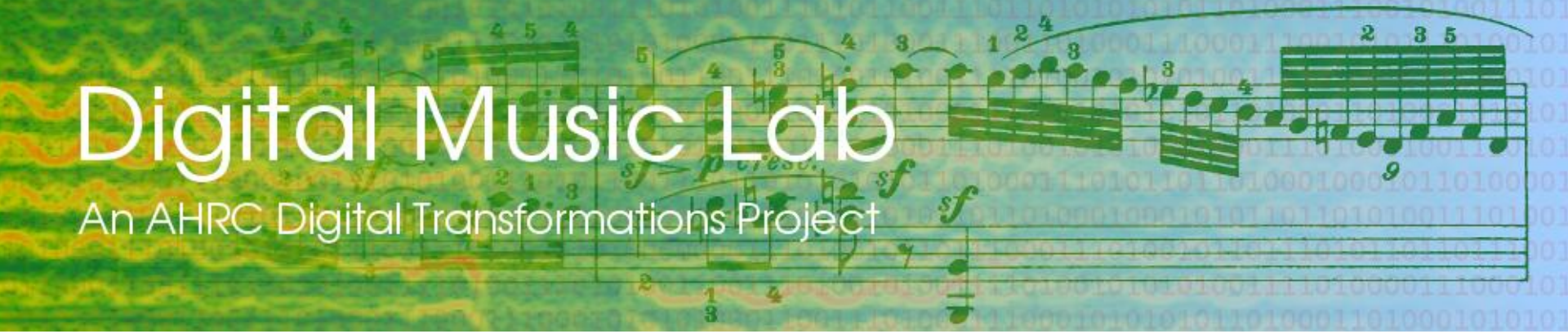

Audio Analysis

Emmanouil Benetos

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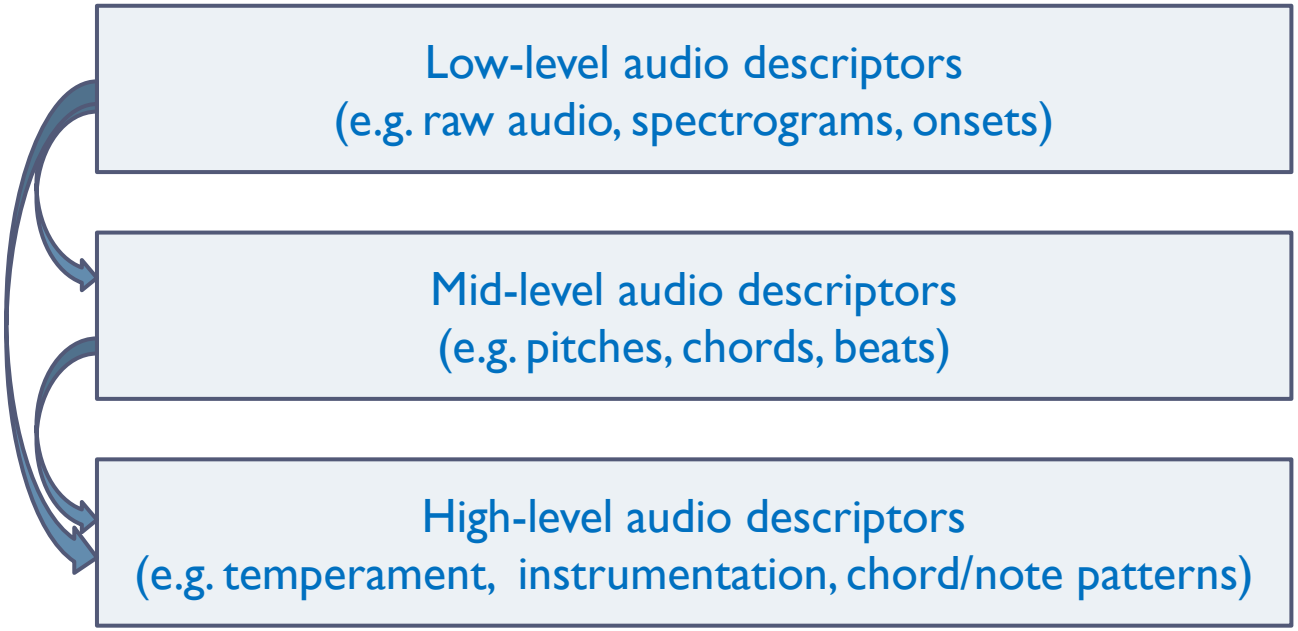
Introduction

