Web Interface Design (DIW)

Unit 4. Audio for the web

Professional Superior Grade of Web Application Development (DAW)

CIFP PauCasesnoves (2023/2024)

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2. Audio formats
3. Dedicated audio software
4. Creation/Edition/Conversion/Export/Import
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1 - Audio properties

- Amplitude
- Frequency
- Sample rate
- Bit depth
- Bit rate
- Compression

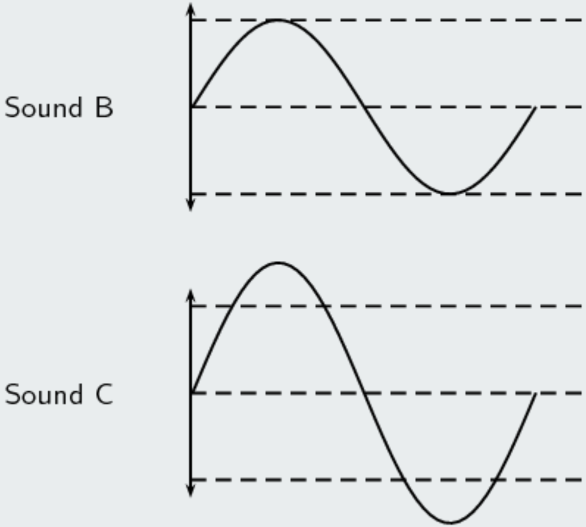
1.1 - Amplitude

The amplitude of a sound wave determines its loudness or volume. A larger amplitude means a louder sound, and a smaller amplitude means a softer sound. Sound C is louder than sound B.

The vibration of a source (analog audio) sets the amplitude of a wave. It transmits energy into the medium through its vibration. More energetic vibration corresponds to larger amplitude. The molecules move back and forth more vigorously.

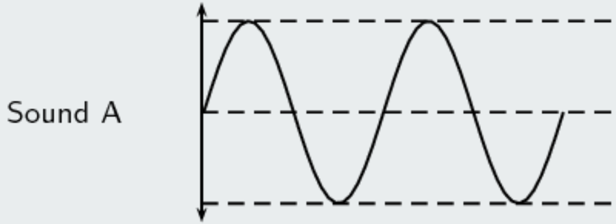
The loudness of a sound is also determined by the sensitivity of the ear. The human ear is more sensitive to some frequencies than to others. The volume we receive thus depends on both the amplitude of a sound wave and whether its frequency lies in a region where the ear is more or less sensitive.

Retrieved from:
https://intl.siyavula.com/read/science/grade-10/sound/10-sound-03

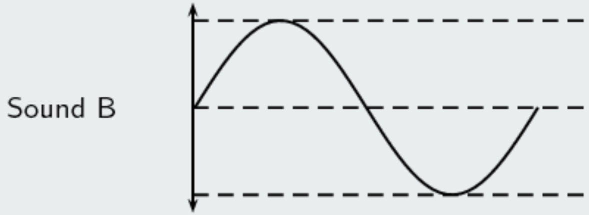


1.2 – Frequency

The frequency of a sound wave is what your ear understands as pitch. A higher frequency sound has a higher pitch, and a lower frequency sound has a lower pitch. The sound A has a higher pitch than sound B. For instance, the chirp of a bird would have a high pitch, but the roar of a lion would have a low pitch.

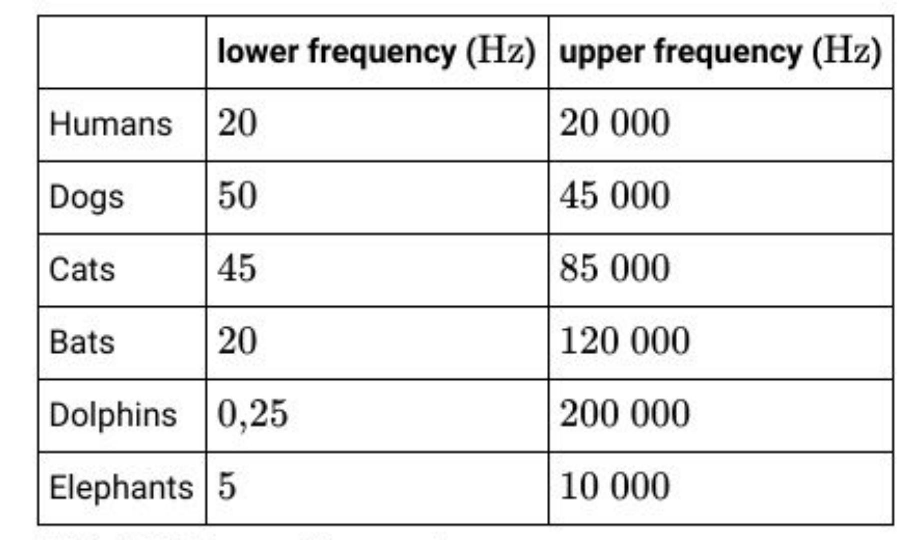


The human ear can detect a wide range of frequencies. Frequencies from 20 to 20 000 Hz are audible to the human ear. Any sound with a frequency below 20 Hz is known as an infrasound and any sound with a frequency above 20 000 Hz is known as an ultrasound.



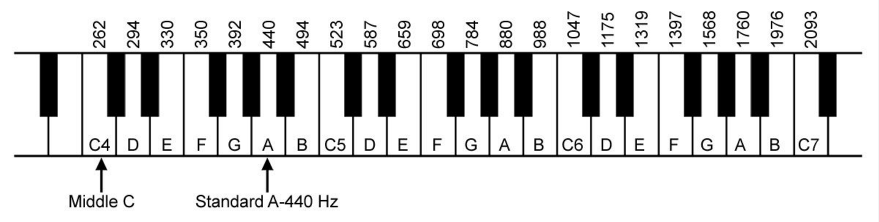
Retrieved from: https://intl.siyavula.com/read/science/grade-10/sound/10-sound-03

1.2 – Frequency



	lower frequency (Hz)	upper frequency (Hz)
Humans	20	20 000
Dogs	50	45 000
Cats	45	85 000
Bats	20	120 000
Dolphins	0,25	200 000
Elephants	5	10 000

Test it

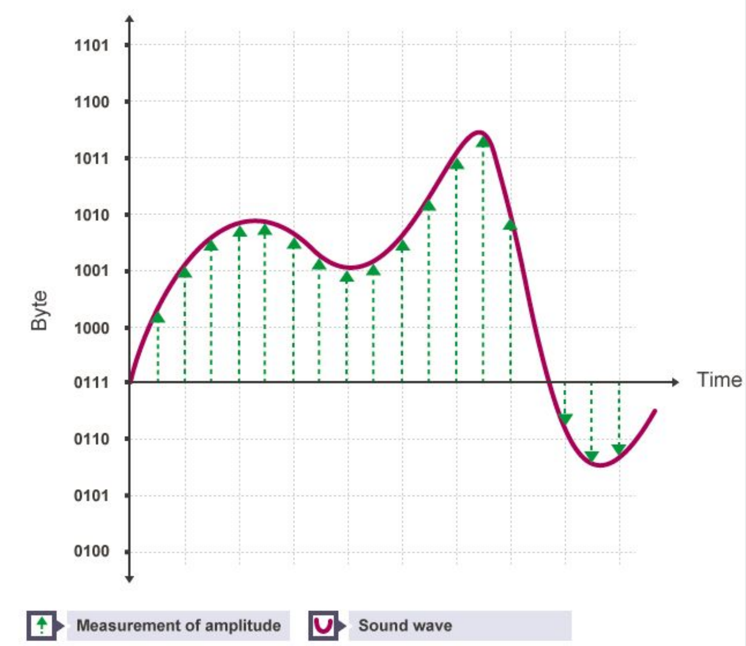


Retrieved from: https://intl.siyavula.com/read/science/grade-10/sound/10-sound-03

1.3 – Sample rate

The **sample rate** is how many samples, or measurements, of the sound are taken each second. The more samples that are taken, the more detail about where the waves rise and fall is recorded and the higher the quality of the audio. Also, the shape of the sound wave is captured more accurately.

A common audio **sample rate** for music is **44,100 samples per second**. The unit for the sample rate is **hertz (Hz)**. 44,100 samples per second is 44,100 hertz or 44.1 kilohertz (kHz).



Retrieved from: https://www.bbc.co.uk/bitesize/guides/z7vc7ty/revision/2

1.4 - Bit depth (sample size) and bit rate

Retrieved from: https://www.bbc.co.uk/bitesize/guides/z7vc7ty/revision/2

Bit depth is the number of **bits** available for each **sample**. The higher the bit depth, the higher the quality of the audio. Bit depth is usually 16 bits on a CD and 24 bits on a DVD.

The bit rate of a file tells us how many **bits** of data are processed every second. Bit rates are usually measured in **kilobits per second (kbps)**.

