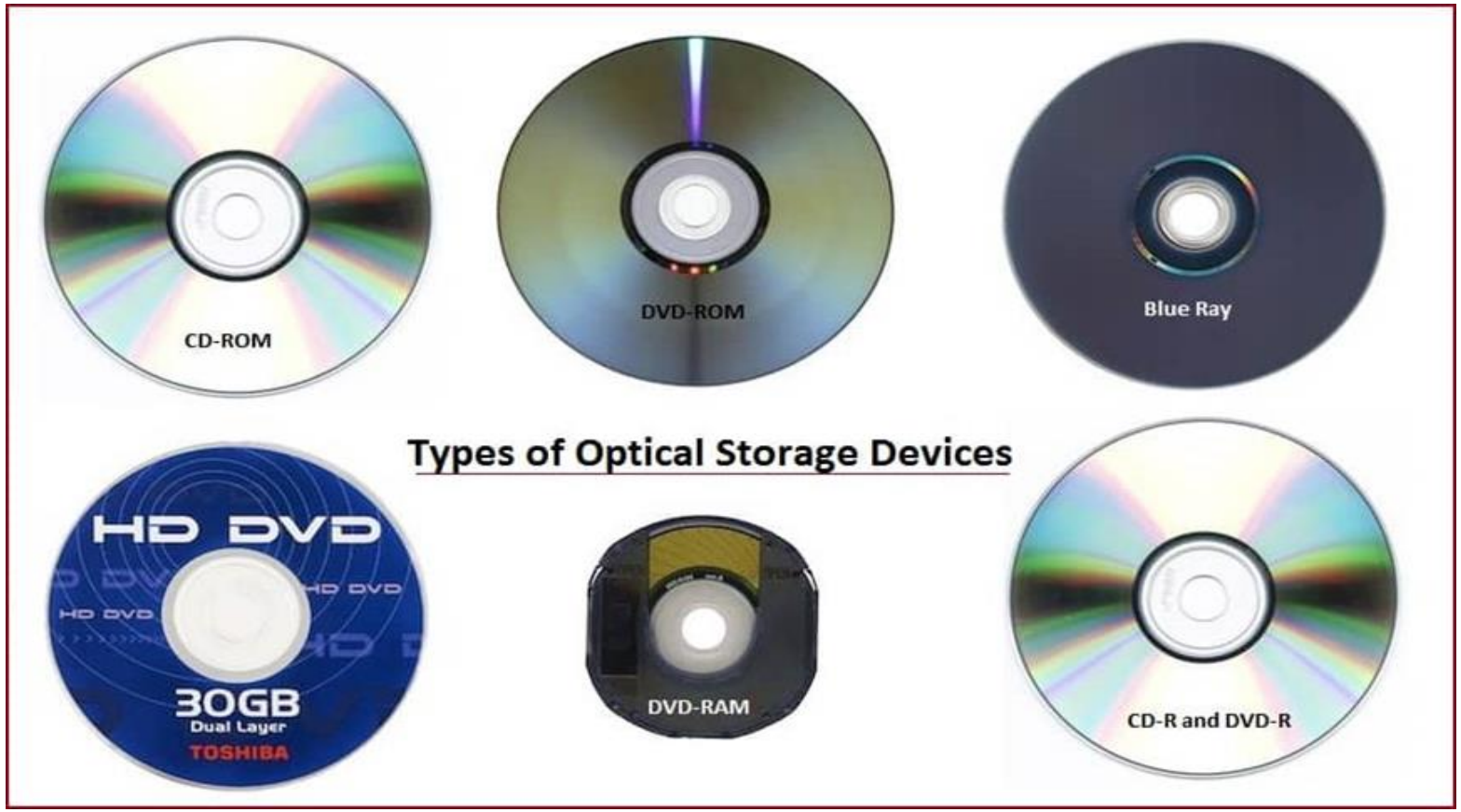


- **What are the different types of optical storage devices?**
- **Six** categories of **optical media** are available to meet most **storage** requirements: CD-ROM, DVD-ROM, DVD-RAM, recordable **media**, write-once read-many (WORM) **optical** cartridges, and erasable **optical** cartridges. CD-ROM is a read-only format that is optimized for read performance.

- **What are the three main types of optical storage?**
- There are **three main types of optical** media: CD, DVD, and Blu-ray **disc**. CDs can store up to 700 megabytes (MB) of data, and DVDs can store up to 8.4 GB of data. Blu-ray discs, which are the newest **type of optical** media, can store up to 50 GB of data.

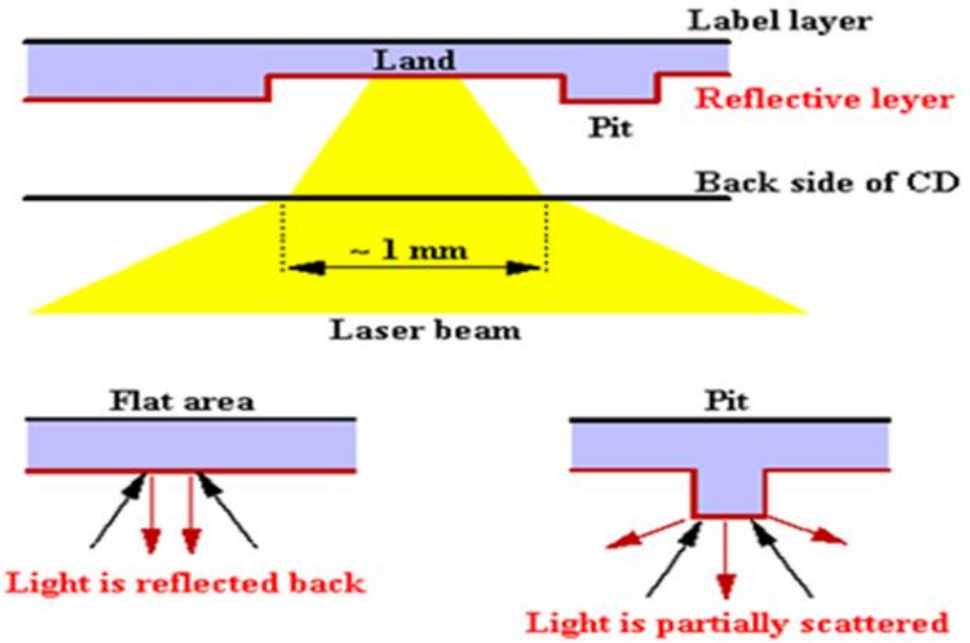
Types of Optical Storage Devices

- There are various types of Optical Storage Devices, and below explain each one



Basic Technology

- The technology uses the intensity of reflected laser light. Laser beam (~780 nm wavelength) can be focused at ~1mm. The polycarbonate *substrate layer* have holes corresponding to coded data, called *pits.*
- Areas between pits are called *lands,* and the depth of pits is 0.12mm. The optical disk consists of sequential order of pits and lands allocated in one track. The substrate layer is covered with thin reflective layer, and the laser beam is focused on reflective layer from substrate layer. The reflected beam is stronger at the lands. Beam lightly scattered at the pits, giving weak intensity
-
- **Compact Disk Layers**
- · The label
- · The protective layer
- · The reflective layer
- · The substrate layer



CD Track

- The entire optical disk information is on 1 track, making it easily played back at continuous data rate. This is advantageous for audio and video.
- *The track is spiral, with the distance between tracks at 1.6mm and the track width of each pit is 0.6mm. The pits have different lengths.*

Comparison with Magnetic Disks

- Optical disk: 1.66 data bits per mm ® data density of 1,000,000 bits per mm2 ® 16,000 tracks per inch.
- Floppy disk: 96 tracks per inch

Magnetization decreases over time and tapes can have cross talk. Laser light positioned ~1mm from disk and not on disk reduces friction and increases life span of components.

Compact Disks

A compact disk has a diameter of 12 cm, a 15 mm centre hole, and has 1.2 mm thickness. It is played at Constant Linear Velocity (CLV), where the number of rotations per time unit depends on radius of the accessed data. It works based on optical media principles as described in previous lecture.

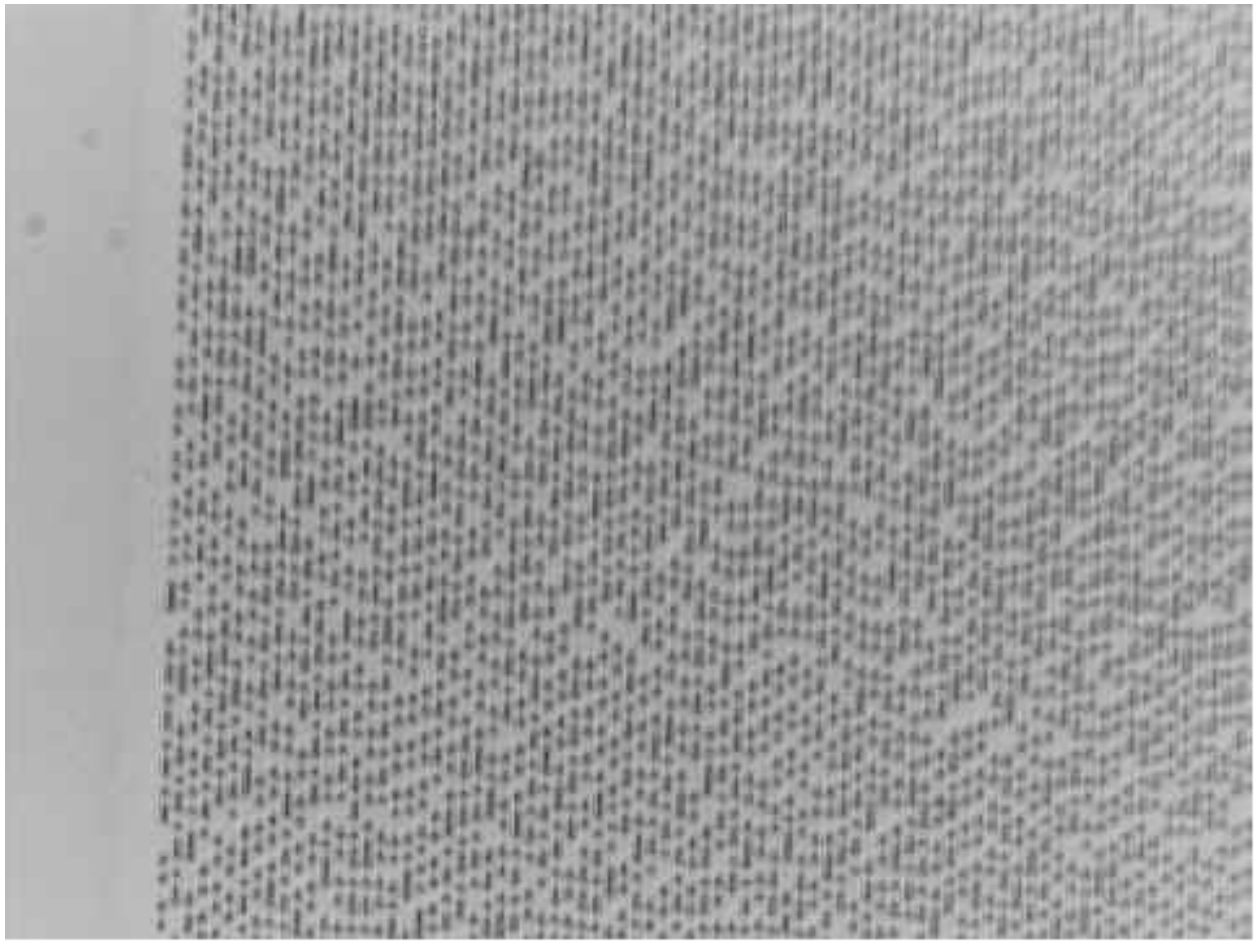
Compact Disk Areas

- Clamping area - innermost 6 mm around centre hole, contains no data
- Lead-in area - ~4 mm wide, contains VTOC (Volume Table of Contents)
- Program area - next 33 mm, contains program data, ~20,000 iterations track
- Lead-out area - 1 mm, marks end of disk
- Handling area - 3 mm, contains no data

CD: Basic design

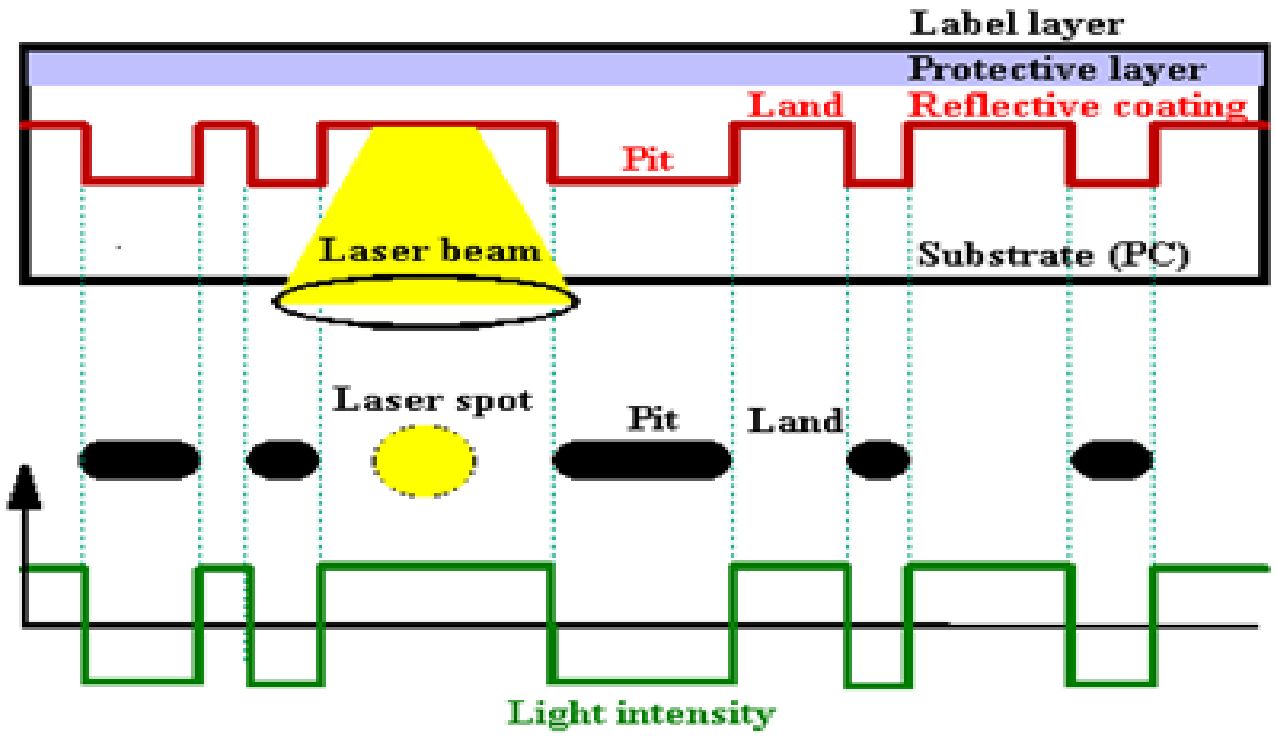
- The figures below illustrate the structure and operating principles of the compact disk. The CD is 12 cm in diameter, 1.2 mm thick, has a center hole 15 mm in diameter, and spins at a constant linear velocity (CLV) or constant angular velocity (CAV).
- Unlike the hard disk or floppy disk, there is only one track on the optical disk and all data are stored in a spiral of about 2 billion small shallow pits on the surface.
- There are about 20,000 windings on a CD - all part of the same track. This translates into about 16,000 tracks per inch (TPI) of track density and an areal density of 1 Mb/mm2. The total length of the track on a CD is almost 3 miles (~4.5 km).

Low-magnification (x 32) image of a CD showing an edge of the data zone.

