

程序代写代做 CS编程辅导

FIT1050 Web Fundamentals



Web Media Formats

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Week 5

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Learning objectives

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How images work

- Understand how image is represented by computers
- Observe how lossy compression can degrade quality



Web image formats

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- Learn about web-safe image formats
- Consider differences between different image formats

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Audio and video formats

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- Compatibility of various web audio and video formats
- Practical considerations when using audio and video online

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Background: How Images Work

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Review: Colour values are numbers

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Colour	RGB Notation	Hexadecimal	Decimal	Binary
Black	rgb(0,0,0)	#000000	0	000000000000000000000000
Blue	rgb(0,0,255)	#0000FF	255	000000000000000001111111
Green	rgb(0,255,0)	#00FF00	65,280	000000011111111100000000
Red	rgb(255,0,0)	#FF0000	16,711,680	111111110000000000000000
White	rgb(255,255,255)	#FFFFFF	16,777,215	111111111111111111111111



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- An 8-bit value can store a decimal number **0-255** or hexadecimal number **00-FF**.
- A typical colour value uses **3 octets** to create a **24-bit** colour value number.
- A single **24-bit** value can represent any of **16.7 million** different colours.

Raster vs vector images

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There are 2 main approaches to storing image information:



- **Raster images** - a grid of colored pixels
 - Fixed number of horizontal and vertical pixels
- **Vector images** - Point coordinates with math to draw connecting lines
 - Describes the outline of a shape using mathematical points

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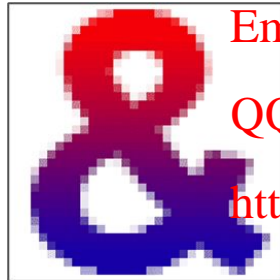
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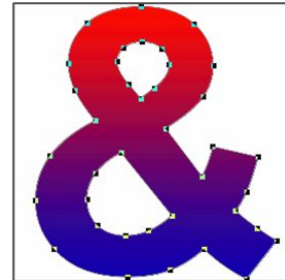
Small image



Zoomed-in
raster image



Zoomed-in
with smoothing



Vector image
(with visible points)

An early raster example: X PixMap

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XPM was an simple optimised image format supported by early web browsers.



! XPM2

48 7 2 1

a c #000066

b c #ffff99

X PixM Tutor CS 2

48 cols, 7 rows, 2 colours, 1 letter per colour

"a" colour = dark blue

"b" colour = light yellow

File header

Colour table

aa

48 letters

abbaababbbabaaabaabaabbadaaabaabaabaabaabbabbba

per line

abababaabaabbabbababababaaaahabbabbabababaaaa

abbaabaabaabababbbbabbabaaaabababababbbbabababbbaa

7 lines

[illegible]

abbaabaabaabaababababaaaaababaaabababababbabbbba

1 byte per

[illegible]

letter

An early raster example: X Pixmap

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XPM was an simple optimised image format supported by early web browsers.



! XPM2

48 7 2 1

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X Pixmap 2

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File header

Colour table

**48 letters
per line**

7 lines

**1 byte per
letter**



Uncompressed raster images are LARGE

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Data requirements per pixel

- Red value 0-255 = 8 bits
- Green value 0-255 = 8 bits
- Blue value 0-255 = 8 bits
- **R + G + B = 24 bits**



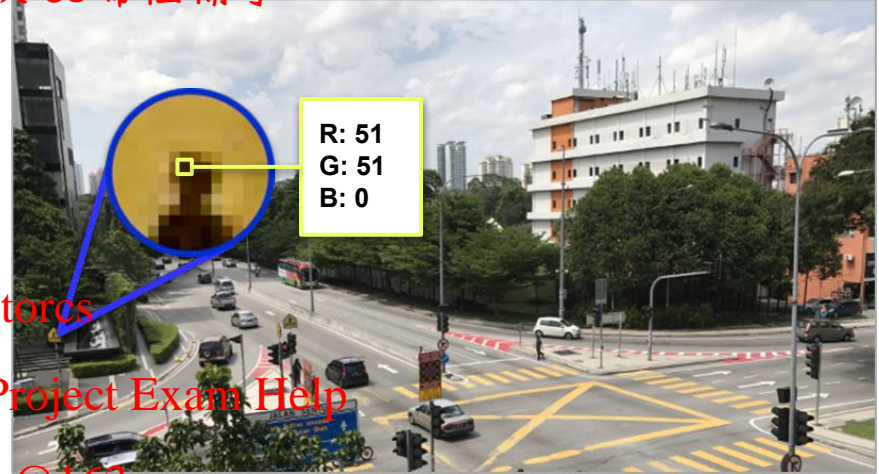
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Number of pixels

