

ECE160 / CMPS182

Multimedia

Spring 2008

Text: Fundamentals of Multimedia
Li and Drew, Prentice Hall

Structure

- Lectures: Tuesday and Thursday 5pm-6:15pm
- Discussion/Lab: **Wednesday** 1:15pm-4pm and 4pm-7pm
 - TA Office Hours: Nathan : Monday 1:30-2:30pm, Phelps 1435
Sandeep: Friday 1:30-2:30pm, Phelps 1435
- Assignments:
 - One per week, not first or last week
- Four Projects:
 - Video Editing
 - Audio Synthesis
 - Rendering
 - Animation
- Grading: Assignments 20%, Projects 50%, Midterm 10%, Final 20%

Introduction

- What is Multimedia
- Presentation
 - Hypermedia
- Internet and Web
- Multimedia Tools
 - Editing
 - Synthesis

What is Multimedia?

- When different people mention the term **multimedia**, they 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 student: applications that use multiple modalities, including text, images, drawings (graphics), animation, video, sound including speech, and interactivity.

What is Multimedia?

- One or more of
 - Video
 - Images
 - Text
 - Audio
 - Music
 - Speech
 - Touch
 - Taste (unlikely)
 - Smell (I hope not)

What is Multimedia?

- Digitization, encoding, compression, transmission, presentation of multimedia
- Synthesis of multimedia
- Recognition, indexing and retrieval of multimedia

Applications of Multimedia

- Interactive Entertainment
- Video teleconferencing.
- Education and Training
- Tele-medicine.
- Co-operative work environments.
- Searching in very large video and image databases for target visual objects.
- Augmented reality: placing real-appearing computer graphics and video objects into scenes.
- Including audio cues for where video-conference participants are located.
- Building searchable features into new video
- Enabling very high- to very low- bit-rate use of scalable multimedia.
- Making multimedia components *editable*.
- Building inverse-Hollywood applications that can recreate the process by which a photograph, video or audio was made.
- Using voice-recognition to build an interactive environment.

Multimedia Topics

- **Multimedia processing and coding:**
multimedia content analysis, multimedia security, content-based multimedia retrieval, audio/image/video processing, compression, etc.
- **Multimedia system support and networking:**
network protocols, Internet, operating systems, servers and clients, quality of service (QoS), and databases.
- **Multimedia tools, end-systems and applications:**
hypermedia systems, user interfaces, authoring systems.
- **Multi-modal interaction and integration:**
ubiquity web-everywhere devices.

Multimedia Research

- **Camera-based object tracking technology:** tracking of the control objects provides user control of the process.
- **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.
- **Multiple views:** allowing photo-realistic (video-quality) synthesis of virtual actors from several cameras or from a single camera under differing lighting.
- **3D capture technology:** allow synthesis of highly realistic facial animation from speech.

Multimedia Research

- **Specific multimedia applications:** aimed at handicapped persons with low vision capability and the elderly, a rich field of endeavor.
- **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.
- **Electronic Housecall system:** an initiative for providing interactive health monitoring services to patients in their homes
- **Augmented Interaction applications:** used to develop interfaces between real and virtual humans for tasks such as augmented storytelling.

History of Multimedia Technology

- **Musical instruments**
- **Printing**
- **Newspaper**: perhaps the first mass communication medium, uses text, graphics, and images.
- **Motion pictures**: conceived of in 1830's in order to observe motion too rapid for perception by the human eye.
- **Wireless radio transmission**: Guglielmo Marconi, at Pontecchio, Italy, in 1895.
- **Television**: the new medium for the 20th century, established video as a commonly available medium and has since changed the world of mass communications.
- The **connection** between **computers** and **ideas about multimedia** covers what is actually only a short period

History of Computers and Multimedia

1945 - Vannevar Bush wrote a landmark article describing what amounts to a hypermedia system called **Memex**.