The bit rate is calculated using the formula : **Frequency × bit depth × channels = bit rate**

A typical, uncompressed high-quality audio file has a **sample rate** of 44,100 **samples** per second, a bit depth of 16 bits per sample and 2 channels of stereo audio. The bit rate for this file would be:

44,100 samples per second × 16 bits per sample × 2 channels = 1,411,200 bits per second (or 1,411.2 kbps)

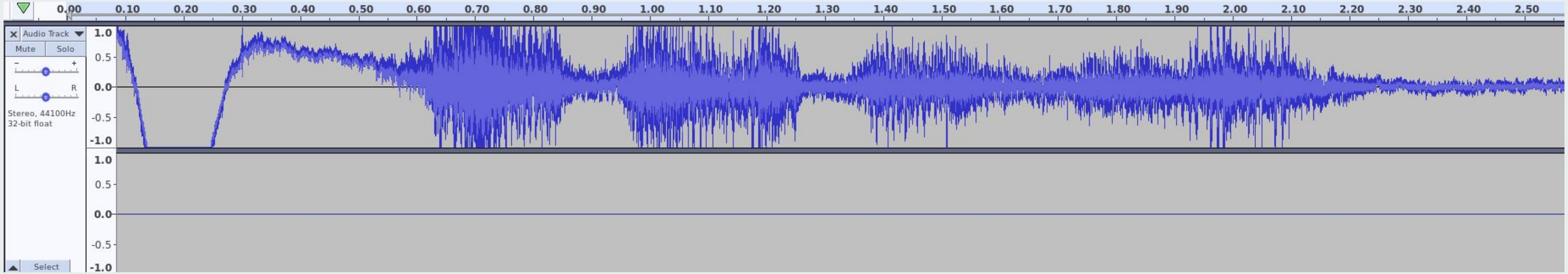
A four-minute (240 second) song at this bit rate would create a file size of:

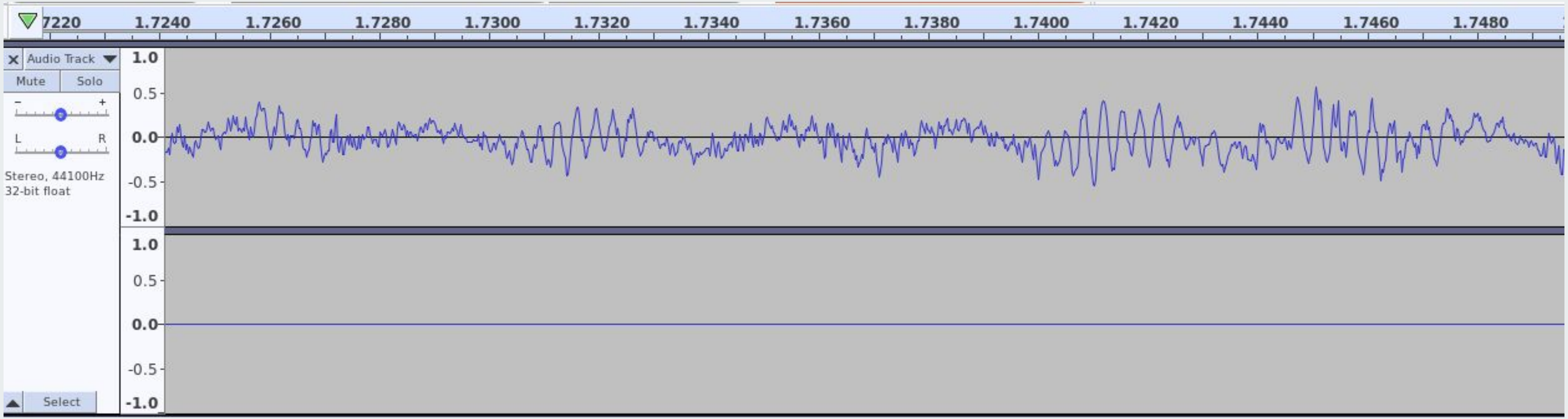
1,411,200 × 240 = 338,688,000 bits (or 40.37 megabytes)

1.5 - Audio compression

- Compression is a useful tool for reducing file sizes.
- When images, sounds or videos are compressed, data is removed to reduce the file size.
- This is very helpful when streaming and downloading files.
- Streamed music and downloadable files, such as MP3s, are usually between 128 kbps and 320 kbps - much lower than the 1,411 kbps of an uncompressed file.
- **Lossless compression** means that as the file size is compressed, the audio **quality remains the same**
- **Lossy compression permanently removes data** and the original **bit depth** is reduced to remove data and reduce the file size. The bit depth becomes **variable**.

Audio wave example





Audio file size: uncompressed vs compressed

bits	kHz	channel type	weight
32 bits	44 kHz	stereo	~21.2 MB
24 bits	44 kHz	stereo	~15.9 MB
16 bits	44 kHz	stereo	~10.2 MB
16 bits	44 kHz	mono	~5.3 MB
16 bits	22 kHz	mono	~2.6 MB
16 bits	11 kHz	mono	~1.3 MB
8 bits	11 kHz	mono	~660 KB

File sizes of one minute uncompressed audio

Bitrate	Weight	Quality
320 kbps	~2.4 MB	MP3 high definition
192 kbps	~1.4 MB	CD
96 kbps	~721 KB	low quality

Weight & Quality comparison for stereo song of 32 bits, 44 kHz of one minute lenght in MP3 format

Class activity 1

1.1 - A mono audio file of 3 seconds length has been recorded and stored to WAV file using a sample rate of 44100 Hz and 16 bit depth. This audio file has been also exported to mp3 by using a bit rate set to 80 kbps. What are the sizes of the WAV and MP3 in kiB?

1.2 - Find on the internet an audio file with a CC license. Download it and look for its audio properties. Using Audacity, load this file and try to modify some of its properties like amplitude, frequency and compression quality. Take some screenshots to prove that this modifications are applied.

2 - Audio formats

Mp3

- Designed by the Fraunhofer Society (1993)
- Is one of the most popular format for music players
- Combines good compression (small files) with high quality
- Lossy data compression
- The compression works by reducing accuracy of certain parts of sound that are beyond the auditory resolution
- Supported by all browsers
- Patent free

Ogg

- For audio and video
- Free, open container format (2000, from other project)
- Designed to provide efficient streaming
- Different codecs available, lossless and lossy (the most known is Vorbis). Open source codecs
- Compatibility with Firefox, Chrome and Opera

2 - Audio formats (2)

WAV or wave (Waveform Audio File Format)

- Microsoft and IBM audio file format standard
- The main format used on Windows systems for raw (uncompressed audio)
- Works well on Windows, Macintosh, and Linux operating systems.
- Supported by HTML5

AAC (Advanced Audio Coding)

- Developed by Apple as the default format for iTunes
- Lossy codec that provides small audio files and works great for online streaming
- Bad option for near-replica of the original recording, because of discarded bits.
- The compressed file size is ideal for mobile devices.
- Not compatible with all web browsers.

2 - Audio formats (3)

rm, ram (Real Audio)

- Was developed as a streaming media format
- Many internet radio stations used it in the past
- Developed by RealNetworks for RealPlayer
- Real Audio files are compressed using several audio codecs
- Does not play in web browsers.

wma (Windows Media Audio)

- Developed by Microsoft for Windows Media Player
- Conceived as a competitor to the popular MP3 and RealAudio codecs
- Lossy audio codec
- It includes an optional DRM (Digital rights management) facility

2 - Audio formats (4)

mid, midi (Musical Instrument Digital Interface)

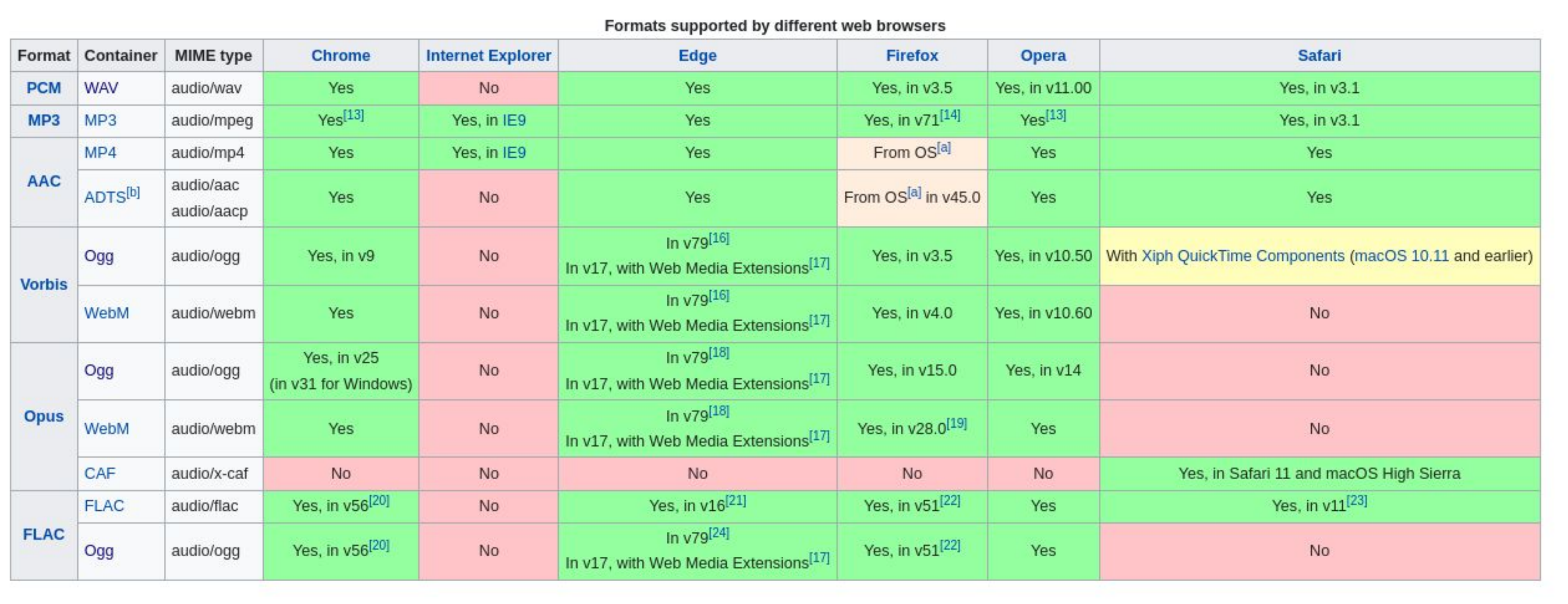
– main format for all electronic music devices like synthesizers and PC sound cards.
– do not contain sound, but digital notes that can be played by electronics.
– plays well on all computers and music hardware, but not in web browsers.

