



Audio for Everybody

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Session overview

- Digital audio — properties and formats
- ADC hardware
- Audacity — what it can do
- Audacity workflow
- Brief demos

Digitizing sound

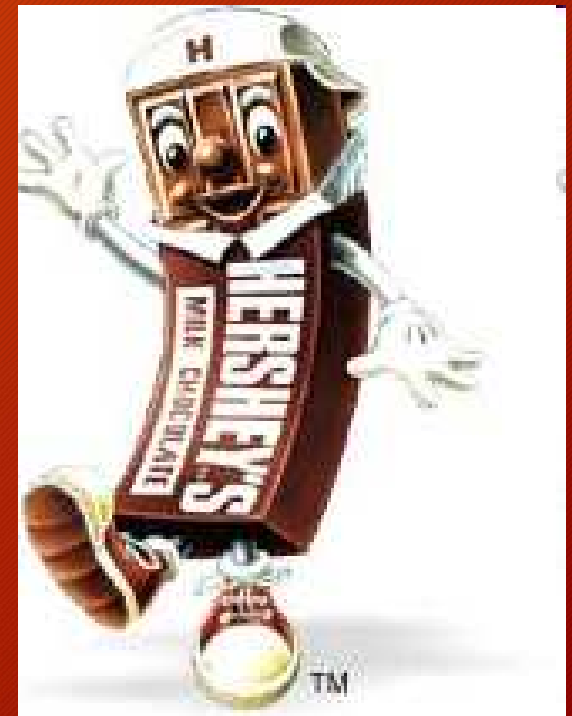
- **Sampling**
 - CD quality: 44.1 kHz = 44,100 samples per second
 - Studio quality: 96 kHz
- **Resolution**
 - AM radio quality: 8 bits/sample
 - CD quality: 16 bits/sample
 - Studio quality: 24 bits/sample
- **CD stereo quality:**
 - ~9 megabytes/minute (regardless of content)
- **Compression...**

Compression

- Challenge: reduce storage requirements
- Solution: compression
 - lossy vs. lossless compression
- Trade-off: sampling rate/quality versus file size
 - 64 kbps (mono) reasonable for speech
 - 128 kbps reasonable for music (depending on context)
 - 192 kbps better for music content

Audio file = Candy bar?

- Two components to an audio file
 - Header or wrapper
 - Audio details
 - Performance details
 - Audio data









Digital audio file formats

- **WAV/AIFF**
 - uncompressed audio
 - Wave → Windows
 - Audio Interchange Format File → MacOS
- **MP3**
- **WMA**
 - Windows Media Audio [Microsoft]
- **AAC**
 - Advanced Audio Coding (part of MPEG4 standard) [Apple]
- **Ogg-Vorbis**
 - open source, more efficient than MP3
- **MIDI**
 - Musical Instrument Digital Interface
- **RA**
 - RealAudio
 - streaming audio
- **Lossless formats:**
 - **FLAC**
 - Free Lossless Audio Codec
 - Apple Lossless
 - Windows Media Audio Lossless



MP3 files

- ISO-MPEG Audio Layer-3
- invented in Germany, 1987
- originally for video
- strips away data that won't be noticed
- compression vs. quality
 - compression is lossy
 - ~1 megabyte/minute (depending on content)
- patent/licensing issues
- most ubiquitous format today

 Carnival of the Animals.wav	19,473 KB	WAVE Audio File	9/18/2006 08:52
 Carnival of the Animals 128kbps.mp3	1,768 KB	MPEG Layer 3 Audio	9/18/2006 08:52
 Carnival of the Animals 96kbps.mp3	1,326 KB	MPEG Layer 3 Audio	9/18/2006 08:53
 Carnival of the Animals 64kbps.mp3	884 KB	MPEG Layer 3 Audio	9/18/2006 08:53
 Carnival of the Animals 32kbps.mp3	442 KB	MPEG Layer 3 Audio	9/18/2006 08:54
 Carnival of the Animals 8kHz 8kbps.mp3	111 KB	MPEG Layer 3 Audio	9/18/2006 08:55

Audio hardware examples



Audacity: What it is



- Free, open source software
- Digital Audio Workstation (DAW)
- Audio recorder
- Audio editor
- Audio mixer
- Multi-platform
 - Windows
 - MacOS X
 - Linux

