

CSc 461/561
Multimedia Systems
MPEG-1/2/4

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Spring 2015

Course projects (1/3)

- * Victor and Ernest: Skype: A Reality Check!
- * Noel: Research in Automatic Musical Accompaniment
- * Simar, Harneet: Netflix
- * Feng, Shu: Speech recognition: talk with machines
- * Andrew L, Jason C, Samuel: To Print or Not To Print?
- * Riz, Harsh, Sumit, Khushbu: capCast
- * Noah, Murray: Project Panic Beats

Course projects (2/3)

- * Andrew E: Analysis of VoIP audio codecs
- * Raed: Convertibles and Hybrids: A survey of different approaches to 2-in-1 devices
- * Leon, Ross: voi.py
- * Yongjun, Xin: Image Classification Approaches and Techniques
- * Brandon: Anonymous File Sharing
- * Adithya, Nishant: Visualizing Virtual Reality
- * Askhay: 3-D Film: Getting Out of Screen

Course projects (3/3)

- * He: Responsive images and web design
- * Brennan, Yuhe: From Smart to Smarter: the Story of Bluetooth
- * Brennan: SVP Investigations
- * Pritpaul, Linh, Jason Y: Driverless Intersections: The Innovation of the Autonomous Car
- * Trison: From Lenses to Bits: The Imaging Process of Digital Photography
- * Tyler: Youtube
- * Robert: ponoproject

Course project website

- Count for 5% in your final grade
 - Updated throughout the project, by you
 - ↳ only a place-holder on wiki right now
 - ↳ please populate with your project proposal
 - what's the problem and why is it important?
 - what have been done on it and why they are not enough? (including your previous and other ongoing projects)
 - what's your approach and expected deliverables?
 - a roughly biweekly schedule toward the end of March
 - **progress/milestone: keep updated at least biweekly**
 - *they are useful materials for your course project report*
- 2/3/15 * ^{csc466/579}connex->course projects and websites->⁵your project

MPEG

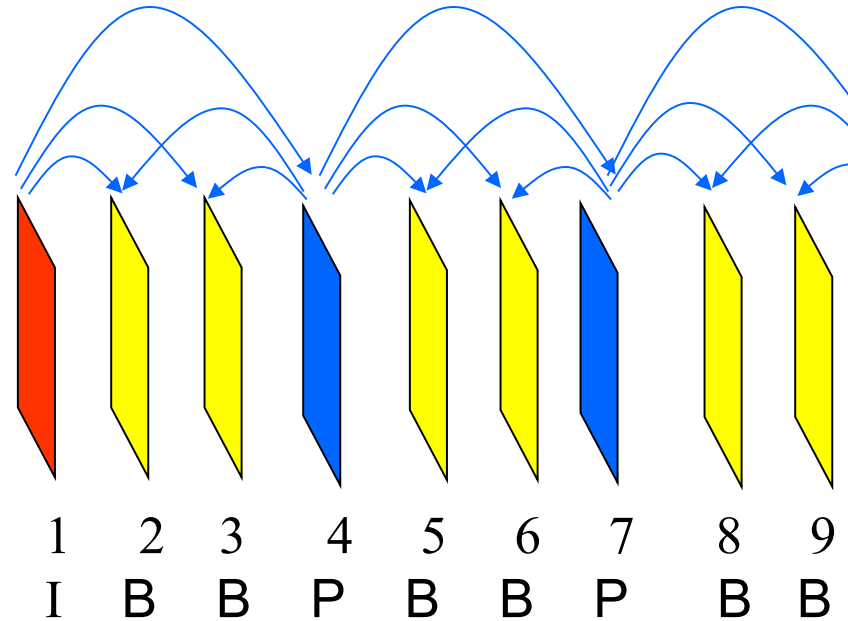
- Motion Picture Experts Group
 - MPEG-1: VCD (VCR-quality)
 - MPEG-2: DVD & HDTV
 - MPEG-3: aborted due to MPEG-2
 - MPEG-4: content-based
 - (future compression standards)
 - MPEG-7: meta-data
 - MPEG-21: DRM (21st century)