- Horizontal width in pixels
- Vertical height in pixels
- **Vertical × horizontal = total**

$$\begin{aligned} 3840\text{px} \times 2160\text{px} &= \mathbf{8.29 \text{ million pixels}} \\ &\times 24 \text{ bits} = \mathbf{199,065,600 \text{ bits}} \\ &= \mathbf{24,883,200 \text{ bytes}} \\ &= \mathbf{23.7 \text{ megabytes}} \end{aligned}$$

Media optimisation challenges

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For use on the web, files should be as small as possible without negatively impacting quality or the overall user experience.



- **Bandwidth**

- Media with a smaller file size will download more quickly.

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- **Quality**

- Better quality is preferable as long as the difference is noticeable.

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- **Compatibility**

- The media formats should be supported in all web browser.

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- **Performance**

- Some file formats require more CPU power and memory to decode.

Types of compression

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All type of file compression encoding can be classified as being either:



Lossless

- Decoded data is **identical** to the original data

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Lossy

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- Quality is lost during encoding
- Decoded data is **perceptively similar** to the original data
- Repeated re-encoding causes further quality degradation

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When data is already compressed, there are fewer gains from recompression.

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Web Image formats

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JPEG images

Joint Photographic Experts Group

- **Lossy** format designed specifically for photographs
 - 24-bit colour depth (16.7 million colours)
 - No transparency support
 - No animation support

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Compression uses block-based approximation

- Split the image into small blocks (8x8 pixels)
- Create an efficient approximation of each block

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JPEG encoding always causes some loss of image detail.



GIF images

Graphics Interchange Format

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- **Lossless** format (within form for images with few colours)



- Stores a dictionary of patterns
- Stored patterns can be reused
- 8-bit colour depth
- Up to 256 unique colours
- 1 colour used as optional transparency

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Simple images with 256 colours or less can be encoded perfectly with no loss of detail.



Flowers illustration (16 colours, 8KB)



Flowers photograph (16 colours, 8KB)

Animated GIF images

GIF files can store a sequence of image frames

- Each frame is stored with timing information
- Frames play back in sequence



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Great for short animations, **not for video content!**

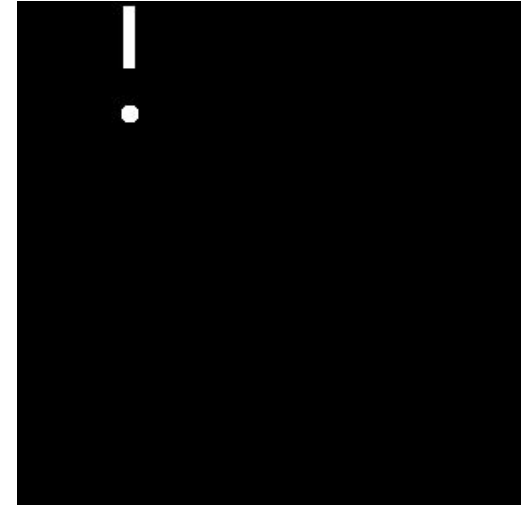
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- Optimised repeated patterns with few colours
- High memory usage for long animations
- Inconsistent playback rate
- No audio or playback control



Snake game (140sec, 608KB)
<https://reddit.com/r/gaming/1buuOz>



Rabbit eating lettuce (1sec, 616KB)
<https://reddit.com/r/aww/1zk1ma>

PNG images

Portable Network Graphic

- **Lossless** format (within form...tions)
- Created as a patent-free alt...to GIF
- Maintained by the W3C