- **Goal**: extracting low- and mid-level descriptors from individual audio recordings
- To be used for high-level musicological analysis
- Using (mostly) existing audio analysis technologies



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Audio Descriptors List

1. Spectrogram
2. MFCCs
3. Chroma
4. Onsets
5. Speech/Music Segmentation
6. Chords
7. Beats/Tempo
8. Key
9. Melody
10. Note Transcription

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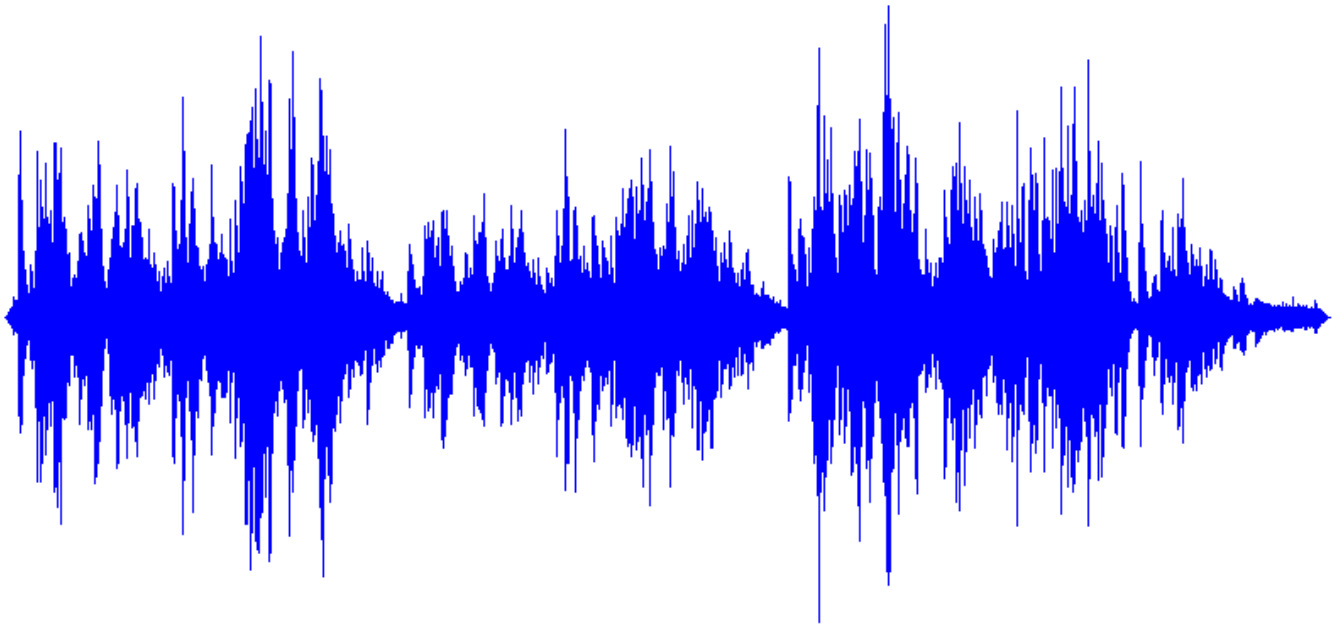
Raw Audio



