

Why audio features?

- Description of sound

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- Description of sound
- Different features capture different aspects of sound

Why audio features?

- Description of sound
- Different features capture different aspects of sound
- Build intelligent audio systems

Audio feature categorisation

- Level of abstraction
- Temporal scope
- Music aspect
- Signal domain
- ML approach

Level of abstraction



High-level

Examples: instrumentation, key, chords, melody, rhythm, tempo, lyrics, genre, mood



Mid-level

Examples: pitch- and beat-related descriptors, such as note onsets, fluctuation patterns, MFCCs



Low-level

Examples: amplitude envelope, energy, spectral centroid, spectral flux, zero-crossing rate

Knees, P., & Schedl, M. (2016). *Music similarity and retrieval: an introduction to audio-and web-based strategies*

Temporal scope

- Instantaneous (~50ms)
- Segment-level (seconds)
- Global

Music aspect

- Beat
- Timbre
- Pitch
- Harmony
- ...

Signal domain

Signal domain

- Time domain

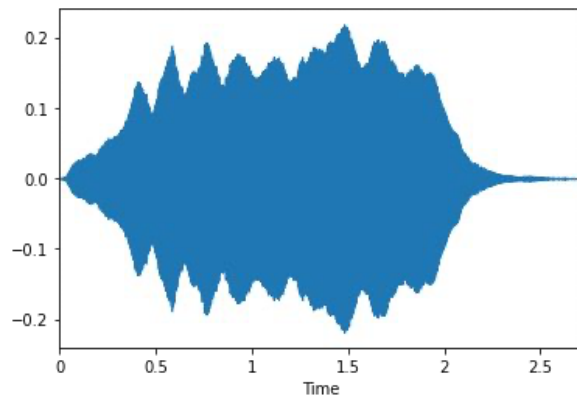
Signal domain

- Time domain

Amplitude envelope
Root-mean square energy
Zero crossing rate

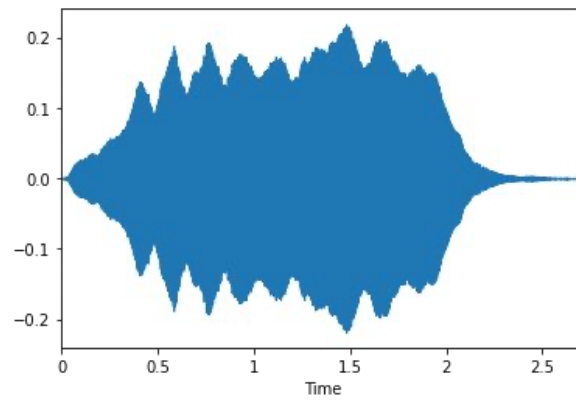
Signal domain

- Time domain



Signal domain

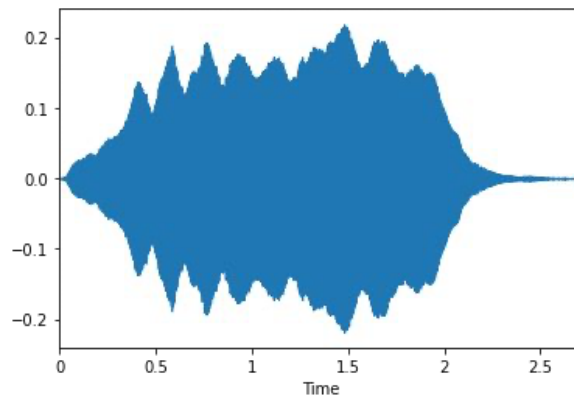
- Time domain
- Frequency domain



Signal domain

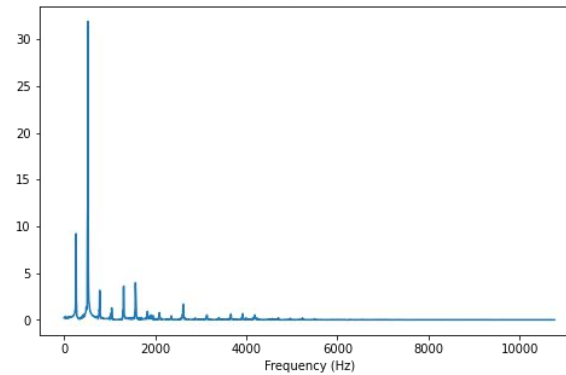
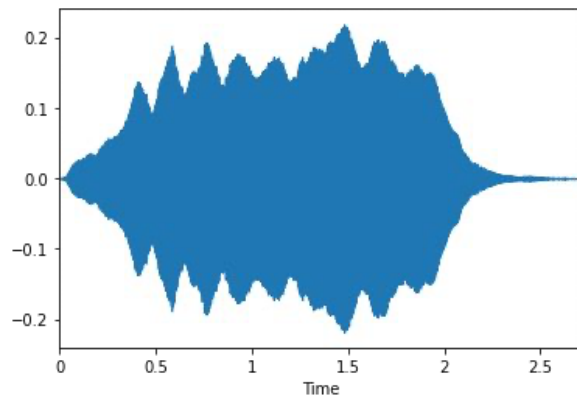
- Time domain
- Frequency domain

