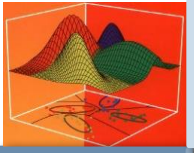
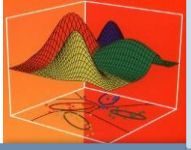


2025 / 2026

IN433
Multimedia Processing

Dr. Zein Al Abidin IBRAHIM

MULTIMEDIA - INTRODUCTION



Lecture Outline

- What is multimedia?
- What is a multimedia application or system?
- Different types of multimedia information
- Possible applications
- Multimedia systems today
  - _Software tools
  - _Hardware devices

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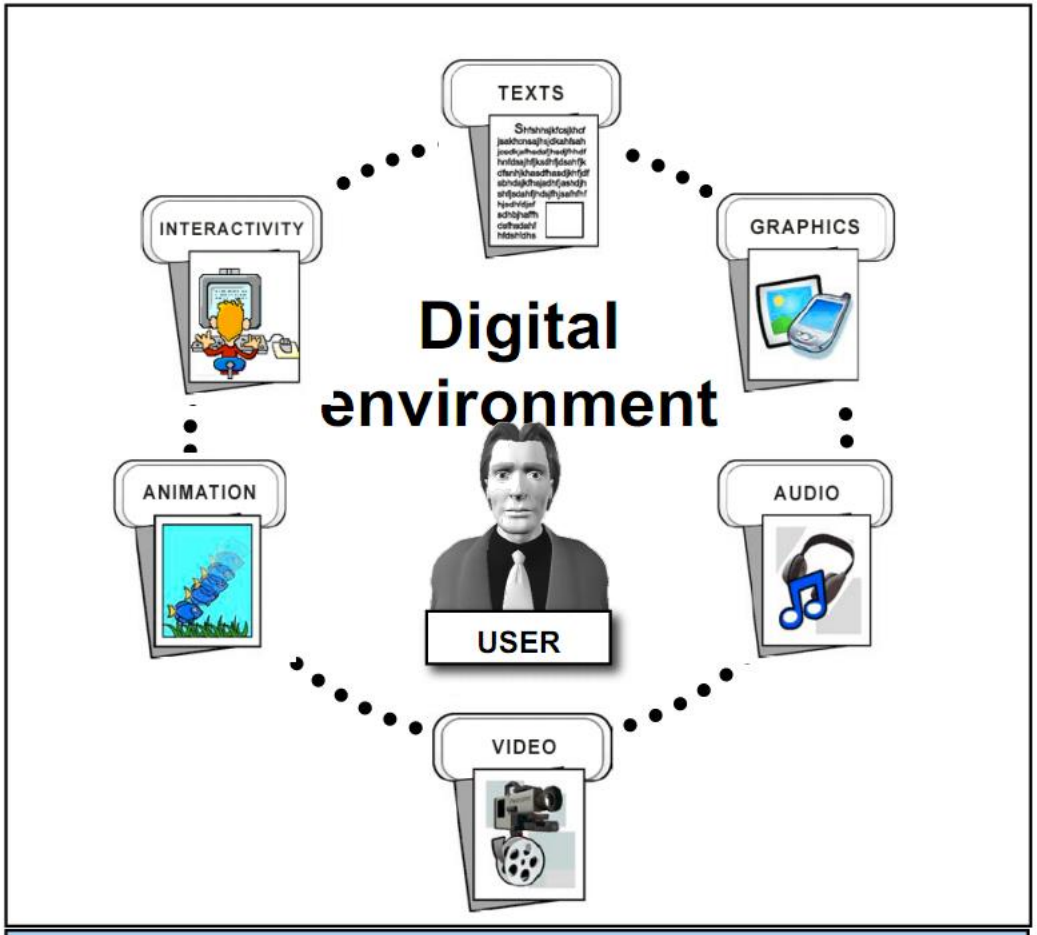
What is Multimedia ?