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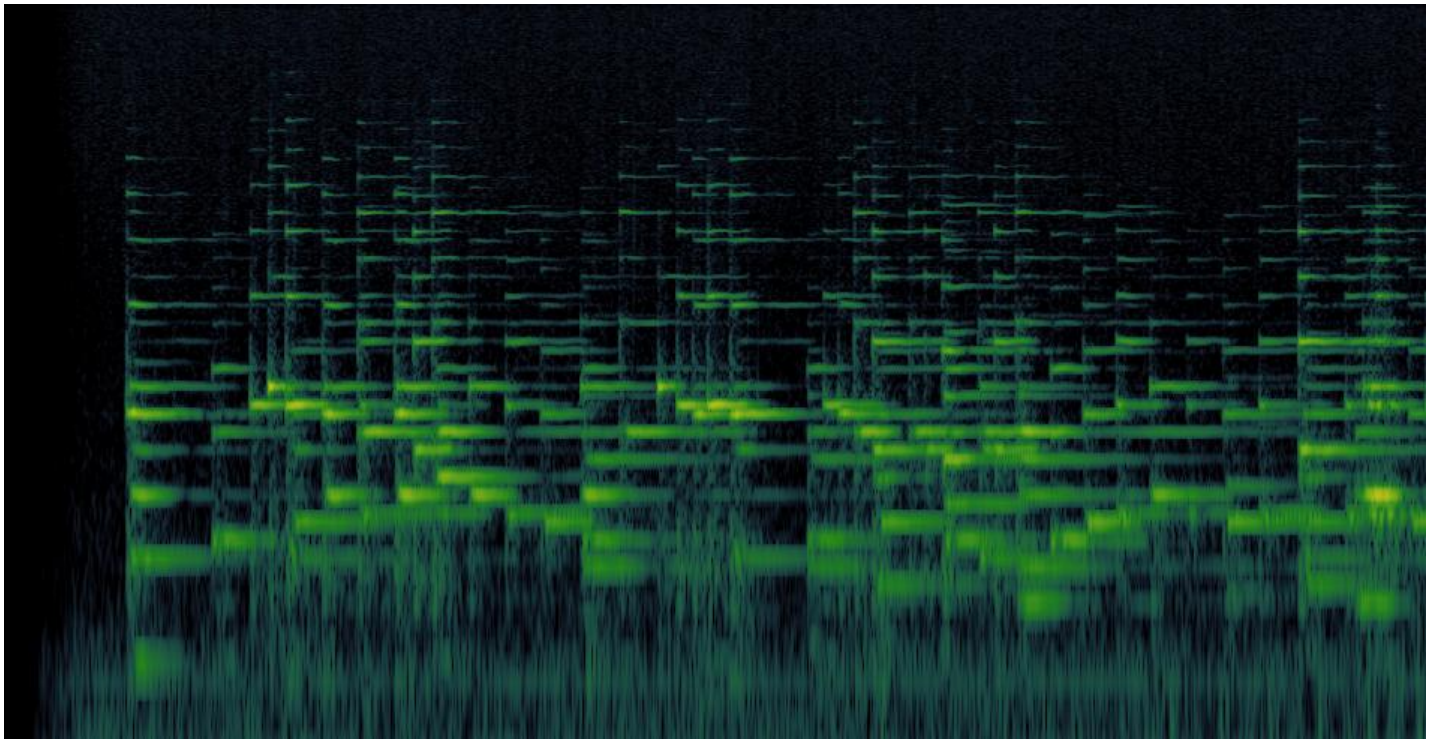
Sample from CHARM: JS Bach, Chorale Prelude - Beloved Jesus, Cohen, Harriet (piano), Columbia, 1935

