



CS 410/510 Introduction to Multimedia Networking

PORTLAND STATE
UNIVERSITY



Class

- Instructor: Prof. Wu-chi Feng
- Office: FAB 120-22
- Schedule: MW 8:15am – 10:05am
FAB 92
- Web page:
<http://www.cs.pdx.edu/~wuchi/Teaching/410>
To get to Notes
Username: lm@ge
Password: N0tes
**** zero**** in N0tes

PORTLAND STATE
UNIVERSITY

Rest of lecture



- **About me**
- **Administrative**
 - ❖ About the course
 - ❖ Grading / policies
 - ❖ Prerequisite check
- **Lecture**
 - ❖ What is multimedia?
 - ❖ Multimedia history
 - ❖ Motivating multimedia

PORTLAND STATE
UNIVERSITY

Course information



- **Course Information**
 - ❖ Credits: 4 (CS 410), 3 (CS 510)
 - ❖ Prerequisites: CS 201
 - ❖ Text – Course Notes / “Book”
 - ❖ Text (optional):
R. Steinmetz, K. Nahrstedt, Multimedia:
Computing, Communications and
Applications, Prentice Hall.

PORTLAND STATE
UNIVERSITY

Web site



- Web page:

<http://www.cs.pdx.edu/~wuchi/Teaching/410>

To get to Notes

Username: lm@ge

Password: N0tes

**** zero**** in N0tes

PORTLAND STATE
UNIVERSITY

Program assignments



- There will be programming assignments
- Basic requirements
 - ❖ Programming language should be either C or C++
 - ❖ Will be tested on cs.pdx.edu machines (SunOS) *not linux boxes*
 - ❖ You will submit a make file and source code for each assignment
 - ❖ Testing online will be automated so you need to follow directions on assignment sheets

PORTLAND STATE
UNIVERSITY

Grading



- Homeworks and Labs 30%
- Pop Quizzes/Participation 5%
- Quiz #1 (Wed. Oct. 14) 15%
- Quiz #2 (Wed. Nov. 4) 15%
- Final exam 35%

Monday, Dec. 7, 2015

~~8:00-9:50~~

8:15 -

PORTLAND STATE
UNIVERSITY

Policies



- No late homeworks/labs will be accepted without prior approval
- All assignments are due at the beginning of class on the due date
- Do not turn-in assignments by placing them under my door or in my mailbox
- Regrade requests must be made in writing within one week of grading/return
- All work must be your own

PORTLAND STATE
UNIVERSITY

Planned course outline



Week	Topic
1	Introduction Compression Basics - Compression perf., Huffman, RLE
2	Compression Basics - LZW compression Digital Media Basics - Representation, capture
3	Image Compression - GIF, PNG, PPM, Review for quiz Midterm #1
4	Image Compression - JPEG Video Compression Fundamentals – Block-based motion compensation
5	Video Compression – H.261, H.263, MPEG-1 Video Compression – MPEG-2, MPEG-4, H.264, HEVC / H.265, WebM, VP8, Compression wars

PORTLAND STATE
UNIVERSITY



Week	Topic
6	Audio Compression – u-law, MPEG mp3 ; Resource management Midterm #2
7	Resource Management / Real-time Veteran's Day – No Class
8	Networking Overview: TCP, UDP, IP, NATs, IP continuity, mobility Video Streaming Overview; Principles of Interactive Streaming Best Effort Streaming –fundamentals of adaptive streaming
9	Best Effort Streaming Video Conferencing Standards / Systems; H.323, SIP, Skype, WebRTC, Video and NATs, WebRTC
10	Transcoding, Multi-rate video, Video adaptation Stored Video Streaming; DASH

PORTLAND STATE
UNIVERSITY

Multimedia and C

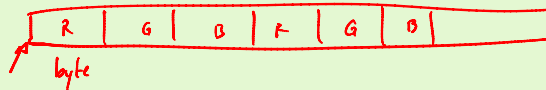


Java + C++ (object oriented programming)

