

## Warmup Review Questions

- What is the frame rate you need on computers for an animation?
- What is rotoscoping?
- What are the 3 stages in 3D animation?

Slide 1 of 75

Computer Science 1033 – Week 10

## VIDEO



Your goal is to count how many times the ball is passed by those wearing white shirts

"A good film is when the price of the dinner, the theatre admission and the babysitter were worth it." → Alfred Hitchcock

## Today

- Announcements
- Intro to video, TVs, resolution
- Colour Sampling
- Compression
- Download vs Streaming
- Other things to consider

Slide 3 of 75

## Announcements

- Major Assignment due Monday, March 30<sup>th</sup>
- Final Exam
  - Thursday, April 23<sup>rd</sup> at 2:00 pm
  - All multiple choice – 2 hour time period
  - Bring:
    - Pencil (soft) and eraser
    - Student card
  - Do NOT bring: calculator, iPod, hat, etc..
- **OUR WHOLE CLASS HAS THEIR EXAM IN ALUMNI HALL:**

CS1033

Crse No.	Class Sect.	Day	Month	Date	Time	Bldg/Room	From	To
1033B	001	Thursday	April	23	2:00 PM	AH 15	ABDELM	GRIECO
1033B	001	Thursday	April	23	2:00 PM	AH 201/STAGE	GU	ZOU

## Make sure you get a copy of all your work!

- Your websites will only be posted for the next month (til about June 1, 2020) so copy of everything you want onto a stick. **YOU WILL NOT BE ABLE TO GET IT BACK AFTER THAT DATE!**

Slide 5 of 75

## Announcements

- Readings: Video

Slide 6 of 75

## Announcements

- Feedback page is open:
  - Please fill in the Feedback form: <https://feedback.uwo.ca>

Slide 7 of 75

## Web Assignment

- Reasons for lost marks on website assignments:
  - Forgot proper titles
  - Forgot images folder or called it Images
  - Called file Index.html instead of index.html
  - Called index.html something like home.html
  - Called aboutus.html something like About Us.html
  - Forgot to check links or images ☹
  - Didn't make the references working links
  - Filepaths should be relative and case-sensitive!

Slide 8 of 75

## Hints for Major Assignment

- **Remember:**
  - Rules for Titles
  - Headers
  - File names, spaces, lowercase
  - Images
    - Alt, Hover/tooltips on home page
    - Size within page
    - On each page
  - Banner
  - No Scrolling horizontal/vertically to see buttons
  - Consistency
  - Buttons → look, ease of use
  - links that go OFF your site open in a new window/tab
- Back to top
- References page layout
- Text colours, contrast
- Broken links
  - Check from a different computer!
- Underlining
- Colours
  - Link Colours
- Paragraphs
- Padding
- Followed the instructions (make the anchor links, etc..)
- Have an *images* subfolder
- **Have an *originals* subfolder**
  - **NEED LINK TO animation .pptx and banner .afphoto**

Slide 9 of 75

## Inspiration from previous years

- [Bit By Bit website](#)
- [Bollywood Blitz website/](#)
- [Lego Batman Movie website](#)
- [Travels](#)

Slide 10 of 75

For Major Assignment life will be much easier if you set up a site in build your folders first (major, then major/images, then major/originals)

- Then move your images into images folder
- Move your banner .afphoto and your animation .pptx into *originals* folder
- Put your animation .mp4 and video .mp4 in a folder called *videanim*

Slide 11 of 75

## Major Assignment

- How to make a link on your references to your animation .pptx file and your banner .afphoto file:
  - Make a folder inside of major called originals, so you should have this:
  - Move your banner.afphoto into the originals folder, so you should now have this:
  - On your references page, type the text like: My Banner and My Animation
  - [Make link to each of those files, like this](#)

Slide 12 of 75

## Major Assignment

- Animation should relate to your theme
- Video should relate to your theme:
  - Can just be images that transition with some captions
  - Keep it under 30 seconds
  - Fade out the sound
  - Need to have soft captions this year!