Spectrogram



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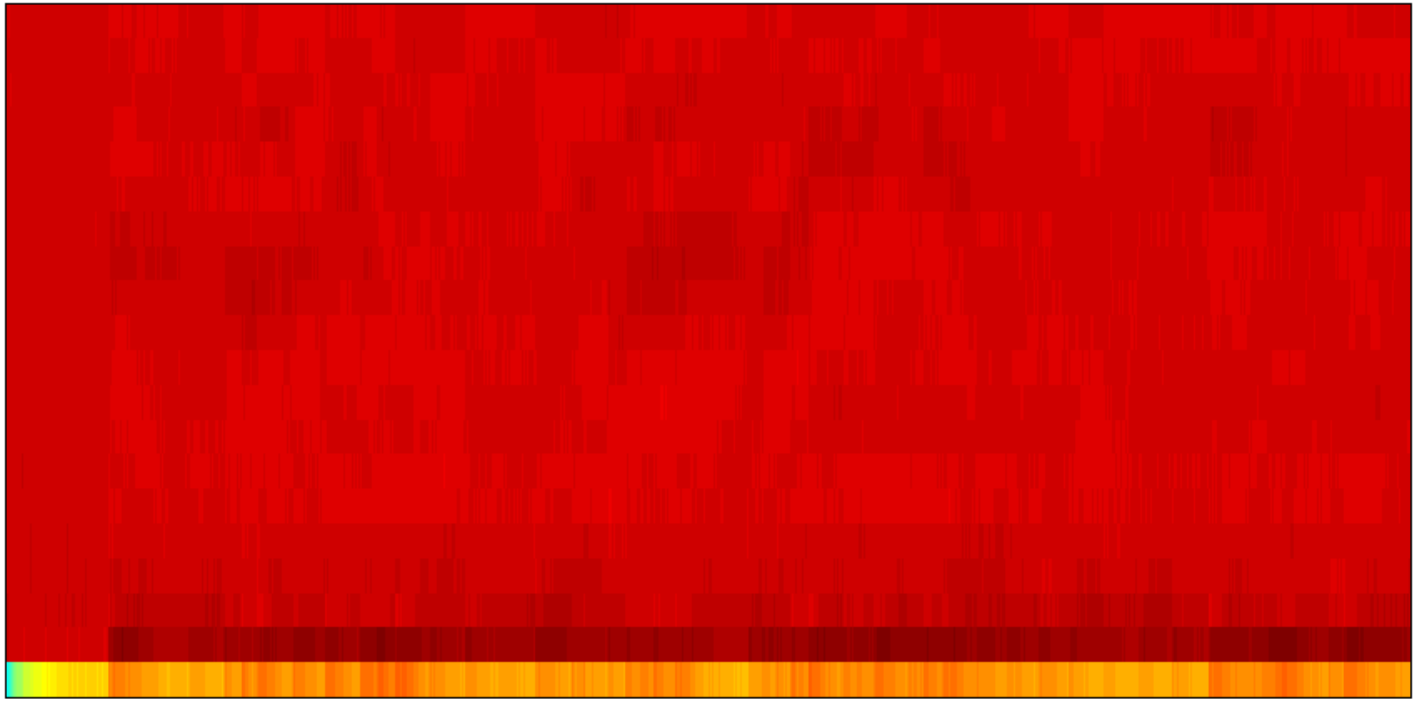
2 versions:

- STFT magnitude spectrogram
- Constant-Q Transform magnitude spectrogram

MFCCs



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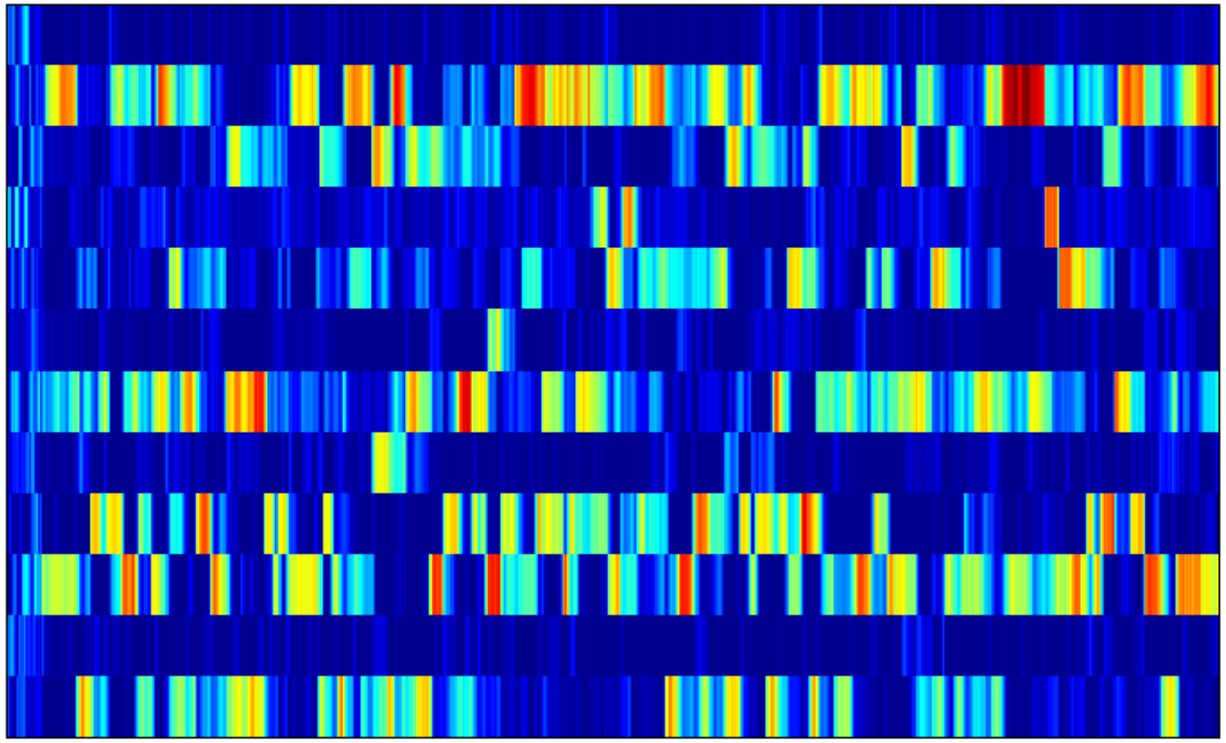
- Stand for: Mel-Frequency Cepstral Coefficients
- Extracted using QM Vamp Plugin Set

Chroma



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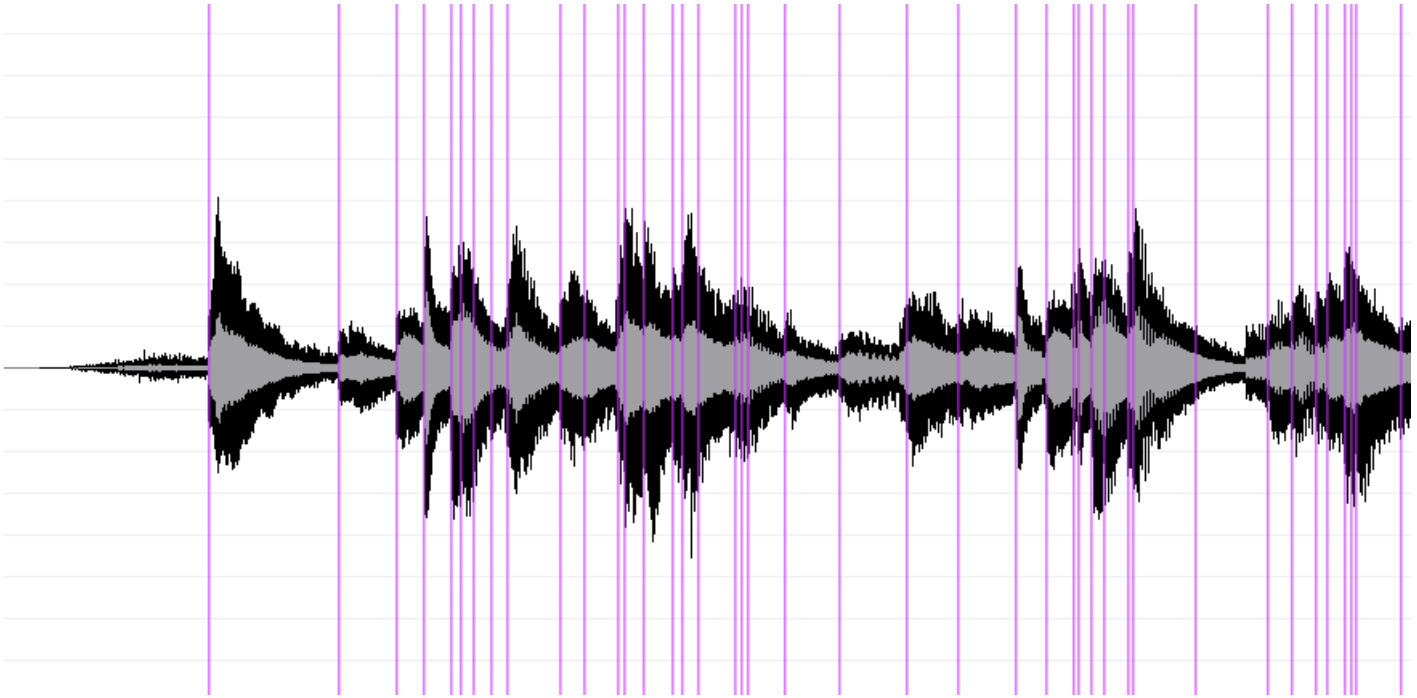
- Spectrum projected onto 12 bins (representing semitones of an octave)
- Extracted using: QM Chromagram and NNLS Chroma Vamp plugins