Type checking

Abstraction

A lot of low level MM codes are written in C



PORTLAND STATE
UNIVERSITY

* Mostly for programming assign

Prerequisite check



□ CS 201 - Concepts

✧ Bits / bytes – manipulating in C / C++

`x = 0x0FB8;`

`y = (x & 0x07) << 2;`

1111 1011 1000
 111

 000 << 2
 000 00

✧ Pointers

`unsigned char foo[300];`

`sprintf(foo, "This is a test string\n");`

`unsigned char *x;`

`x = &foo[10];`

`x++; x++;`

`printf(" value [%c]\n", *x);`

foo[10]
 s

PORTLAND STATE
UNIVERSITY

Prerequisite check



□ CS 201 - Concepts

❖ Bit Masks

& operator *AND*
| operator *OR*

Masking n-bits *010110011101*

0x01F

❖ Shifting

<< *>>*

PORTLAND STATE
UNIVERSITY

Prerequisite check



□ CS 201 - Concepts

❖ Computer architecture basics

Memory – registers, cache, main memory

CPU – floating point units

❖ Processes

What are they?

Basic scheduling concepts

PORTLAND STATE
UNIVERSITY

Prerequisite check



- ▣ CS 201 - Concepts
 - ❖ Programming
- We will be programming!!

All grading will be done on cs.pdx.edu machines
(SunOS) boxes

PORTLAND STATE
UNIVERSITY

Lectures



- ▣ Annotated lecture notes will be put on the class web site
 - ❖ You should still come to class 😊
 - ❖ “Book” is being written to the class

PORTLAND STATE
UNIVERSITY

What is multimedia?



Audio Video

PORTLAND STATE
UNIVERSITY

What is multimedia?



- **Businessdictionary.com** - Integration of animation, audio, graphics, text, and full-motion video through computer hardware and software for education, entertainment, or training.
- **Wikipedia.com** - Multimedia is media and content that uses a combination of different content forms. The term can be used as a noun (a medium with multiple content forms) or as an adjective describing a medium as having multiple content forms. The term is used in contrast to media which only use traditional forms of printed or hand-produced material.

PORTLAND STATE
UNIVERSITY

Multimedia definitions



- “If you ask 10 different people for the definition of multimedia, you will certainly get 10 different answers” - G.R. Wichman
- Multimedia - “... computer information that can be represented through audio and/or video, in addition to text, image, graphics and animation”
- “Digital multimedia is the field concerned with the computer-controlled integration of text, graphics, still and moving images, animation, sounds, and any other medium where type of information can be represented, stored, transmitted, and processed digitally”
- “A general term used for documents, applications, presentations, and any information dissemination that uses a combination of techniques, including text, graphics, audio, and video.”

PORTLAND STATE
UNIVERSITY

Is multimedia networking important?



- Video is becoming ubiquitous
 - ❖ Easily capture / share video on smartphones
 - ❖ YouTube
 - 50% increase in video downloads over previous year
 - 6 billion hours of video are watched each month
 - 100 hours of video are uploaded every minute
 - 25% of YouTube watch time is mobile
 - ❖ Cisco
 - Video is dominating all network traffic
 - By 2017, 80-90% of global IP traffic will be video (including P2P, 70% without)
 - By 2017, 70% of mobile bandwidth is delivering video

PORTLAND STATE
UNIVERSITY

Is multimedia networking important?

- Broadcasting companies are finally embracing Internet streaming

- ❖ Many shows available online
- ❖ Live Masters viewing
 - Multiple holes
 - Following select groups
- ❖ NHL playoffs available online
- ❖ NBA playoffs available online



UNIVERSITY

Multimedia computing / networking?

- What are some of its requirements?