MPEG-1

- MPEG-1 (1991): VCD (VCR+CD quality)
 - 352x240, 1.2Mbps video CBR, 256Kbps audio
 - progressive scan only (1x CD-ROM)
- MPEG-1 video compression
 - similar to H.261, with a few differences
 - more formats, flexible *slices*, quantization table
 - I-frame: JPEG-like compression
 - P-frame: prediction-based; B-frame

MPEG-1: more

- Bi-directional search
 - search both previous and next frames for *similar* macro-blocks



- MPEG-1 GOP
 - I-frame, P-frame, B-frame

- display order: IBBPBBPBBPBBPBBBI (M=3, N=15)
- coding order: IPBBPBBPBBPBBIBB; timestamps

– D-frame: for search through the video, DC only

MPEG-2

- MPEG-2 (1994): DVD, HDTV, etc
 - also adopted as ITU-T H.262
 - many video formats and data rates; better audio
 - profiles: simple (4:2:0, I/P), main (+B), SNR (+variable quality), spatial (+variable resolution), high (+4:2:2)
 - levels: low (352x288), main (720x576), high 1440 (1440x1152), high (1920x1152)
 - support interlaced video (broadcasting!)

LEVELS and PROFILES	Simple Profile	Main Profile	SNR Scalable Profile	Spatial Scalable Profile	High Profile
	No B-frames	B-frames	B-frames	B-frames	B-frames
	4:2:0	4:2:0	4:2:0	4:2:0	4:2:0 or 4:2:2
	Not Scalable	Not Scalable	SNR Scalable	SNR Scalable or Spatial Scalable	SNR Scalable or Spatial Scalable
High Level 1920 pixels/ line 1152 lines		≤ 80 Mbit/s			≤ 100 Mbit/s
High-1440 Level 1440 pixels/ line 1152 lines		≤ 60 Mbit/s		≤ 60 Mbit/s	≤ 80 Mbit/s
Main Level 720 pixels/ line 576 lines	≤ 15 Mbit/s	≤ 15 Mbit/s	≤ 15 Mbit/s		≤ 20 Mbit/s
Low Level 352 pixels/ line 288 lines		≤ 4 Mbit/s	≤ 4 Mbit/s		