Slide 13 of 75

## Assignment 2

- [Student 1](#) – BEAUTIFUL – Amazing colour scheme!
- [Student 2](#) – lovely banner but it is a bit tall – references a problem ☹️ (and the property titles)
- [Student 3](#) – lovely layout on all pages, only issue is the image is skewed on home page
- [Student 4](#) – love the buttons but can you spot the mistake?
- [Student 5](#) – great layout on the pages but forgot headings
- [Student 6](#) – did a great job with layout but 2 problems with references

Slide 14 of 75

## What is Video?

- A sequence of still images (photographs) that create the illusion of movement when played in succession.
- **Question:** What is each still image called?
- Frames Per Second (fps)
  - Movies on film → 24-30 fps
  - TV was originally 29.97 fps (59.94 fields per second)
  - Computer Displayed Video → AT LEAST 12-15 fps
    - Humans can distinguish as single images at less than 10 fps
  - <https://frames-per-second.appspot.com/>
    - Set Motion Blur to None and Frame Per Second to 5 fps
- Digital Video → each frame is a bitmapped graphic, stored as 0s and 1s
- Does this sound familiar?

Slide 15 of 75

## Sampling and Quantizing of Motion

- Since each frame is just an image →
  - Each frame is sampled into a discrete samples and each sample becomes a pixel → **Sampling process**
    - Remember:
      - More samples means better quality (10 pixels by 10 pixels vs 200 pixels by 200 pixels)
      - More samples means bigger file sizes (10 pixels by 10 pixels vs 200 pixels by 200 pixels)
  - Each pixel gets assigned a colour, maybe just 2 colours (black and white → 1 bit colour) or maybe 16 million colour (24 bit colour) → **Quantization process**
- **What else can we "sample" with MOTION?**
  - Timing of the motion
  - Sampling = frames
  - Higher FPS = more accurate motion, but larger file size

Slide 16 of 75

## Quantizing → Colour Compression In The Video

- For still images RGB is commonly used
- For video the model is YUV (YIQ) or YCbCr (for MPEG compression)
- Y → **luminance** (brightness)
- UV → (CbCr) **chrominance** (color/hue)
- **Question:** Black and White TV only used the \_\_\_ signal (fill in the blank with Y, U, or V)
- **Question:** Which one will the human eye detect changes in more easily? How does this help us with compression? Where have we seen this used before?

Slide 17 of 75

space

www.anime-music-videos.org/guides/avtech/colorspace.html

Info of Individual... CS1033 Google Information Techno. Yahoo Calendar Yahoo Mail

So, when dealing with YUV you can imagine Y as being the black and white image then U and V as the "colors" of the image. Here's a visual example:

original luma (channel Y) chroma (channels UV)

You can see straight away that the color information is much less detailed. This is true, but even if it wasn't the reality is that you just can't notice detail as much in the chroma channel (remember biology - rods and cones... you have more rods, you can't actually see colour as clearly as you can see luma.)

Although you can have one Y, U and V sample per pixel like you do with R, G and B, it is common for the chroma samples (the U and V) to be sampled less often because the accuracy of the chroma is less noticeable.

Slide 18 of 75

## YUV / YCbCr Components

Original Picture      Y Component

Cb Component      Cr Component

Slide 19 of 75

- You may see that the compression used 4:1:1 Color Sampling Method what does this mean?
- Assume we have 16 pixels that we are looking at in blocks of 4 →

Color Sampling Method	Amount of Y (luminance)	Amount of U (color or hue)	Amount of V (color or hue)	Amount of Compression	Used in
4:4:4	4 samples (i.e. 4 pixels)	4 samples	4 samples	None 12 samples for each group of 4 pixels	
4:2:2	4 samples	2 samples	2 samples	Reduced from 12 samples to 8, 33% reduction in storage	Digital Betacam format
4:2:0	4 samples	2 samples of either U or V, one scan line of U, then one scan line of V		12 to 6, 50% reduction in storage	HDTV, MPEG-1, DVD, MPEG-2, PAL DV
4:1:1	4 samples	1 sample	1 sample	12 to 6, 50% reduction in storage	NTSC DV, miniDV digital camcorder

Slide 20 of 75

- If we look at a grid of 4x4 pixels, the ratio tells us how many values from the YCbCr or YUV layers are showing.

- In this example there are 4 of each layer (Y, U, and V) so this is a 4:4:4 image.
- Watch this starting at 2:45

[http://blogs.adobe.com/VideoRoad/2010/06/color\\_subsampling\\_or\\_what\\_is\\_4.html](http://blogs.adobe.com/VideoRoad/2010/06/color_subsampling_or_what_is_4.html)

Slide 21 of 75

- Here we have Y in every pixel but the U and V are only in every 2<sup>nd</sup> column.
- This is 4:2:2.
- The U and V only appear once in four columns.
- This is 4:1:1.