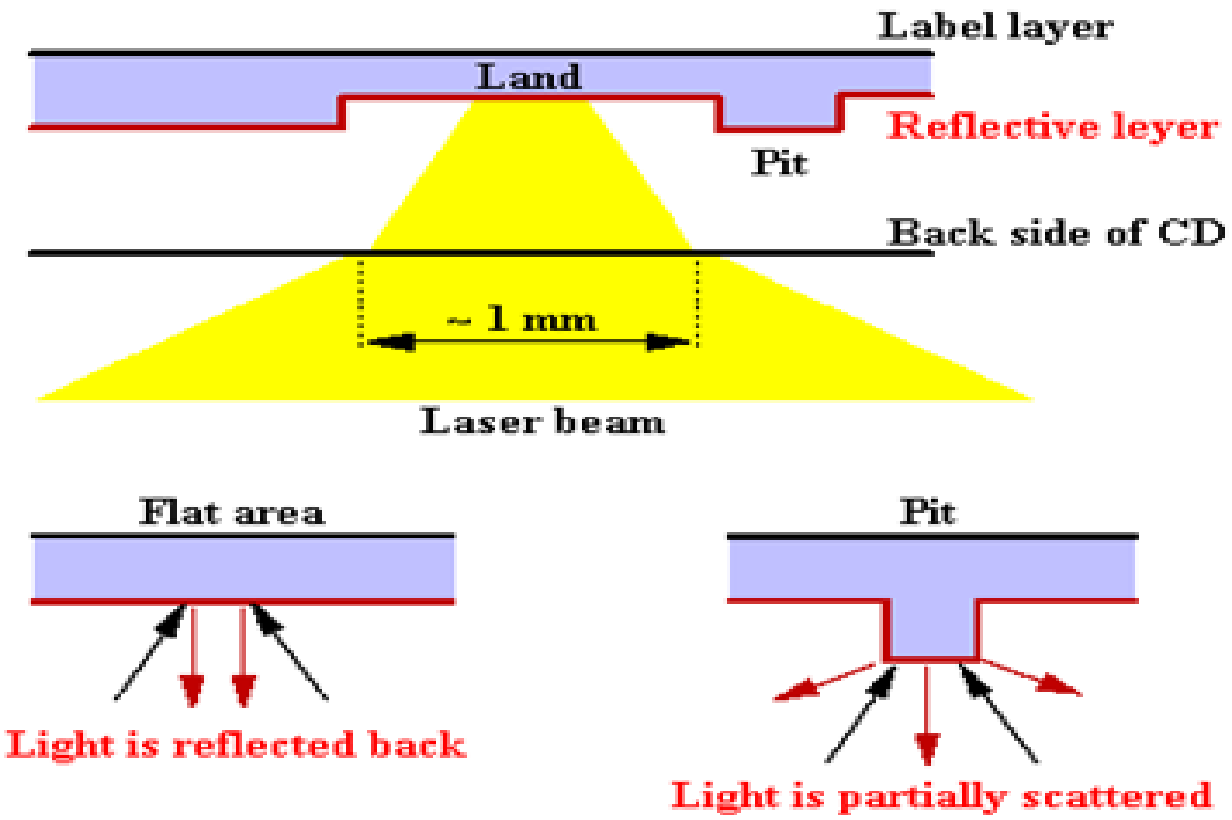


- A transparent polycarbonate (PC) polymeric substrate (layer) has the pits molded onto its surface. These pits are the coded data and carry the information. The areas in between the pits, which are 0.9 mm (microns) to 3.3 mm long, are called "lands".
- The substrate layer is covered with a thin reflective layer of metal (aluminum) and with a protective layer of lacquer. On top of the CD sits the label layer.

- A laser beam of approximately 780 nm wave length is focused on the data side of the disk into a spot of about 1 micron in diameter. The laser moves in the radial direction over the fast spinning disk and scans the data track for the intensity of the reflected light.



The data pits are about 0.12 microns (120 nanometers) deep and about 0.6 microns wide. The distance between the neighboring windings of the track is about 1.6 microns. The laser beam scattering occurs when it scans the pits, which translates into a slight drop in intensity of the reflected beam

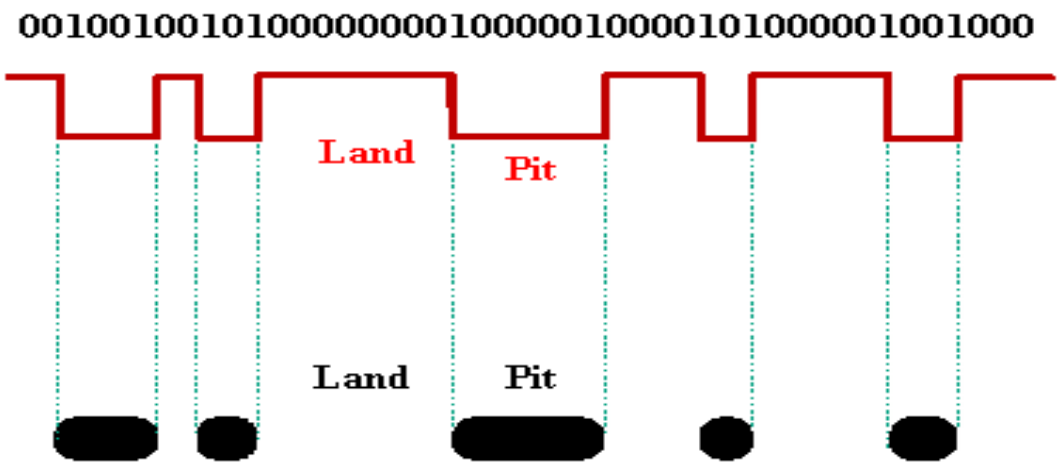


The change in reflected light intensity occurs every time the laser spot moves from the pit onto the land and vice versa. The high-frequency modulated signal produced by these changes in light intensity represents the data stored on the CD.

- The reason for the high reliability of the CD is good protection of the data from damage both inside and outside CD drive.
- Outside, the data layer is protected by tough 1.2 mm thick layer of polycarbonate on one side and 10-20 microns of a protective lacquer layer on the other side. Small scratches on the surface of CD do not directly erase the data, but just create additional areas of light scattering.
- This can confuse the drive's electronic, which is also much less sensitive to radial scratches than to the circumferential ones. Gentle polishing of the scratch can (in many cases) make the CD readable again. But, this is rarely necessary thanks to the large size of the laser spot on the surface of the PC layer - about 1 mm. This large spot diameter "integrates" the signal over the large area making the system much less sensitive to dirt and scratches on the disk surface.

- Inside the drive, the disk and the drive's optics are separated by a distance of about 1 mm, making mechanical interaction and "crashes", even with wavy disks and imperfect clamping almost impossible.

- **Data encoding**
- In the compact disk, every transition from pit to land and back is interpreted as 1. No transition means 0, and the length of each land segment represents the number of 0s in the data stream. This principle is illustrated in the figure below, which shows a stream of pits and lands and above it is the corresponding digital data stream



•All codes needed to convert bits into their physical representation and back are called channel codes. The channel code for CD-DA and CD-ROM is called EFM: "eight-to-fourteen modulation". It interprets user's data along with the error correction data, address data, synchronization data, and other content into a stream of "channel bits". The "channel bits" are converted into a binary code and, eventually, turned into pits by the mastering machine.

•During the play back, the EFM decoder of the CD-ROM works in the opposite direction converting light modulations on the bits into a binary data stream, which is then cleared of any miscellaneous data by the drive's electronics.

Examples of Optical Storage Devices

- **CD-ROM**
- CD-ROM stands for “Compact Disc Read Only Memory”, and CD-ROM comes in the “Random Access” category’s devices. These types of disc can capable to store almost 800 MB of digital data. These data can’t discard by mistaken.
- **DVD-ROM**
- DVD-ROM stands for “Digital Versatile Disc – Read Only Memory”, and it also comes in the “Random Access” category’s devices. DVD-ROM discs can store data up to 4.7 GB, but Dual Layer DVD device’s storage capacity is double. These types of disc are used to store ultra quality video.

- **Blue Ray (Blu-Ray)**
- Blue Ray discs are totally replaced by DVDs, because these discs are capable to hold data up to 25-50 GB, as well as double layer Blue Rays discs can store double data. Due to high storage capacity, Blue Ray discs are used to store HD (High Definition) videos.

- **HD DVD**
- HD DVD stands for “High Density DVD”, and these devices are capable to store data up to 15 GB (Dual Layer HD DVDS have **storage capacity** double). High-Density DVD discs are also used to hold HD Videos.

- **DVD-RAM**
- DVD-RAM stands for “DVD-Random Access Memory”, and it is able to Re-Write data. DVD-RAM are available in market like as floppy-disc style case. These types of discs have storage capacity of data similar to DVD (up to 4.7 GB).
- DVD-RAM devices are used in several Camcorders such as “Video Recording Cameras”, and it can be used for data back-up and archiving.

Recordable Optical Devices

- There are two types of discs such as “CD-R and DVD-R” and “CD-RW and DVD-RW”.
- **CD-R & DVD-R**
- Full form of (CD-R & DVD-R) is “CD-Recordable and DVD Recordable”, and they are able to burn data on to them, but not easy to delete data. Users can add any type of data, but they can’t discard added data or re-use fully disc.
- **CD-RW & DVD-RW**
- CD-RW & DVD-RW stands for “CD-Re Writable and DVD-Re Writable”, and they are capable to burn data similar (CD-R and DVD-R) onto them. Users can also delete and Re-Used data.

Advantages of Optical Storage Devices

- It is capable to store vast amount of data.
- Affordable price
- It can be recycled (Re-used).
- It has ultra data stability.
- Countable/uncountable storage units
- Best Durability, Transport-ability, and archiving.

Disadvantages Optical Storage Devices

- Some traditional PCs are not able to read these disks.
- It is getting trouble while recycling.

What Is the Difference Between Blu-Ray and DVD?

- It’s the age-old question. Do I go Blu-Ray or do I go DVD? While new technologies traditionally supplant old ones fairly quickly, Blu-Ray discs and DVDs seem to have been sitting side-by-side in the market together for some time. *So, what’s the difference between Blu-Ray video and HD DVD videos*? What are the pros and cons of each, and is one better than the other? ماهي إيجابيات وسلبيات كل منها؟
- Fortunately, on this issue, there is actually no debate. It may surprise some DVD fans to learn that Blu-Ray is unequivocally better on pretty much every level. Let’s break it down.

- **Storage Capacity**
- Blu-Ray discs have more storage capacity — a LOT more. A standard DVD holds 4.7 gigabytes of data. This is enough to hold one movie. If that movie is longer than two hours, you need two DVDs or a double-layer DVD that can store around 9GB. On the other hand, a double-layer Blu-ray disc can hold a massive 50 GB of data.
- **Image Resolution**
- Image resolution just means how your picture looks when you are viewing the disc, which is usually all people really care about. When looking at the DVD vs. Blu Ray resolution, Blu-Ray easily wins this battle, too. A DVD is a standard definition device. You won’t get high-definition movie viewing on your DVD, just 480 SD.
- On the other hand, Blu-Ray is made for HD, and you’ll get the best picture possible, with 1080 HD capability for your Blu-Ray movies. So if you are looking for a quality picture, Blue Ray is the clear winner.

Laser Technology

- Both DVD and Blu-Ray players use lasers to read the discs. The difference is that the DVD laser is a red laser that works at a 650nm wavelength. The Blu-Ray laser is — you guessed it — blue and works on shorter 405nm wavelengths, meaning they can read information more closely and precisely.
- **Disc Construction**
- DVDs and Blu-ray discs look the same to the naked eye, but the Blu-Ray's grooves are much closer together and thinner since the blue laser can read more precise data. *This is what enables the Blu-Ray disc to store so much more information. Blu-ray discs are also more scratch-resistant than DVDs.*

The Case for DVDs

- So, is it time to throw out all your DVDs and replace them? Maybe not quite yet. If you are wondering can a Blu-Ray player play a DVD – It can! All Blu-Ray players can read and play DVDs, so you don't have to if you don't want to buy the same movie twice. If, however, you do not have a Blu-Ray player, you won't be able to play Blu-Rays. The DVD laser is too big to read a Blu-Ray disc.
- Secondly, DVDs are currently cheaper than Blu-Rays, so if you're not looking to spend the extra money and don't care that much about picture quality, you can still buy DVDs. You also may not be able to find the movie you want yet in a Blu-Ray format

Optical Storage Media Types: Audio, Data, and Video

- **Audio CD**
- An audio CD, like a music CD that you buy in a store, can be played on any standard CD player. Music is stored on Audio CDs as **uncompressed** digitally encoded files. When compressed audio files (RealAudio, MP3, etc.) are transferred to an audio CD, RealPlayer makes temporary uncompressed copies of each song before the CD is burned. This increases the time it takes to create the CD and requires up to 700Mb of free hard drive space.
- You can confidently burn Audio CDs only onto CD-R media. While some CD players can read **CD-RW** discs, not all are capable. You can use CD-RW with RealPlayer, but you should check with the manufacturer of your home or car CD player before burning CD-RWs for use in any of these devices.

Data Disc

- A data disc is similar to a CD or DVD used to install software on your computer: it is just data files. Use this feature to backup or store your media files. You can burn RealPlayer***compatible files*** (RealAudio, MP3, etc.) from your local drives directly onto a data CD. During burning, the files are copied to the disc just as they are, without conversion or modification.
- Data discs may be created using CD-R or CD-RW media.

MP3 Disc

- An MP3 CD is a specialized type of data disc. All files copied to an MP3 disc will be converted to MP3 format (if needed). Like the Data CD, files can be organized into folders. Media files on the MP3 CDcan be accompanied by M3U formatted playlists, which are used by some portable players to play the MP3 files on the disc. When placed in an MP3 compatible CD or DVD player, MP3 discs are played like any audio CD.
- MP3 Discs can be created using CD-R or CD-RW media.

- **Video CD**
- Video CD (or VCD) stands for "Video Compact Disc." It is a standard digital format for storing video onto compact discs. VCDs are playable in dedicated VCD players, nearly all personal computers, most modern DVD players, and some video game consoles. VCD displays less video resolution quality than SVCD, but holds more content per disc than SVCD.
- **Super Video CD**
- Super Video CD (SVCD) stands for "Super Video Compact Disc." This format is essentially identical to VCD, but in terms of technical capability and picture quality SVCD falls between VCD and DVD. SVCD displays less video resolution quality than DVD, but noticeably greater resolution than VCD. SVCD holds less content per disc than VCD.

- **DVD**
- DVD ("Digital Versatile Disc" or "Digital Video Disc") is a format that can be used for data storage, including movies with high video and sound quality. DVDs have a storage capacity several times greater than CDs. A DVD reader or writer can usually read CDs.
- **AVCHD disc**
- AVCHD stands for Advanced Video Coding High Definition, a type of format for recording and playing high-definition video. When high-definition video is created and burned onto a standard DVD, the result is an AVCHD disc designed to be compatible with Blu-ray format. An AVCHD disc can be burned on a standard DVD burner, but played only on Blu-ray disc players.

Lecture 11
Digital Image in Multimedia

Image

- The word ‘image’ comes from the Latin language. And considering that Latin was spoken in the Roman Empire, one can imagine for how long images have been in our lives. From ancient pictures and statues, to the most complex 3D graphics, images represent an integral part of our lives.
- An **image** is a visual representation of something. In information technology, the term has several usages:
- 1) An **image** is a **picture** that has been created or copied and stored in electronic form.
- *An example of an image is a painting of your father.*
- *An example of image is a picture taken with a camera and developed.*
- *An example of an image is when you picture your kids laughing together.*
- *An example of image is a CT scan.*

IMAGES

ANALOG

Continuous

For Human Viewing

DIGITAL

Matrix of Pixels

Each Image Point

Brightness

Film Density

Color

Number

56	56	57	56
56	56	57	56
57	57	57	59
58	58	58	60

For Computer Systems

Sprawls

Digital Image Pixel Bit Depth

Bits per Pixel

1	4	8

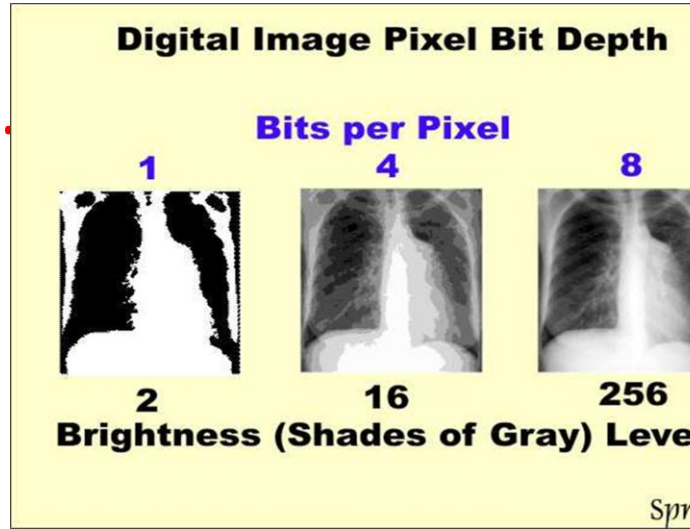
2	16	256

Brightness (Shades of Gray) Levels

Sprawls

- In multimedia we referred to image by digital image. An image consists of a rectangular array of dots called pixels. The size of the image is specified in terms of width X height, in numbers of the pixels. The physical size of the image, in inches or centimeters, depends on the resolution of the device on which the image is displayed. The resolution is usually measured in DPI (Dots Per Inch).
- An image will appear smaller on a device with a higher resolution than on one with a lower resolution.
- For color images, one needs enough bits per pixel to represent all the colors in the image. The number of the bits per pixel is called the depth of the image.

- **Number of colors**
- Images start with differing numbers of colors in them. The simplest images may contain only two colors, such as black and white, and will need only 1 bit to represent each pixel. Many early PC video cards would support only 16 fixed colors. Later cards would display 256 simultaneously, any of which could be chosen from a pool of 2^{24}, or 16 million colors. Current cards devote 24 bits to each pixel, and are therefore capable of displaying 2^{24}, or 16 million colors without restriction. A few display even more. Since the eye has trouble distinguishing between similar colors, 24 bit or 16 million colors is sometimes called TrueColor.
- Better modern cameras can capture even more colors.