Onsets



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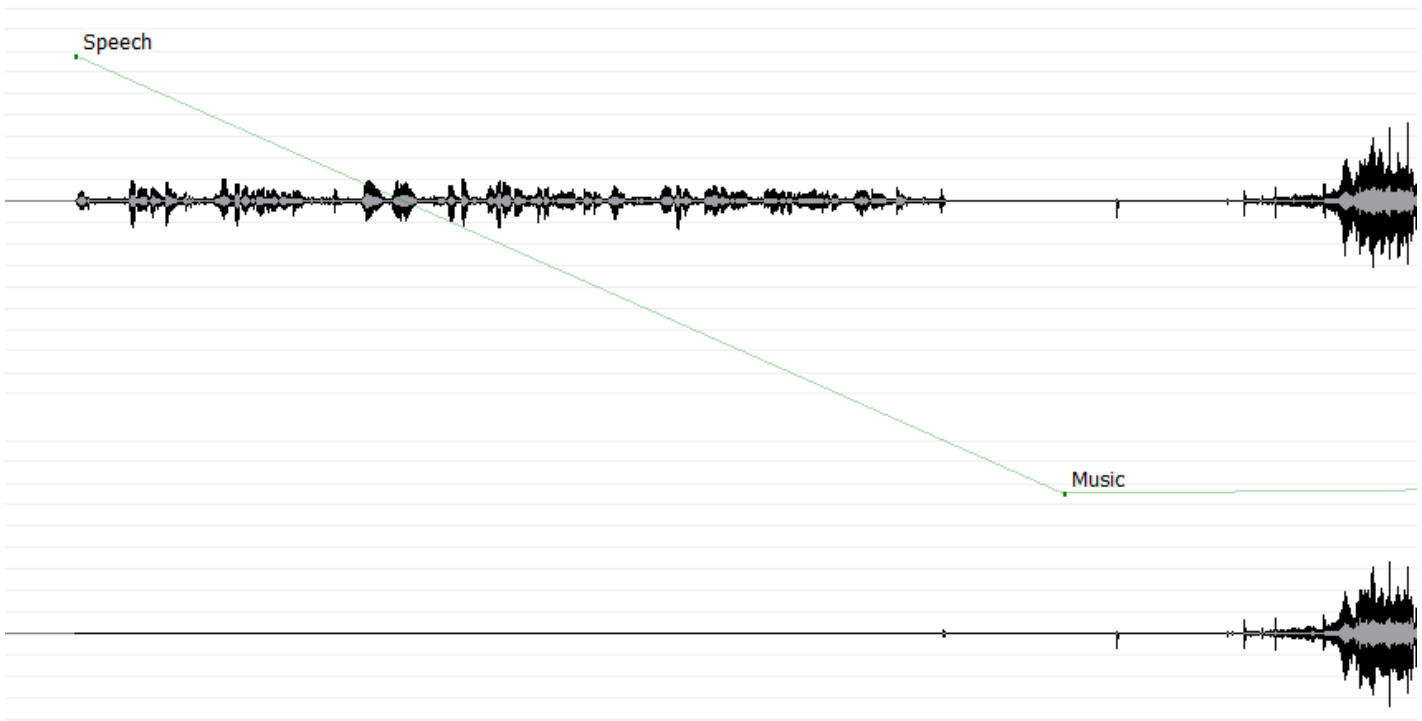
- Onset: the beginning of a musical note or another sound
- Extracted using QM Onset Vamp plugin