[http://blogs.adobe.com/VideoRoad/2010/06/color\\_subsampling\\_or\\_what\\_is\\_4.html](http://blogs.adobe.com/VideoRoad/2010/06/color_subsampling_or_what_is_4.html)

Slide 22 of 75

## How did the original TV display work?

- Our eyes see phosphor dots on the screen.
- An electron beam (gun) activates the dots. The gun scans through the dots horizontally
- A complete scan is when the gun starts at the top left and scans several times horizontally till it gets to the bottom right

Slide 23 of 75

- The scan only draws every OTHER line (1,3, 5, ...479) then starts back at the top and draws the even lines (2,4,...480).
  - Thus two passes
  - Each pass is called a **field**
  - The process is called **interlaced display**
- This way it can cheat the eye, while the phosphor dots are disappearing, it is drawing the line underneath.
- Interlacing should be avoided now, instead use progressive (interlacing is for old TVs) for video that will be displayed on the web.

[http://www.crotchfield.com/Learn/learningcenter/home/understanding\\_resolution.html](http://www.crotchfield.com/Learn/learningcenter/home/understanding_resolution.html)

Slide 24 of 75

The image on the left simulates the picture resolution of an old-fashioned TV, while the image on the right simulates high-definition TV. Notice the soft edges and jagged lines in the non-HD image.

480i  
640 x 480 pixels

720p  
1280 x 720 pixels

1080p  
1920 x 1080 pixels

i means interlaced

p means progressive

## 2000's TVs

- Question: On a HD TV, what does the circled area mean?

SAVE \$200  
**\$899.99**  
AFTER SAVINGS  
Available at select stores and at BestBuy.ca

Side 26 of 75

## Do you notice anything odd here?

480i TV

1080p HD ready

TV Screen Resolutions

Resolution	Width	Height	Total Pixels
DVD	720	480	345,600
720p	1280	720	921,600
1080p	1920	1080	2,073,600
4K	3840	2160	8,294,400
8K	7680	4320	33,177,600

## What do TV specs mean?

SHARP 50" 4K UHD HDR LED Roku Smart TV (LC-50LX591C) Only at Best Buy

**\$499.99**

Scan

Horizontal

## 2010's TVs

- Most TVs sold now are 4K → 4K resolution (4096 x 2160 → 4K refers to WIDTH now???)
- <https://www.youtube.com/watch?v=RodCjVf-5AE>
- Initially they were very expensive and there was very little content available for them
- Now the prices have come down a lot, and there are a lot more shows and movies shot in 4K now
- Newer phones have 4K video cameras
- 4K video games are being made for the PS4 Pro and Xbox One S and Xbox One X

Slide 29 of 75

## Comparison of Resolutions

- Standard Definition resolution was 480 or 576
- High Definition resolutions started at 720, then up to 1080, 1440, and then to 4K. Now companies are beginning to make 8K TVs but they are very expensive (and not much content)

8K Ultra HD

4K Ultra HD

Full HD

SD

Slide 30 of 75

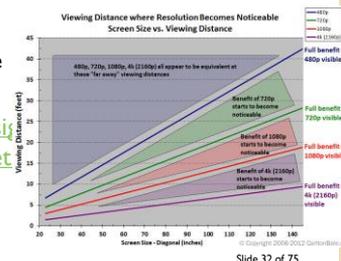
## 2010's Small Devices Matter Too!

- Apple suggests that small devices (iPads, etc) should be held at 10-12 inches away from your face, and that the screen resolution should be at least 300ppi to look crisp. Apple uses the term "high retina display" for this.
  - <http://www.makeuseof.com/tag/how-does-the-retina-display-work/> (watch Steve Jobs video)
  - <https://www.youtube.com/watch?v=Zi5cN8Z7LnM> (just watch the first two minutes)

Slide 31 of 75

## For Retina Display:

- **Retina Displays** – have a pixel density high enough so that your eyes cant detect pixels at a normal viewing distance. You need to consider:
  - Pixel density
  - Viewing distance
  - Display size
- <https://www.designsources.com/is-this-retina/>