mp4

– MP4 is a video format, but can also be used for audio.
– This leads to automatic support for MP4 audio by all browsers.

2 – Audio formats (5)

More information
Timeline of audio formats

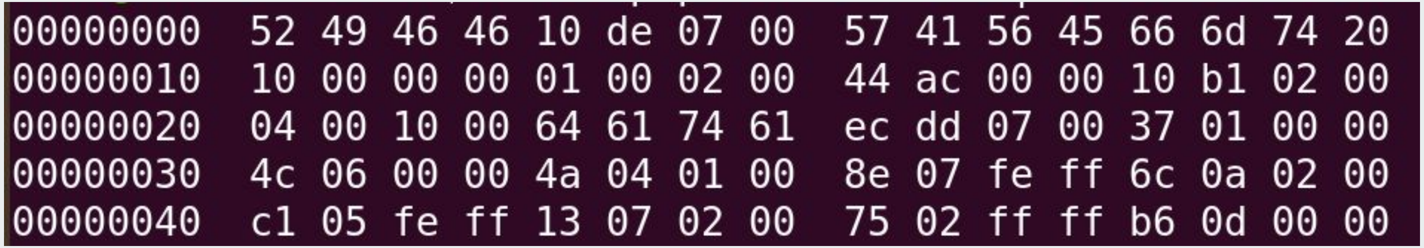


Formats supported by different web browsers

Format	Container	MIME type	Chrome	Internet Explorer	Edge	Firefox	Opera	Safari
PCM	WAV	audio/wav	Yes	No	Yes	Yes, in v3.5	Yes, in v11.00	Yes, in v3.1
MP3	MP3	audio/mpeg	Yes[13]	Yes, in IE9	Yes	Yes, in v71[14]	Yes[13]	Yes, in v3.1
AAC	MP4	audio/mp4	Yes	Yes, in IE9	Yes	From OS[a]	Yes	Yes
	ADTS[b]	audio/aac audio/aacp	Yes	No	Yes	From OS[a] in v45.0	Yes	Yes
Vorbis	Ogg	audio/ogg	Yes, in v9	No	In v79[16] In v17, with Web Media Extensions[17]	Yes, in v3.5	Yes, in v10.50	With Xiph QuickTime Components (macOS 10.11 and earlier)
	WebM	audio/webm	Yes	No	In v79[16] In v17, with Web Media Extensions[17]	Yes, in v4.0	Yes, in v10.60	No
Opus	Ogg	audio/ogg	Yes, in v25 (in v31 for Windows)	No	In v79[18] In v17, with Web Media Extensions[17]	Yes, in v15.0	Yes, in v14	No
	WebM	audio/webm	Yes	No	In v79[18] In v17, with Web Media Extensions[17]	Yes, in v28.0[19]	Yes	No
	CAF	audio/x-caf	No	No	No	No	No	Yes, in Safari 11 and macOS High Sierra
FLAC	FLAC	audio/flac	Yes, in v56[20]	No	Yes, in v16[21]	Yes, in v51[22]	Yes	Yes, in v11[23]
	Ogg	audio/ogg	Yes, in v56[20]	No	In v79[24] In v17, with Web Media Extensions[17]	Yes, in v51[22]	Yes	No

Class activity 2

Given the header content of an audio file:



```
00000000  52 49 46 46 10 de 07 00  57 41 56 45 66 6d 74 20
00000010  10 00 00 00 01 00 02 00  44 ac 00 00 10 b1 02 00
00000020  04 00 10 00 64 61 74 61  ec dd 07 00 37 01 00 00
00000030  4c 06 00 00 4a 04 01 00  8e 07 fe ff 6c 0a 02 00
00000040  c1 05 fe ff 13 07 02 00  75 02 ff ff b6 0d 00 00
```

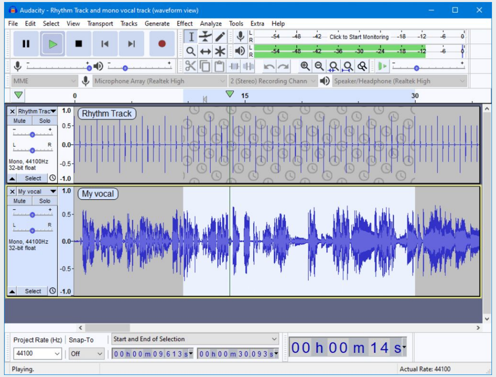
Answer the following questions and explain your answer.

- What is the format?
- What is the file size?
- What is the bit depth?
- What is the sample rate?
- How many channels does the audio file have?

Note: you can use this link to get help

3 – Dedicated audio software

- Audacity download
- Audacity manual
- Exiftool (manage metadata)
- ffmpeg (cmd audio/video conversion)

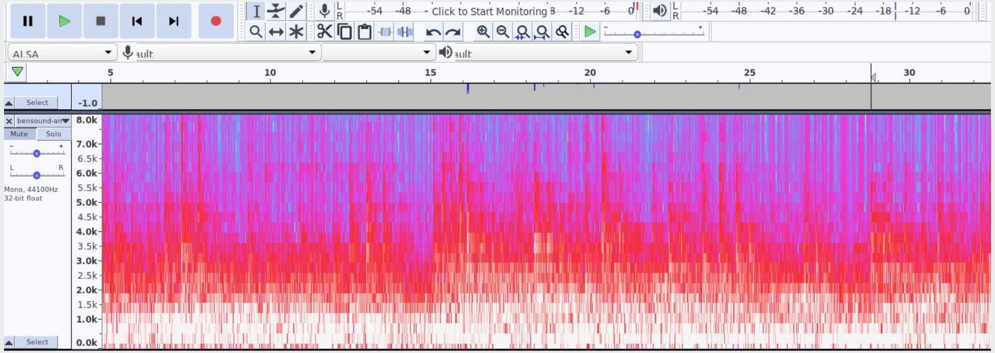

Audacity - Rhythm Track and mono vocal track (waveform view)
File Edit Select View Transport Tracks Generate Effect Analyze Tools Extra Help
Click to Start Monitoring
MME
Microphone Array (Realtek High
2 (Stereo) Recording Chann
Speaker/Headphone (Realtek High
Rhythm Track
My vocal
Mute Solo
Mono, 44100Hz 32-bit float
Select

Project Rate (Hz): 44100 | Snap-To: Off | Start and End of Selection: 00 h 00 m 09.613 s – 00 h 00 m 30.093 s