Band energy ratio
Spectral centroid
Spectral flux



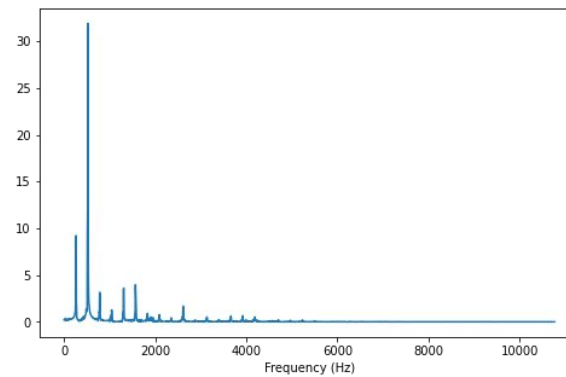
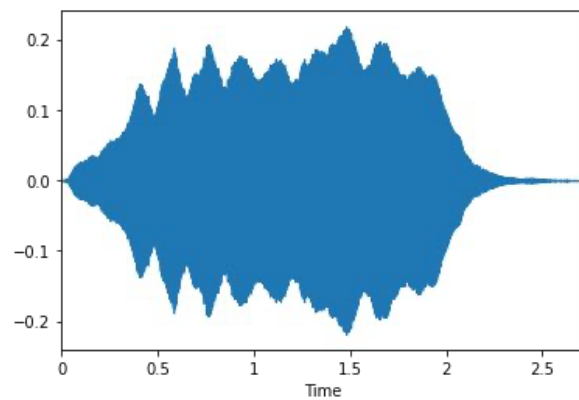
Signal domain

- Time domain
- Frequency domain



Signal domain

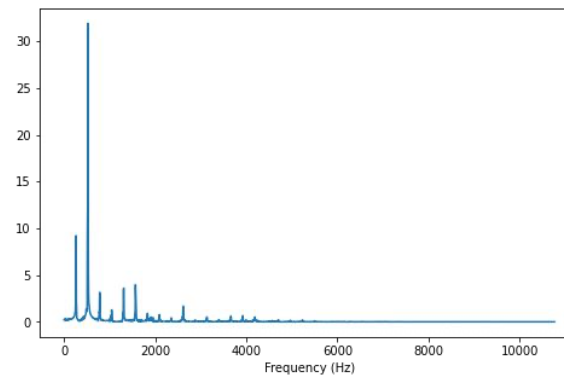
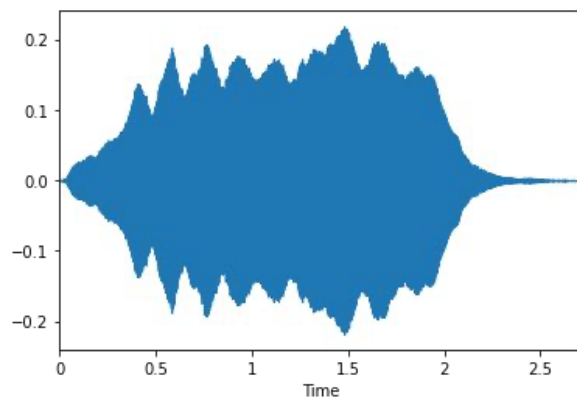
- Time domain
- Frequency domain
- Time-frequency representation



