# Lecture #11 – Intro to Video (Part 1)

**Making a Video (*Capturing, Editing, Outputting)**
- Video: a sequence of still images (photographs) that create the illusion of movement when played in succession
- 2 types of video:
    1. Analog → smooth electronic waves ex. TV
    2. Digital → each frame is a bitmapped graphic, stored as 0s and 1s
- Steps to making a video: Take footage, transfer video to computer, edit video, store and play

**Analog vs. Digital – understanding it**
- Analog Camcorder:
    o Electronic signals are recorded
    o Disadv:  *Picture loses quality
    o Must convert it to digital BEFORE we can put it on our computer to edit
    o To convert analog video to digital video we need a *video capture card**
- Digital Video Camcorder:
    o Records binary code (string of 1s and 0s)
    o Adv:  No image degradation
    o Thus no need to convert!
    o Use Firewire or USB cable to move video to computer

**Digital Video Camcorders – DV25 specs**
- **DV25** is the most common **DV(digital video) compression** used by today's camcorders
- DV25 Format Specs:
    o Pixel Dimension is 720 X 480 (note this is 3:2 ratio)
    o Frame Aspect Ratio either 4:3 or 16:9
    o Data Rate: 25 mega bits per second (that's why it is DV25)
    o Frame Rate: 29.97 fps
    o Colour Sampling:  **YUV 4:1:1  (compression)**

**YUV (YIQ) or YCbCr (for MPEG compression) and Color Sampling**
Color Compression in the camera
- For still images RGB is commonly used
- For video the model is YUV (YIQ) or YCbCr (for MPEG compression)
- *Y →luminance (brightness)
- *UV or (CbCr) → chrominance (color/hue)
- Black and White TV only used the Y signal
- Human eye is more sensitive to variations in brightness (our eyes have more rods which detect brightness. Cones detect color but we have fewer of them.
- **VIDEO COMPRESSION** works on **reducing COLOR**; therefore, use **Color Sampling technique**

**Color Sampling:**
- Refers to compression technique for video
- **Scale:**
    - 4– no compression
    - 0 – max compression
    - 4:4:4 – means no compression
- **X:Y:Z  (ex.4:4:4)**
    - X- brightness
    - Y, Z – color
    - 4- no compression, 0-full compression

**Video Capture Devices: video capture card vs. Firewire vs. Thunderbolt**
- <mark>Firewire 400</mark>
    - Firewire is a high speed data transfer technology
    - Could transmit at *400 Mbps*
    - Peer to Peer Technology
- <mark>PC's solution →USB 1.1</mark>
    - USB 1.1 could transmit at **12 Mbps**
    - too slow for video, thus used for mice, keyboards, printers
- USB 2.0
    - came along, backward compatible, transmitted at *\***480 Mbps**
    - could beat  with Firewire 400 and does video
    - Master/Slave technology
- <mark>Thunderbolt technology</mark> <mark>(for Mac Laptops)</mark>
    - **10Gbps**   - Faster than Firewire
    - 

\*PC's now have Firewire 800 Mbps and USB3.0 emerged at 5Gbps

**Digital Video standards for TV**
- 2 standards:  **NTSC** and **PAL**
- **NTSC standard**
    - frame rate was originally 30fps but went down to 29.97 to accommodate for color information
    - Began in the U.S.
- **PAL standard**
    - Began in Britain, Europe
    - Frame rate is set for 25 fps
- **Tv scanning methods**
    - Interlaced (scans lines 1,3,5,7.. or lines 2,4,6,8..)
    - Progressive (scans lines 1,2,3,4,5..)

**NTSC Standards: Frame Size**

**High Definition for NTSC:**

1440 X 1080
→ ratio is (4:3)
→ pixels are not square

1280 X 720
→ ratio is 16:9
→ pixels are square

**The Frame Size of Standard DV Frame:**

For **NTSC** → 720 X 480 pixels
→ **3:2** ratio  (1.5)
→ Pixels are distorted
(not square)

For **Pal**   → 720 X 576 pixels
→ **4:3 ratio** (1.3)
→ Pixels are distorted
(not square)

**Resolution Comparisons**
- Older technology → Screen resolution 480
- PLASMA  or LCD →Screen resolutions 720p  or 1080p

| Format | Lines of Resolution |
|---|---|
| VHS, VHS-C | 240 lines |
| 8mm | 240 lines |
| Hi 8mm | 400 lines |
| Most older TVs (standard, SDTV) | 480 lines |
| DV 8mm, Mini DV | 480 lines |
| High Definition (HD) TV | 720 lines Or 1080 lines |

