Chapter 1

Introduction to Multimedia
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1.1 What is Multimedia?

- When different people mention the term multimedia, they often have quite different, or even opposing, viewpoints.
  - A PC vendor: a PC that has sound capability, a DVD-ROM drive, and perhaps the superiority of multimedia-enabled microprocessors that understand additional multimedia instructions.
  - A 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.
  - A Computer Science (CS) student: applications that use multiple modalities, including text, images, drawings (graphics), animation, video, sound including speech, and interactivity.

  Multimedia is the use of several different media to convey information (text, audio, graphics, animation, video, and interactivity).

- Multimedia and Computer Science:
  - Graphics, HCI, visualization, computer vision, data compression, graph theory, networking, database systems. Multimedia and Hypermedia
Multimedia Research Topics and Projects

- To the computer science researcher, multimedia consists of a wide variety of topics:

  1. **Multimedia processing and coding**: multimedia content analysis, content-based multimedia retrieval, multimedia security, audio/image/video processing, compression, etc.

  2. **Multimedia system support and networking**: network protocols, Internet, operating systems, servers and clients, quality of service (QoS), and databases.

  3. **Multimedia tools, end-systems and applications**: hypermedia systems, user interfaces, authoring systems.

  4. **Multi-modal interaction and integration**: “ubiquity” — web-everywhere devices, multimedia education including Computer Supported Collaborative Learning, and design and applications of virtual environments.

Current Multimedia Projects

- Many exciting research projects are currently underway. Here are a few of them:

  1. **Camera-based object tracking technology**: tracking of the control objects provides user control of the process.

  2. **3D motion capture**: used for multiple actor capture so that multiple real actors in a virtual studio can be used to automatically produce realistic animated models with natural movement.

  3. **Multiple views**: allowing photo-realistic (video-quality) synthesis of virtual actors from several cameras or from a single camera under differing lighting.

  4. **3D capture technology**: allow synthesis of highly realistic facial animation from speech.
5. **Specific multimedia applications**: aimed at handicapped persons with low vision capability and the elderly — a rich field of endeavor.

6. **Digital fashion**: aims to develop smart clothing that can communicate with other such enhanced clothing using wireless communication, so as to artificially enhance human interaction in a social setting.

7. **Electronic House call system**: an initiative for providing interactive health monitoring services to patients in their homes.

8. **Augmented Interaction applications**: used to develop interfaces between real and virtual humans for tasks such as augmented storytelling.

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**1.2 Multimedia and Hypermedia**

- **History of Multimedia**:

  1. **Newspaper**: perhaps the *first mass communication medium*, uses text, graphics, and images.

  2. **Motion pictures**: conceived in the 1830's in order to observe motion too rapid for perception by the human eye.

  3. **Wireless radio transmission**: Guglielmo Marconi, at Pontecchio, Italy, in 1895.

  4. **Television**: the new medium for the 20th century, established video as a commonly available medium and has since changed the world of mass communications.
5. The connection between computers and ideas about multimedia covers what is actually only a short period:

1960 – Ted Nelson coined the term *hypertext*.

1967 – Nicholas Negroponte formed the *Architecture Machine Group*.

1968 – Douglas Engelbart demonstrated the *On-Line System (NLS)*, another very early hypertext program.

1969 – Nelson and van Dam at Brown University created an early hypertext editor called *FRESS*.

1985 – Negroponte and Wiesner co-founded the *MIT Media Lab*.

1989 – Tim Berners-Lee proposed the *World Wide Web*.

1991 – *MPEG-1* was approved as an international standard for digital video —led to the newer standards, *MPEG-2, MPEG-4*, and further *MPEGs in the 1990s*.

1992 – *JPEG* was accepted as the international standard for digital image compression — led to the new *JPEG2000* standard.

1993 – The University of Illinois National Center for Supercomputing Applications produced *NCSA Mosaic— the first full-fledged browser*. 
1994 – Jim Clark and Marc Andreessen created the Netscape program.

1995 – The JAVA language was created for platform-independent application development.

1996 – DVD video was introduced; high quality full-length movies were distributed on a single disk.

1998 – XML 1.0 was announced as a W3C Recommendation.

1998 – Hand-held MP3 devices first made inroads into consumerist tastes in the fall of 1998, with the introduction of device holding 32MB of flash memory.

2000 – WWW size was estimated at over 1 billion pages.

**Hypermedia and Multimedia**

- A hypertext system: meant to be read nonlinearly, 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.

• **Examples of typical present multimedia applications include:**
  – Digital video editing and production systems.
  – Electronic newspapers/magazines.
  – On-line reference works: e.g. encyclopedia, games, etc.
  – Home shopping.
  – Interactive TV.
  – Video conferencing.

1.3 **World Wide Web**

• **The W3C has listed the following goals for the WWW:**

  1. Universal access of web resources (by everyone everywhere).

  2. Effectiveness of navigating available information.

  3. Responsible use of posted material.

• **History of the WWW**

  1960s – Charles Goldfarb et al. developed the Generalized Markup Language (**GML**) for IBM.

  1986 – The ISO released a final version of the Standard Generalized Markup Language (**SGML**).
1990 – Tim Berners-Lee invented the HyperText Markup Language (HTML), and the HyperText Transfer Protocol (HTTP).

1993 – NCSA released an alpha version of Mosaic based on the version by Marc Andreessen for X-Windows — the first popular browser.

1994 – Marc Andreessen et al. formed Mosaic Communications Corporation — later the Netscape Communications Corporation.

1998 – The W3C accepted XML version 1.0 specifications as a Recommendation

**HTTP (HyperText Transfer Protocol)**

- **HTTP**: a protocol that was originally designed for transmitting hypermedia, but can also support the transmission of any file type.

- The **URI** (Uniform Resource Identifier): an identifier for the resource accessed, e.g. the host name, always preceded by the token “http://”.

- Two popular methods: **GET** and **POST**.

- Two commonly seen **status codes**:
  1. **200 OK** — the request was processed successfully.
  2. **404 Not Found** — the URI does not exist.
1.4 Overview of 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

Music Sequencing and Notation

- Cakewalk: now called Pro Audio. 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.
Digital Audio

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

  - **Cool Edit**: a very powerful and popular digital audio toolkit; emulates a professional audio studio — multi-track productions and sound file editing including digital signal processing effects.

  - **Sound Forge**: a sophisticated PC-based program for editing audio WAV files.
  - **Pro Tools**: a high-end integrated audio production and editing environment — MIDI creation and manipulation; powerful audio mixing, recording, and editing software.

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.
Video Editing

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

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

- **Final Cut Pro**: a video editing tool by Apple; Macintosh only.

Animation

- **Multimedia APIs**:
  
  - **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.
    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.
• **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.