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 (and also bit mapped display and mouse).

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

1976: The MIT Architecture Machine Group proposed a project entitled **Multiple Media** - resulted in the *Aspen Movie Map*, the first hypermedia videodisk, in 1978.

History of Computers and Multimedia

1985: Negroponte and Wiesner founded the **MIT Media Lab**.

1989: Tim Berners-Lee proposed the **World Wide Web**

1990: Kristina Hooper Woolsey headed the **Apple Multimedia Lab**.

1991: **MPEG-1** approved as an international standard for digital video - led to the newer standards, **MPEG-2**, **MPEG-4** in the 1990s.

1991: **PDAs** began a new period in the use of computers in multimedia.

1992: **JPEG** accepted as the international standard for digital image compression - led to the new JPEG2000 standard.

1992: The first **MBone** audio multicast on the Net was made.

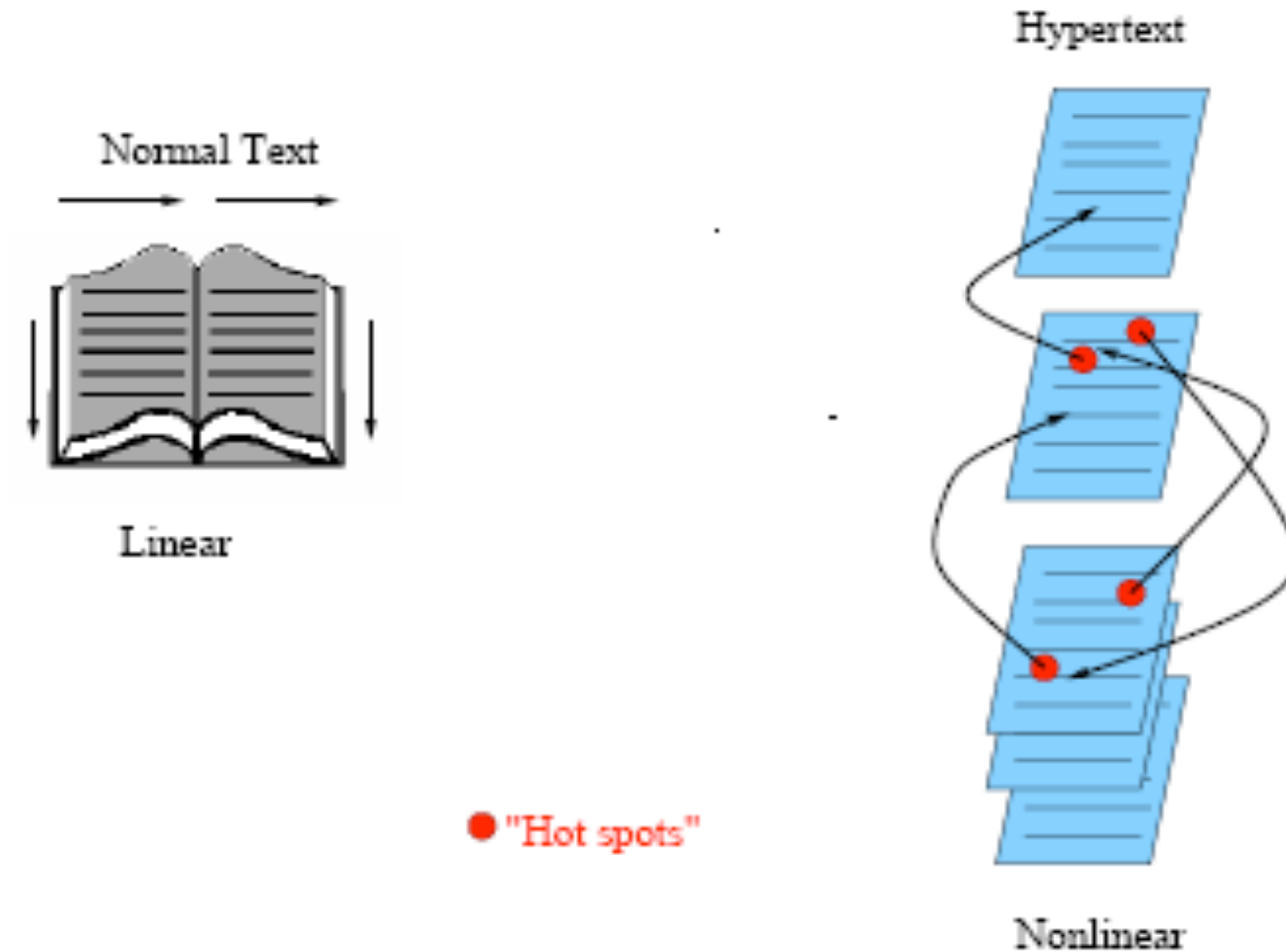
History of Computers and Multimedia

- 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 **Netscape**.
- 1995: **JAVA** for platform-independent application development.
- 1996: **DVD video** - high quality full-length movies on a single disk.
- 1998: **XML** 1.0 was announced as a W3C Recommendation.
- 1998: **Hand-held MP3 devices** first inroad into consumer tastes, with devices 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.

Hypertext is nonlinear



World Wide Web

The W3C has listed the following goals for the WWW:

- Universal access of web resources (by everyone every-where).
- Effectiveness of navigating available information.
- Responsible use of posted material.

History of the WWW

- 1960s: Charles Goldfarb developed the Generalized Markup Language (**GML**) for IBM.
- 1986: ISO released 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 **Mosaic** by Marc Andreessen for X-Windows - the first popular browser.
- 1994: Marc Andreessen formed Mosaic Communications Corporation - later **Netscape**.