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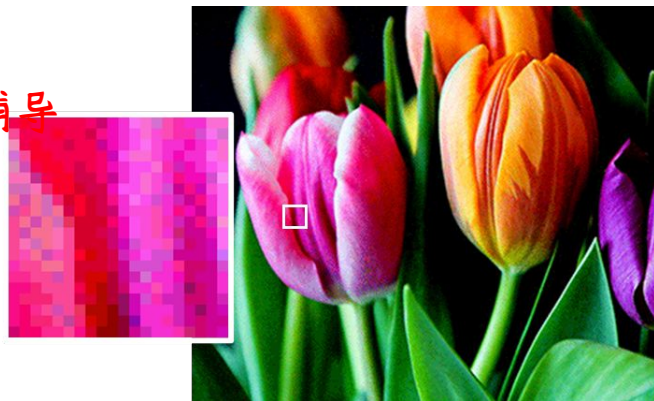
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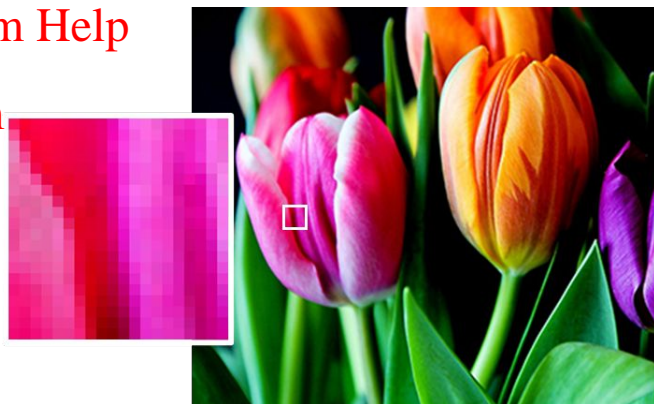
http://tutorms.com



Flowers photograph (8-bit, 45KB)

DEFLATE compression (similar to ZIP files)

- Optimized for artwork with repeated patterns
- 8-bit palette including 1 transparent colour
- 24-bit palette including 8-bit alpha transparency



Flowers photograph (24-bit, 145KB)

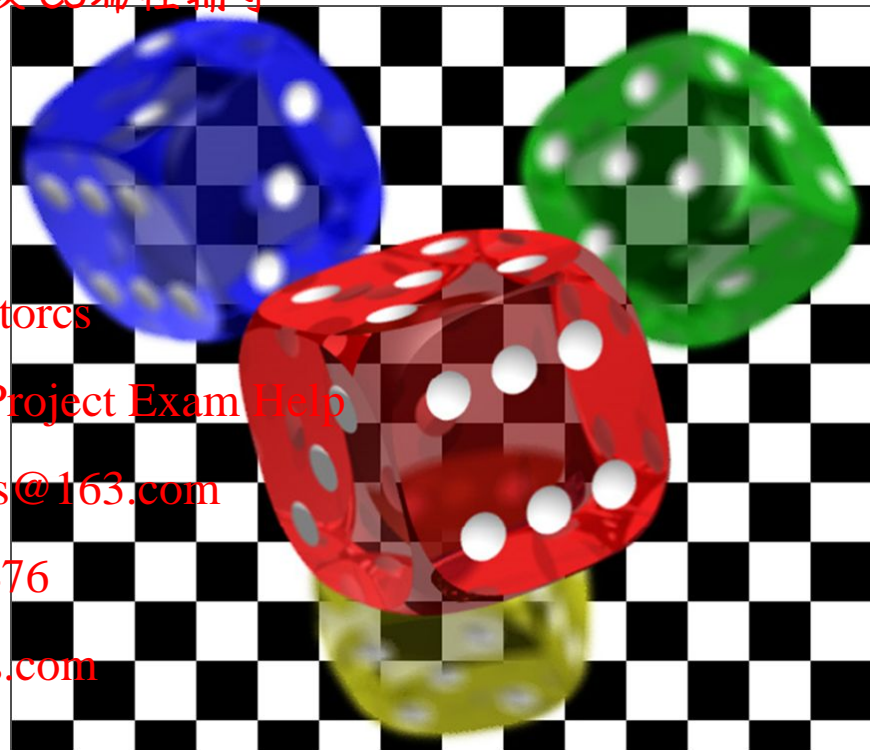
Files sizes often slightly smaller than GIF

PNG palette transparency vs alpha transparency

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PNG-8, 1 transparent colour (54KB)



PNG-24, 8-bit transparency (214KB)

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Animated PNG

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In 2004, Mozilla developed **APNG**, an extension to the PNG specification.