MPEG-2 profiles and levels

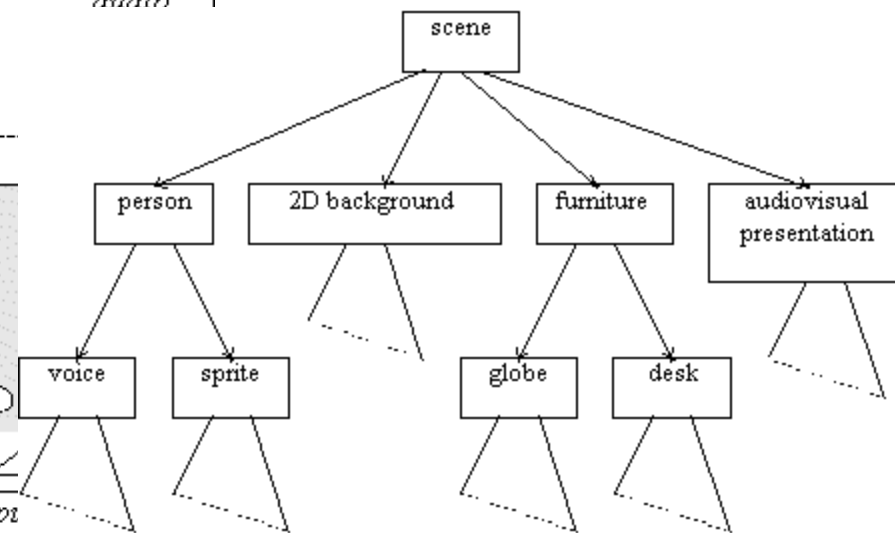
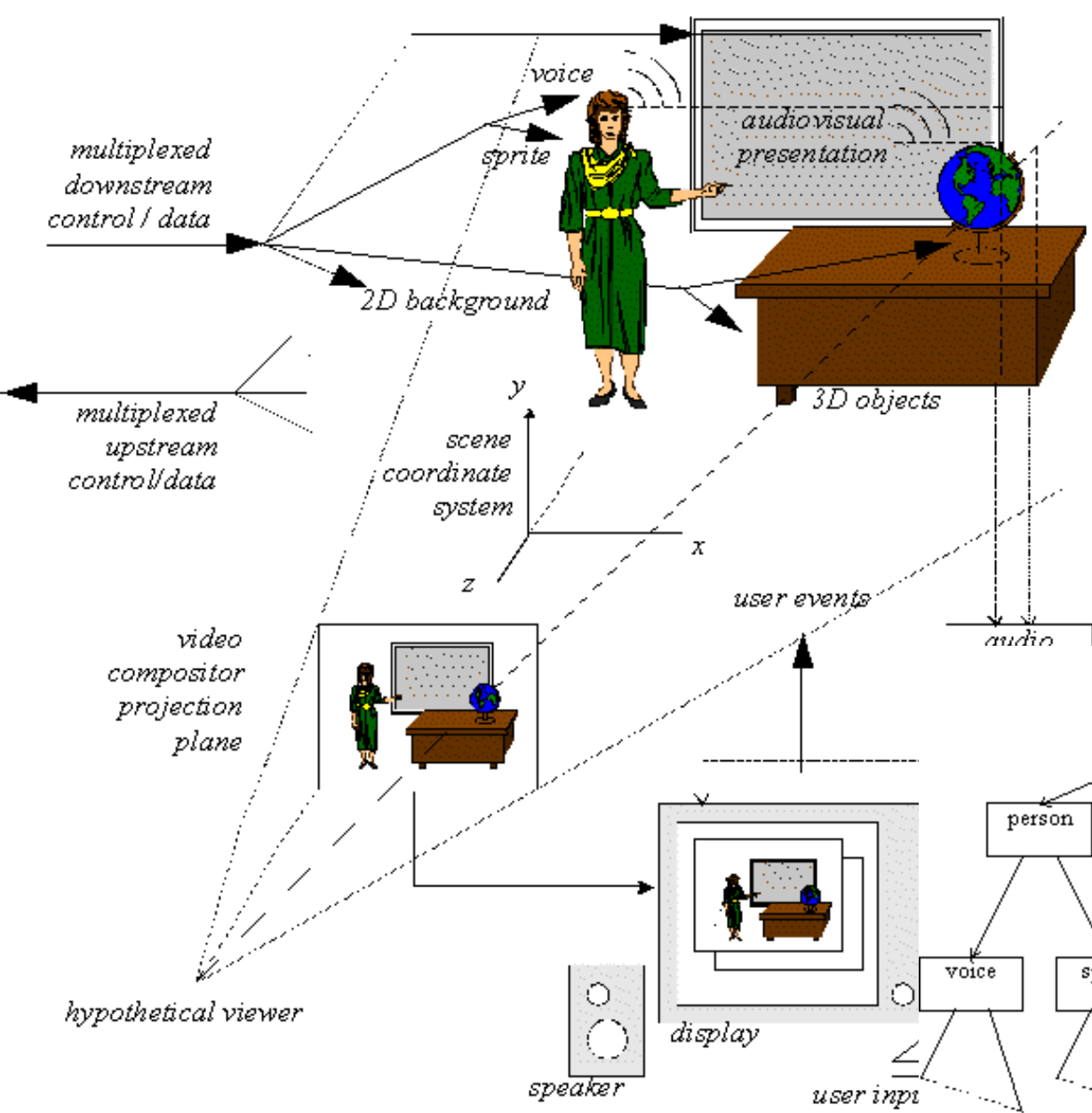
MPEG-2 scalability

