

CSc 461/561 Multimedia Systems Overview

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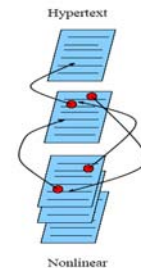
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Multimedia

- Information presented in multiple formats
 - text (structured/unstructured, hypertext, etc)
 - images
 - graphics (drawings)
 - animation
 - audio
 - video
- Discrete/continuous media, interactivity



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Multimedia systems

- Systems that represent, manipulate, deliver multimedia information
- Producer-consumer process
 - capture, represent, transform, compress, store, transmit, ..., reproduce, etc
- Examples
 - world wide web, video conferencing, interactive TV, online games, virtual reality, ...

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Audio representation

- How to digitize analog audio (sound wave)?

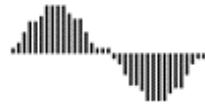
analog signal



44.100 samples per sec at 16Bit



22.000 samples per sec at 16Bit



44.100 sample per sec at 8 bit

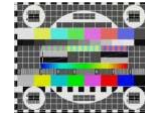
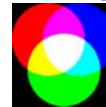
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Image representation

- Digital image is a 2-d array of pixels
- Pixel is represented by bits in “color” space
 - RGB for CRT
 - additive color
 - CMY for printing
 - subtractive color
 - YUV for black-white/color TV
 - luminance/chrominance



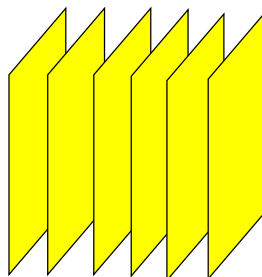
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Video representation

- Video is a sequence of images
 - displayed at a certain rate



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Why multimedia compression

- “A picture is worth a thousand of words!”
 - so is the amount of data
- One-minute audio CD clip
 - sampling rate: 44.1 KHz
 - sample size: 16-bit
 - channels: 2
 - bit-rate: 1.4 Mbps
 - data size: 10.6 MB

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Generic data compression

- Lossless compression
 - no information loss
 - e.g.: executable file compression
 - relatively low compression ratio
- Lossy compression
 - may lose some information
 - e.g.: multimedia data compression
 - usually higher compression ratio

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Multimedia compression

- There is (a lot of) redundancy in multimedia
 - data redundancy
 - how information is represented
 - some formats are better than others
 - information redundancy
 - how human receives the information
 - some information is more important than the other
- To do: remove redundancy *adequately*

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Audio encoding

- Surprisingly, audio is *hard* to compress!
- Sampling
 - Frequency band and sub-bands
- Quantization
 - uniform or non-uniform quantizer, differential
- Encoding
- Standards: ITU-T G.7xx, MP-3, AAC, etc

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Image compression

- Transformation
 - exploit spatial redundancy
- Quantization
 - remove information redundancy
- Encoding
 - remove data redundancy
- Standards: JPEG (1993), JPEG2000, etc

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Video compression

- Video is a sequence of images
 - there is temporal redundancy between frames
- Image compression
 - transformation, quantization, encoding
- Further, for video compression
 - motion estimation, differential
- Standards: MPEG-1/2/4, H.26x, etc

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Generic data networking

- Move data from one location to another
 - elastic, error-free, in-sequence
- TCP/IP-based Internet
 - TCP: flow, error and congestion control
 - IP: addressing and routing
 - Best-effort paradigm
- Applications
 - Telnet, FTP, email, Web, etc

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Why multimedia is different?

- The amount of multimedia data is huge
 - many need certain (minimum) bandwidth
 - some can tolerate packet loss to a certain extent
- Multimedia applications often interactive
 - many have upper bound on end-to-end delay
 - some are sensitive to delay variance (jitter)
- Multimedia may involve multiple endpoints
 - some need multicast support, session mgmt

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Multimedia networking

- Better than “best-effort” paradigms
 - IntServ/RSVP and DiffServ
- Multicast support
 - in network or application layer
- “Realtime” protocols
 - RTP/RTCP, RTSP
- Session management
 - SIP/SDP, media synchronization

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This lecture

- An overview on multimedia systems
 - audio/image/video representation
 - lossless/lossy compression and examples
 - multimedia communication technologies
- After class
 - start to think about your presentation topics

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Next lecture

- Multimedia representation
 - audio [Li&Drew Chap 6]
 - what is sound wave?
 - sampling [6.1.3]
 - quantization [6.1.6]
 - encoding
 - examples
 - PCM [6.3.2], DPCM [6.3.5], ADPCM [6.3.7]