Slide 32 of 75

## Editing of Video

- **Before Digital Video:**
    - Had to copy from one tape to another tape
    - Had to load up tapes on a machine to copy
    - Loss of quality after each copy made
  - **Now:**
    - Can easily move clips around
    - No loss of quality
    - Slight compression occurs in the camcorder when the video is captured
- [https://www.youtube.com/watch?v=Wa\\_VZISu6fc](https://www.youtube.com/watch?v=Wa_VZISu6fc)

Slide 33 of 75

## A Little History of Camcorders

Before 1967 NOTHING was portable (had to use tripods)

**1967** → Sony came up with first portable black and white camcorder (needed BIG shoulders)

**1971** → first cassettes (didn't need to load reels)

**1982** → combine video, sound recording and playback (camera recorder)

**2001** → Most camcorders record at 5fps

**2019** → iPhoneX records 4K at 60fps



## Break

- Take a 10 minute break
- Check out some Poster Assignments during break

Slide 35 of 75

## Things to think about before exporting video:

- Where will I be putting my video?
  - On the web:
    - Bandwidth is an issue, need good compress
    - Standard file format is now mp4
  - On CD-Rom (playback speed is an issue)
  - DVD video (must be in mpeg2 format)
- Who is my audience?
  - Will they be on different platforms
  - How old will their computer be, how old will their CD or DVD player be?
- Will I still need to edit it later on? Should I compress it at all?

Slide 36 of 75

## Why Compress? An Example

- Assume we have video that is:
  - 1440 X 1080 pixels → 1,555,200 pixels per frame
  - 24-bit colour
  - 30 fps
  - 1 second long
  - Audio is stereo so 2 channels
  - Audio is 48,000Hz and 16 bit =  $48,000 \times 1 \text{sec} \times 16 \text{bits/sample} \times 2 = 1,536,000 \text{bits}$
- Video**
  - $1,555,200 \times 24 \text{ bits per pixel (for color)} = 37,324,800 \text{ bits per frame}$
  - $37,324,800 \times 30 \text{ frames per second} \times 1 \text{ second} = 1,119,744,000 \text{ bits} / 8 = 139,968,000 \text{ bytes} = 133 \text{ MB}$
- Audio**
  - $1,536,000 \text{ bits} / 8 \rightarrow 188 \text{ KB}$
- Total**
  - $133 \text{ MB} + 188 \text{ KB} \approx 133 \text{ MB} \rightarrow \text{LOTS OF STORAGE FOR JUST 1 SECOND}$
  - OR 1,067 Mb
  - OR 1.04 Gb
  - THUS a DVD could hold 35 seconds of uncompressed video... Not a very long movie ☹

<https://www.youtube.com/watch?v=r6Rp-uo6HmI>

Slide 37 of 75

## Data Rate or Bit Rate

- Amount of video processed per second
- Average **bit rate** = **file size/length** in seconds of video
- Our example from previous slide → 133MB per second
- Consider a 48X Speed CD Rom
  - Average playback (bit/data rate) rate is 7MB/s
  - Our video would be VERY CHOPPY
- Consider a video that is 100MB and 10 Seconds long:
  - Question: what would its data rate be?**
  - it would be choppy on our CD Player
- Consider a video that is 100MB and 33 second long, it would play back at 3MB per second and be fine on our CD Player
- NOTE: problems occur not just because of file size but also because of data rate!
- Bit rate is normally measured in bits NOT bytes (Mb is mega bits, MB is mega bytes)

Slide 38 of 75

## Analogy

- Don't know how long it will take to fill a pool so you have to estimate the amount of water in the pool
- Think of a pipe as a pipe from a fire hydrant to another pool via a pipe.
  - Amount of water in the pool is the **file size**
  - Diameter of the pipe is the **bandwidth** (you can't have a pipe that is too small for you)
  - Amount of water flowing through the pipe is the **data rate** (if you have a pipe that is too small, you can't get much water through it, the pressure will be too high and there will be a lot of leaks (i.e. quality issues))



Slide 39 of 75

## Compression

- Question: What things do you think we should think about optimizing to decrease video file size?**
  - One thing to think about: what we did to an image to make it smaller
  - Another idea: think about what you could do with the frames on CNN Piers Morgan vs. a tennis match