- Different people: Different viewpoints
  - PC vendor → PC has sound capability, DVD-ROM drive, & perhaps the superiority of multimedia-enabled microprocessors that understand additional multimedia instructions.
  - Consumer entertainment vendor → interactive cable TV with hundreds of digital channels available, or a cable TV-like service delivered over a high-speed Internet connection.
  - Computer Science (CS) student → applications that use multiple modalities, including text, images, drawings (graphics), animation, video, sound including speech, and interactivity.

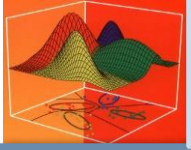
What is Multimedia ?

- Multimedia: a working definition
  - A combination of one (two) or more categories of information having different transport signal characteristics.
  - Text, image, audio, video and graphics are examples of media
  - When you allow the user to control what and when these elements are delivered, it is interactive multimedia.

What is Multimedia ?



Elements of Multimedia



What is a Multimedia Application?

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

A Multimedia System Today

- Examples of Multimedia Applications include:
  - World Wide Web
  - Multimedia Authoring → involves assembling, arranging and presenting information in the structure of a digital multimedia
  - Video-on-demand
  - Interactive TV
  - Computer Games
  - Virtual reality
  - Digital video editing and production systems
  - Multimedia Database systems
  - …..

What is a multimedia system

- A system that involves:
  - generation → production/authoring tools
  - representation → compression and formats
  - storage → file system design
  - transmission → networking issues
  - search and retrieval → database management
  - delivery → server design, streaming

  of multimedia information

Where to use Multimedia?

- Business application
  - presentations, training, marketing, advertising, product demos, simulations, databases, catalogs, ….
- Schools
  - Learning, e-learning,…
- Home
  - CD, DVD, TV, NINTENDO, …..
- Public Places
  - In hotels, train stations, shopping malls, museums, libraries, and stores, multimedia is already available at stand-alone terminals or kiosks, providing information and help for customers.
- Virtual Reality
  - simulation of physical presence in places in the real world,…

History

- The multimedia started to change our ways of communication because of:
  - Availability of low-cost capture devices, rendering devices, and smarter software to create content;
  - Larger, less expensive storage devices along with research in better compression of media content; and
  - Technological advances in digital networks and standardization of distribution protocols.

Processes

- Starting from these three points → three essential processes in multimedia systems:
  - **Multimedia content creation or multimedia authoring →** involves digitizing media (audio, images, video) using capture devices and assembling/processing them using smart software and hardware.
  - **Storage and compression →** Multimedia content has significant memory requirements and has to be engineered so as to minimize necessities for storage and distribution.
    - Compression algorithms and standards for audio, video, images, and graphics.
  - **Distribution →** How multimedia content is distributed via various media, such as wired cables, optical networks, satellite, wireless networks, or any combination thereof, to specific platforms ranging from television, computers, personal digital assistants (PDAs), and so on.

Common properties

- Multimedia information share common properties:
  - **Digital** — All media content are bits and bytes regardless the type.
  - **Voluminous** — Combination of media contents produce large and voluminous content → Storage and transmission needs compression.
  - **Interactive** — Multimedia content can be interactive.
    - From high-level application point of view such as choosing a video to watch or a set of images to browse
    - Down to a low level, where you can click on areas of an image causing an action to be taken.
  - **Real-time and synchronization** — When transmitting content involving different media types → Issue of real-time and synchronization.
- Understanding these properties → core to design good working multimedia applications.

Media types

➢ Different Media Types Used Today

Text

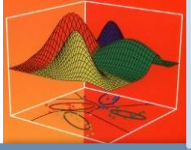
- Large amount of text can be browsed and accessed (example: by internet).
- representation and writing of text information has evolved from simple text to more meaningful and easy-to-read formatted text.
- Today, hypertext is commonly used in digital documents, allowing nonlinear access to information.

Image

- Images consist of a set of units called pixels organized in the form of a two-dimensional array. The two dimensions specify the width and height of the images. Each pixel has bit depth, which defines how many bits are used to represent each pixel.
  - Bit-depth.
  - Formats.
  - Dimensionality.

Video

- Video is represented as a sequence of images. Each image in the sequence typically has the same properties of width, height, and pixel depth + length of video.