Images in computing

- Images were in people's lives long before computers were introduced. However, with the advance in technology, very soon computers were not only able to handle images, but also to create new ones and edit them. With the introduction of the computer GUI (graphical user interface), images entered in the computer world with a bang, giving the user a more comfortable workstation and marking the boom of the home computer.
- ***Graphical User Interface***, *a* ***GUI*** *(pronounced as either G-U-I or gooey) allows the use of icons or other visual indicators to interact with electronic devices, rather than using only text via the command line. For example, all versions of Microsoft Windows utilize a GUI, whereas MS-DOS does not*

- Any Microsoft program (i.e. Word, Excel, Outlook)
- Internet browser (i.e. Internet Explorer, Chrome, Firefox)

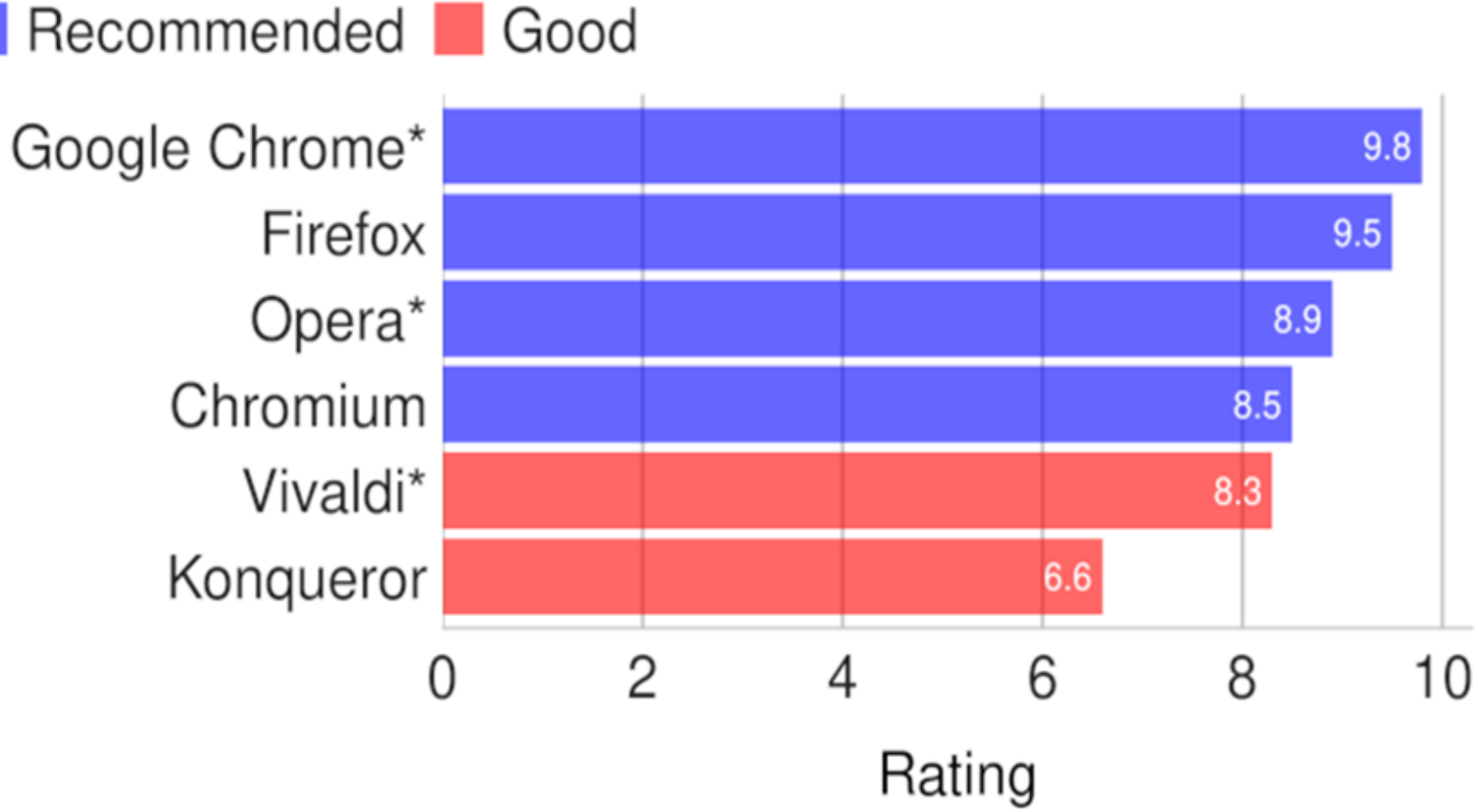
Images on the Web

- Soon after the introduction of the GUI for the home computer, the first graphical web browser was created - Mosaic. This web browser presented web pages much like the way we see them today and a lot of the modern browsers still look like the Mosaic browser. It was also the first web browser, which was capable of showing up an image on a website.
- From this moment on, web page designers started slowly introducing images to their websites, be that simple pictures or buttons, or whole navigation menus. This marked the start of the multimedia website content.

- Web browsers allow users to view web pages which often contain a mixture of:
- text,
- images,
- videos,
- and other multimedia
- Example: (such as Google Chrome and Firefox……

Google Chrome: Secure web browser with minimalistic user interface
Firefox: Highly popular browser delivering safe, easy web browsing

Best Free Graphical Web Browsers



* Not Open Source

LINUX LINKS

Types of images

- There are two types of images - still images and animated images
- Still images
- Still images are the images everyone is used to - from pictures taken with a camera to paintings on canvases. Still images were the first images introduced to the computer world in the form of pictures and icons. Still images represent the majority of the images used today, since they tend to be of small file size and require less disk space than animations or movies. They also don't require special software to be installed in order to view them - today every operating system, be that Windows or Linux, can open a still image without the need of additional software.
- The most popular file formats for still images are JPG and PNG. and Webp

Animations

- Animated images were introduced to the computer world shortly after the still images. They represent a series of still images shown in a quick succession, giving the user the idea of an animation. In the Internet world, animations were introduced by animated GIF files. GIF was originally a file format for still images, but is now synonymous with animated images.
- GIF animations usually are short, not more than several seconds long, and consist of less than 10 still images

Computer generated images

- Today, images can be easily created with a computer program or programming language by simply entering several parameters. The ImageMagick software is a popular choice among PHP(Personal Home Page language) programmers. With it, one can easily create simple still images with several effects.
- This software is very handy when you have to resize several images online or create thumbnails for them - all of this can be added in a simple script.

- *PHP: used for the creation of dynamic web pages(*A ***dynamic web page*** is a ***web page*** that displays different content each time it's viewed. For example, the ***page*** may change with the time of day, the user that accesses the webpage, or the type of user interaction. There are two types of ***dynamic web pages***.)**client –side scripting and server-side scripting
- This is perfect for online image galleries, since it can automatically resize uploaded images and at the same time - generate thumbnails for them, which are then to be used on the index page.
- *In the context of computing and IT technologies, the 'index' is a universal term, used in a variety of cases - from the index directory listing of websites to the database index and the index of the search engines*

ImageMagick software

- *Use ® to create, edit, compose, or convert bitmap images. It can read and write images in a variety of formats (over 200) including PNG, JPEG, JPEG-2000, GIF, TIFF, DPX, EXR, WebP, Postscript, PDF, and SVG.*
- *Use ImageMagick to resize, flip, mirror, rotate, distort, shear and transform images, adjust image colors, apply various special effects, or draw text, lines, polygons, ellipses and Bézier curves.*

Types of Digital Image Files

- **The 5 Types of Digital Image Files: TIFF, JPEG, GIF, PNG, and Raw Image Files, and When to Use Each One**
- There are 5 main formats in which to store images. Why would you choose one over another, and what are the differences?
- **1. TIFF (also known as TIF), file types ending in .tif**
- TIFF stands for Tagged Image File Format. TIFF images create very large file sizes. TIFF images are uncompressed and thus contain a lot of detailed image data (which is why the files are so big) TIFFs are also extremely flexible in terms of color (they can be grayscale, or CMYK for print, or RGB for web).

- TIFF is the most common file type used in photo software (such as Photoshop), as well as page layout software (such as Quark and InDesign), again because a TIFF contains a lot of image data.

- **2. JPEG (also known as JPG), file types ending in .jpg**
- JPEG stands for Joint Photographic Experts Group, which created this standard for this type of image formatting. JPEG files are images that have been compressed to store a lot of information in a small-size file. Most digital cameras store photos in JPEG format, because then you can take more photos on one camera card than you can with other formats.

- A JPEG is compressed in a way that loses some of the image detail during the compression in order to make the file small (and thus called “lossy” compression).
- JPEG files are usually used for photographs on the web, because they create a small file that is easily loaded on a web page and also looks good.
- JPEG files are bad for line drawings or logos or graphics, as the compression makes them look “bitmappy” (jagged lines instead of straight ones).

3. GIF, file types ending in .gif

- GIF stands for Graphic Interchange Format. This format compresses images but, as different from JPEG, the compression is lossless (no detail is lost in the compression, but the file can't be made as small as a JPEG).
- GIFs also have an extremely limited color range suitable for the web but not for printing. This format is never used for photography, because of the limited number of colors. GIFs can also be used for animations.

- **4. PNG, file types ending in .png**
- PNG stands for Portable Network Graphics. It was created as an open format to replace GIF, because the patent for GIF was owned by one company and nobody else wanted to pay licensing fees. It also allows for a full range of color and better compression.
- It's used almost exclusively for web images, never for print images. For photographs, PNG is not as good as JPEG, because it creates a larger file.

- **5. Raw image files**

- Raw image files contain data from a digital camera (usually). The files are called raw because they haven't been processed and therefore can't be edited or printed yet. There are a lot of different raw formats–each camera company often has its own proprietary format.

- Raw files usually contain a vast amount of data that is uncompressed. Because of this, the size of a raw file is extremely large. Usually they are converted to TIFF before editing and color-correcting.

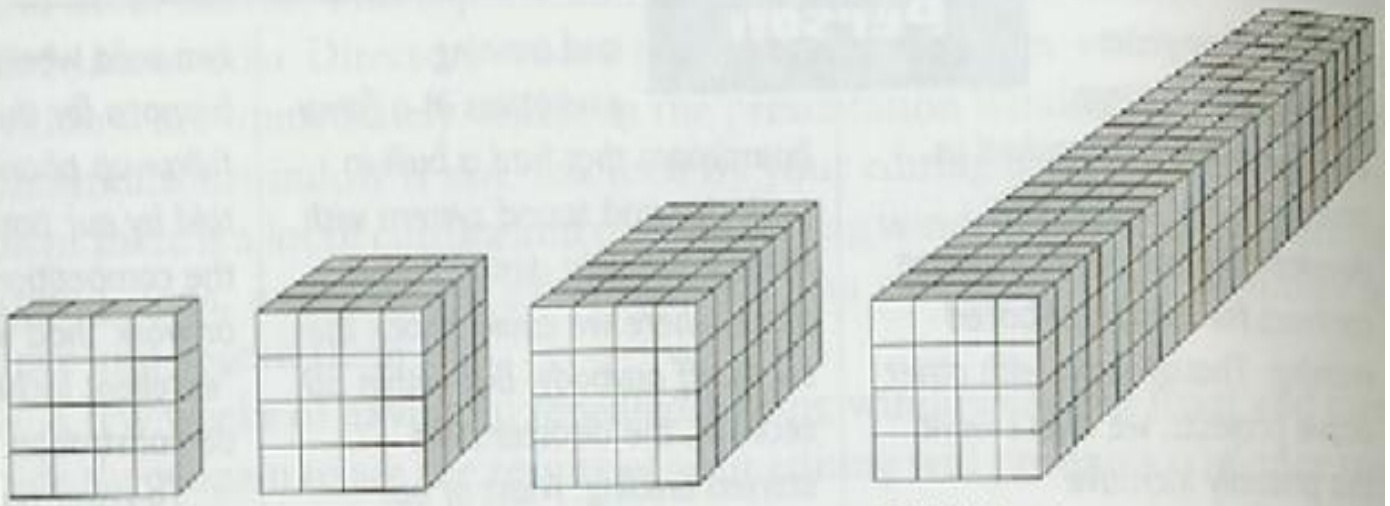
WebP

- WebP is a new open image format that uses both lossless and lossy compression. It was designed by Google to reduce image file size to speed up web page loading: its principal purpose is to supersede JPEG as the primary format for photographs on the web.

- BMP Images
- Bmp It is a simple information matrix describing the individual dots that are the smallest element of resolution on a computer screen or other displaying or printing devices(Bitmap is a matrix that describes the characteristics of the all pixels making up an image) .1D matrix is required for monochrome(B&W) ; greater depth (more bits of information) is required to describe the more than 16 million colors the picture element may have. As in the following figure:

FIGURE 11-1

A bitmap is a matrix that describes the characteristics of all the pixels making up an image



- Also BMP is the native format for WINDOWS as well as OS/2, where the most common graphic format in your computer is BMPs,. It is a standard image format mainly used on Microsoft Windows platform it is used for wallpaper, backgrounds and other windows graphics.
- The BMP file format is designed specifically for that purpose. It is not used on the internet or e-mail because they are not compressed and the file tend to be very large. But they load and display quickly because they don't have to be decompressed first. it is not good for transmitting on the internet. image data is stored with 8 bits/pixel or 24 bits/pixel without applying any compression . BMP file is automatically identified by the file name extension (.bmp)
- Bitmap images can have 1-, 4-, 8-, or 24- bit color depth