**Popular Digital Video Formats: advantages of each**
- Digital Advantage: higher resolution  (# of horizontal lines)

**Review**
- Which is faster: Firewire 400 or USB 2.0 or Thunderbolt? →Thunderbolt – 10GBps
- Every Apple computer has a firewire port, true or false ? →TRUE
- What was the *Frame Rate* for NTSC TVs in the 80s? →30 fps and then 29.97 fps (color)
- What is the *Frame Ratio* for NTSC TVs? → 720 x 480 (4:3)
- What is the *Frame Ratio* for HD TVs? → 1440 x 1080 4:3 and 1280 x 720 16:9
- What does 1080p mean? →Horizontal line
- two types of data transfer methods you can use to move your video from your camcorder to your computer → USB, Firewire
- How many scan lines are there on an analog TV from the 1970s? → 480 lines -HD 720 x 1080
- What does 720p mean? →720 lines progressive scan 1,2,3,4,5
- name of the most common form of compression in the camcorder → DV 25

# Lecture #12 – Video Part 2

**Compression Strategies**
- Date rate
  - Amount of video processed per second
  - Average data rate= file size/length=MB/sec
- General Compression Strategies →GOAL:  Lower the file size of a video
  1. Lower the frame size of the video (less pixels)
  2. Lower the frame rate of the video (frames per second)
  3. Pick a codec that does higher compression
  4. Lower the picture quality of the video
- **NOT** IMPORTANT WITH VIDEO COMPRESSION
  1. Lowering the color depth
  2. Playing with the audio

**Codecs**
- A codec is a piece of code or program that shrinks large movie files
- It compresses video or audio as it is created (when stored →coded)
- when displaying it to the user, it decompresses the video or audio (when viewed →decoded)
- Most common codecs are:
  - Sorenson Spark
  - H.264
  - DivX

**Video File formats (common types)**
- .mov → Codecs: Animation, Sorenson Video, H.264, PlanarRGB, Cinepak
- .avi → Codecs: Microsoft RLE, Intel Indeo Video, Cinepak
- .wmv → Pixelated quality/ Poorest  quality
- .mpg/.mpeg → Good quality but big file  quality
- .flv → Codecs: Sorenson Spark, On2 VP6 (can have transparent video), H.264 – Best quality

**Spatial vs. temporal compression**
- 2 types of compression techniques:
  1. Spatial compression → within a frame
  2. Temporal compression → between frames
- Spatial
  - Compress each frame individually
  - Uses the same techniques as JPG compression
  - Codecs that do spatial compression are:  Animation, PlanarRGB
- Temporal
  - Just save info on selected frames (called keyframes)
  - All other frames just save the differences from the previous keyframe
  - Good when the difference between current frame and keyframe is small
  - Codecs using temporal compression are: Sorenson Video, H.264

**Container File Formats**
- A file format that stores both the data (the frames) AND how to play the data(which codec to use)
- Some common containers are: **avi**, **mov, flv, mkv**

**Digital Media Players**
- A piece of software that plays multimedia files  (video or audio)
- Examples of media players: Quicktime, Itunes, Flash player, Real player

**Video Transfer on the Web**
- 3 main ways to get video/audio (media) from a website onto your computer so you can view it:
    1. Download
    2. Progressive Download
    3. Streaming
- <mark>Download</mark>
    - Entire video clip must be downloaded before it plays
    - Usually uses **HTTP protocol**
    - Data is permanently stored on machine
- <mark>Progressive download</mark>
    - After part of video is downloaded,  it begins to play
    - Data is permanently stored on machine
- <mark>Streaming (</mark>aka as Webcasting<mark>)</mark>
    - Packets sent down & immediately starts playing
    - uses **RTSP protocol**
    - file is never permanently saved

**Streaming**
- streaming is either On-Demand or Live
- on demand → saves the file to a hard disk and then is played from that location
- Live → sends the information straight to the computer or device without saving the file to a hard disk
- **In order to do streaming video, you need two things:**
    1. A streaming web server (RTSP) – Real server
    2. A video that has been converted to be streamed
- RealServer serves media clips to clients. It allows users to stream, rather than download, the media clips.
- Web server delivers pages to Web browsers over the Internet
- What streaming website has revolutionized video? → YOUTUBE

**Unicast vs Multicast**
- Unicast → each user gets his/her own stream of video, the server has to send out A LOT of data if several users are watching at once
- Multicast → sends the same stream to a bunch of users but then they lose the ability to pause, rewind, etc.

**You Tube**

- YouTube accepts video in the following formats: .WMV, .AVI, .MOV, MPEG and .MP4
- then converts them to the flv format (a Flash format)
- and uses one of: Sorenson Spark, V6 or H.264 video codec
- Youtube quality →Standard (original) format 320X240 pixels, mono audio

**Review**

- .avi is a container file format → TRUE
- avi files will always use the same codec to play them → FALSE
- 3 ways of reducing the file size of a piece of video before moving it onto your website
  1. Lower frame size
  2. Lower frame rate
  3. Choose a codec
- Codec → A piece of software used for compression/decompress of videos and audios