- Similar to animated GIFs, multiple image frames are stored in one file
- Backwards compatible with standard PNG (displays 1 static frame)



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Adoption of the format has been slow.

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- **2008** Mozilla Firefox
- **2014** Apple Safari
- **2017** Google Chrome

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Never supported in Microsoft Internet Explorer, but is supported in Microsoft Edge,

WebP images

An open format developed by Google

- Supported in all current mobile browsers (Safari requires macOS 11+)
- Limited support in operating systems and image editing software
- Supports lossless or lossy compression, transparency and animation
- Often (but not always) produces better quality than JPEG

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PNG-8 (1.5KB)
Original Image



JPEG (1.5KB)
Saved at 0% quality



Lossy WebP (0.48KB)
Default Settings

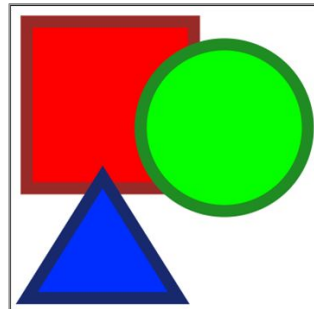
SVG: Scalable Vector Graphics

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Graphics as mathematical descriptions of shapes.

- Written as markup within HTML or as an external file
- Can display text using system or embedded fonts
- Can contain code for hyperlinks, animation and interactions