Digital image and electromagnetic spectrum

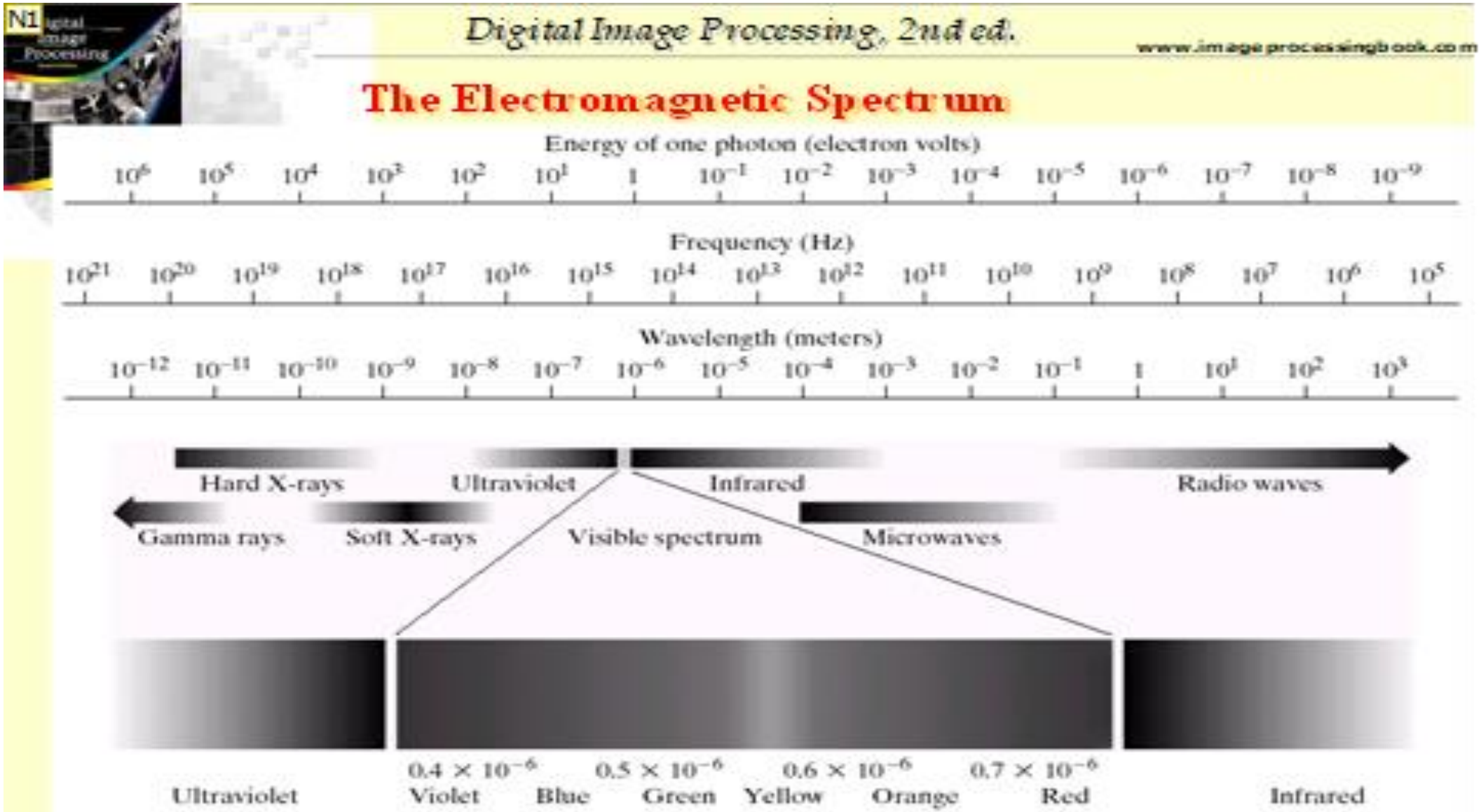
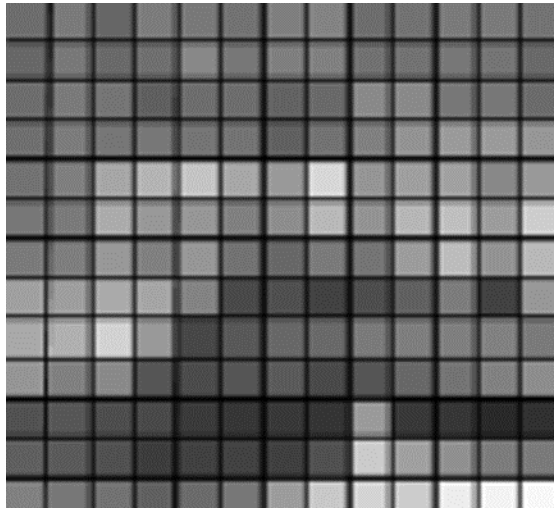
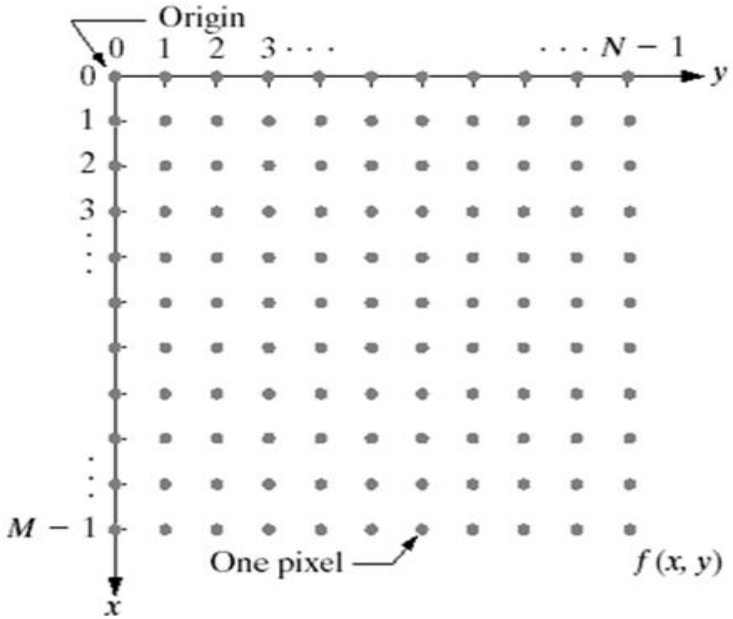
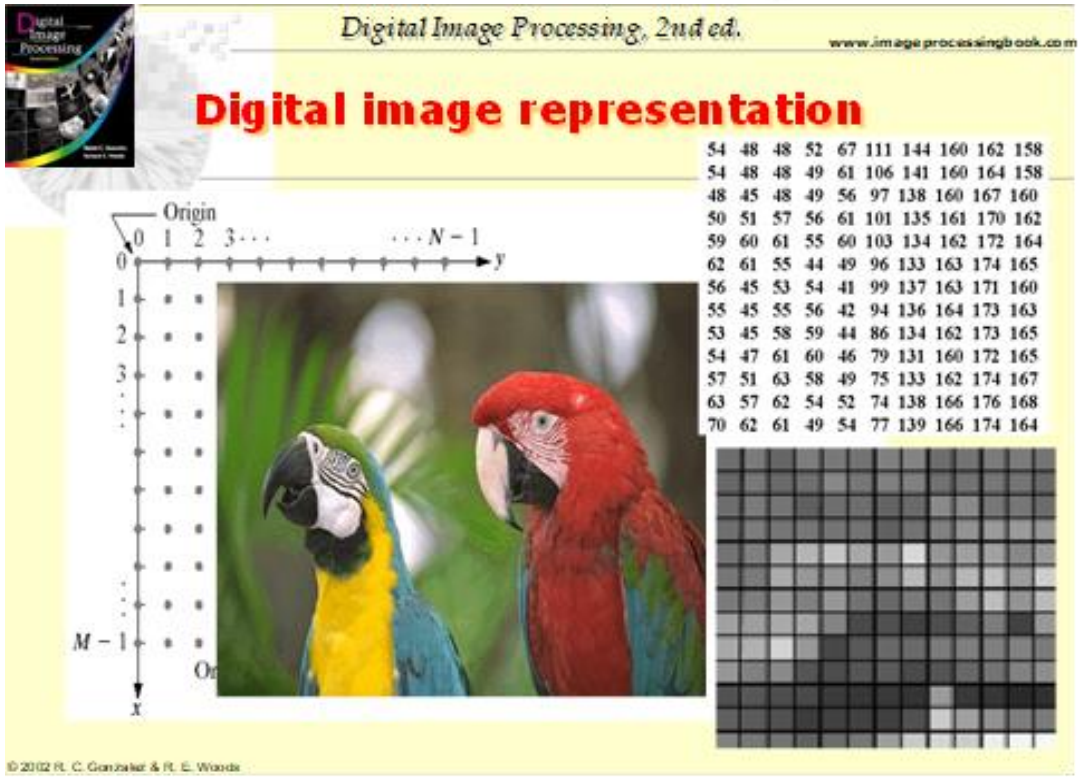


FIGURE 2.10 The electromagnetic spectrum. The visible spectrum is shown zoomed to facilitate explanation,

- **Digital image definition**
- **Digital image**: An image may be defined as a two –dimensional function, *f(x, y),* where *x* and y are spatial (plane) coordinates, and the amplitude of ***f*** at any pair coordinates *(x, y)* is called the intensity or gray level of the image at that point.
- When *x, y* , and the amplitude values of ***f*** are all finite, discrete quantities, we call the image a digital image.







$$f(x,y)=\begin{bmatrix} f(0,0) & f(0,1) & \ldots\ldots\ldots\ldots & f(0,N-1) \\ f(1,0) & f(1,1) & \ldots\ldots\ldots\ldots & f(1,N-1) \\ \vdots & & & \\ \vdots & & & \\ f(M-1,0) & f(M-1,1) & \ldots\ldots & f(M-1,N-1) \end{bmatrix}$$

Pixel Values

- **Each of the pixels that represents an image stored inside a computer has a *pixel value* which describes how bright that pixel is, and/or what color it should be. In the simplest case of binary images, the pixel value is a 1-bit number indicating either foreground or background. For a grayscale images, the pixel value is a single number that represents the brightness of the pixel.**
- **The most common *pixel format* is the *byte image*, where this number is stored as an 8-bit integer giving a range of possible values from 0 to 255. Typically zero is taken to be black, and 255 is taken to be white. Values in between make up the different shades of gray.**

color images

- **To represent color images, separate red, green and blue components must be specified for each pixel (assuming an RGB colorspace), and so the pixel `value' is actually a vector of three numbers. Often the three different components are stored as three separate `grayscale' images known as *color planes* (one for each of red, green and blue), which have to be recombined when displaying or processing.**

Examples simple operation on digital images

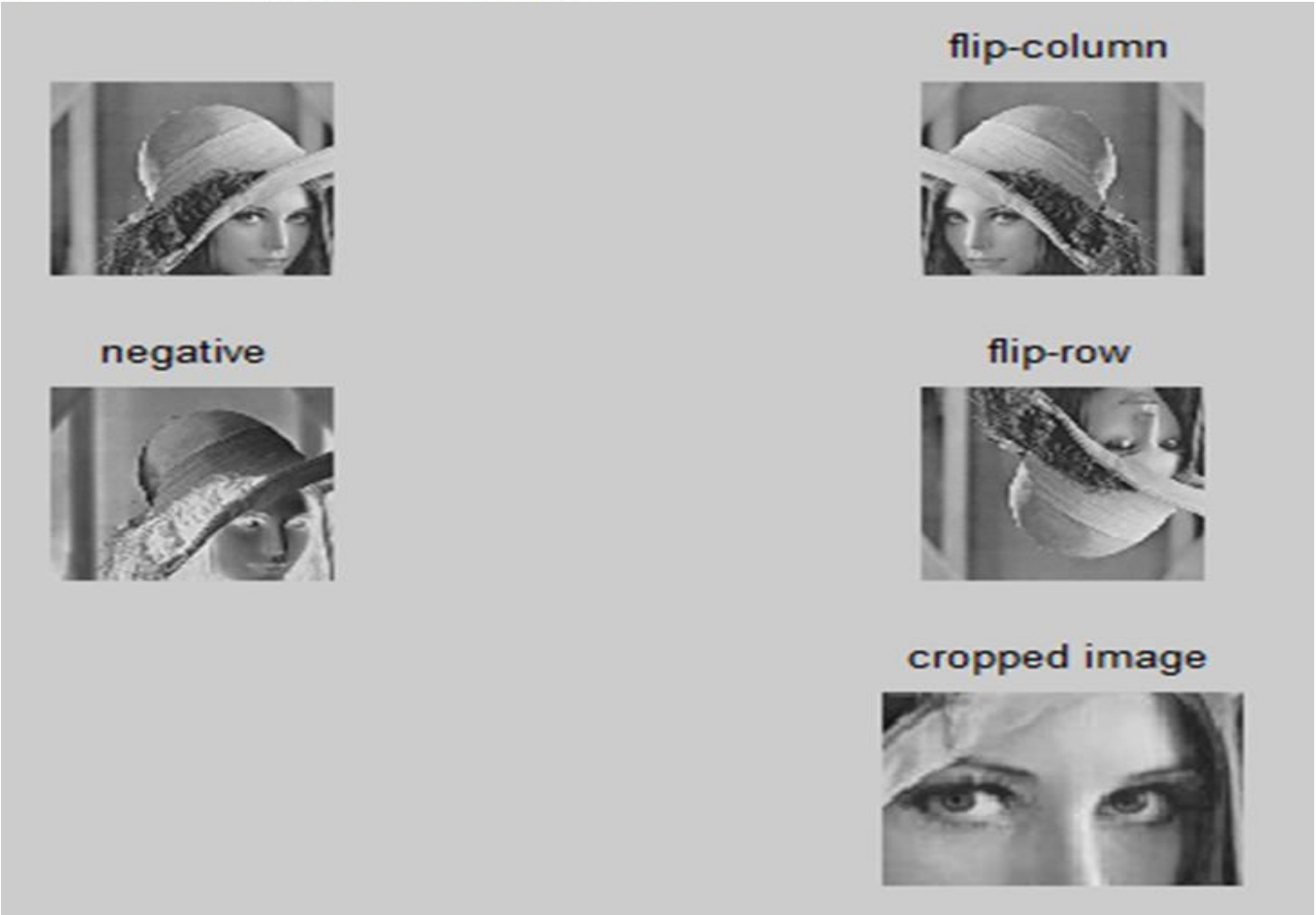
- **The image of a ramp (256 *x 256):***
- for i = 1 : 256
- for j = 1 : 256
- A(i,j) = j -1;
- end
- end
- image(A);
- colormap(gray(256));
- axis('image');

- Transpose
- for *i = 1 : 512*
- for *j = 1 : 512*
- *B(j, i) = A(i, j);*
- end
- end
- ***flipped***
- **clear *B;***
- ***for i = 1 : 512***
- **for *j = 1 : 512***
- ***B(i, 512 + 1 - j) = A(i, j);***
- **end**
- **end**

cropped image

- The cropped image B (*N1xN2) of A (N xM), starting from (n1; n2), can* be obtained as *B(k; l) = A(n1+k; n2+l) where (k = 0; ....;N1-1; l = 0; .....;N2-1).*
- clear B;
- A=imread('c:\lena1.jpg');
- for k = 0 : 64
- for l = 0 : 128
- B(k + 1, l + 1) = A(100 + k + 1, 100 + l + 1);
- % where n1=n2=100 N1=64, N2=128
- end
- end

```
for i=1:256
    for j=1:256
        B(i,256+1-j)=A(i,j);
        C(i,j)=255-A(i,j);
        D(256+1-i,j)=A(i,j);
    end
end
```



Display the results

- figure
- subplot(1,2,1)
- imshow(A)
- title('origin image')
- subplot(1,2,2)
- imshow(B) disp(A(190,190))

Image Editing

- **Definition - What does *Image Editing* mean?**
- ***Image editing refers to modifying or improving digital or traditional photographic images using different techniques, tools or software. Images produced by scanners, digital cameras or other image-capturing devices may be good, but not perfect.***
- ***Image editing is done to create the best possible look for the images and also to improve the overall quality of the image according to different parameters.in lect 4 ,the following tools were introduced for graphics and image editing.***

Graphics and Image Editing

- **Adobe Illustrator**: a powerful publishing tool from Adobe. Uses vector graphics; graphics can be exported to Web.
- **Adobe Photoshop**: the standard in a graphics, image processing and manipulation tool.
  - Allows layers of images, graphics, and text that can be separately manipulated for maximum flexibility.
  - Filter factory permits creation of sophisticated lighting-effects filters
- **Macromedia Fireworks**: software for making graphics specifically for the web.
- **Macromedia Freehand**: a text and web graphics editing tool that supports many bitmap formats such as GIF, PNG, and JPEG.

Image Editing continue

- **www.Techopedia**.com is an IT education website that provides insight and inspiration to IT professionals, technology decision-makers, and many more.
- It explains *Image Editing* ***as follows:***
- Image editing is considered a creative, artistic act. Image editing is done for removing unwanted elements such as dust specks and scratches, adjusting the geometry of the image like rotating and cropping, correcting for lens aberrations, sharpening or softening the image, making color changes or adding special effects to the image. Often the tasks involved in image editing are repetitive and need intense processing.
- Image editing software applications are also available for editing images. Unlike other conventional methods, these tools provide advanced image editing operations like data compression, photo organization and selection of image properties.

- *In digital image processing, image editing is basically categorized into pixel editing and parametric image editing. Pixel editing focuses on altering the image by working at the pixel level. Parametric image editing, on other hand, focuses on changing the appearance of the image without altering the original image*
- There are benefits associated with image editing. It enhances the original images in accordance to the user's requirements. They can bring more color and life to the image. It helps in bringing the best possible image in the interests of the viewers.
- There are a few drawbacks for image editing. Advanced software for image editing is expensive and often requires time for an individual to understand and become familiarized with its features. Furthermore, some consider edited images to be false or misleading, causing a negative reputation for some people toward image editing.

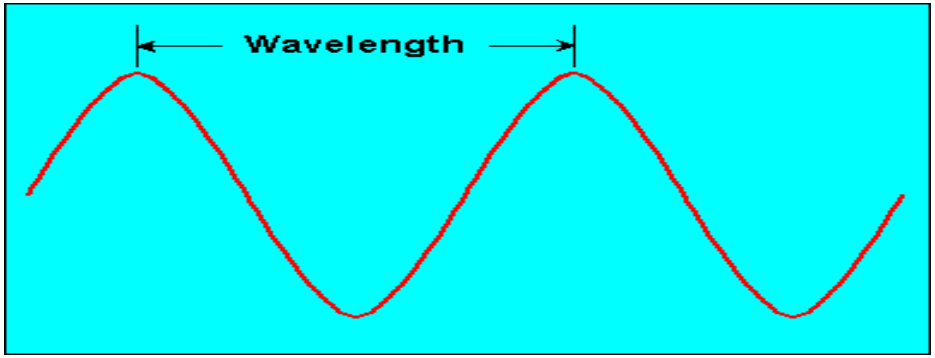
Lect. 12:
Colors in multimedia

- Color is a sensation produced by the human eye and nervous system. It is related to light, but an understanding of the properties of light is not sufficient to understand color, and is especially not sufficient to understand the art of color reproduction.
- Overwhelming experimental evidence tells us that the perception of a color is related to the strength of three signals which are transmitted along the optic nerve to the brain.
- Color is a phenomenon of light caused by how our eyes detect differing qualities of projected or reflected light.

- Color plays an important role in the human perception and interpretation of the visual world. It is therefore not surprising that in many application areas manufacturers and consumers have been losing interest in conventional grayscale imaging and have been turning instead to its information-richer, color-driven counterpart.
- An explosive growth in the diversity of image and video processing solutions developed in the past decade has resulted, among others, in a number of commercial products for digital imaging and multimedia applications where color provides crucial information for both human observers and data processing machines

Color Science: Light and Spectra

- Light is an electromagnetic wave.
- Its color is characterized by the wavelength content of the light



- Figure 4.1 shows the phenomenon that white light contains all the colors of a rainbow (**dispersion**).