00 h 00 m 14 s

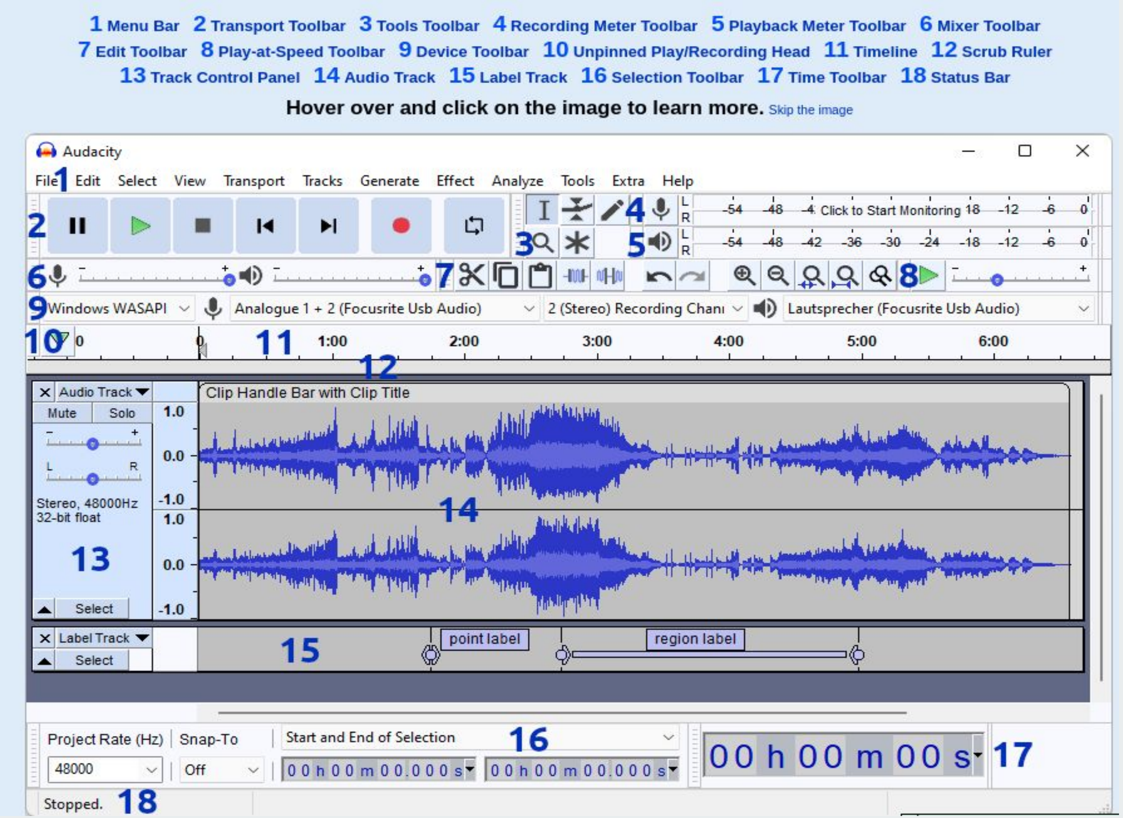
Playing.

Actual Rate: 44100



3 – Dedicated audio software: Audacity

- [Audacity download]
- [Audacity manual]



1 Menu Bar 2 Transport Toolbar 3 Tools Toolbar 4 Recording Meter Toolbar 5 Playback Meter Toolbar 6 Mixer Toolbar
7 Edit Toolbar 8 Play-at-Speed Toolbar 9 Device Toolbar 10 Unpinned Play/Recording Head 11 Timeline 12 Scrub Ruler
13 Track Control Panel 14 Audio Track 15 Label Track 16 Selection Toolbar 17 Time Toolbar 18 Status Bar

Hover over and click on the image to learn more. Skip the image

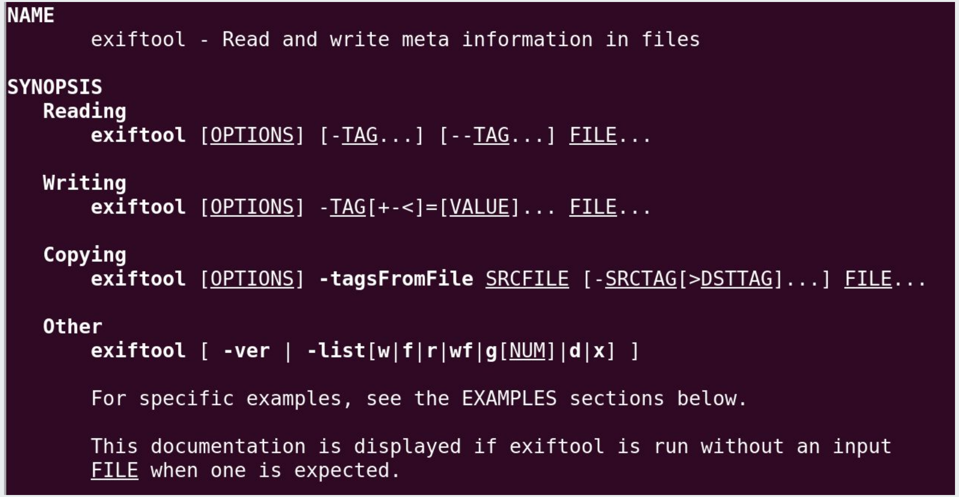
Audacity
File Edit Select View Transport Tracks Generate Effect Analyze Tools Extra Help
Click to Start Monitoring
Windows WASAPI
Analogue 1 + 2 (Focusrite Usb Audio)
2 (Stereo) Recording Chann
Lautsprecher (Focusrite Usb Audio)
1:00 2:00 3:00 4:00 5:00 6:00
Audio Track
Mute
Solo
Stereo, 48000Hz
32-bit float
Select
Clip Handle Bar with Clip Title
Label Track
point label
region label
Project Rate (Hz)
48000
Snap-To
Off
Start and End of Selection
00 h 00 m 00.000 s
00 h 00 m 00 s
Stopped.

3.1 – Audio metadata: exiftool

- **All files in our system may contain extra information, known as *metadata***
- **We can access metadata using our File Explorer or a dedicated software like exiftool.**

Examples (using regular expressions):

- exiftool *.mp3 | Select-String "^Dur\|Genre\|File Name" (WINDOWS)
- exiftool *.mp3 | grep "^Dur\|Genre\|File Name" (UNIX)



```
NAME
       exiftool - Read and write meta information in files

SYNOPSIS
   Reading
       exiftool [OPTIONS] [-TAG...] [--TAG...] FILE...

   Writing
       exiftool [OPTIONS] -TAG[+-<]=[VALUE]... FILE...

   Copying
       exiftool [OPTIONS] -tagsFromFile SRCFILE [-SRCTAG[>DSTTAG]...] FILE...

   Other
       exiftool [ -ver | -list[w|f|r|wf|g[NUM]|d|x] ]

       For specific examples, see the EXAMPLES sections below.

       This documentation is displayed if exiftool is run without an input
       FILE when one is expected.
```

4 – Audio edition

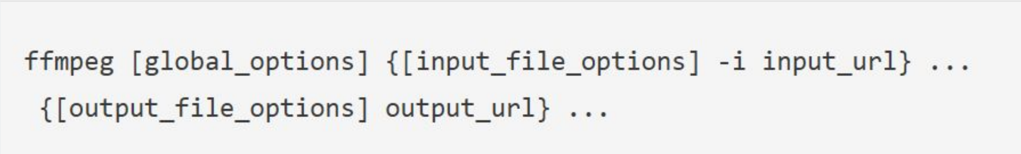
Some examples of what can be changed with audio editing software:

- Import and export tracks to different formats
- Record audio
- Modify volume
- Apply special effects (fade in/fade out, reverb, wahwah, change pitch, reverse, increase/decrease speed…)
- Cut & combine audio tracks
- Noise reduction / adding noise
- Adding rhythm and pure waves
- Spectrograms and metadata
- Karaoke mode / adding label fields
- Size optimizations → Quality, Bit rate, …

4.1 Audio edition: ffmpeg

- FFmpeg is a multimedia framework, able to decode, encode, transcode, mux, demux, stream, filter and play from ancient formats up to the newest ones.
- Works on Linux, Mac OS X, Microsoft Windows, the BSDs, Solaris, etc.

The typical syntax of the FFmpeg command is:



```
ffmpeg [global_options] {[input_file_options] -i input_url} ...
 {[output_file_options] output_url} ...
```

> ffmpeg -i input_file → show file info

> ffmpeg -formats → check list of supported formats

> ffmpeg -i input.mp4 -vn output.mp3 → converts video file to audio file

> ffmpeg -i input.mp3 -ab 128 output.mp3 → changing the bitrate

> ffmpeg -i input.mp3 -af 'volume=0.5' output.mp3 → change the volume of an audio file

> ffmpeg -i input.mp3 -af "atempo=2.0" -vn output.mp3 → increase or decrease audio speed (values between 0.5 - 2.0)

> ffplay audio.mp3 → plays audio file

Class activity 3 - AUDACITY

Download at least three audio files of more than 2 minutes length each. Cut for each track a piece between 5-20 seconds and combine tracks in a single combined track by using a crossfade effect between songs. Use this combined with a fragment of a podcast as the main audio voice. You can also add some effects from here. Export the track to mp3 with a bit rate of approximately 192 kbps. Note: your audio file must be between 30 and 60 seconds length.

- Base music to download (II) (III)

Class activity 4

Write a cmd or ps1 script that converts all *.wav files in a directory into *.mp3 and *.ogg using specified bit-rate or quality value. Use ffmpeg to implement the conversion. What is the equivalent *.ogg quality value associated with 192 kbps for mp3?

- passing parameters through cmd script
- ffmpeg
- cmd loop by files (II)
- powershell loop through lines

Class activity 5

Write a bash or cmd script that shows a menu with at least 5 different audio operations using ffmpeg. Explain your code.