- Layered encoding
 - base layer: independent for basic quality
 - enhancement layer: dependent on the base layer
- E.g., SNR scalability
 - base: low SQNR (coarse quantization)
 - enhance: high SQNR (fine Q on actual-base)
- E.g., spatial scalability
 - base: low resolution; enhance: high resolution

MPEG-4

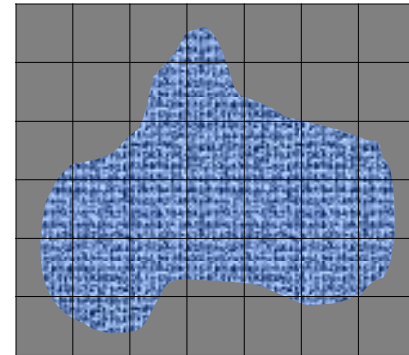
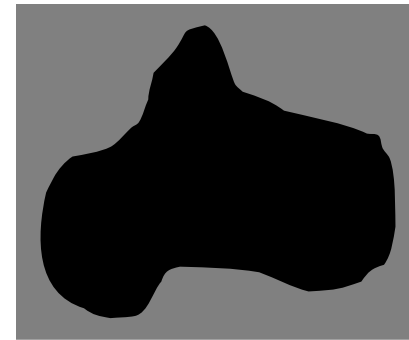
- MPEG-4 (1999): content-based, object-oriented
 - based on H.263, initially for low bit-rate apps
 - video sequence: a collection of media *objects*
 - objects: still image, moving object, audio, etc
 - how to decompose is NOT specified (encoder)
 - VOP: video object plane
 - GOV: I-VOP, P-VOP, B-VOP
 - VOP is divided into many macro-blocks
 - motion estimation: bounding box; padding

MPEG-4: object oriented

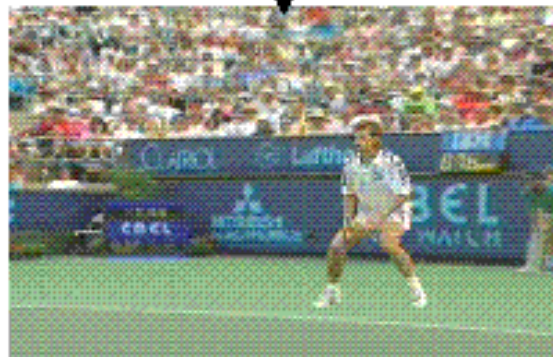


Object coding

- Texture coding
 - DCT-based
 - SA-DCT: shape adaptive
- Shape coding
 - binary shape; grayscale (transparency) shape
- Static texture coding
 - wavelet-based (good for scaling)
- 2-D and 3-D mesh coding



Sprite coding



MPEG-4: more

- Fine gain scalability
 - spatial scalability
 - temporal scalability
 - quality scalability
- MPEG-4 audio
 - general audio (2~64Kbps)
 - speech (2~4Kbps: HVXC; 4~24Kbps: CELP)
 - synthesized (e.g., MIDI, TTS)

H.264

- H.264 (2003)
 - also as MPEG-4 AVC (advance video coding)
 - initially: low data rate for high picture quality
 - now a wide variety of bit-rates, applications, systems
 - enhanced motion estimation and compensation
 - multi-picture, variable block-size, quarter-pixel precision, weighted prediction, etc
 - profiles: baseline, main, extended; 15 levels
 - fidelity range extension: high, 10, 4:2:2, 4:4:4

H.265

- H.265 (2013)
 - also as MPEG-H (high efficiency video coding)
 - goal: doubled CR at the same quality
 - or higher quality at the same data rate
 - a wider range of complexity wrt H.264/AVC
 - support higher resolutions: 8KTV!
 - parallel processing; coding tree units vs blocks
 - profiles: main/10, still; +16 extensions
 - x.265; VP9 (Google), etc

This lecture

- Video compression standards
 - MPEG-1: GOP
 - MPEG-2: scalability
 - MPEG-4: content-based, object-oriented
 - H.264: AVC
 - H.265: HEVC
- Explore further
 - H.264 and 265

Next lecture

- Multimedia delivery
 - multimedia networking
 - review on data networking