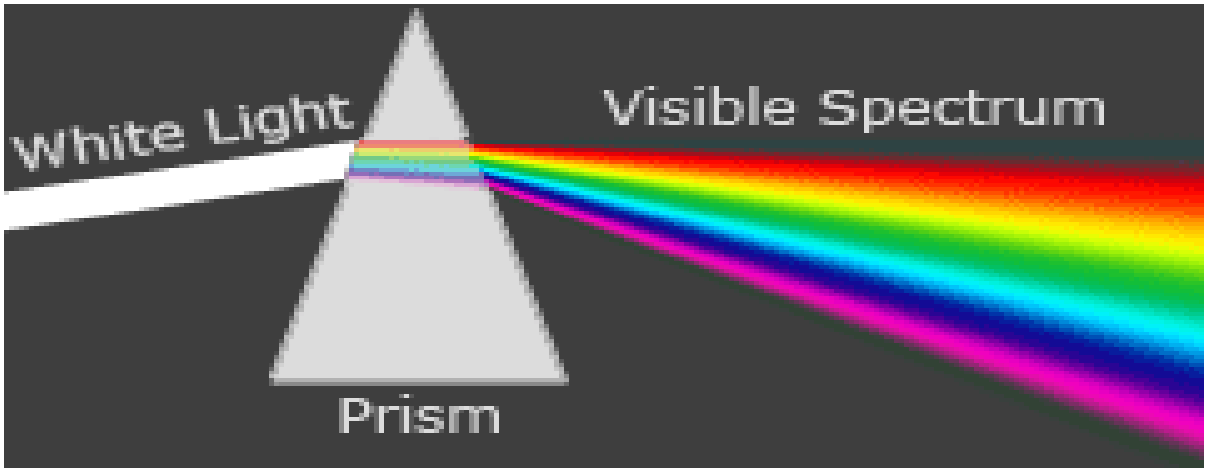
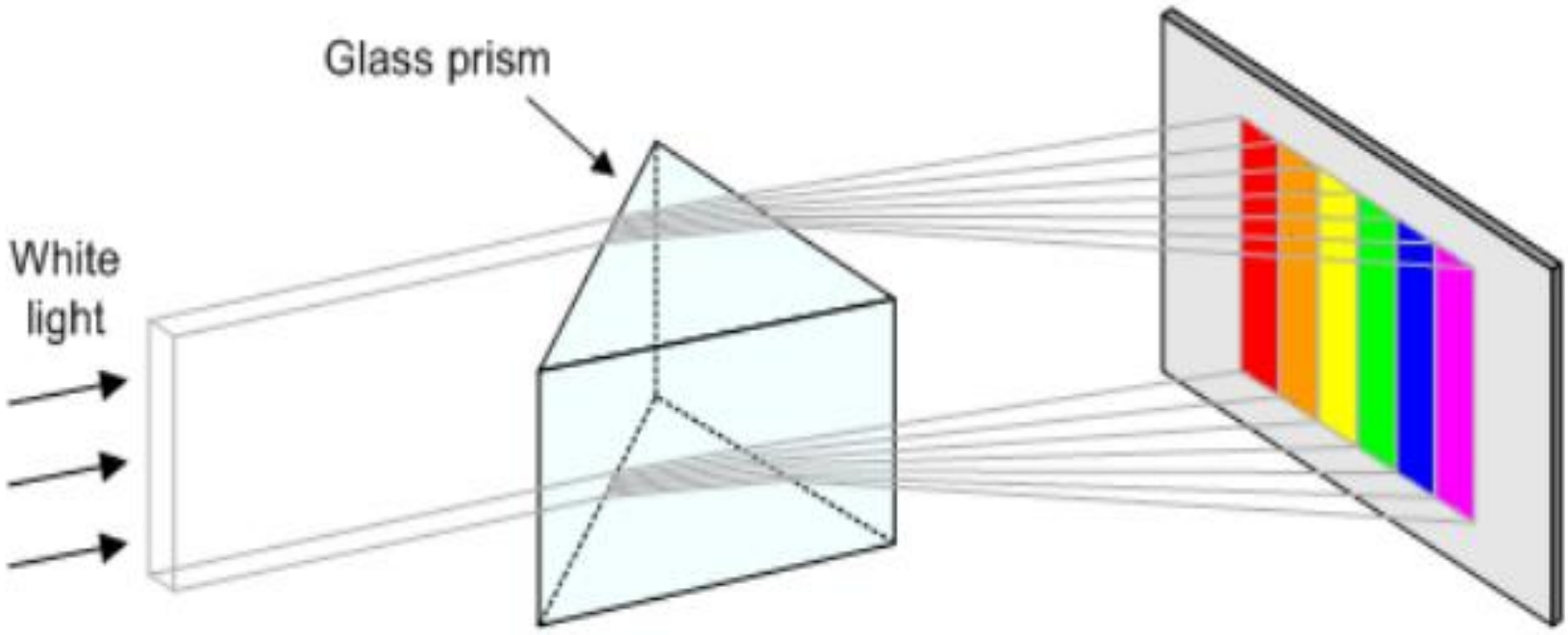
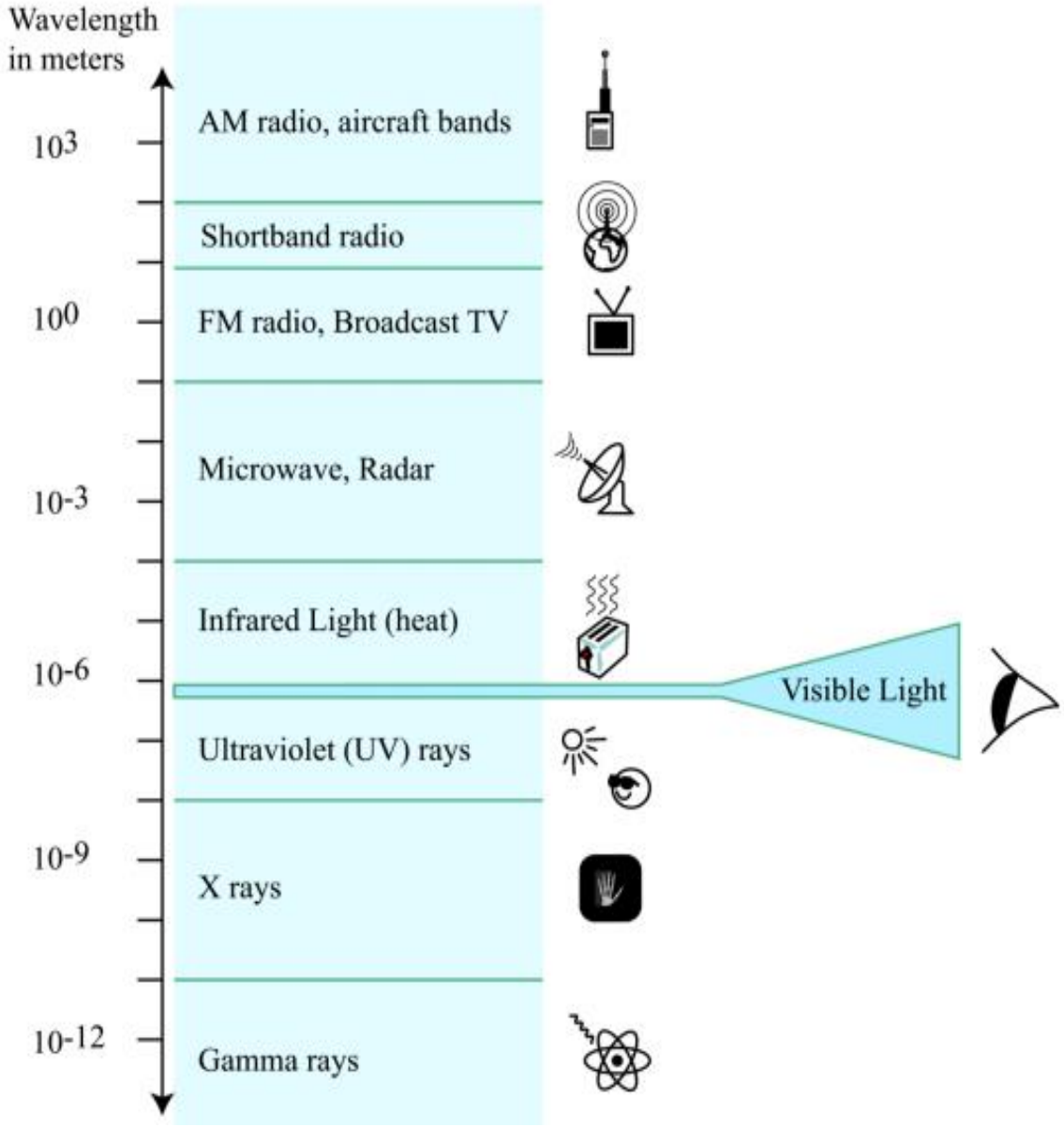


Fig. 4.1

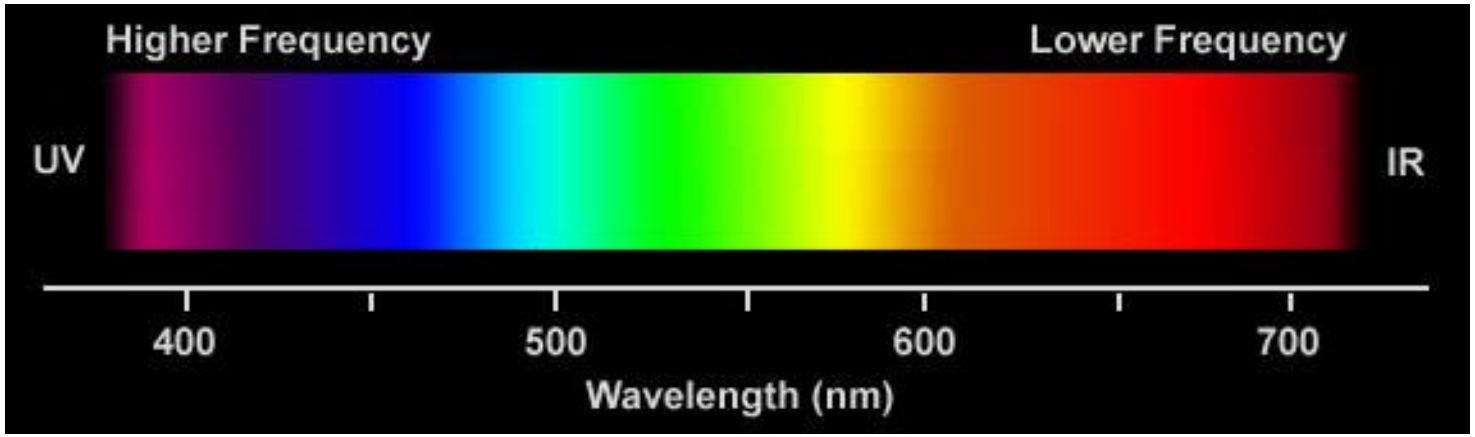


Newton's experiment for splitting white light into a spectrum

- *The electromagnetic spectrum, of which visible light is a very thin band*



- Most light sources produce contributions over many wavelengths.
- However, humans cannot detect all light, just contributions that fall in the “visible wavelengths".
- Short wavelengths produce a blue sensation, long wavelengths produce a red one.
- Visible light is an electromagnetic wave in the range 400 nm to 700 nm (where nm stands for nanometer, 10^{-9} meters).



- Color depends primarily on the reflectance properties of an object. We see those rays that are reflected, while others are absorbed
  - Green objects reflect light with wavelengths primarily in the 500 to 570 nm range while absorbing most of the energy at other wavelengths.

- **Achromatic (void of color):** it has only one attribute; intensity, or gray level amount.
- **Chromatic light**: spans the visible spectrum.

Dimensions of the colors :HSI Model

- There are three dimensions to color-hue, value and intensity. This makes color multidimensional-any color appearance can be described in terms of these three dimensions
- The characteristics generally used to distinguish one color from another are:
  - Hue: is the attribute associated with the dominant wavelength in a mixture of light waves. Hue represents the dominant colors as perceived by the an observer. Thus, when we call an object red, we are specifying its hue.so Hue refers to the names of the colors. It is the contrast between redness, blueness and greenness
  - Brightness (value): achromatic notion of intensity. Value refers to the lightness or darkness of a color. It is often related to a gray scale where white is the lightest value followed by a series of grays to black, the darkest value

Saturation(intensity): refers to relative purity or the amount of light mixed with a hue. Pure color are fully saturated. Pink (red+white) are less saturated. Intensity refers to the purity or impurity of a hue. The more pure hue a given color contains, the more intense it is.

Hue and saturation taken together are called chromaticity. Therefore color can characterized by its brightness and chromaticity.

Primary and Secondary Colors

- Colors are seen as variable combinations of the so-called primary colors R, G and B.

Mixture of lights (additive primaries)

- The primary colors of light can be added to produce the secondary colors of light : magenta (M=R+B), cyan (C=G+B), and yellow (Y=R+G)
- Mixing the three primaries in the right intensities produces white light.

Mixture of Pigments (Subtractive primaries)

- Primary color of pigments is defined as one that subtracts or absorbs a primary color of light and reflects or transmits the other two.
- The primary colors of pigments are magenta, cyan, and yellow. And the secondary colors are R,G and B.
- The proper combinations of the three pigments primaries, produces black.

- Fig. 4.16: color combinations that result from combining primary colors available in the two situations, additive color and subtractive color.

magenta (M=R+B), cyan (C=G+B), and yellow (Y=R+G)

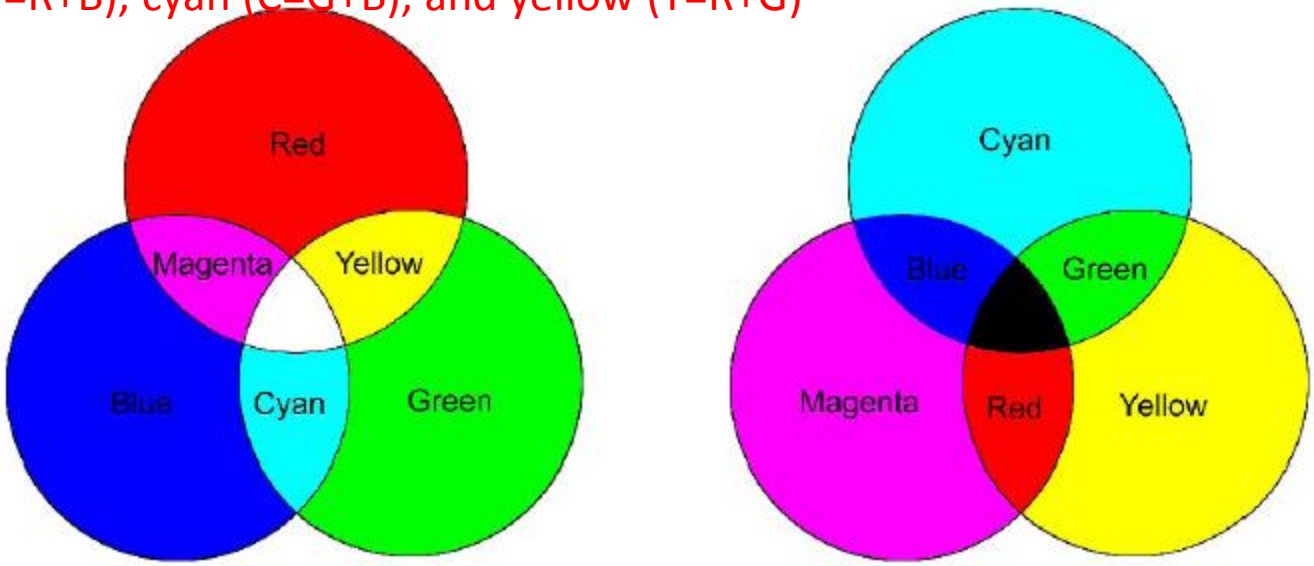
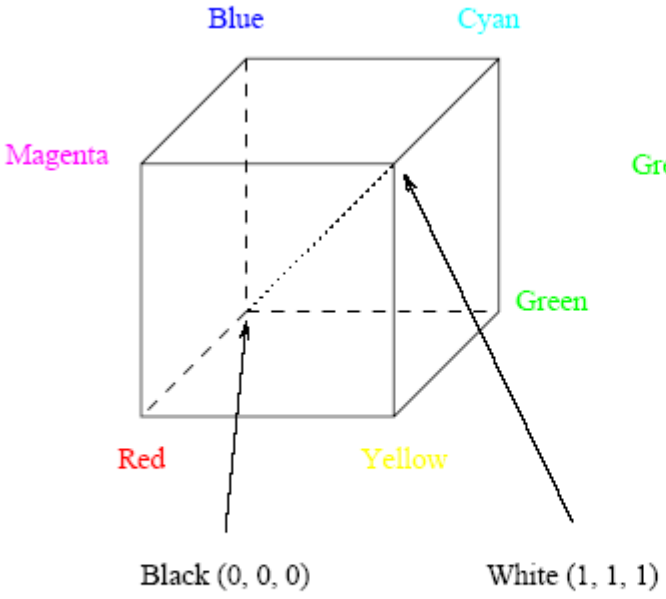
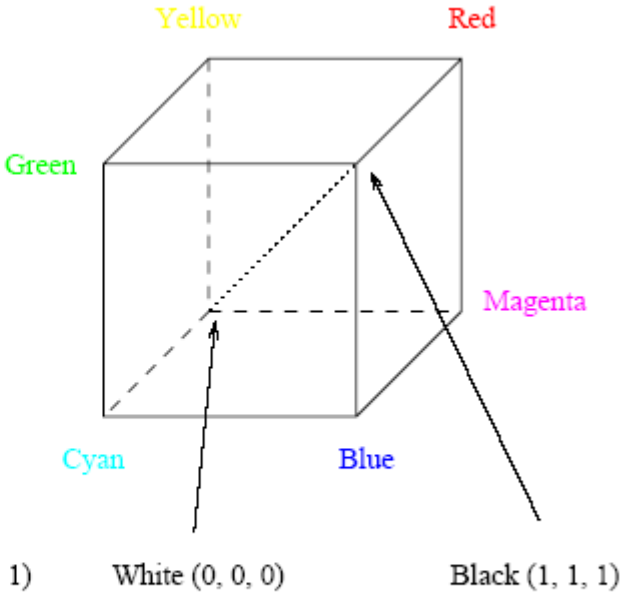


Fig. 4.16: Additive and subtractive color. (a): RGB is used to specify additive color. (b): CMY is used to specify subtractive color

Primary color of pigments is defined as one that subtracts or absorbs a primary color of light and reflects or transmits the other two.