Slide 40 of 75

## General Compression Strategies

- Lower the frame size of the video**
  - If it was 640 by 480, change it to 320 by 240, less pixels!
- Lower the frame rate of the video**
  - Changing the frame rate by  $\frac{1}{2}$  (say 20 fps to 10fps) will generally  $\frac{1}{2}$  the file size (remove  $\frac{1}{2}$  of the frames). Common fps are 24, 30, 60
  - Question: What type of video would you NOT want to do this on?**
- Pick a codec that does higher compression**
  - Question: What is a codec?**

Slide 41 of 75

## Codec

- A **codec** is a piece of code that **compresses** video or audio as it is created (exported from the editing software) and then when displaying it to the user **decompresses** the video or audio (also stands for **coder/decoder**)
- There are LOTS of codecs. You have to use the same one to decompress that was used to compress a video.
  - <https://www.youtube.com/watch?v=GhWki9a7s18>
- Most common codecs are:**
  - H.264 – the one YouTube uses
  - DivX
- Can sometimes get a piece of video on your machine and then not be able to play it, this is because you are missing the **appropriate codec!** (just watch till 2:30)

Slide 42 of 75

## Codec Continued

- For example ...if you take your friend's camera and plug it into your computer and the jpgs will display but the videos won't play then likely: **You are missing the codec!**
- Codecs sometimes depend on the file format.
- What are the file formats available for video?

Slide 43 of 75

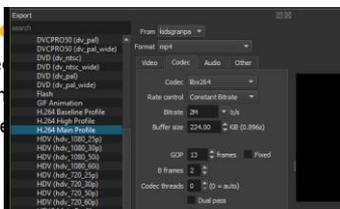
## Video File Formats

File Type	Also known as:	Originally created by	More Info	Platforms
.mov	QuickTime movie	Apple	<ul style="list-style-type: none"> <li>•Also for audio</li> <li>•Supports MIDI</li> <li>•Streaming with QuickTime Streaming Server</li> <li>•Can watch video as it is downloaded</li> </ul>	Apple QuickTime player available for Mac and Windows
.avi	Audio Video Interleave	Intel	<ul style="list-style-type: none"> <li>•Codecs → Microsoft RLE, Intel Indeo Video, Cinepak</li> </ul>	Mostly Windows but Apple QuickTime player can play avi files
.rm	Real Video		<ul style="list-style-type: none"> <li>•Used on connection speed Server compromises quality</li> </ul>	Cross platform Need Real Player
.wmv	Windows Media			Used with Windows Media Player
.mpeg, .mpeg, .mp4 (container)	MPEG	Motion Picture Experts Group	<ul style="list-style-type: none"> <li>•mpeg-1 → VCD,</li> </ul>	Cross Platform
.flv	Flash Video, H.264	Adobe	<ul style="list-style-type: none"> <li>•Flash video is becoming obsolete</li> <li>•have transparent video), H.264</li> </ul>	Cross Platform Need Flash Player to play a SWF file that holds the flv file

Slide 44 of 75

## Compression Strategies Continued

- **Pick a codec that does higher compression**
  - QuickTime and AVI use different codecs so you can pick one that gives better compression.
  - [Watch this.](#)
- **Lower the picture quality**
  - Sorenson code
  - H.264 is current
  - Some let you se



Slide 45 of 75

## Compression Strategies Continued

- **Lower the color depth**
  - Not popular because video looks best at 24bit color (unless it is a cartoon)
  - Some compressors won't compress color
- **Play with the audio**
  - Unfortunately the audio is usually not the problem so compressing it more won't usually help much!

Slide 46 of 75

## Compression Concepts

- **Temporal Compression vs. Spatial Compression:**
  - **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
- **Question:** What kinds of video would not do well with temporal compression?
- [Watch this starting at 3:50](#) (just till 5min)

Slide 47 of 75

## Compression Concepts

- **Lossy vs. Lossless Compression**
  - Depends on the codec
  - **Lossless**
    - looks for large blocks of pixels that are the same to do RLE (run length encoding)
    - QuickTime Animation and PlanarRGB are lossless
  - **Lossy**
    - Lowers video quality but get better file size and better data rate (bit rate).
- [How this relates to bit rate](#) (just watch first 2 minutes and 40 seconds)

Slide 48 of 75

## HTML5

- A new standard for the html in webpages. It includes a way to watch video on a website that does NOT require the browser to have a plug in (all new browsers can display the video using HTML5)