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```
<svg xmlns="http://www.w3.org/2000/svg" width="200" height="200" viewBox="0 0 200 200">  
  <rect x="10" y="10" width="110" height="110" style="stroke: rgb(153,0,0);  
stroke-width: 8; fill: rgb(255,0,0);" />  
  <circle cx="135" cy="90" r="55" style="stroke: rgb(0,153,0); stroke-width: 8;  
fill: rgb(0,255,0);" />  
  <polygon points="60,110 110,190 10,190" style="stroke: rgb(0,0,153); stroke-width: 8;  
fill: rgb(0,0,255);" />  
</svg>
```

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Audio and Video Formats

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Deprecation of browser plugins

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Early web browsers lacked native media playback capabilities. Websites would require users to install third-party browser plug-ins.



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Plug-ins and the reliance on third-party developers creates **serious problems**:

- Lack of standards and interoperability between devices and platforms.
- Additional software to install/update leading to potential security issues.

Major browsers began removing support for third-party plug-ins from 2013-2020.

The death of Adobe Flash Player

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Before HTML5, **Adobe Flash Player** was the preferred plugin for media playback.



- In **2005**, about 98% of computers had Flash Player installed.
- In **2007**, Modern mobile browsing begins to grow in popularity.
- **25 July 2017**, Adobe announces plans for Flash Player's end-of-life.
- **1 January 2021**, browser support for Flash Player officially ends.

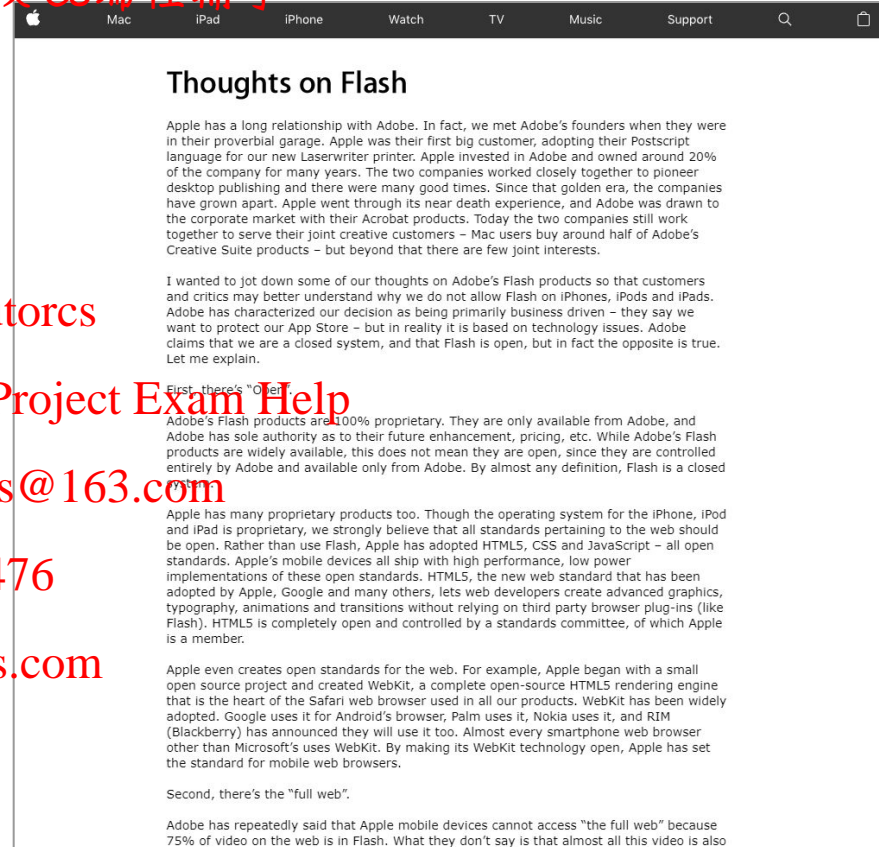
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HTML5 media

Modern browsers natively support "HTML5 media elements" using **audio** and **video** HTML tags.

- Simpler code to embedding
- Further customisation of playback and controls using JavaScript

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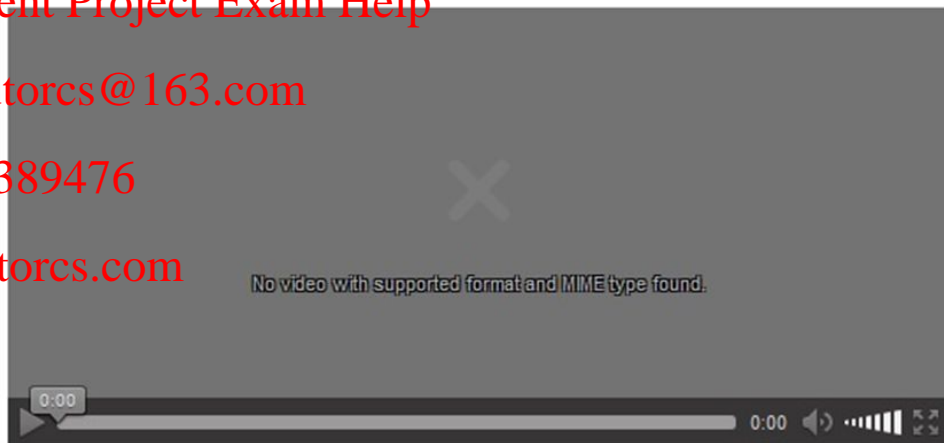
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However, different browsers may still support different media file formats. Compatibility issues may occur depending on formats used.

Right: Firefox loading an unsupported video file.



HTML5 audio formats

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Most web audio formats typically use **lossy** compression.