- Resource requirements can be large
 - $1920 \times 1080 \approx 2 \text{ m pixels}$
 - RGB $\approx 6 \text{ Mbytes}$
 - $30 \text{ fps} \approx 180 \text{ Mbytes/sec}$
- Synchronization - requirement between components
- Integration of computing system
- Continuity requirement \rightarrow must be done over time

PORTLAND STATE
UNIVERSITY

A motivating example

□ CD-ROM has ~650 Mbytes of storage

✦ CD Audio ~ 74 minutes

✦ MP3's ~ 500 - 740 minutes

✦ Text (100 5 letter words / minute) → ~~3.5 years~~
2.6 years

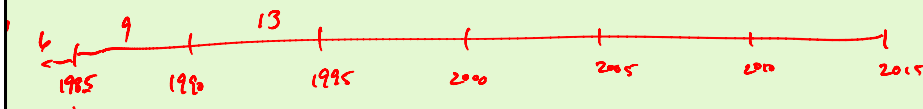
□ Video is much worse!

1920x1080 video uncompressed ≈ 3 sec ~3.65 seconds

720x480 \approx sec ~21.9 seconds

PORTLAND STATE
UNIVERSITY

How old are we?



PORTLAND STATE
UNIVERSITY

Noteworthy events in multimedia



- 1940 – First color television broadcast
 - 1963 – First home video tape recording
 - 1969 – Ted Nelson proposes “Hypertext”.
 - 1974 – Kahn and Cerf propose TCP
 - 1980 – Sony introduces consumer camcorder
 - 1982 – CD-audio is introduced
 - 1983 – TCP/IP is the transport mechanism of the new “Internet”
 - □ 1985 – CD-ROMs introduced
 - 1987 – Apple introduces Hypercard
 - 1988 – Compuserve introduces the graphics interchange format. = GIF
 - 1989 – Tim Berners-Lee proposes World Wide Web based upon the HyperText Markup Language (HTML) to CERN.
 - □ 1989 – MPEG (Motion Pictures Experts Group) standards group formed
- Handwritten notes:*
 80's dig. audio
 very basic images
 digital video

PORTLAND STATE UNIVERSITY

Noteworthy events in multimedia



- 1990 – JPEG image compression format ✓
 - 1990 – ITU standardizes the H.261 video telephony ✓
 - 1991 – MPEG-1 draft approved ✓
 - 1993 – Mosaic web browser released by NCSA
 - 1994 – MPEG-2 standardized by the ISO
 - 1995 – H.263 developed for video conferencing and mobile systems.
 - □ 1995 – Real Networks distributes a “streaming” media player
 - 1995 – NSFnet decommissioned ←
 - 1995 – DVD video format
 - 1996 – RFC 1945 describes HTTP/1.0
 - 1998 – NetMeeting released by Microsoft ←
 - 1999 – Shawn Fanning develops Napster
- Handwritten notes:*
 90's network centric society
 what can we do w/ this for video

PORTLAND STATE UNIVERSITY

Noteworthy events in multimedia



- 2001 – Apple introduce the iPod MP3 player
- 2003 – Wikipedia started
- 2003 – Social networking becomes popular starting with MySpace
- 2003 – Skype released. Solves NAT issues for video communications
- 2004 – Multimedia enabled phones begin to be released.
- 2005 – Facebook launched
- 2006 – YouTube is started.
- 2007 – eBook readers released
- 2007 – NetFlix begins streaming service... primitive
- 2009 – U2 concert streamed by YouTube to 10 million people

*video streaming
takes off*

PORTLAND STATE
UNIVERSITY

Noteworthy events in multimedia



- 2010 – Apple introduces the iPad portable device primarily for consuming multimedia information
- 2010 – Apple introduced FaceTime, Apple's entry into video communications
- 2011 – Skype acquired by Microsoft
- 2011 – Work at the World Wide Web Consortium (W3C) begins work on browser-based multimedia communications
- 2011 – Google starts beta testing Google Hangout, Google's entry into video communications

PORTLAND STATE
UNIVERSITY