Slide 49 of 75

## Before HTML5, to insert video, the code looked like this ☹️:

```
<object classid="clsid:D27CDB6E-AE6D-11cf-96B8-444553540000" width="475" height="269" id="FLVPlayer">
  <param name="movie" value="FLVPlayer_Progressive.swf" />
  <param name="quality" value="high" /> <param name="wmode" value="opaque" />
  <param name="scale" value="noscale" /> <param name="align" value="left" />
  <param name="FlashVars"
    value="&amp;MM_ComponentVersion=1&amp;skinName=Clear_Skin_1&amp;streamName=pictures_1&amp;autoPlay=false&amp;autoRewind=false" />
  <param name="swfversion" value="8,0,0,0" />
  <!-- This param tag prompts users with Flash Player 6.0 r65 and higher to download the latest version of Flash Player.
  Delete it if you don't want users to see the prompt. -->
  <param name="expressinstall" value="Scripts/expressinstall.swf" /> <!-- Next object tag is for non-IE browsers. So hide it
  from IE using IECC. --> <!--[!IE]-->
  <object type="application/x-shockwave-flash" data="FLVPlayer_Progressive.swf" width="475" height="269">
    <!--[endif]--> <param name="quality" value="high" /> <param name="wmode" value="opaque" />
    <param name="scale" value="noscale" /> <param name="align" value="left" />
    <param name="FlashVars"
      value="&amp;MM_ComponentVersion=1&amp;skinName=Clear_Skin_1&amp;streamName=pictures_1&amp;autoPlay=false&amp;autoRewind=false" />
    <param name="swfversion" value="8,0,0,0" /> <param name="expressinstall" value="Scripts/expressinstall.swf" />
    <!-- The browser displays the following alternative content for users with Flash Player 6.0 and older. --> <div>
    <h4>Content on this page requires a newer version of Adobe Flash Player. </h4> <p><a
    href="http://www.adobe.com/go/getflashplayer">
    <img alt="http://www.adobe.com/images/shared/download_buttons/get_flash_player.gif" alt="Get Adobe Flash player"
    /></a>
    </p> </div> <!--[!IE]--> </object> <!--[endif]--> </object>
```

Slide 50 of 75

## Inserting Video into your webpage using...HTML5

- Currently HTML5 supports 3 video formats:
  - MP4
  - WebM
  - Ogg
- Have to worry about what browser your viewer is going to use:

Browser	MP4	WebM	Ogg
Internet Explorer	YES	NO	NO
Chrome	YES	YES	YES
Firefox	YES	YES	YES
Safari	YES	NO	NO
Opera	YES (from Opera 25)	YES	YES

je 51 of 75

## HTML5 Video Formats

- Apple is trying to get away from Flash so it won't support .flv,
- HTML5 does NOT support .flv
- HTML5 Standards group wanted:
  - Good compression, good image quality
  - Royalty free
  - Should handle hardware issues as well as software issues
- Works on handheld devices too ☺️

Slide 52 of 75

## HTML5 supports →ogg, webm and mp4

- Originally only wanted to use codec: Theora or Vorbis (.ogg containers) because they were open source but Apple wasn't sure if they were open source
- WebM another file format, royalty free, open source, backed by Google
  - YouTube uses WebM
- Apple and Microsoft only support the codec: H.264 which creates .mp4 files
  - Used in blu-ray discs, vimeo, YouTube and iTunes
  - H.264 is lossy but can do lossless

Slide 53 of 75

## How to add video in HTML5

- Make sure you encode your video as a mp4, ogg or WebM file using Adobe Encoder
- Put your video somewhere inside the folder containing your website (perhaps a subfolder). E.g. if you folder is assign3, maybe put video in *assign3/myvideo* folder:



- Make sure the first line of your webpage is:
  - <!DOCTYPE html> (this indicates it is html5)

Slide 54 of 75

## HTML5 <video> tag

- Edit the html code in the assign3 folder (e.g. the index.html file) and put the following <video> tag where you want the video as follows:

```
<video width="320" height="240">
  <source src="myvideo/dog.mp4" type="video/mp4">
</video>
```

- Might need this →
- QUESTION: What do you think each of these parameters do?

```
<video width="320" height="240" controls autoplay loop muted poster="doggy.jpg">
  <source src="myvideo/dog.mp4" type="video/mp4">
</video>
```

- QUESTION: What do you think this does:

```
<source src="myvideo/dog.mp4#t=10,22" type="video/mp4">
```

Slide 55 of 75

## Other Terms You Need To Know

- **Container File Format**
  - 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 → sometimes has uncompressed video, just depends, no streaming
    - .flv (doesn't allow subtitle)
    - .ogg (free open source container format)
    - .mp4
- Newer container formats support subtitles, chapters, etc...
- **Question:** Why can your computer sometimes play one .avi file but then not play another .avi file?