Signal domain

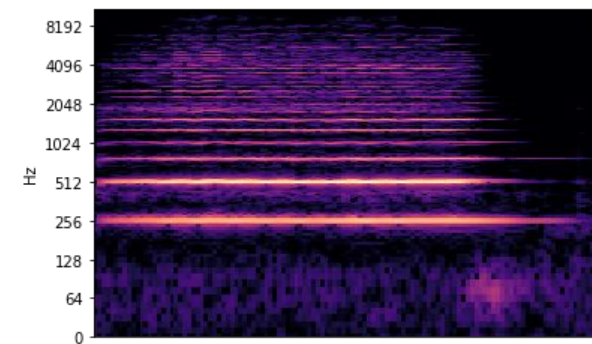
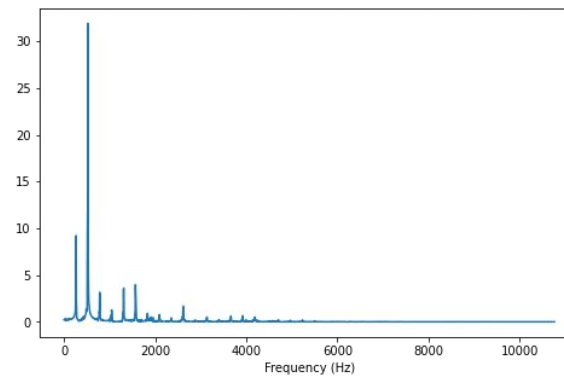
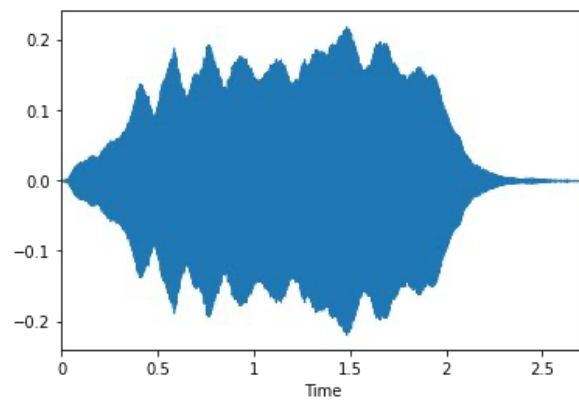
- Time domain
- Frequency domain
- Time-frequency representation

Spectrogram
Mel-spectrogram
Constant-Q transform



Signal domain

- Time domain
- Frequency domain
- Time-frequency representation



Machine learning approach

- Traditional machine learning
- Deep learning

Traditional ML

- Amplitude envelope
- Root-mean square energy
- Zero crossing rate
- Band energy ratio
- Spectral centroid
- Spectral flux
- Spectral spread
- Spectral roll-off
- ...

Traditional ML

Amplitude envelope

Root-mean square energy

Zero crossing rate

Band energy ratio

Spectral centroid

Spectral flux

Spectral spread

Spectral roll-off

...

Traditional ML

Amplitude envelope

Zero crossing rate

Spectral flux

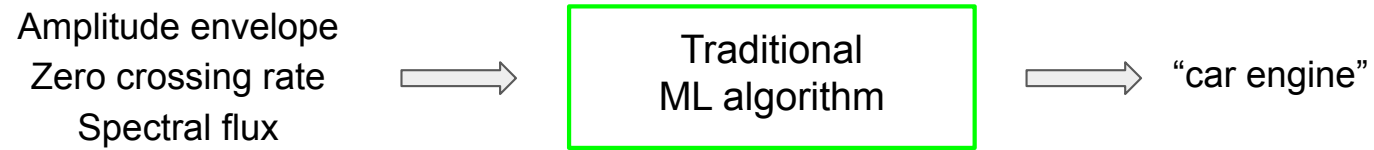
Traditional ML

Amplitude envelope
Zero crossing rate
Spectral flux



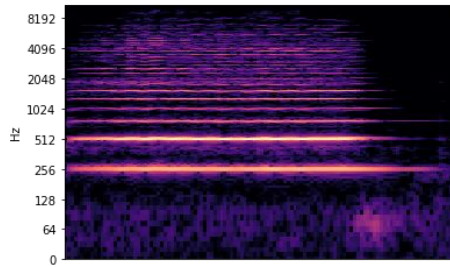
Traditional
ML algorithm

Traditional ML

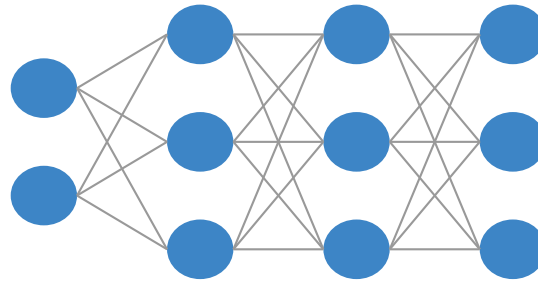
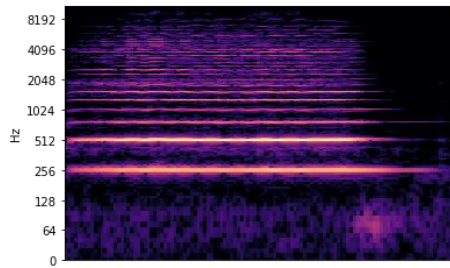