Media types

➢ Different Media Types Used Today

Audio

- Digital audio is characterized by a sampling rate in hertz, which gives the number of samples per second. A sample can be defined as an individual unit of audio information.

2D Graphics

- 2D graphic element is represented by 2D vector coordinates and normally has properties such as a fill color, boundary thickness, and so on.

3D Graphics

- 3D graphics largely make use of vector coordinate spaces. 3D graphics concepts and practices have advanced considerably as a science but, until recently, were not a commonplace media type.

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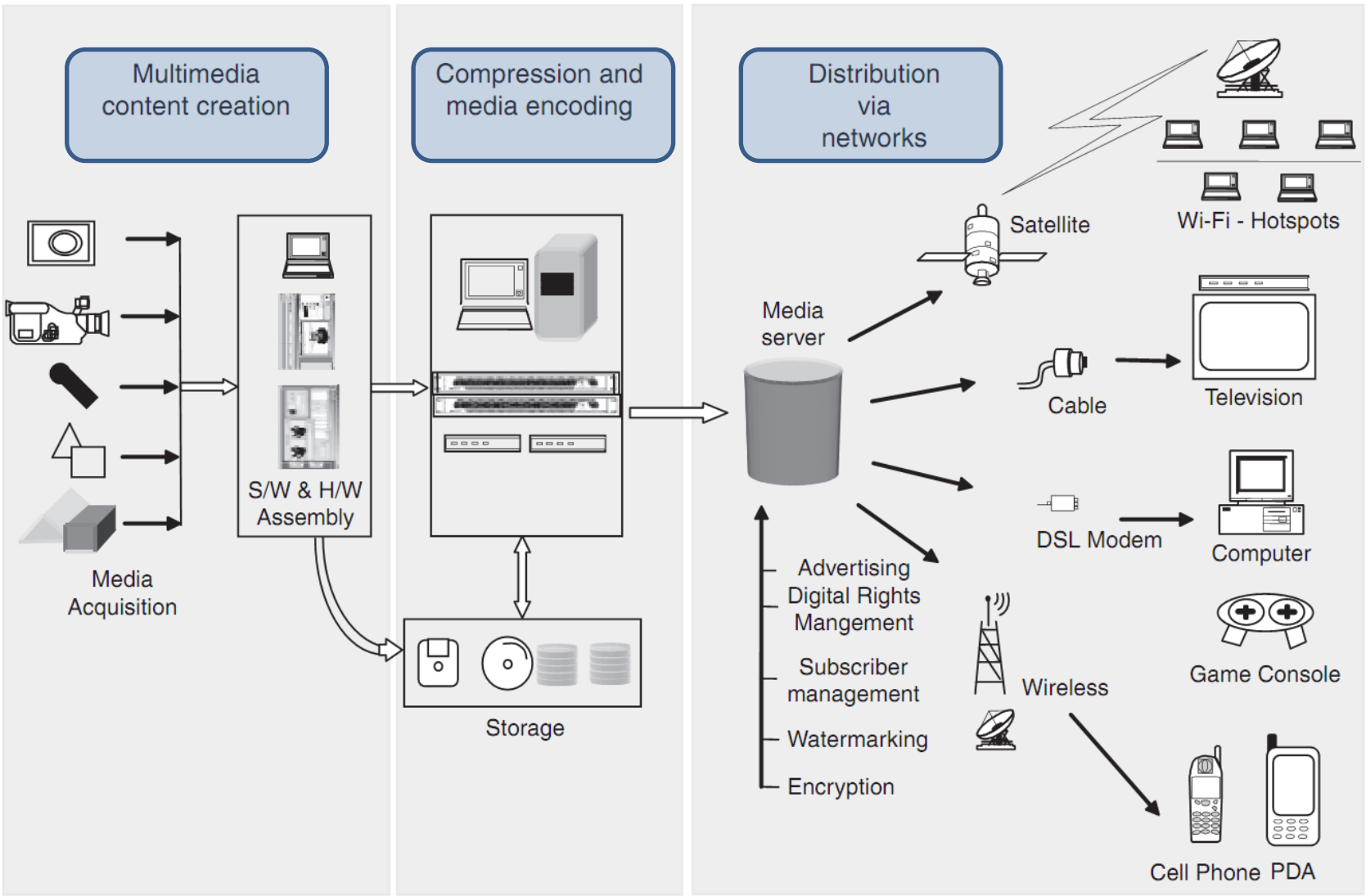
A MULTIMEDIA SYSTEM TODAY: 3 parts