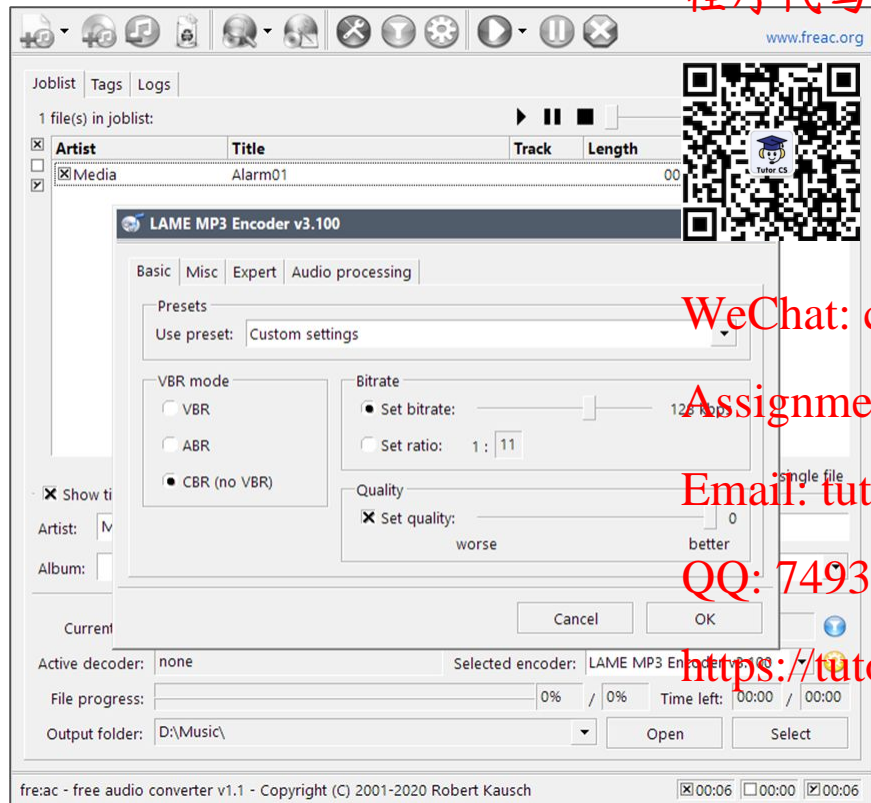
- High quality uncompressed audio is relatively large: about 10MB/minute
- Good **lossy** compression typically brings this down to **1MB/minute**
- Learn more and test your browser: <http://hpr.dogphilosophy.net/test/>

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Browser	MP3	Assignment Project Exam Help	APC	FLAC	OGG Vorbis
Google Chrome	Yes	Email: tutorcs@163.com	Yes	Yes	Yes
Mozilla Firefox	Yes	QQ: 749389476	Partial	Yes	Yes
Apple Safari	Yes	https://tutorcs.com	Yes	Yes	No
Microsoft Edge	Yes		Yes	Yes	Yes
Internet Explorer	Yes		Yes	No	No

Audio encoding bitrate

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Bitrate is the amount of data used for each second of audio

Higher bitrate = higher quality
= larger file

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For MP3 encoding:

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- Low 64kbps 0.5MB/min
- Medium 128kbps 1MB/min
- High 192kbps 1.5MB/min
- Max 320kbps 2.5MB/min

Considerations for using audio

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Sound can be immersive

- Music and ambient noise can enhance the atmosphere of a website.



Sound can be informative

- Audio is a form of feedback that can help users understand an interface.

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Sound can be annoying

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- Requires appropriate visual cues to be effective
- Is the user wearing headphones? Are speakers turned on?
- Is the volume level predictable?
- **Always give the user a obvious way to stop or disable sounds**

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HTML5 video formats

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- Video is data intensive - all web formats use **lossy** compression.
- Uncompressed Full HD video is 2 megapixel images per second but **10GB per minute**
- Good **lossy** compression brings this down to **50MB per minute**.

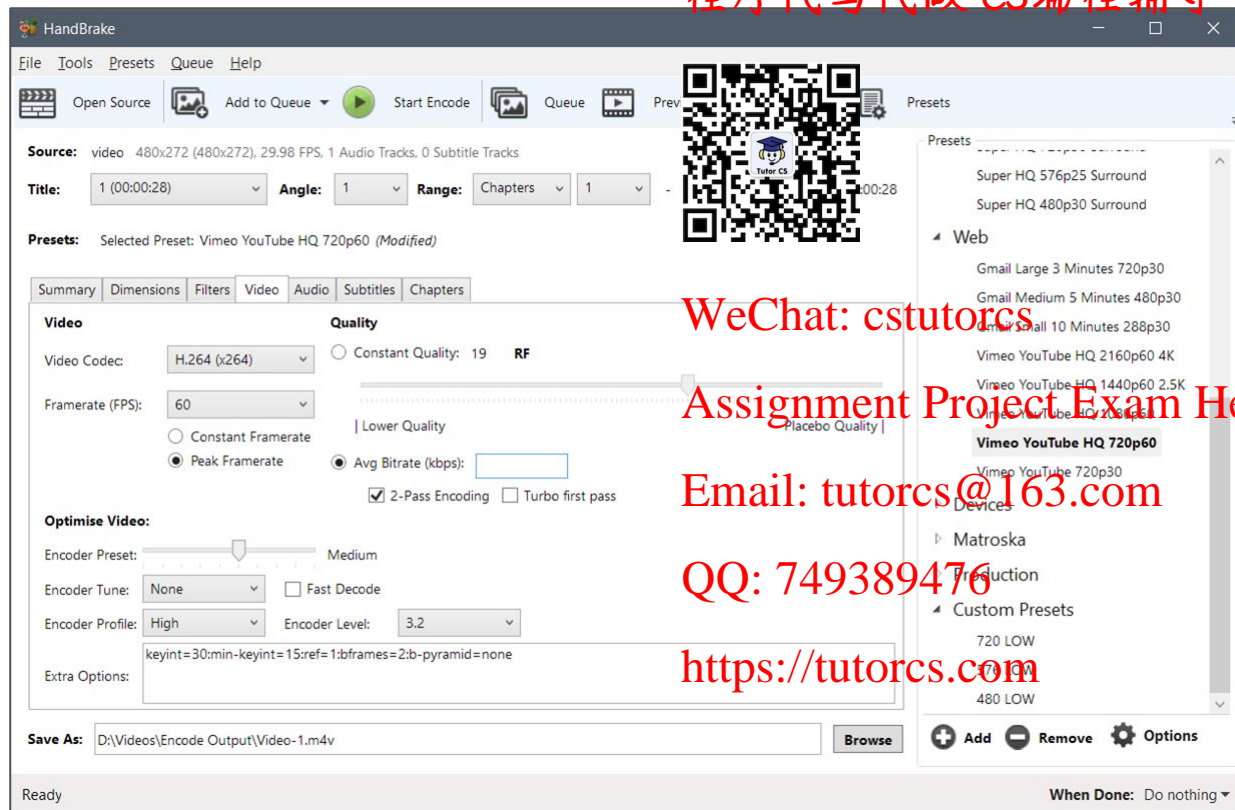


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Browser	MP4	WebM VP8	WebM VP9	OGG Theora
Google Chrome	Yes	Yes	Yes	Yes
Mozilla Firefox	Yes	Yes	Yes	Yes
Apple Safari	Yes	Partial	Partial	No
Microsoft Edge	Yes	Yes	Yes	Yes
Internet Explorer	Yes	No	No	No

Video encoding bitrate

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For streaming, average
bitrate (audio + video)
should be lower user's
available bandwidth!