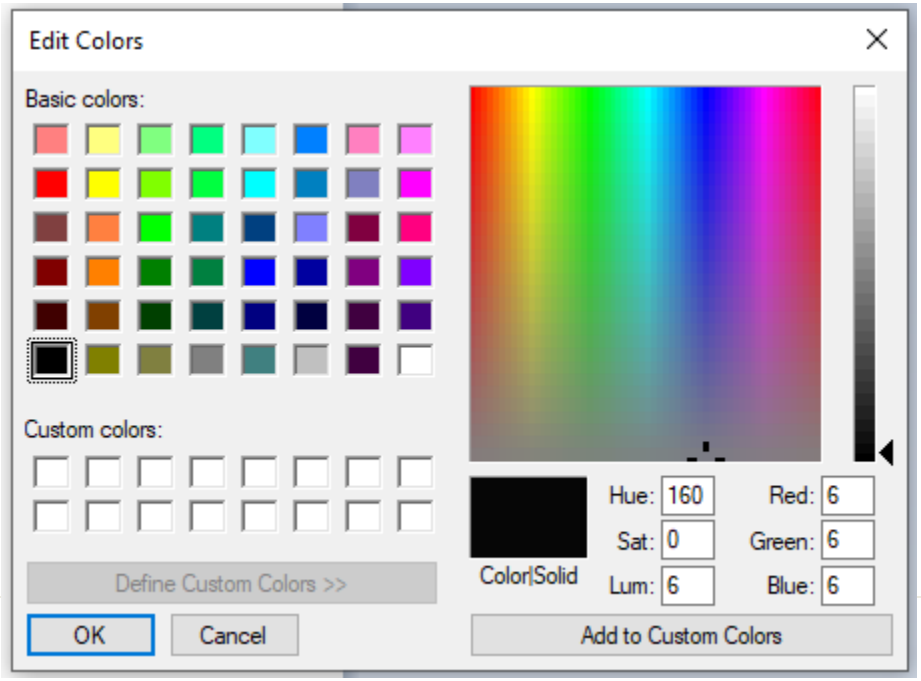


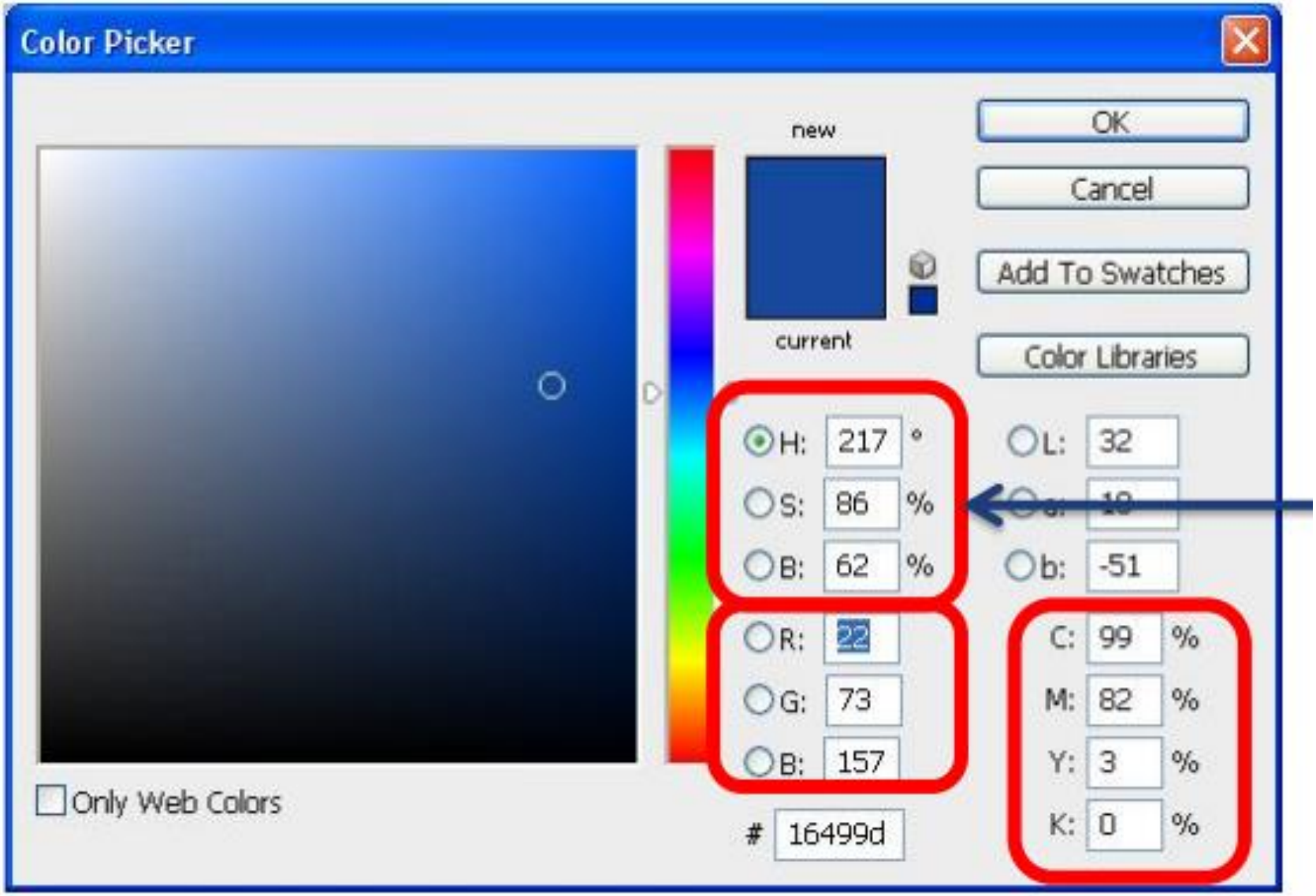
The RGB Cube



The CMY Cube

- So far, we have effectively been dealing only with **additive color**. Namely, when two light beams impinge on a target, their colors add; when two phosphors on a CRT screen are turned on, their colors add.
- But for ink deposited on paper, the opposite situation holds: yellow ink subtracts blue from white illumination, but reflects red and green; it appears yellow.
- **The basic colors in computer as follows:**




Color Picker
new
current
OK
Cancel
Add To Swatches
Color Libraries
H: 217 °
S: 86 %
B: 62 %
R: 22
G: 73
B: 157
L: 32
a: 19
b: -51
C: 99 %
M: 82 %
Y: 3 %
K: 0 %
16499d
Only Web Colors

Subtractive Color: CMY Color Model

- Most devices that deposit colored pigments on paper, such as color printers, require CMY data input or perform an RGB to CMY conversion internally (all colors values have been normalized to the range [0,1]).

$$\begin{bmatrix} C \\ M \\ Y \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

C=1-R

Then the inverse transform is:

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} C \\ M \\ Y \end{bmatrix}$$

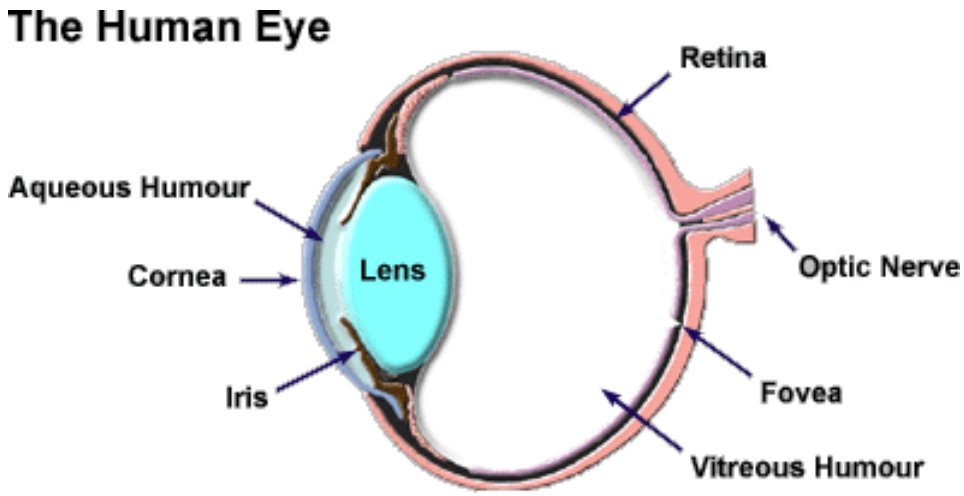
Under-color removal :CMYK System

- Equal amounts of the pigments primaries should produce black. In practice, combining theses colors produces a muddy-looking black. So, in order to produce true black, a fourth color , black, is added, giving rise to the CMYK color models

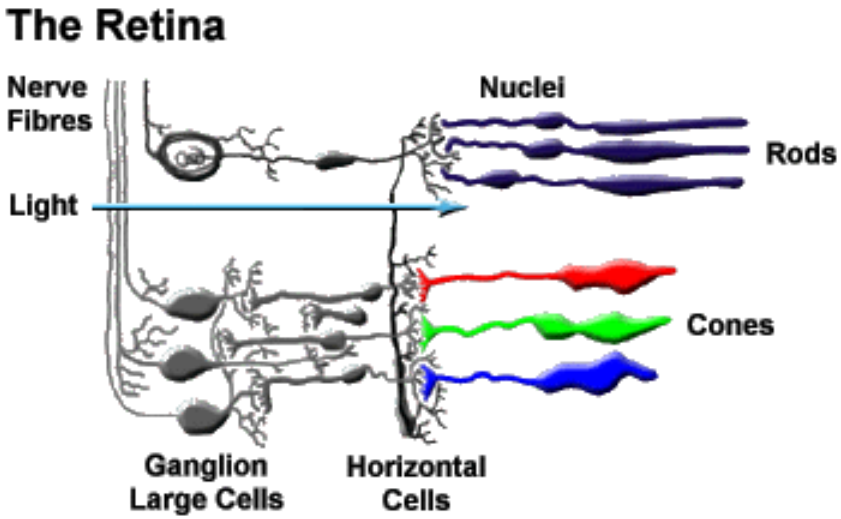
Note:

- RGB and CMY are not well suited for describing colors in terms that are practical for human interpretation.
  - One doesn't refer to the color of a car by giving the percentage of each of the primaries color of it.
- When humans view a color object we describe it by Hue, saturation and brightness.

Human Vision



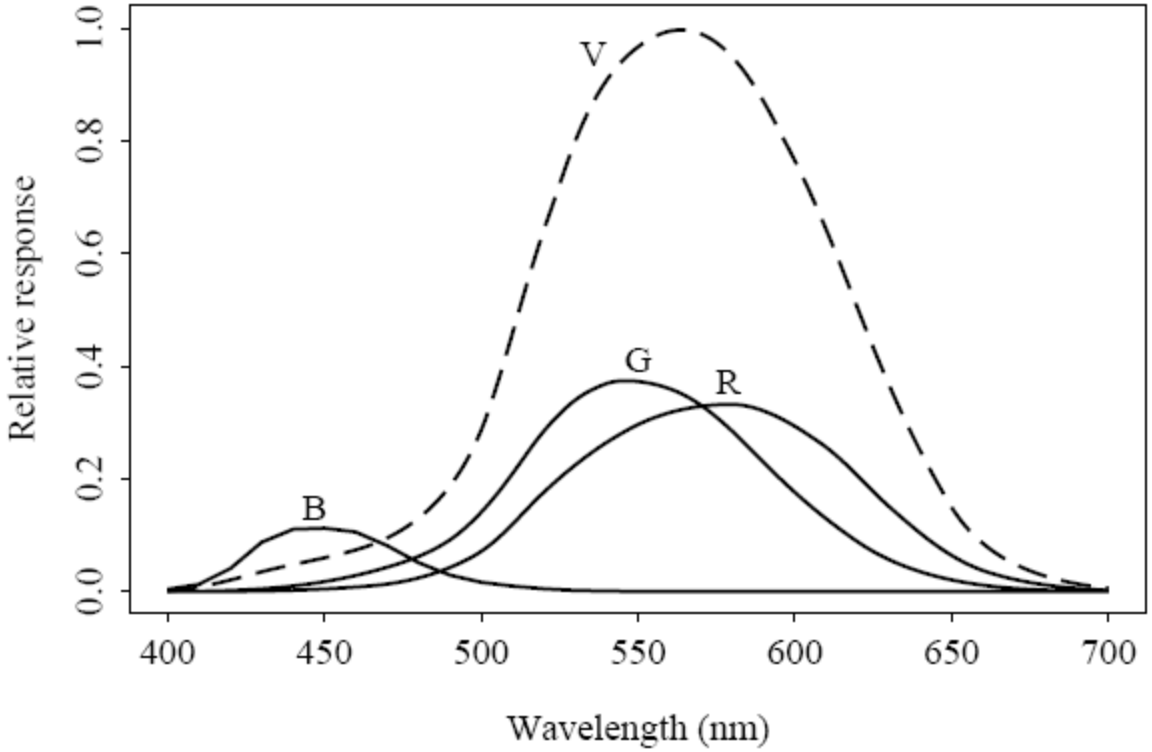
- The eye works like a camera, with the lens focusing an image onto the retina (upside-down and left-right reversed).
- The retina is the inner layer of the eye. It contains the light receptors, the rods and cones (and thus serves as the "film" of the eye). The retina also has many inter-neurons that process the signals arising in the rods and cones before passing them back to the brain.



- Four kinds of light-sensitive receptors in the retina:
  1. Rods : The rods come into play when light levels are low and produce a image in shades of gray
  2. three kinds of **cones**, each "tuned" to absorb light from a portion of the spectrum of visible light
  3. cones that absorb long-wavelength light (red)
  4. cones that absorb middle-wavelength light (green)
  5. cones that absorb short-wavelength light (blue)

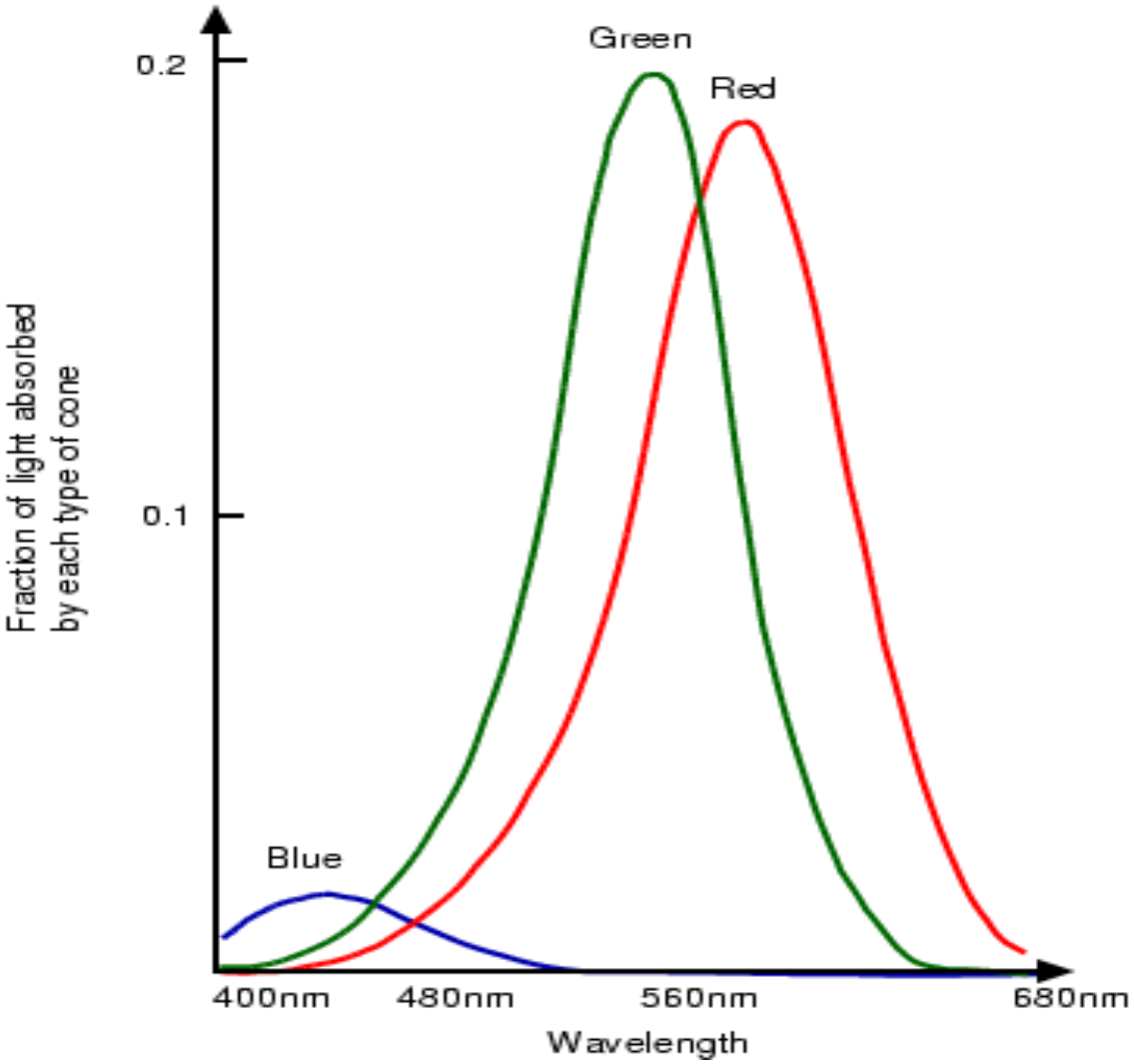
- The eye has about 6 million cones: approximately 65% of all cones are sensitive to red , 33% green and 2% for blue
  - Due to this absorption of light, colors are seen as variable combinations of the so called primary colors (R, G and Blue).
- The **sensitivity** of our receptors is also a function of wavelength (Fig. 4.3).
- The overall sensitivity curve is called the luminous-efficiency function.
  - It is usually denoted $V(\lambda)$ and is formed as the sum of the response curves for Red, Green, and Blue. It gives a measure of the amount of energy an observer perceive from light source.