MDN Reference

5 - Audio for the web: <audio> element

<Audio> attributes	**Effect**
Autoplay	Sound will be reproduced automatically as soon as possible
Controls	Reproduction controls will be displayed
Loop	Sound will be restarted when finish.
Muted	Sound will be initiated muted. State must be changed from start options
src	The URL of the audio to embed. This is optional; you may instead use the <source> element within the audio block to specify the audio to embed.
Volume	Volume of audio, between 0.0 (silence) and 1.0 (high volume).

```
<audio controls>
<source src="http://m09-u2.surge.sh/so/Batty_McFaddin.mp3" type="audio/mp3">
<source src="http://m09-u2.surge.sh/so/Batty_McFaddin.ogg" type="audio/ogg">
Sorry, your web browser doesn’t support HTML5 audio
</audio>
```

5 – Audio for the web

Javascript Audio() object

Javascript basic example

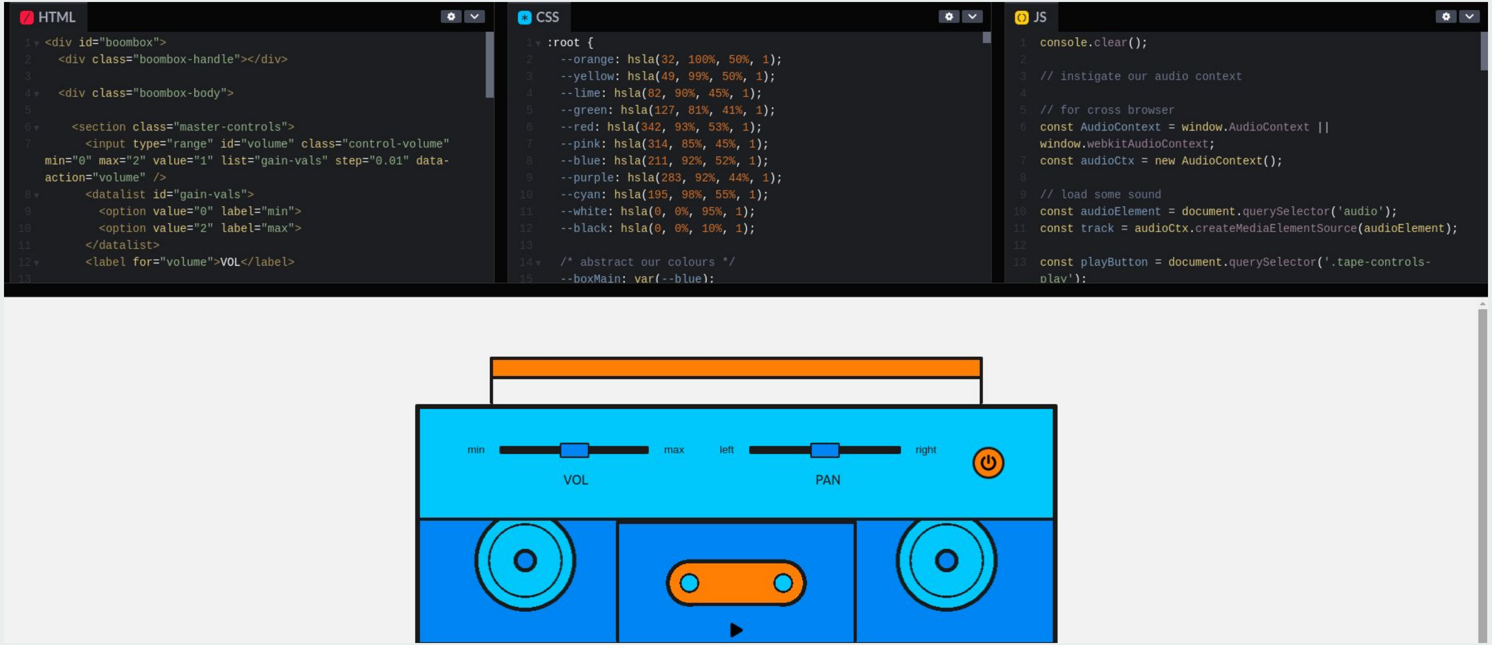
```
<script>
var so = new Audio('audio.mp3'); //take the local audio file audio.mp3
so.volume = 0.5; // here we set the volume (optional)
so.loop = true; // loop set to True
so.play(); // reproduce the sound
</script>
```

Javascript control using button

```
<script>
var so = new Audio('audio.mp3');
function reprod() {
so.play();
}
</script>
<button onclick="reprod();">Play music</button>
```

5 – Audio for the web: WebAudio API

WebAudio API example



```html
<div id="boombox">
  <div class="boombox-handle"></div>

  <div class="boombox-body">

    <section class="master-controls">
      <input type="range" id="volume" class="control-volume" min="0" max="2" value="1" list="gain-vals" step="0.01" data-action="volume" />
      <datalist id="gain-vals">
        <option value="0" label="min">
        <option value="2" label="max">
      </datalist>
      <label for="volume">VOL</label>
```

```css
:root {
  --orange: hsla(32, 100%, 50%, 1);
  --yellow: hsla(49, 99%, 50%, 1);
  --lime: hsla(82, 90%, 45%, 1);
  --green: hsla(127, 81%, 41%, 1);
  --red: hsla(342, 93%, 53%, 1);
  --pink: hsla(314, 85%, 45%, 1);
  --blue: hsla(211, 92%, 52%, 1);
  --purple: hsla(283, 92%, 44%, 1);
  --cyan: hsla(195, 98%, 55%, 1);
  --white: hsla(0, 0%, 95%, 1);
  --black: hsla(0, 0%, 10%, 1);

  /* abstract our colours */
  --boxMain: var(--blue);
```

```javascript
console.clear();

// instigate our audio context

// for cross browser
const AudioContext = window.AudioContext || window.webkitAudioContext;
const audioCtx = new AudioContext();

// load some sound
const audioElement = document.querySelector('audio');
const track = audioCtx.createMediaElementSource(audioElement);

const playButton = document.querySelector('.tape-controls-play');
```

Mixed collection of links

- Random audio generation
- 10 software programs for audio processing
- Programs for audio edition
- Audio with python
- Audio HTML tag (w3c)
- Interaction with embed web audio
- Audio modulation
- Music to download (II) (III)
- Command line tool for audio processing (SOX)
- ffmpeg tool documentation
- Noise samples (II), (III)
- spectrograms

Web Interface Design (DIW)

Unit 4. Video for the web

Professional Superior Grade of Web Application Development (DAW)

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Contents

1. Video properties
2. Video codecs
3. File types and containers
4. Video for the website
5. Video players
6. Video editors

1 - Video properties

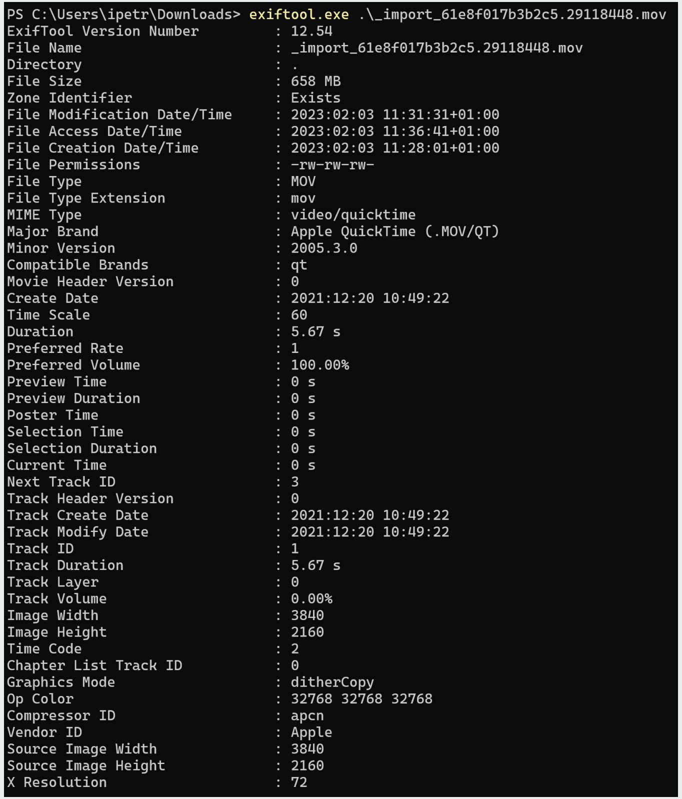
We will understand *video* as the digital medium to display a moving visual media. When using video on a web, we need to attend to:

- Duration of the clip, usually expressed in seconds
- Size of the clip (how much it occupies in the storage device: MB, GB,...)
- Resolution: size of every frame in pixels. It determines the amount of detail in your video, or how realistic and clear the video appears (pixels width X pixels height)
- Aspect Ratio: the comparison of the width pixels with respect to the height of the frames
- Frame rate or number of frames per second or (fps)
  - Illusion of movement ~ 16 fps
  - Cinema movies: 24 fps (PAL) / 29 fps (NTSC)
  - Videogames: 60 fps