- 1998: The W3C accepted **XML** 1.0 specification (XHTML) as the main focus of W3C and supersedes HTML.

HTTP

(HyperText Transfer Protocol)

- **HTTP**: a protocol that was originally designed for transmitting hypermedia, but can also support the transmission of any file type.
- HTTP is a **stateless** request/response protocol: no information carried over for the next request.
- The basic request format:
 - Method URI Version
 - Additional-Headers:
 - Message-body
- The **URI** (Uniform Resource Identifier): an identifier for the resource accessed, e.g. the host name, always preceded by the token "http://".

HTTP

(HyperText Transfer Protocol)

- Two popular methods: **GET** and **POST**.
- The basic response format:
 - Version Status-Code Status-Phrase
 - Additional-Headers
 - Message-body
- Two commonly seen **status codes**:
 1. **200 OK** - the request was processed successfully.
 2. **404 Not Found** - the URI does not exist.

HTML

(HyperText Markup Language)

- **HTML**: a language for publishing Hypermedia on the World Wide Web - defined using SGML:
 1. HTML uses ASCII, it is portable to all different (possibly binary incompatible) computer hardware.
 2. The current version of HTML is version 4.01.
 3. The next generation of HTML is XHTML - a reformulation of HTML using XML.
- HTML uses **tags** to describe document elements:
 - `<token params>` | defining a starting point,
 - `</token>` | the ending point of the element.
 - Some elements have no ending tags.

HTML

(HyperText Markup Language)

- A very simple HTML page is as follows:

```
<HTML> <HEAD>
```

```
<TITLE>
```

A sample web page.

```
</TITLE>
```

```
<META NAME = "Author" CONTENT = "Cranky Professor">
```

```
</HEAD> <BODY>
```

```
<P>
```

We can put any text we like here, since this is a paragraph element.

```
</P>
```

```
</BODY> </HTML>
```

- Naturally, HTML has more complex structures and can be mixed in with other standards.