Slide 56 of 75

## Something else cool you can do with HTML5 and container file formats:

- Pick a subtitle or closed captioning file

```
<video controls width="640" height="360">
  <source src="devstories.mp4" type="video/mp4">
  <track src="devstories-en.vtt"
  label="English subtitles" kind="subtitles"
  srclang="en" default></track>
</video>
```

<http://www.html5rocks.com/en/tutorials/video/basics/>

Slide 57 of 75

## Subtitles

- Subtitles help the viewer understand dialogue
  - Especially important for hearing impaired
- Two main types: hard and soft
  - Hard (hardsubs): embedded into the video file so they can not be turned off or removed
  - Soft (softsubs): usually stored in a separate file telling what text to appear at what time in the video. These can be turned off/on as needed.
  - Both types have pros and cons, but we will just work with softsubs here.

Slide 58 of 75

## Subtitles

- You must specify the **start time, end time,** and the **text** to be displayed for each subtitle panel on the video
- This format is also often used if you want to set up Karaoke.
- For videos embedded in a website, the format has to be a .vtt (Web Video Text Tracks) file.

Slide 59 of 75

## Subtitles

- In the webpage, add the following HTML:

```
<video width="1280" height="720" controls>
  <source src="cat.mp4" type="video/mp4">
  <track label="English" kind="subtitles" srclang="en"
  src="cat.vtt" default>
  Your browser does not support the video tag.
</video>
```

- The width, height, video source file, and subtitles file may need to be updated.

Slide 60 of 75

## Subtitles

- Here is a SOFT subtitled video demo: <http://www.csd.uwo.ca/~bsarlo/cs1033a/samples/video.html>
- Here is a HARD subtitle video demo:
  - [http://www.csd.uwo.ca/~lreid/cs033/moviedemo/RachelB%20project\\_final.wmv](http://www.csd.uwo.ca/~lreid/cs033/moviedemo/RachelB%20project_final.wmv)
- Have a look at the WebVTT subtitle file here: <http://www.csd.uwo.ca/~bsarlo/cs1033a/samples/cat.vtt>

Slide 61 of 75

## Vote Now:

- Which video would YOU rather have (no right or wrong answer)
  - This one: <http://www.csd.uwo.ca/~lreid/cs1033/ExamplesForLectures/videoslag/144example.mp4>
  - OR
  - This one: <http://www.csd.uwo.ca/~lreid/cs1033/ExamplesForLectures/videoslag/8kexample.mp4>

Slide 62 of 75

## Video on the Web

- Getting video/audio (media) from a website to your computer so you can view it:
  - **Downloading**
    - Make a copy of the file/video on your machine
  - **Streaming**
    - Like listening to the radio – you can listen but can't save it (without difficulties)

Slide 63 of 75

## Download

- Used to be the ONLY option!
- When you visit a website containing video, the entire video must be downloaded to your computer before you can play it.
  - Progressive downloads allow you to listen as soon as it has downloaded enough bits to stay ahead of the download
- For the web, usually stored on a HTTP protocol
- Data that is sent is **permanently** stored on the end machine.
- Disadvantages:
  - **Question:** What do you think is a disadvantage?
- Advantages:
  - **Question:** What do you think is an advantage?

Slide 64 of 75

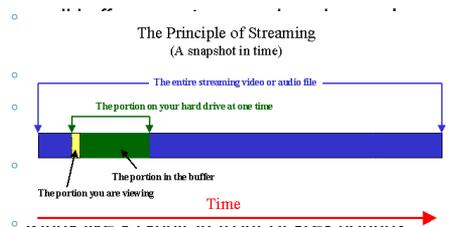
## Streaming

- In true streaming the file is never permanently saved to the user's hard drive, media begins to play as soon as it gets enough packets to stay ahead of the viewer
- Disadvantages:
  - **Question:** What do you think is a disadvantage?
- Advantages:
  - **Question:** What do you think is an advantage?