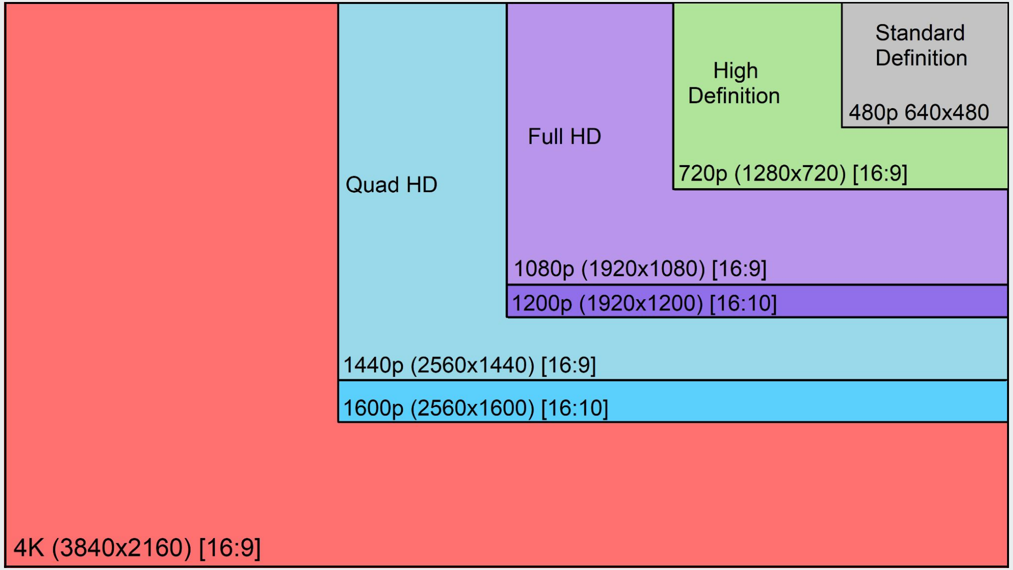
Video codec: software or hardware that compress and decompress digital video. Some modern and popular video codecs are H.264 (AVC) and H.265 (HEVC)

As we know, a container is like a box that contains video, audio, and metadata (vital data such as captions, SEO, and other information that pieces the video together for playback)

Aspect Ratio



```
PS C:\Users\ipetr\Downloads> exiftool.exe .\_import_61e8f017b3b2c5.29118448.mov
ExifTool Version Number         : 12.54
File Name                       : _import_61e8f017b3b2c5.29118448.mov
Directory                       : .
File Size                       : 658 MB
Zone Identifier                 : Exists
File Modification Date/Time     : 2023:02:03 11:31:31+01:00
File Access Date/Time           : 2023:02:03 11:36:41+01:00
File Creation Date/Time         : 2023:02:03 11:28:01+01:00
File Permissions                : -rw-rw-rw-
File Type                       : MOV
File Type Extension             : mov
MIME Type                       : video/quicktime
Major Brand                     : Apple QuickTime (.MOV/QT)
Minor Version                   : 2005.3.0
Compatible Brands               : qt
Movie Header Version            : 0
Create Date                     : 2021:12:20 10:49:22
Time Scale                      : 60
Duration                        : 5.67 s
Preferred Rate                  : 1
Preferred Volume                : 100.00%
Preview Time                    : 0 s
Preview Duration                : 0 s
Poster Time                     : 0 s
Selection Time                  : 0 s
Selection Duration              : 0 s
Current Time                    : 0 s
Next Track ID                   : 3
Track Header Version            : 0
Track Create Date               : 2021:12:20 10:49:22
Track Modify Date               : 2021:12:20 10:49:22
Track ID                        : 1
Track Duration                  : 5.67 s
Track Layer                     : 0
Track Volume                    : 0.00%
Image Width                     : 3840
Image Height                    : 2160
Time Code                       : 2
Chapter List Track ID           : 0
Graphics Mode                   : ditherCopy
Op Color                        : 32768 32768 32768
Compressor ID                   : apcn
Vendor ID                       : Apple
Source Image Width              : 3840
Source Image Height             : 2160
X Resolution                    : 72
```



Which is the aspect ratio of a video file?

4:3 ~ 1.3333333....
16:9 ~ 1.77777777...
21:9 ~ 2.333333...
3:2 ~ 1.5

How video compression works

- Uncompressed video requires a very high data rate. Although lossless video compression codecs perform at a compression factor of 5 to 12, a H.264 lossy compression video has a compression factor between 20 and 200.

- The two key video compression techniques used in video coding standards are the discrete cosine transform (DCT) and motion compensation (MC). Most video coding standards, such as the H.26x and MPEG formats, typically use motion-compensated DCT video coding (block motion compensation).

2 - Video codecs evolution

- H.120 was the first digital video compression standard (developed in 1984). Does not give adequate quality, but it provided important knowledge leading directly to its practical successors, such as H.261.
- H.264 (AVC- Advanced Video Codec). First published in August, 2004, is the most commonly used format for the recording, compression, and distribution of video content, used by 91% of video industry developers as of September 2019. It supports resolutions up to and including 8K UHD.
- H.265 (HEVC - High Efficiency). Successor of H.264. In comparison to AVC, HEVC offers from 25% to 50% better data compression at the same level of video quality, or substantially improved video quality at the same bit rate.
- H.266 (VVC - Versatile) Finalized development on July 2020. Successor of H.265.It was developed with two primary goals : improved compression performance and support for a very broad range of application. The aim is to make 4K broadcast and streaming commercially viable.
- VP9. Developed by Google. Is the successor to VP8 and competes mainly with (H.265 /HEVC). First release was launched on july 2013 and was mainly used on Google's video platform YouTube. In contrast to HEVC, VP9 support is common among modern web browsers.

3 - File format and container

- The video format is the *type of file format* that is storing digital video data on a computer system
- A video file type (standardized or not) is a profile specified by a restriction on which container format and which video and audio compression formats are allowed
- What we find inside the container?
  - video data in a coding format
  - Audio data in a coding format
  - Can contain: synchronization information, subtitles and other metadata
- A lot of video file formats with different specs: the relation size/quality, video coding format and audio coding format
  - Matroska
  - OGG
  - MPEG-4
  - WebM
  - WMV
- So, if we want to create or play a video we need a codec that understands that video file format and a media player
- FFmpeg project's codec libraries with a wide support of video file formats (has been used in hundreds of other software projects)
- VLC Mediaplayer uses FFmpeg libraries

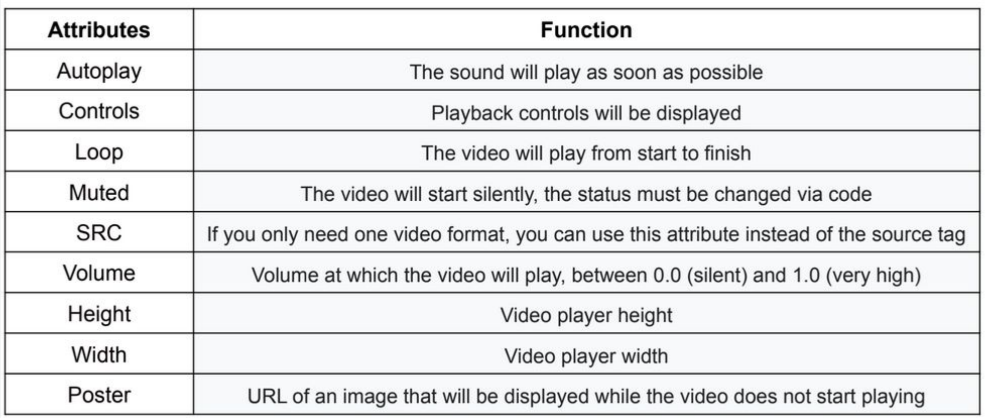
Video containers

- AVI. Introduced by Microsoft in 1992, can contain both audio and video data in a file container.
- WMV. Developed by Microsoft, uses the Advanced Systems Format (ASF) container format to encapsulate the encoded multimedia content. It can also put on Matroska and AVI containers.
- MPEG-4 (MP4). Initial released on October 2001, allows streaming over the Internet. The only filename extension for MPEG-4 Part 14 files as defined by the specification is .mp4.
- Matroska. Initial released on December, 2002. Is an universal, free and open container format that can hold an unlimited number of video, audio, picture, or subtitle tracks in one file. Matroska file extensions are .mkv for video (which may include subtitles or audio), .mk3d for stereoscopic video, .mka for audio-only files, and .mks for subtitles only.
- WebM. Primarily intended to offer a royalty-free alternative to use in the HTML5 video and the HTML5 audio elements. It has a sister project, WebP, for images. The development of the format is sponsored by Google, and the corresponding software is distributed under a BSD license.