Deep Learning

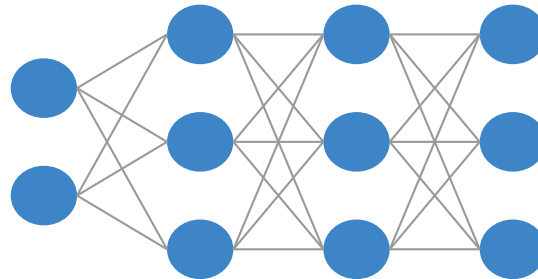
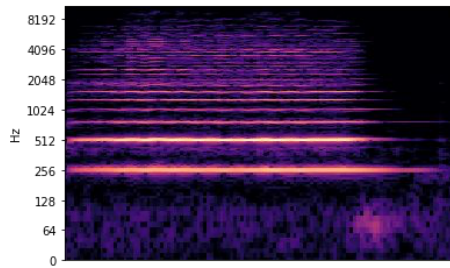
Deep Learning



Deep Learning



Deep Learning



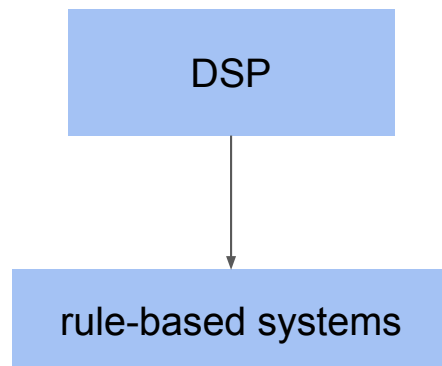
“car engine”