Fig. 4.3: R,G, and B cones, and Luminous Efficiency curve V(λ).



Note: The Blue receptor sensitivity is not shown to scale because it is much smaller than the curves for Red or Green (see the next fig)

- luminous power measured in lumen (lm). it reaches a maximum at 550 nm and drops to zero for both 380 and 770 nm.


Green
Red
Blue
0.2
0.1
Fraction of light absorbed
by each type of cone
400nm
480nm
560nm
680nm
Wavelength

- These spectral sensitivity functions are usually denoted by letters other than "R; G;B"; here let's use a vector function

$$\mathbf{q}\,(\lambda) = [q_R(\lambda);\ q_G(\lambda);\ q_B(\lambda)]$$

i.e.

$$R = \int E(\lambda)\, q_R(\lambda)\, d\lambda$$

$$G = \int E(\lambda)\, q_G(\lambda)\, d\lambda$$

$$B = \int E(\lambda)\, q_B(\lambda)\, d\lambda$$

For self-luminance object

- The total response of the red channel is the sum over all the light falling on the retina to which the red cone is sensitive, weighted by the sensitivity at that wavelength

Image Formation

- Surfaces reflect different amounts of light at different wavelengths, and dark surfaces reflect less energy than light surfaces.
- The **reflectance** function is denoted **S(λ).**

Image formation is thus:

- Light from the source with SPD E(λ) illuminate on a surface, with surface spectral reflectance function S(λ), is reflected, and then is filtered by the eye's cone functions **q** (λ).
- Reflection is shown in Fig. 4.5 below.
- The function C(λ) is called the **color signal** and consists of the product of E(λ), the illuminant, times S(λ), the reflectance:

$$C(\lambda) = E(\lambda)S(\lambda).$$

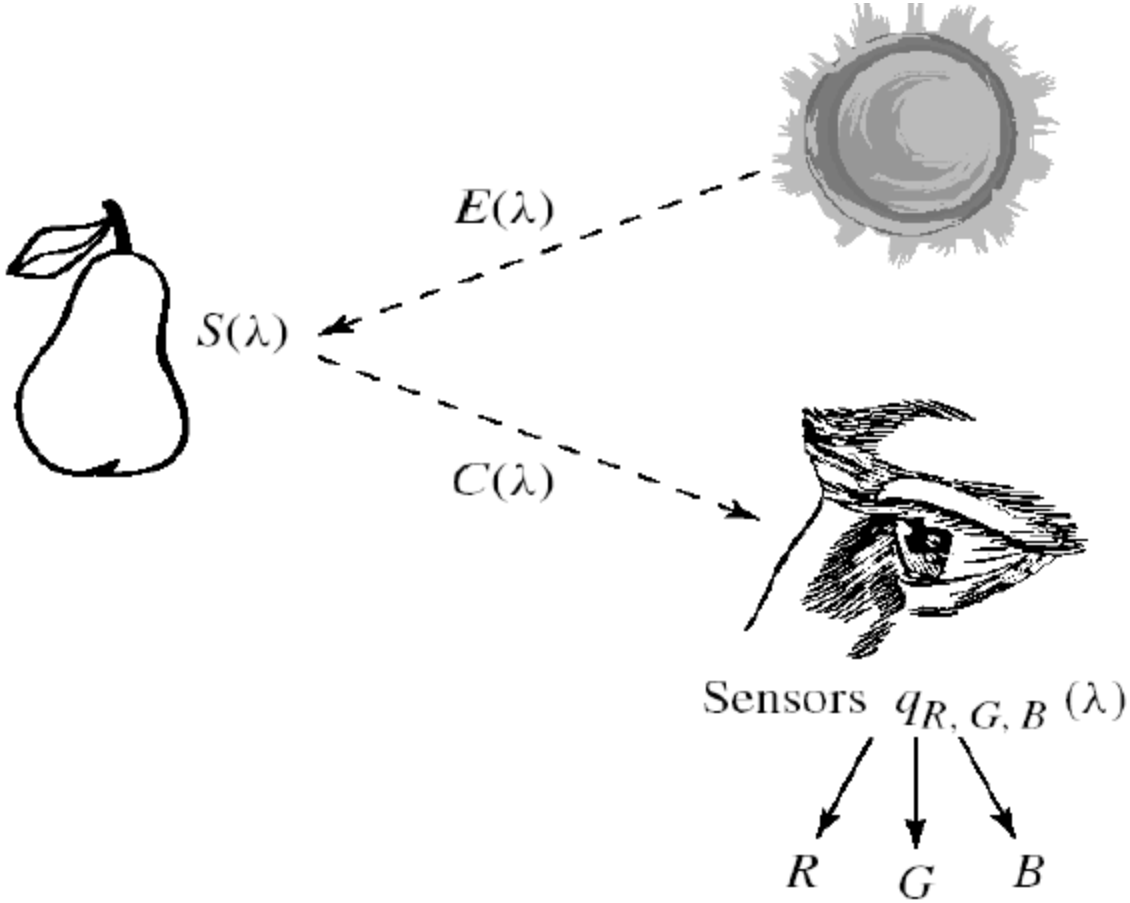


Fig. 4.5: Image formation model.

- The equations that take into account the image formation model are:

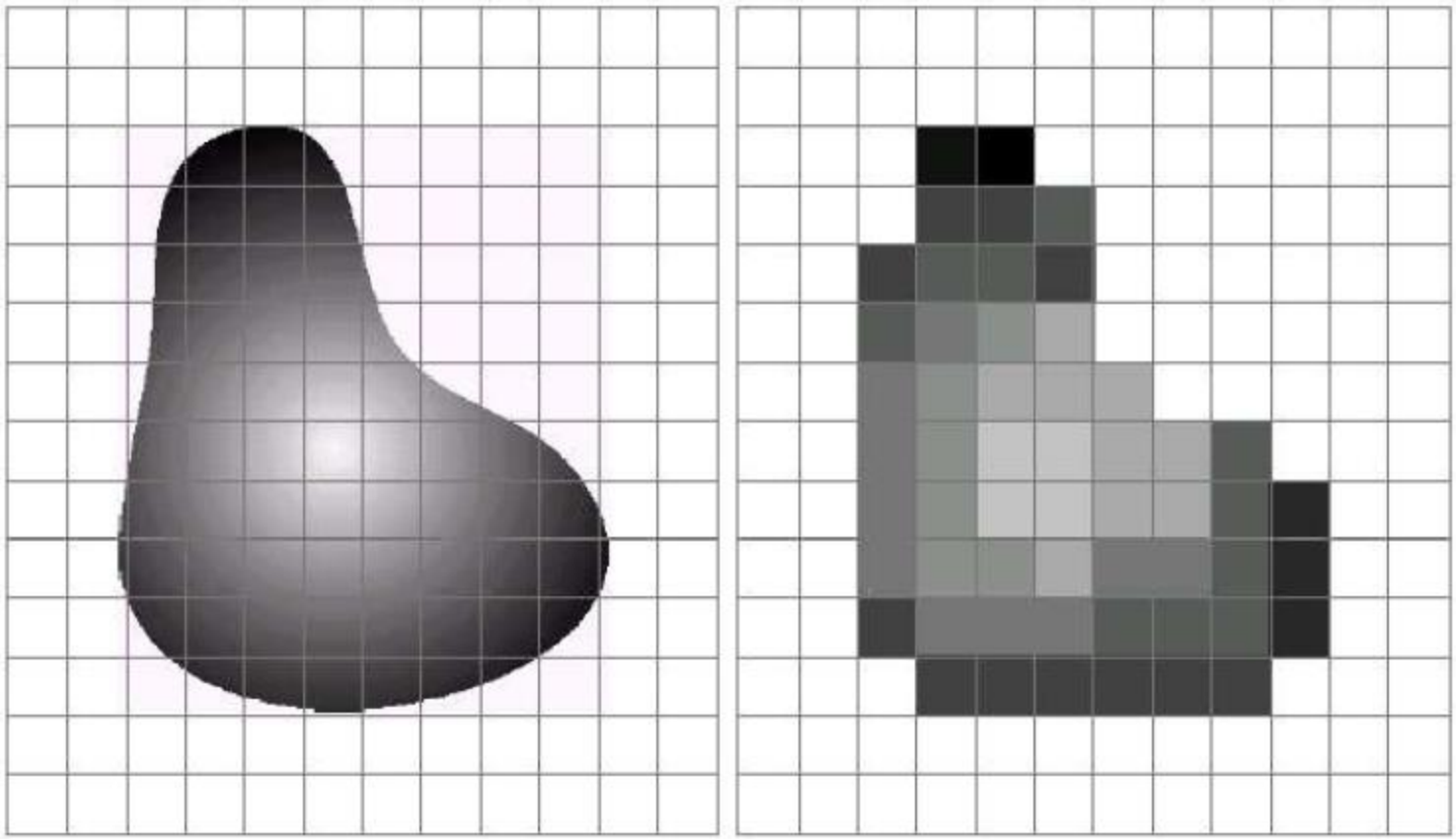
$$R = \int E(\lambda)\, S(\lambda)\, q_R(\lambda)\, d\lambda$$

$$G = \int E(\lambda)\, S(\lambda)\, q_G(\lambda)\, d\lambda$$

$$B = \int E(\lambda)\, S(\lambda)\, q_B(\lambda)\, d\lambda$$

- Three quantities are used to describe the quality of a chromatic light source:
  - **Radiance:** Total amount of energy that flows from light source
  - **Luminance**: The amount of energy an observer perceives from light source.
  - **Brightness**: Achromatic notion of intensity.

- **To create a digital image**: convert the continuous sensed data into digital form. This involves two processes:
  - Sampling: digitizing the coordinate values
  - Quantizing: Digitizing the amplitude values.



The quality of a digital image is determined to a large degree by the number of samples and discrete gray level used in sampling and quantizing.

Color Models in Images

Colors models and spaces used for stored, displayed, and printed images

RGB Color Model

- Used with color monitor and a broad class of color video camera.
- This model is based on a Cartesian coordinate system.
- The number of bits used to represent each pixel in RGB space is called pixel depth.

- Given the variety of systems in current use, it is of considerable interest to have a subset of colors that are likely to be reproduced faithfully, reasonably independently of viewer hardware capabilities. This subset of colors is called the set of **safe RGB colors**, or the set of all-system-safe-colors. In internet, they are called **safe Web colors** or safe browser colors.

No. of colors and image file size

$$colors \quad number = 2^{color \ \ resolution}$$

$$image \quad size = image \quad resolution \quad x \quad color \quad resolution$$

النظام العشري	النظام الثنائي	السادس عشر
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7

تكملة النظام 16

8	1000	8
9	1001	9
A	1010	10
B	1011	11
C	1100	12
D	1101	13
E	1110	14
F	1111	15

تمثيل البكسل الملونة

11011001 00111011 00001111		
11011001	00111011	00001111
الاحمر	اخضر	ازرق

تمثيل البكسل الملونة بنظام الـ16

11011001 00111011 00001111					
11011001		00111011		00001111	
1101	1001	0011	1011	0000	1111
D	9	3	B	0	F
D9		3B		0F	
#D93B0F					

الالوان الاساسية في نظام RGB بالاضافة الى الاسود والابيض

The color	Red	Green	Blue	
Red	255	0	0	
Green	0	255	0	
Blue	0	0	255	
White	255	255	255	
Black	0	0	0	
C	0	255	255	G+B
M	255	0	255	B+R
Y	255	255	0	R+G

CMY System

The color	Y	M	C	
Red	255	255	0	Absorb C and reflect Y,M
Green	255	0	255	
Blue	255	0	0	
White	0	0	0	
Black	255	255	255	المعادلات ادناه من مقارنة الجدولين
C	0	0	255	C=255-R or C=1-R
M	0	255	0	M=255-G
Y	255	0	0	Y=255-B

احتساب قيم CMYK من CMY حيث L تمثل اقل قيمة بين القيم CMY

$$C = \frac{C - L}{255 - L}$$

$$M = \frac{M - L}{255 - L}$$

$$Y = \frac{Y - L}{255 - L}$$

$$K = \frac{L}{255}$$

حول القيم (96,134,200) من النظام RGB الى النظام CMYK

اولا: نجري التحويل من النظام RGB الى النظام CMY ثم من CMY الى النظام CMYK

$$C = 255 - R = 255 - 96 = 159$$

$$M = 255 - G = 255 - 134 = 121$$

$$Y = 255 - B = 255 - 200 = 55$$

$$\therefore CMY = (159,121,55)$$

$$C = \frac{C - L}{255 - L} = \frac{159 - 55}{255 - 55} = 0.52$$

$$M = \frac{M - L}{255 - L} = \frac{121 - 55}{255 - 55} = 0.33$$

$$Y = \frac{Y - L}{255 - L} = \frac{55 - 55}{255 - 55} = 0$$

$$K = \frac{L}{255} = \frac{55}{255} \approx 0.216$$

$$\therefore CMYK = (52\%,33\%,0\%,21.6\%)$$

مثال: حول اللون #7AB50F الى الفضاء اللوني CMY
نقوم بتحويل التمثيل 16 لنظام RGB الى النظام العشري
ثم نقوم بالتحويل من RGB الى CMY