4 - Video for the website

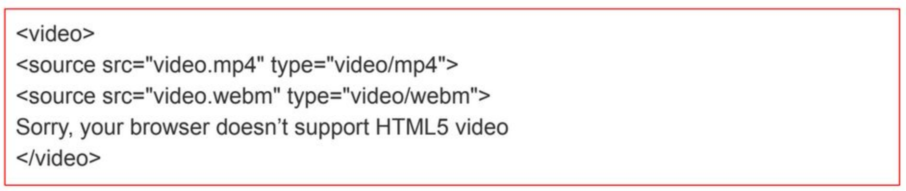
- When using a video on a web, need to know how will be used
  - Using a video stream platform, embedded player (like Youtube): EASY
  - As HTML5 video element (LINK): MORE CONTROL
- Format conversion
  - A lot of source file formats: must be supported by our codecs
  - Choose a good video format for the web:
    - MP4: one of the earliest digital video file formats, great browser support
    - OGG(OGV/OGA): file format designed for efficient streaming over internet, less supported
    - WebM: open-source, more recent, modern features (can adjust file weight depending on connection and processing power), but less supported
- Video encoder: we need a program where we can adapt the video to our requirements in file size, frame size (aspect-ratio), fps, quality, output file-format, …
- Finally, we need to control the bandwidth needed to reproduce the video. It depends on the frame rate and the capacity of the connection of the user. If this user can’t achieve the required bandwidth the video will not be displayed correctly (cuts, desynchronization, too long to start playback)

HTML5 video element



Attributes	Function
Autoplay	The sound will play as soon as possible
Controls	Playback controls will be displayed
Loop	The video will play from start to finish
Muted	The video will start silently, the status must be changed via code
SRC	If you only need one video format, you can use this attribute instead of the source tag
Volume	Volume at which the video will play, between 0.0 (silent) and 1.0 (very high)
Height	Video player height
Width	Video player width
Poster	URL of an image that will be displayed while the video does not start playing

[Video Embed using CSS (W3C example)]

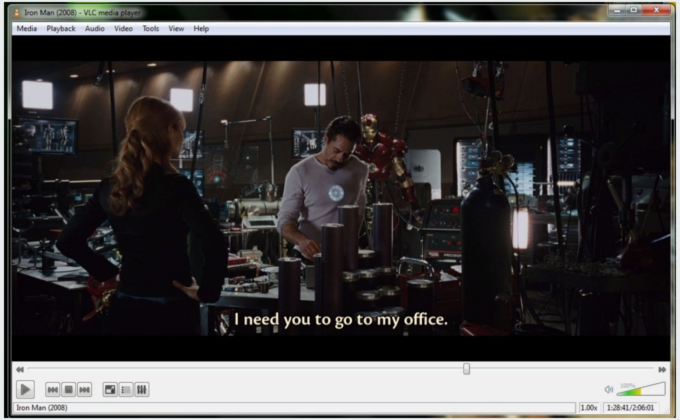


```
<video>
<source src="video.mp4" type="video/mp4">
<source src="video.webm" type="video/webm">
Sorry, your browser doesn’t support HTML5 video
</video>
```

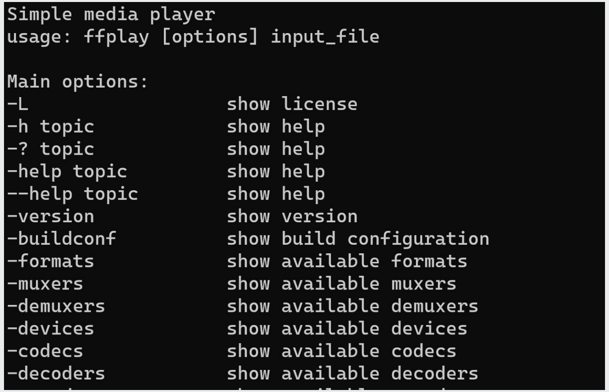
5 - Video players

VLC mediaplayer is one of the most used open players

- Open-source
- Available on Linux / Win / MAC
- Core written in C
- Supports 48 languages
- Can apply filters
- Can be used for screen-casting



ffplay is a command-line player installed together with ffmpeg software. It’s very useful for playing files (audio or video) that are being edited from command-line



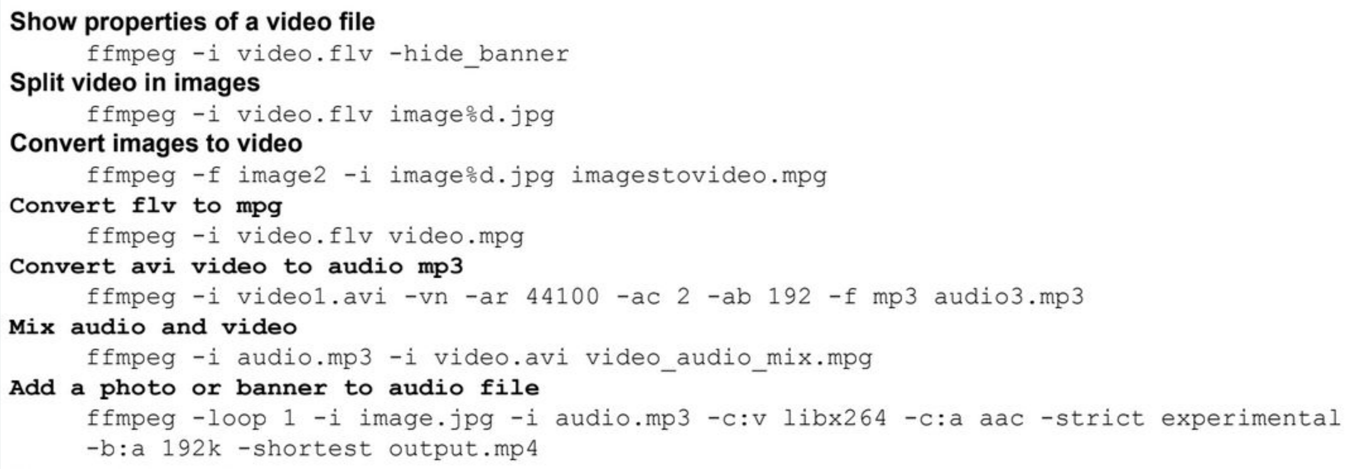
```
Simple media player
usage: ffplay [options] input_file

Main options:
-L                  show license
-h topic            show help
-? topic            show help
-help topic         show help
--help topic        show help
-version            show version
-buildconf          show build configuration
-formats            show available formats
-muxers             show available muxers
-demuxers           show available demuxers
-devices            show available devices
-codecs             show available codecs
-decoders           show available decoders
```

6 - ffmpeg: The CLI video editor

When modifying a set of files with the same options, it's useful to create a CLI script that do the work for us. ffmpeg is a complete, cross-platform solution to record, convert and stream audio and video.

Some examples of what can be done. Check the ffmpeg documentation for a full list of its capabilities.



Show properties of a video file

```
ffmpeg -i video.flv -hide_banner
```

Split video in images

```
ffmpeg -i video.flv image%d.jpg
```

Convert images to video

```
ffmpeg -f image2 -i image%d.jpg imagestovideo.mpg
```

Convert flv to mpg

```
ffmpeg -i video.flv video.mpg
```

Convert avi video to audio mp3

```
ffmpeg -i video1.avi -vn -ar 44100 -ac 2 -ab 192 -f mp3 audio3.mp3
```

Mix audio and video

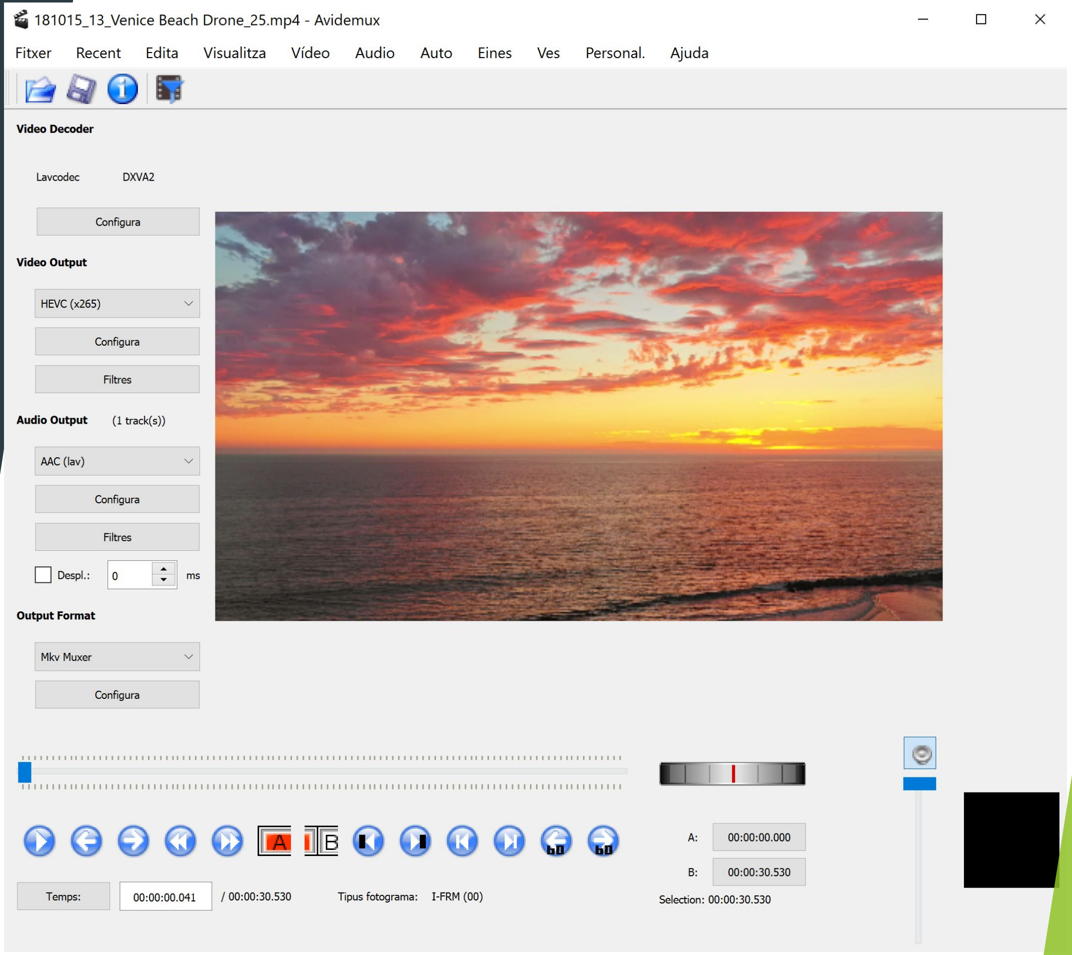
```
ffmpeg -i audio.mp3 -i video.avi video_audio_mix.mpg
```