XML

(Extensible Markup Language)

- **XML**: a markup language for the WWW in which there is modularity of data, structure and view so that user or application can be able to define the tags (structure).
- Example of using XML to retrieve stock information from a database according to a user query:
 1. First use a global Document Type Definition (**DTD**) that is already defined.
 2. The server side script will abide by the DTD rules to generate an XML document according to the query using data from your database.
 3. Finally send user the *XML Style Sheet* (XSL) depending on the type of device used to display the information.

XML

(Extensible Markup Language)

- The current XML version is XML 1.0, approved by the W3C in Feb. 1998.
- XML syntax looks like HTML syntax, although it is much more strict:
 - All tags are in lower case, and a tag that has only inline data has to terminate itself, i.e., `<token params />`.
 - Uses name spaces so that multiple DTDs declaring different elements but with similar tag names can have their elements distinguished.
 - DTDs can be imported from URIs as well.

XML

(Extensible Markup Language)

- An example of an XML document structure | the definition for a small XHTML document:

```
<?xml version="1.0" encoding="iso-8859-1"?>
```

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0"  
    "http://www.w3.org/TR/xhtml1/DTD/xhtml1  
    transition.dtd">
```

```
<html xmlns="http://www.w3.org/1999/xhtml">
```

```
... [html that follows
```

```
    the above mentioned
```

```
    XML rules]
```

```
</html>
```

XML

(Extensible Markup Language)

- The following XML related specifications are also standardized:
 - **XML Protocol**: used to exchange XML information between processes.
 - **XML Schema**: a more structured and powerful language for defining XML data types (tags).
 - **XSL**: basically Cascading Style Sheets for XML.
 - **SMIL**: synchronized Multimedia Integration Language, pronounced “smile” - a particular application of XML (globally predefined DTD) that allows for specification of interaction among any media types and user input, in a temporally scripted manner.

SMIL (Synchronized Multimedia Integration Language)

- **Purpose of SMIL:** To publish multimedia presentations using a markup language.
- A multimedia markup language needs to schedule and synchronize different multimedia elements, and define interactivity with the user.
- W3C established a Working Group in 1997 to specify a multimedia synchronization language - SMIL 2.0 was accepted in August 2001.
- SMIL 2.0 is specified in XML using a *modularization* approach similar to the one used in xhtml:

SMIL (Synchronized Multimedia Integration Language)

1. All SMIL elements are divided into modules - sets of XML elements, attributes and values that define one conceptual functionality.
2. In the interest of modularization, not all available modules need to be included for all applications.
3. **Language Profiles:** specifies a particular grouping of modules, and particular modules may have integration requirements that a profile must follow.
 - SMIL 2.0 has a main language profile that includes almost all SMIL modules.

SMIL (Synchronized Multimedia Integration Language)

```
<!DOCTYPE smil PUBLIC "-//W3C//DTD SMIL 2.0"
"http://www.w3.org/2001/SMIL20/SMIL20.dtd">
<smil xmlns= "http://www.w3.org/2001/SMIL20/Language">
<head>
  <meta name="Author" content="Some Professor" />
</head>
<body>
  <par id="MakingOfABook">
    <seq>
      <video src="authorview.mpg" />
      
    </seq>

    <audio src="authorview.wav" />
    <text src="http://www.cs.sfu.ca/mmbook/" />
  </par>
</body>
</smil>
```

Multimedia Software Tools

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.
 - The term **sequencer** comes from older devices that stored sequences of notes (“events”, in MIDI).
 - 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.

Digital Audio

- **Digital Audio** tools for accessing and editing the actual sampled sounds that make up audio:
 - **Cool Edit**: powerful and popular digital audio toolkit; emulates a professional audio studio - multitrack 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.
 - **C-Sound**: professional music synthesis

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 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, superimpositions 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 to and change existing movies. Can add many effects: lighting, shadows, motion blurring; layers.
- **Final Cut Pro:** a video editing tool by Apple; Macintosh only.

Video Rendering

- **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.

Multimedia Authoring

- **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 - 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.