Types of intelligent audio systems

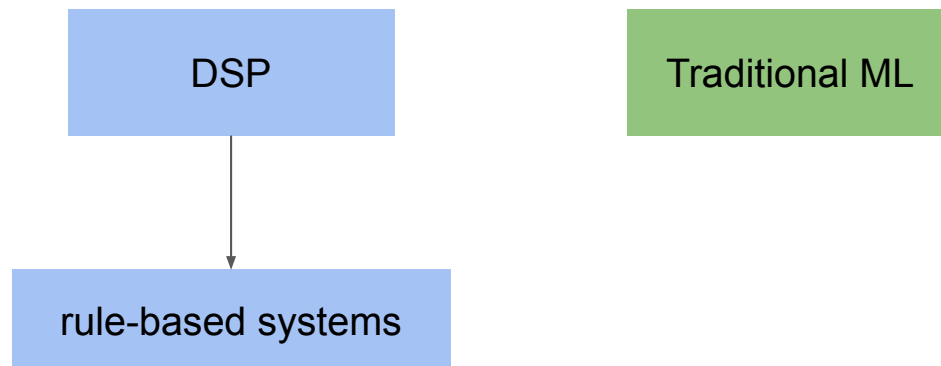
Types of intelligent audio systems

DSP

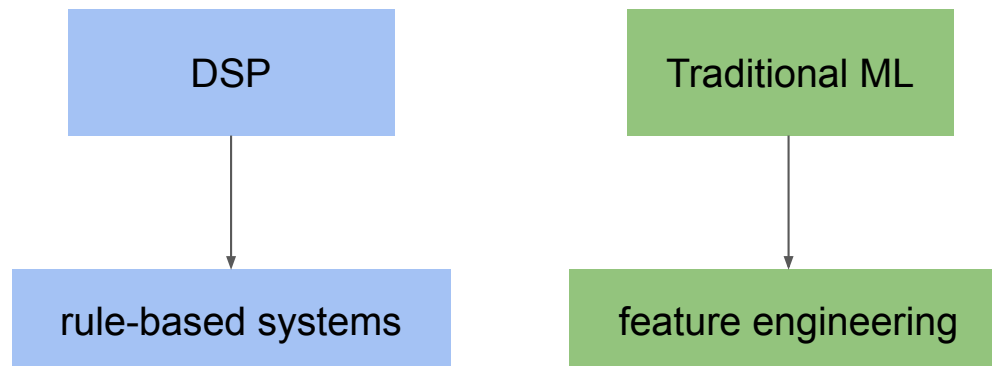
Types of intelligent audio systems



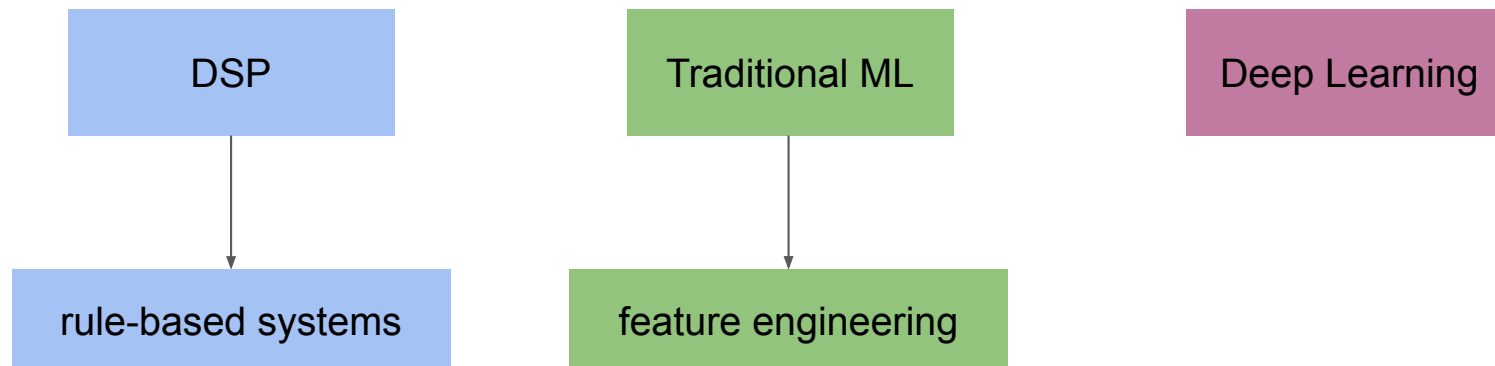
Types of intelligent audio systems



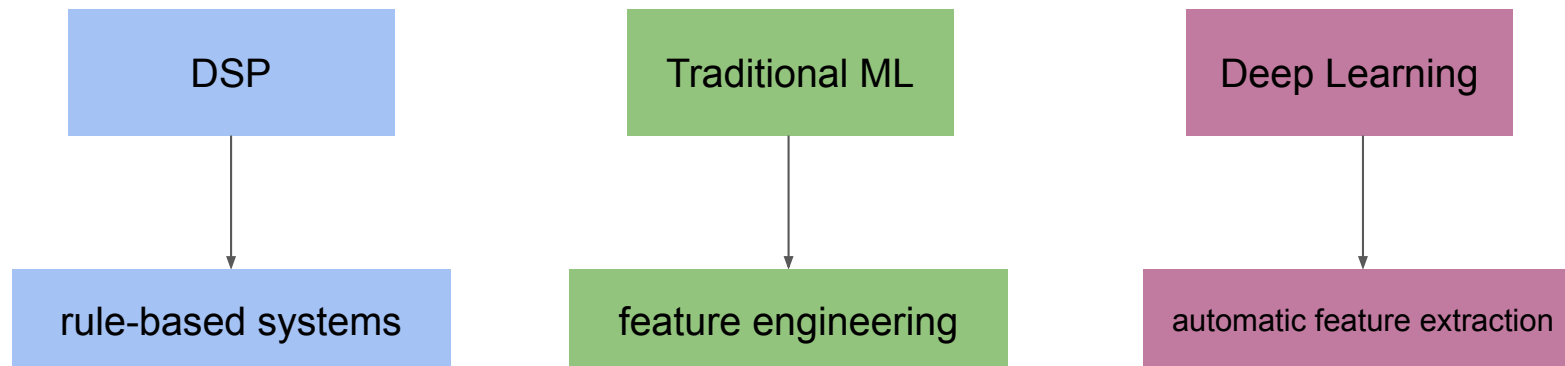
Types of intelligent audio systems



Types of intelligent audio systems



Types of intelligent audio systems



What's up next?

- Feature extraction pipeline