Add a photo or banner to audio file

```
ffmpeg -loop 1 -i image.jpg -i audio.mp3 -c:v libx264 -c:a aac -strict experimental
-b:a 192k -shortest output.mp4
```

Graphical Video Editors
Avidemux

- Free and open-source, GNU/GPL Licensed
- Powerful
- Can add (multiplexing) or extract audio streams from video files
- FFmpeg codecs
- Can apply filters and visual effects
- Can cut, resize and encode in multiple video formats



181015_13_Venice Beach Drone_25.mp4 - Avidemux

Video Decoder

Lavcodec DXVA2

Video Output

HEVC (x265)

Audio Output (1 track(s))

AAC (lav)

□ Despl.: 0 ms

Output Format

Mkv Muxer

Temps: 00:00:00.041 / 00:00:30.530

Tipus fotograma: I-FRM (00)

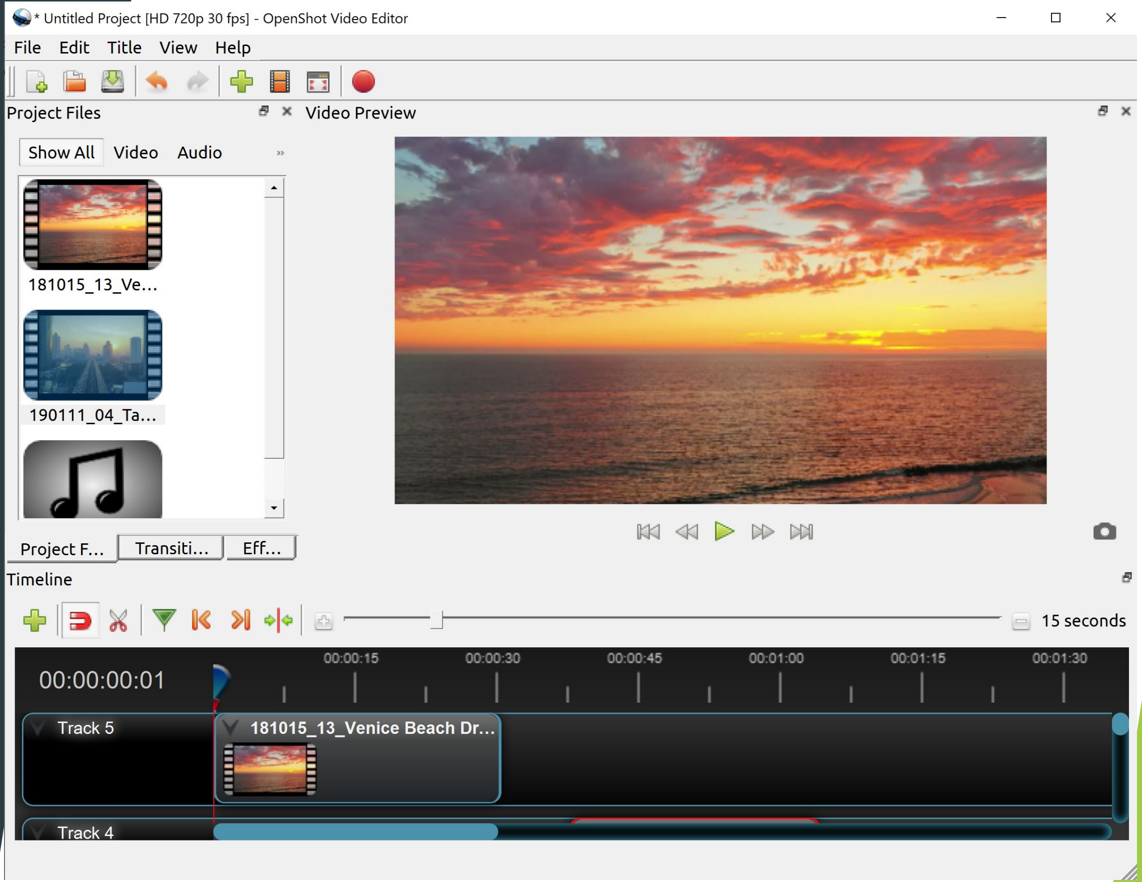
A: 00:00:00.000

B: 00:00:30.530

Selection: 00:00:30.530

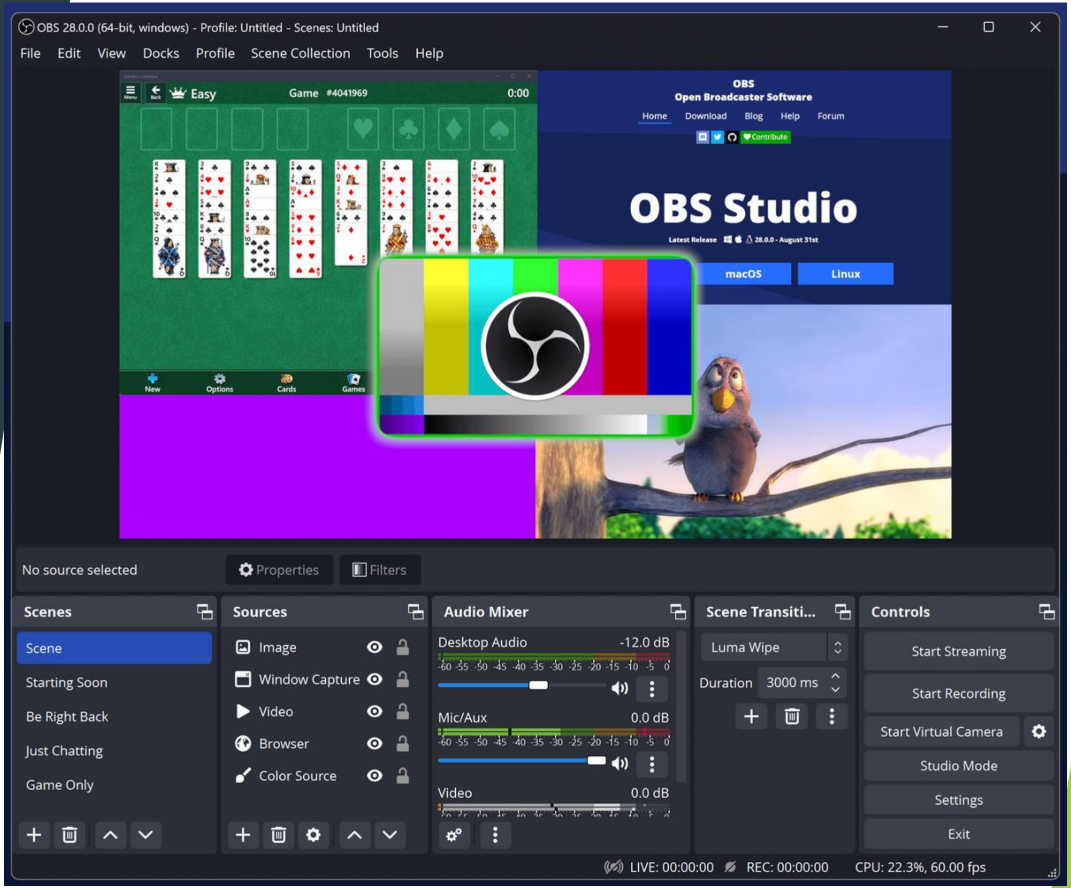
Graphical Video Editors
OpenShot

- Open-source
- Audio and video files sources
- More “user friendly”
- Multiple timelines
- Designed to be easy to use
- Multiple profiles included
- Text and subtitles edition
- Can edit 3D Video
- Adjust video speed



Graphical Video Editors
OBS (Open Broadcaster Studio)

- Free and open source software
- Video recorder, screencast and streaming
- Based on scenes
- Can manage transitions between scenes
- Multiple media sources
- Multiple video outputs: flv, mp4, mov, mkv, …
- Audio outputs: mp3, aac


OBS 28.0.0 (64-bit, windows) - Profile: Untitled - Scenes: Untitled

No source selected

Desktop Audio -12.0 dB

Mic/Aux 0.0 dB

Video 0.0 dB

Luma Wipe

Duration 3000 ms

LIVE: 00:00:00 REC: 00:00:00 CPU: 22.3%, 60.00 fps