$$(7A)_{16} = 7X16 + 10 = 122 \Rightarrow red$$

$$(B5)_{16} = 11X16 + 5 = 181 \Rightarrow green$$

$$(0F)_{16} = 0X16 + 15 = 15 \Rightarrow blue$$

$$C = 255 - R = 255 - 122 = 133$$

$$M = 255 - G = 255 - 181 = 74$$

$$Y = 255 - B = 255 - 15 = 240$$

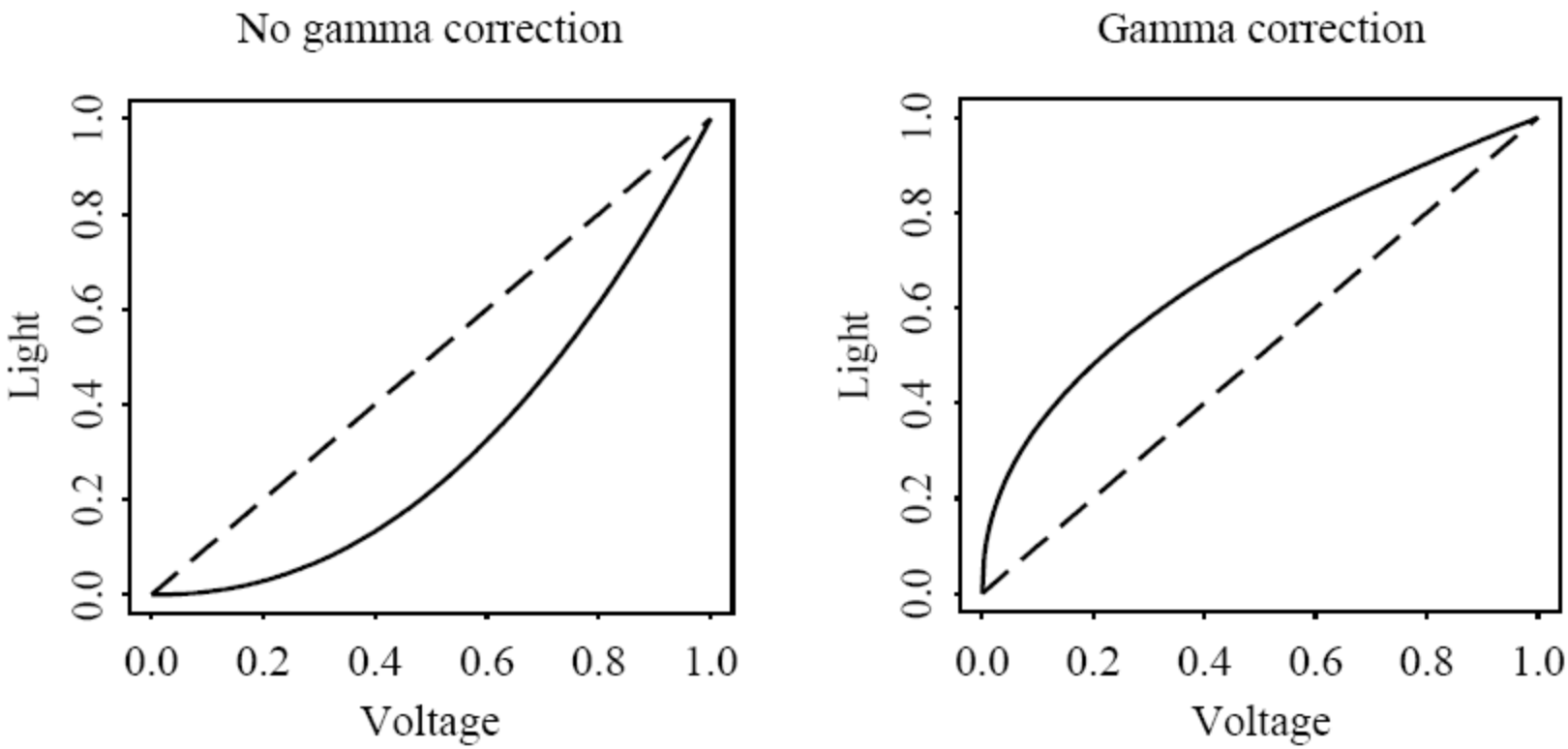
$$\therefore CMY = (133,74,240)$$

Gamma Correction

- The light emitted is -in fact- roughly proportional to the voltage raised to a power; this power is called **gamma**, with γ symbol.
- The value of gamma is 2.2.
- Thus, if the file value in the red channel is R, the screen emits light proportional to R^{γ}.
- To correct the signal (**gamma-corrected):** raise it to the power (1/ γ) before transmission. Thus we arrive at **linear signals**.

$$R \rightarrow R' = R^{1/\gamma} \Rightarrow (R')^{\gamma} \rightarrow R$$

- Fig. 4.6(a) shows light output with no gamma-correction applied. We see that darker values are displayed too dark. This is also shown in Fig. 4.7(a), which displays a linear ramp from left to right.
- Fig. 4.6(b) shows the effect of pre-correcting signals by applying the power law $R^{1/\gamma}$; it is customary to normalize voltage to the range [0,1].



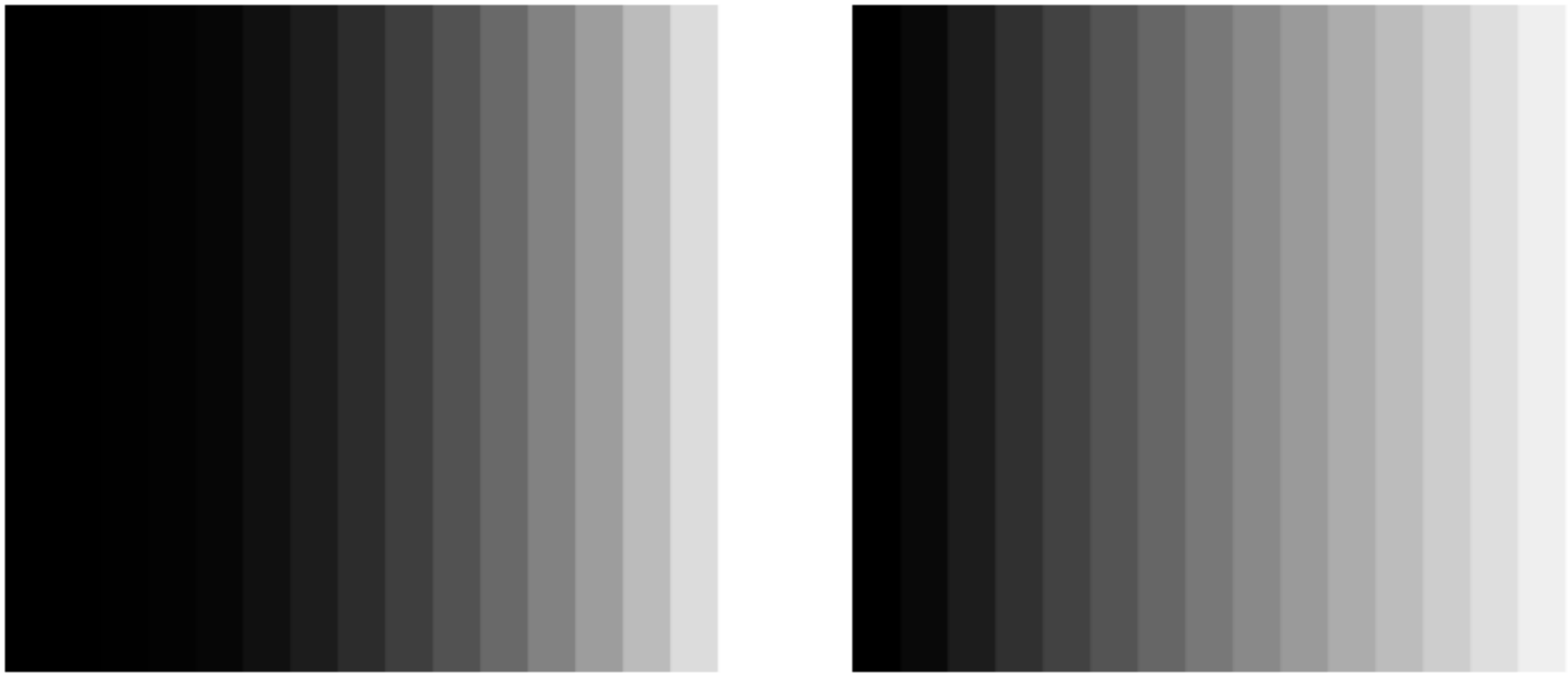


Fig. 4.7: (a): Display of ramp from 0 to 255, with no gamma correction. (b): Image with gamma correction applied

- **The end**

Multimedia course
Lect. 13

- **Macromedia Flash**

- About M. flash
- What is M. flash
- M.Flash documents
- M. Flash file types
- What you can do with M. Flash
- M. Flash applications and basic steps
- Why learn M. flash and programming?
- M.Flash workspace
- Important information

About M. Flash

- M. Flash is an authoring tool that lets you create anything from a simple animation to a complex, interactive web application such as an online store. You can make your Flash applications media rich by adding pictures, sound, and video. Flash includes many features that make it powerful but easy to use, such as drag-and-drop user interface components, built-in behaviors that add ActionScript to your document, and special effects that you can add to objects.
- When you author in Flash you work in a Flash document, a file that, when saved, has the file extension .fla. When you are ready to deploy your Flash content, you publish it, creating a file with the extension .swf. Flash Player, described in the next section, runs the SWF file.

What is M. Flash

- M. Flash is an authoring tool that designers and developers use to create presentations, applications, and other content that enables user interaction. Flash projects can include simple animations, video content, complex presentations, applications, and everything in between. In general, **individual pieces of content made with Flash are called *applications***, even though they might only be a basic animation. You can make media-rich Flash applications by including pictures, sound, video, and special effects

Flash is extremely well suited to creating content for delivery over the Internet because its files are very small. Flash achieves this through its extensive use of vector graphics.

Vector graphics require significantly less memory and storage space than bitmap graphics because they are represented by mathematical formulas instead of large data sets.

Bitmap graphics are larger because each individual pixel in the image requires a separate piece of data to represent it.

To build an application in Flash, you create graphics with the Flash drawing tools and import additional media elements into your Flash document. *Next, you define how and when you want to use each of those elements to create the application you have in mind.*

When you author content in Flash, you work in a Flash document file. Flash documents have the file extension .fla (FLA). A Flash document has four main parts:

The Stage is where your graphics, videos, buttons, and so on appear during playback. The Stage is described further in Flash Basics.

The Timeline is where you tell Flash when you want the graphics and other elements of your project to appear. You also use the Timeline to specify the layering order of graphics on the Stage. Graphics in higher layers appear on top of graphics in lower layers.

The Library panel is where Flash displays a list of the media elements in your Flash document.

ActionScript code allows you to add interactivity to the media elements in your document. For example, you can add code that causes a button to display a new image when the user clicks it. You can also use ActionScript to add logic to your applications. Logic enables your application to behave in different ways depending on the user's actions or other conditions. Flash includes two versions of ActionScript, each suited to an author's specific needs. For more information about writing ActionScript, see *Learning ActionScript 2.0 in Flash* in the Help panel.

Flash includes many features that make it powerful but easy to use, such as prebuilt drag-and-drop user interface components, built-in behaviors that let you easily add ActionScript to your document, and special effects that you can add to media objects.

When you have finished authoring your Flash document, you publish it using the File Publish command. This creates a compressed version of your file with the extension .swf (SWF). You can then use Flash Player to play the SWF file in a web browser or as a stand-alone application. For an introduction to Flash Player, see About Flash Player.

About Flash files

The primary Flash file type, FLA files, contain three basic types of information that comprise a Flash document. These include the following:

Media objects are the various graphic, text, sound and video objects that comprise the content of your Flash document. By importing or creating these elements in Flash and then arranging them on the Stage and in the Timeline, you define what the viewer of your document will see and when they will see it.

The Timeline is the place in Flash where you tell Flash when specific media objects should appear on the Stage. The Timeline is like a spreadsheet that progresses from left to right, with the columns representing time. The rows represent layers, with the content in higher layers appearing above lower layers' contents on the Stage.

ActionScript code is the programming code you can add to Flash documents to make them respond to user interactions and to more finely control the behavior of your Flash documents. Much can be accomplished in Flash without ActionScript, but using ActionScript offers many more possibilities.

Flash can be used to work with a variety of file types. Each type has a separate purpose. The following list describes each file type and its uses:

- FLA files are the primary files you work with in Flash. These are the files that contain the basic media, timeline, and script information for a Flash document.
- SWF files are the compressed versions of FLA files. These files are the ones you display in a web page.
- AS files are ActionScript files. You can use these files if you prefer to keep some or all of your ActionScript code outside of your FLA files. These can be helpful for code organization and for projects that have multiple people working on different parts of the Flash content.
- SWC files contain the reusable Flash components. Each SWC file contains a compiled movie clip, ActionScript code, and any other assets that the component requires.
- ASC files are files used to store ActionScript that will be executed on a computer running Flash Communication Server. These files provide the ability to implement server-side logic that works in conjunction with ActionScript in a SWF file.

- JSFL files are JavaScript files that you can use to add new functionality to the Flash authoring tool. See *Extending Flash* for more information.
- FLP files are Flash Project files (Flash Professional only). You can use Flash Projects to manage multiple document files in a single project. Flash Projects allow you to group multiple, related files together to create complex applications.

What you can do with Flash

With the wide array of features in Flash, you can create many types of applications. The following are some examples of the kinds of applications Flash can generate:

Animations: These include banner ads, online greeting cards, cartoons, and so on. Many other types of Flash applications include animation elements as well.

Games: Many games are built with Flash. Games usually combine the animation capabilities of Flash with the logic capabilities of ActionScript.

User interfaces : Many website designers use Flash to design user interfaces. The interfaces include simple navigation bars as well as much more complex interfaces. You can find an example of a navigation bar created with Flash across the top of the www.macromedia.com home page.

Flexible messaging areas: These are areas in web pages that designers use for displaying information that may change over time. A flexible messaging area (FMA) on a restaurant website might display information about each day's menu specials. You can find an example of an FMA on the www.macromedia.com home page. The tutorial in Tutorial: Building Your First Flash Application guides you through the process of building an FMA.

Rich Internet applications: These include a wide spectrum of applications that provide a rich user interface for displaying and manipulating remotely stored data over the Internet. A rich Internet application could be a calendar application, a price-finding application, a shopping catalog, an education and testing application, or any other application that presents remote data with a graphically rich interface.

You can find many examples of real projects created by Flash users on the Macromedia website at www.macromedia.com/cfusion/showcase/.

To build a Flash application, you typically perform the following basic steps:

1. Decide which basic tasks the application will perform.
2. Create and import media elements, such as images, video, sound, text, and so on.
3. Arrange the media elements on the Stage and in the Timeline to define when and how they appear in your application.
4. Apply special effects to media elements as you see fit.
5. Write ActionScript code to control how the media elements behave, including how the elements respond to user interactions.
6. Test your application to determine if it is working as planned and find any bugs in its construction. Test your application throughout the creation process.
7. Publish your FLA file as a SWF file that can be displayed in a web page and played back with Flash Player.

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Introduction to Flash *with CS3/CS4 & ActionScript 3.0*

(Flash as a design-tool, techniques & timeline-animations)

"What is Flash?" At first, said it was hard to sum that up in just a few words. Then I thought for a moment and replied that Flash was a "powerful animating and programming tool..."

Why learn Flash & programming?

(as an Interaction Designer)

- *Flash is the leading tool/technique for creating multimedia, applications, presentations, games on Internet – a powerful platform for developing systems, prototypes, desktop applications and mobile applications*

Examples of general usage for a designer:

- Presentations / online portfolio
- Video applications for design-projects
- Concept design (with basic interactivity/navigation)
- Interaction interfaces
- Prototype development (usability tests)
- Working in project-teams (communicate with/understand programmers)

Flash workspace

1. Menu
2. Tool panel
3. ActionScript panel
4. Timeline (main)
5. Properties/parameters/output
6. Main toolbar
7. Align/Info/Transform
8. Color/swatches
9. Components
10. Library
11. Main stage
12. Document Properties
13. Frames/tween
14. Object on stage

What is the latest version of Macromedia Flash?

- **Macromedia Flash** is a program that creates interactive, and animated media such as motion graphics, videos, presentations and websites. You can control an object's actions and behaviors using the Behavior panel and the Timeline

- **Macromedia Flash** Player **version**

  The **current version** of **Flash** Player 8 is 8.0. 34.0.

- **What is Macromedia Flash 8?**

- **Macromedia Flash 8**. **Macromedia Flash 8** gives designers a platform to create cartoons, videos, and games that make Web sites dance and sing, and it does so with ease. This **Flash** upgrade facilitates an evolution in the animated Web experience, and it's a must-have for serious site developers.

The Flash Player

- The **Flash** Player was deprecated in 2017 and officially discontinued on December 31, 2020, with many web browsers and operating systems scheduled to remove the **Flash** Player software around the same time. Adobe continues to develop Adobe Animate, which supports web standards such as HTML5 instead of the **Flash** format.
- **HTML5** is lightweight, fast and takes less CPU time to render web pages whereas **Flash** is CPU intensive and not as lightweight as compared to **HTML5**. Audio and Video support with **HTML5** is not in-built whereas **Flash** has nice support for Audio and video formats.
-

Adobe Flash

- Adobe Flash, animation software produced by **Adobe Systems Incorporated**. The development of Adobe Flash software can be traced back to American software developer **Jonathan Gay's** first experiments with writing programs on his Apple II computer in high school during the 1980s.

- www.adobe.com/products/**cs6**.html. Adobe Creative Suite (**CS**) is a discontinued software suite of graphic design, video editing, and web development applications developed by Adobe Systems.

Will Flash still work after 2020?

- Adobe is officially killing **Flash** player on December 31, **2020**. All major browsers **will** remove **Flash** by the end of **2020** or early 2021.
  With **Flash** support ending, websites that offer **Flash**-based content like games and animations **will** have no choice but to remove them too

- Why is Macromedia Flash used?

- **Macromedia Flash** is a program that creates interactive, and animated media such as motion graphics, videos, presentations and websites. You can control an object's actions and behaviors using the Behavior panel and the Timeline.
-

Difference between macromedia flash and adobe flash

- Macromedia flash and Adobe flash are interchangeable terms. When the first flash software was created by FutureWave, it was known as the Future Splash Animator. Then in 1996, it was introduced to the public as **Macromedia Flash** when **Macromedia** purchased it from them**.** Later on, in 2005, the product of was purchased by **Adobe** which has remained under its name ever since.
- Is Macromedia Flash and Adobe flash the same?
- **Flash** was a two-part system, a graphics and animation editor known as **Macromedia Flash**, and a player known as **Macromedia Flash** Player.

- **The end**