Slide 65 of 75

## Streaming

- When streaming video (like on youtube), the video must be delivered fast enough so there appears to be no delay
- Uses buffering:



Slide 66 of 75

## Streaming...

- Sometime requires special streaming server (RTSP)
- Video starts almost immediately
- If the data rate (bit rate) of the encoded video file is bigger than the amount of bandwidth available, the video will frequently STOP PLAYING ☹
- Unicast vs. Multicast - <http://www.bolermountain.com/>
  - **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** → send the same stream to a bunch of users but then they lose the ability to pause, rewind, etc.

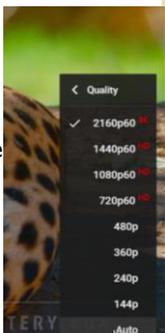
Slide 67 of 75

## Adaptive Streaming

- YouTube is now (because of 4K content) doing *Adaptive Streaming*
- When you upload a 4K video, it makes several versions of it (1440 version, 1080 version, etc):



- When you upload your 4K video, give youtube a few hours to make the different versions THEN TEST THE QUALITY.
- Vimeo also does this.
- If the viewer picks Auto, it will serve up the BEST quality video it can to avoid buffering depending on the current bandwidth
- People find buffering MUCH more annoying than low quality, so youtube ADAPTS (adaptive streaming) depending on bandwidth



Slide 69 of 75

## YouTube

- YouTube accepts video in several formats including: .WMV, .AVI, .MOV, MPEG and .MP4
- Uses many codecs but the most common is H.264
- YouTube used to output everything in as either .flv or .f4v (Flash video) as every computer had Flash BUT NOW IT CONVERTS UPLOADED VIDEO TO .mp4
- YouTube ALWAYS re-encodes your video, so don't upload something that you have already highly compressed, it will get compressed again, instead upload high quality video
  - **QUESTION: what is the downside of uploading high quality uncompressed video?**

Slide 70 of 75

## Consider

- Going from 1080p HD video to 4K video will NOT always improve video quality on the internet because of compression
  - If you encode at the same bit rate and the bitrate is low, the 1080p video will be clearer than the 4K video because it had less compression done to it.
  - **Comparison: which video looks better?**
    - **A**
    - **B**
  - One of the videos is 4K and one is 1080p but both were given a bitrate of 1Mbps.

Slide 71 of 75

## Also consider:

- Over 75% of all videos are viewed on mobile devices now
- VERY Confusing:
  - How can a smart phone record 4K but not have 4K display?
  - Smartphones that are capable of recording 4K video do NOT necessary have a 4K display (they have at least an 8.8 Megapixel sensor for recording)

MODEL	OPERATING SYSTEM	PHYSICAL SIZE (IN)	PHYSICAL SIZE (CM)	WIDTH (PX)	HEIGHT (PX)
iPhone 7	iOS	4.7	11.5	750	1334
iPhone 7+	iOS	5.5	14.0	1080	1920
iPhone 6	iOS	4.7	11.0	750	1334

## Check your connection right now!

- <http://google.com>

The screenshot shows a Google search interface. The search bar contains the text "internet speed test". Below the search bar, there are navigation links for "All", "News", "Shopping", "Videos", "Images", "More", "Settings", and "Tools". The search results show "About 1,640,000,000 results (0.52 seconds)". The first result is titled "Internet speed test" and includes a brief description: "Check your Internet speed in under 30 seconds. The speed test usually transfers less than 40 MB of data, but may transfer more data on fast connections." Below this is a privacy notice: "To run the test, you'll be connected to Measurement Lab (M-Lab) and your IP address will be shared with them and processed by them in accordance with their privacy policy. M-Lab conducts the test and publicly publishes all test results to promote Internet research. Published information includes your IP address and test results, but doesn't include any other information about you as an Internet user." At the bottom of the result is a blue button labeled "RUN SPEED TEST".

## Review Questions

- How many lines of HORIZONTAL resolution did TVs from the 1970s have?
- Every avi file was encoded using the same codec → TRUE or FALSE?
- It is not possible to add tracks to HTML5 videos → TRUE or FALSE?
- How is bitrate measured?

Slide 74 of 75