What Audacity can do

- Work with many audio file formats/encodings
- Record live audio
- Convert legacy analog media to digital
- Make movie soundtracks
- Perform multichannel recording
- Edit and mix multiple tracks
- Create podcasts
- Create ringtones
- Overdub
- Use special effects
 - wah-wah
 - change pitch and tempo
 - bass boost
 - reverse
 - phaser
 - more...
- Fade in, fade out
- Normalize volume levels
- Fix defects
 - hiss | static | pops | hum
- Cut / copy / splice / mix sounds together
- Create own plug-ins

What Audacity can't do

- MIDI integration is limited

Audacity history

- **Started at Carnegie Mellon University**
 - *Dominic Mazzoni, Roger Dannenberg* – 1999
- **Now a large team of contributors**
- **11th most popular download from SourceForge**
 - 80 million+ downloads

The Competition

- DAW = digital audio workstation
 - sophistication vs. simplicity
- Sound Forge (Sony)
- ProTools (Avid)
- WaveLab (Steinberg)
- Reaper
- Garage Band (MacOS, iOS)
- Ardour (Mac + Linux) - FOSS
- Audacity: good balance of capability, quick start, ease of use

Audacity workflow

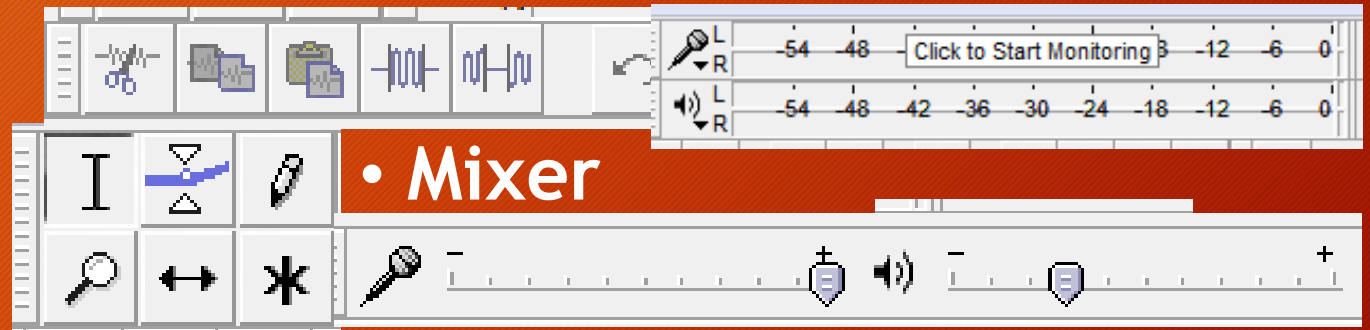
- Configure input/output devices
- Set recording levels
- Record
- Edit
- Mix
- Save project
- Export audio
 - (Export as MP3 as final step)
- *Tip:* connect USB devices before launching Audacity

Audacity toolbars

• Tools

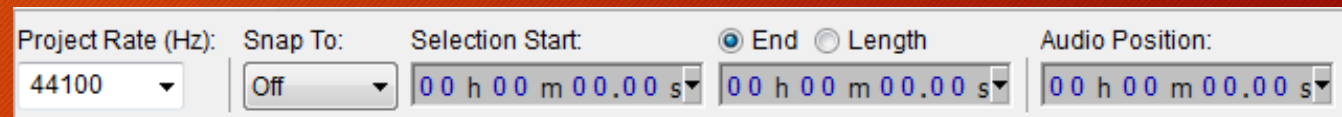
- Selection
- Envelope
- Draw
- Zoom
- Time shift
- Multi-tool

• Edit



• Mixer

• Selection



Creating a mix

- Each track can be manipulated individually
- Set pan
- Set volume — for entire track or shape
- Apply effects
- Use of solo/mute buttons

Signal processing

Optimizing sound quality, bit by bit

- Track split
- DC offset
- Noise reduction
- Pop/click removal
- Compression
- Equalization
- Normalization
- (can't fix warped records!)

Convert to MP3

- *Reminder:* Audacity project file contains no audio!
- *Important:* defer to final step!
 - otherwise, loss of quality
- Make sure LAME MP3 encoder installed
- File | Export As MP3
- Add ID tags
 - title, artist, album, comments

Vinyl (or tape) conversions

(See Audacity help or YouTube for tutorials)

- Convert signal to digital and record it
 - Hardware
 - Soundcard (quality?)
 - Xitel INport
 - USB turntables
 - USB cassette players
 - SoundTech LightSnake
 - Avid mbox
 - Software
- Clean
- Split into individual songs
- Burn

Demos



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