2.6 Audio

Audio basics

Audio, or sound, is the vibration of air molecules that human ears can detect. Audio is naturally an ***analog*** signal, meaning t changes continuously over time, like a flowing river. Because computers can only store 0's and 1's, a computer records aud signal, meaning as a series of numbers—digital means countable like a hand's fingers (fingers are also known as "digits", he "digital").

A microphone converts vibrating air into an analog electrical voltage on a wire. An audio recording app may then rapidly "sa voltage (44,100 samples / second is common for music), using hardware called an analog-to-digital converter to convert e number, and storing the numbers in a file. An ***audio file*** is basically a series of numbers of sampled audio voltages, along w rate. An ***audio player*** app plays an audio file such that the audio can be heard, by sending numbers one at a time to a digita converter, at the specified rate.

PARTICIPATION ACTIVITY 2.6.1: How digital audio works.

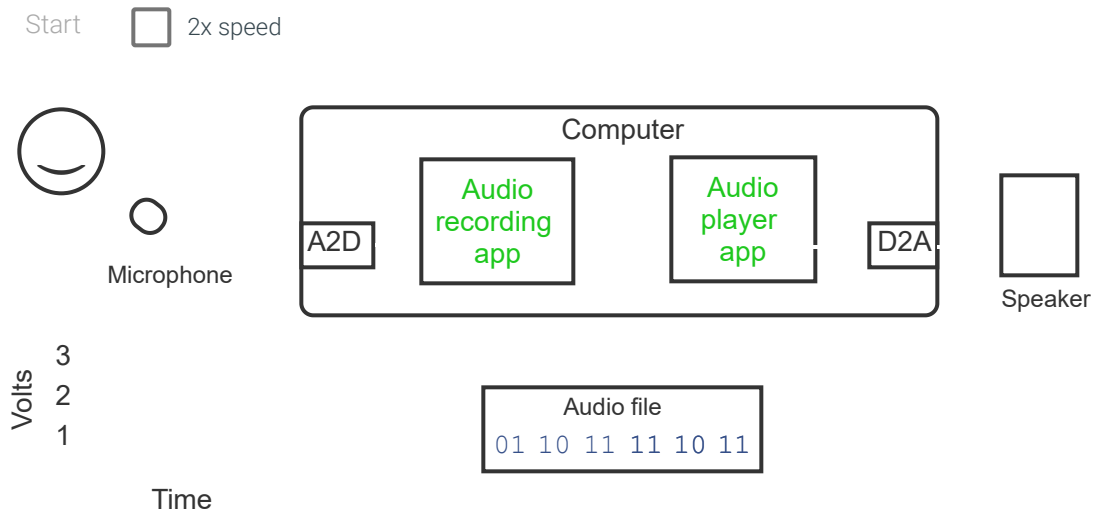
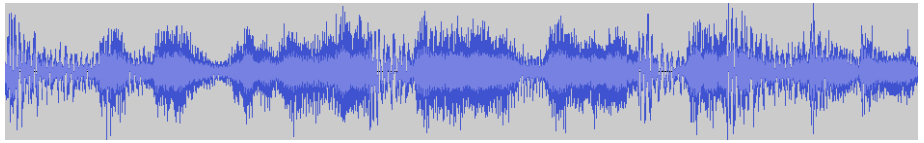


Figure 2.6.1: Audio on a computer is viewed as varying voltage levels, as in this 3 second excerpt "Welcome to the Hotel California" from the song Hotel California (viewed using Audacity).



PARTICIPATION ACTIVITY 2.6.2: Microphone to digital audio signal.

Microphone | **Song**

Start microphone

Microphone is off.

Uses wavesurfer.js (katspaugh) / CC BY 3.0

PARTICIPATION ACTIVITY 2.6.3: Audio basics.

1) A microphone converts sound into an analog signal.
   - ○ True
   - ○ False

2) A computer records audio as an analog signal.
   - ○ True
   - ○ False

3) An audio recording app samples the voltage output of a microphone.
   - ○ True
   - ○ False

4) An audio file stores a song's notes.
   - ○ True
   - ○ False

Storing audio

Each sampled audio value is stored using a fixed number of bits, known as ***bit depth***, commonly 16 or 24 bits. Thus, an auc simply be a series of 0's and 1's, such as 0000000000000001 0000000000000010 0000000000000011 000000000000001 (representing numbers 1, 2, 3, 3). Of course, values typically span the range of possible values, such as 0011110111011110 1111000000000011.