YouTube bitrates:

- 480p \approx 1000kbps
- 720p \approx 2500kbps
- 1080p \approx 4500kbps
- 4K \approx 4500kbps

Considerations for using video

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Ensure compatibility with a wide range of web browsers:



- **Option 1: Using HTML5 video with MP4 format only**

- Requires the least effort, but older browsers show no video at all

- **Option 2: Using HTML5 video with MP4 and WebM formats**

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- Slightly wider compatibility, but requires more server storage space

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Where possible different resolutions and bitrates can be provided

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- Requires scripting to switch between different files

- Requires more server storage space

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- **Consider embedding videos using an third-party video service (e.g. YouTube)**

Automatic media playback policies

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In 2017, Google Chrome adopted strict policies for autoplay of media.



Chrome forcibly disables autoplay

- Embedded audio and unmuted videos
- Audio or video playback started by JavaScript without a user interaction

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Autoplay is bad for most users!

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- Unexpected audio playback can annoy or frighten users
- Unexpected motion from video content can be distracting
- Audio is disruptive for users who rely on screen-reader technologies

Next week

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- Learn web information architecture theory and techniques.
- Practice practical web information architecture design.



Important reminders

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- **Participation Milestone 2 takes place in class this week.**

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- Show your tutor your completed CSS formatting lab activity.

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- **The Assignment 2 brief has been released.**

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- Mockup image and report for a website redesign.

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- **Participation Milestone 3 takes place in class next week.**

- Choose a website to redesign for Assignment 2 and inform your tutor.