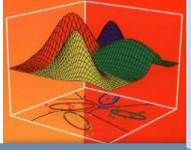


Components of a multimedia system today

Multimedia Software Tools

- The categories of software tools briefly examined here are:

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



Digital Audio

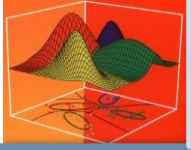
- Digital Audio tools deal with accessing and editing the actual sampled sounds that make up audio:
  - **Adobe Audition**
  - **Ableton Live**
  - **Audacity**

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.
- **GIMP, Figma, …**

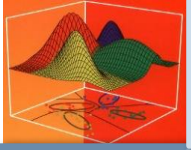
Video Editing

- Adobe Premiere Pro
- DaVinci Resolve
- Final Cut Pro



Animation

- **Multimedia APIs:**
  - **Java3D**
  - **DirectX**
  - **OpenGL**
  - **Unity Engine**
  - **Unreal Engine**



Rendering Tools

- **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.
- **GIF Animation Packages**: a simpler approach to animation, allows very quick development of effective small animations for the web.

Multimedia Authoring

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

New Technologies

- **Generative AI:** The most significant omission is the role of generative AI in multimedia. This includes **text-to-image**, **text-to-audio**, and **text-to-video** models (e.g., Midjourney, Stable Diffusion, DALL-E, Sora). A master's level course should discuss how these tools are changing content creation.

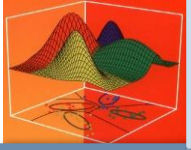
- **Streaming Protocols and Delivery:** The slides mention DSL and Wi-Fi, but a modern course should cover **adaptive bitrate streaming** (HLS, DASH) and content delivery networks (**CDNs**), which are essential for today's media consumption.

New Technologies

- **Virtual and Augmented Reality:** While **Virtual Reality** is mentioned, the topic should be expanded to include modern **Augmented Reality (AR)** and **Mixed Reality (MR)** applications, which are a major part of the multimedia landscape today.

- **Cloud Computing:** A modern multimedia system relies heavily on the cloud for processing, storage, and distribution. Concepts like **cloud-based video encoding** and **serverless architectures for media delivery** should be introduced.

- **Codec Evolution:** The slides mention MPEG, but a detailed discussion should include modern, highly efficient codecs like **HEVC (H.265)** and **AV1**



Multimedia Hardware Peripherals

- Input devices
- Output devices
- Storage devices
- Communication devices
  - Modems
  - Network Interfaces

Components of a Multimedia System

- Components (Hardware and Software) required for a multimedia system:
  1. **Capture devices** — Video Camera, Video Recorder, Audio Microphone, Keyboards, mouse, graphic tablets, 3D input devices, tactile sensors, VR devices + Digitizing Hardware.
  2. **Storage Devices** — Hard disks, CD-ROMs, DVD-ROM, etc.
  3. **Communication Networks** — Local Networks, Intranets, Internet, Multimedia or other special high speed networks.
  4. **Computer Systems** — Multimedia Desktop machines, Workstations, MPEG/VIDEO/DSP Hardware
  5. **Display Devices** — CD, quality speakers, HDTV, SVGA, Hi-Res monitors, Color printers etc…

Multimedia or No?

- Watching MS PowerPoint presentation (95%)
- Playing a video game (100%)
- Drawing and describing a picture to your friend (10%)
- Reading the newspaper in the morning (20%)
- Videoconferencing (100%)
- Watching TV or listening to radio (80%)
- Going to a movie theatre (90%)
- Assembling a car in a garage (0%)
- Browsing/searching using the Internet (100%)
- Having a telephone conversation (60%, voip)