Audio files may be large. If each sample's number requires two bytes, the sampling rate is 44,100 samples / second, and a minutes (180 sec), then a song's audio file would require about 180 sec × 44100 samples / sec × 2 bytes / sample = 16 MB million bytes).

Audio files are usually stored in compressed form to reduce file size. As such, a typical song file might only be about 4 MB. compressed audio file formats include ***mp3***, ***AAC***, and ***AIFF***. A common uncompressed format (primarily for Microsoft Win WAV format.

PARTICIPATION ACTIVITY 2.6.4: Audio file storage.

1) Assume each audio sample is stored as one byte and the sampling rate is 48,000 samples / second. What is the size of a 2 minute audio recording?
   - ○ 180 × 44,100 × 1 = 7.9 MB
   - ○ 120 × 48,000 × 1 = 5.8 MB
   - ○ 2 × 48,000 = 96,000 B

2) Which is NOT an audio file format?
   - ○ mp3
   - ○ WAV
   - ○ pdf

3) Humans can only hear frequencies up to about 20,000 Hz. To capture audio frequencies that humans can hear, an audio sample rate should be at least

double that frequency. Thus, music audio frequency sampling rates should be at least _____.

- 20,000 Hz
- 40,000 Hz
- 80,000 Hz

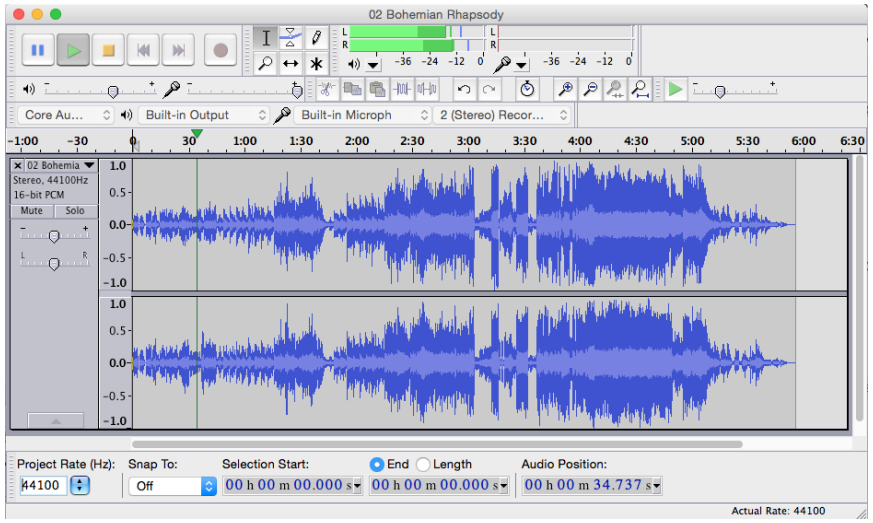
Audio apps

Popular computing devices come with audio player apps, such as ***iTunes*** (comes with Macs, iPhones, iPads, and other App ***Music app*** or ***Windows Media Player*** (for Microsoft Windows products), and a built-in music player for Android devices.

Popular computing devices also come with apps for audio recording, such as ***Quicktime*** or ***Garage Band*** for Macs.

Apps for editing audio files such as getting excerpts or mixing music are also available, such as ***Garage Band*** for Macs, or t app.

Figure 2.6.2: Users can create, edit, and save audio files with audio editor apps such as Audacity.



PARTICIPATION ACTIVITY 2.6.5: Audio apps.

1) Most computers, including tablets and smartphones, come with an app for playing audio.
   - ○ True
   - ○ False

2) Most computers, including tablets and smartphones, come with an app for editing audio.
   - ○ True
   - ○ False

Exploring further:

- Digital audio (Wikipedia)
- Audio file formats (Wikipedia)
- Audio player apps (Wikipedia)
- Audio editing apps (Wikipedia)

Provide feedback on this section