Speech/Music Segmentation



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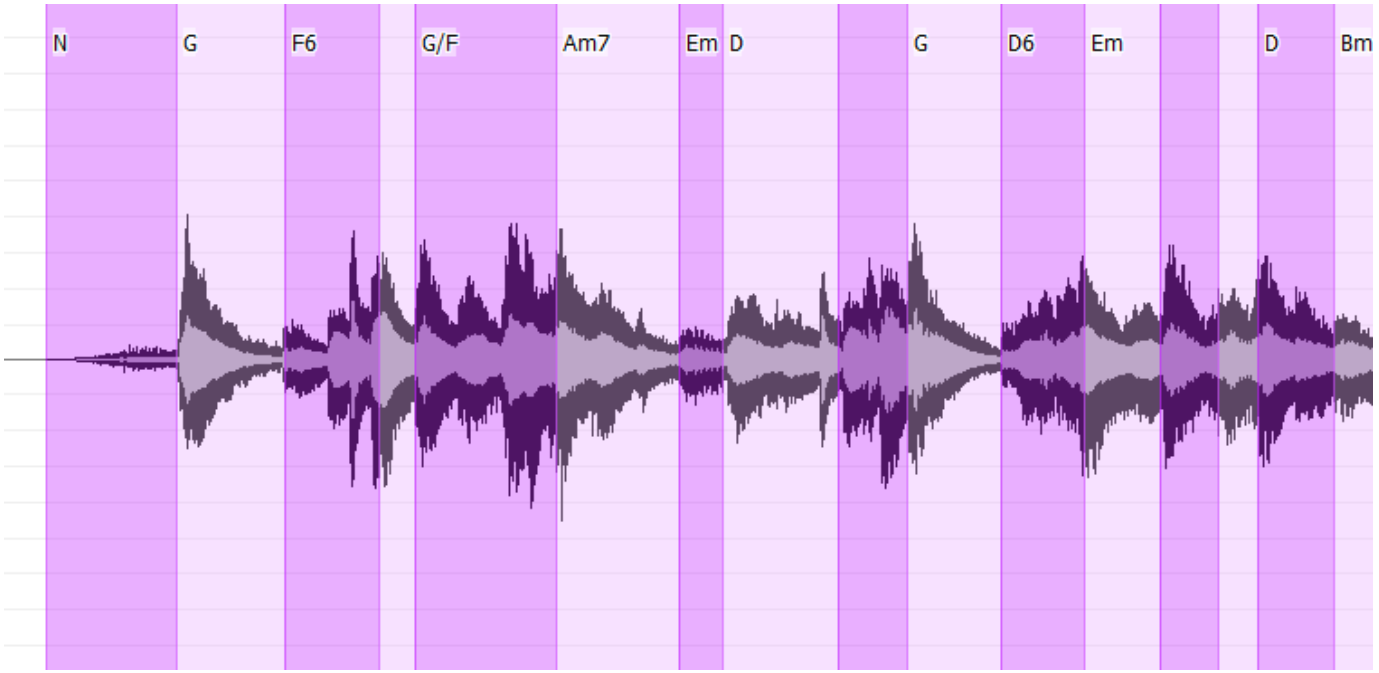
- Useful for ethnographic recordings/radio broadcasts
- Extracted using BBC Speech/Music Segmentation Vamp Plugin

Chords



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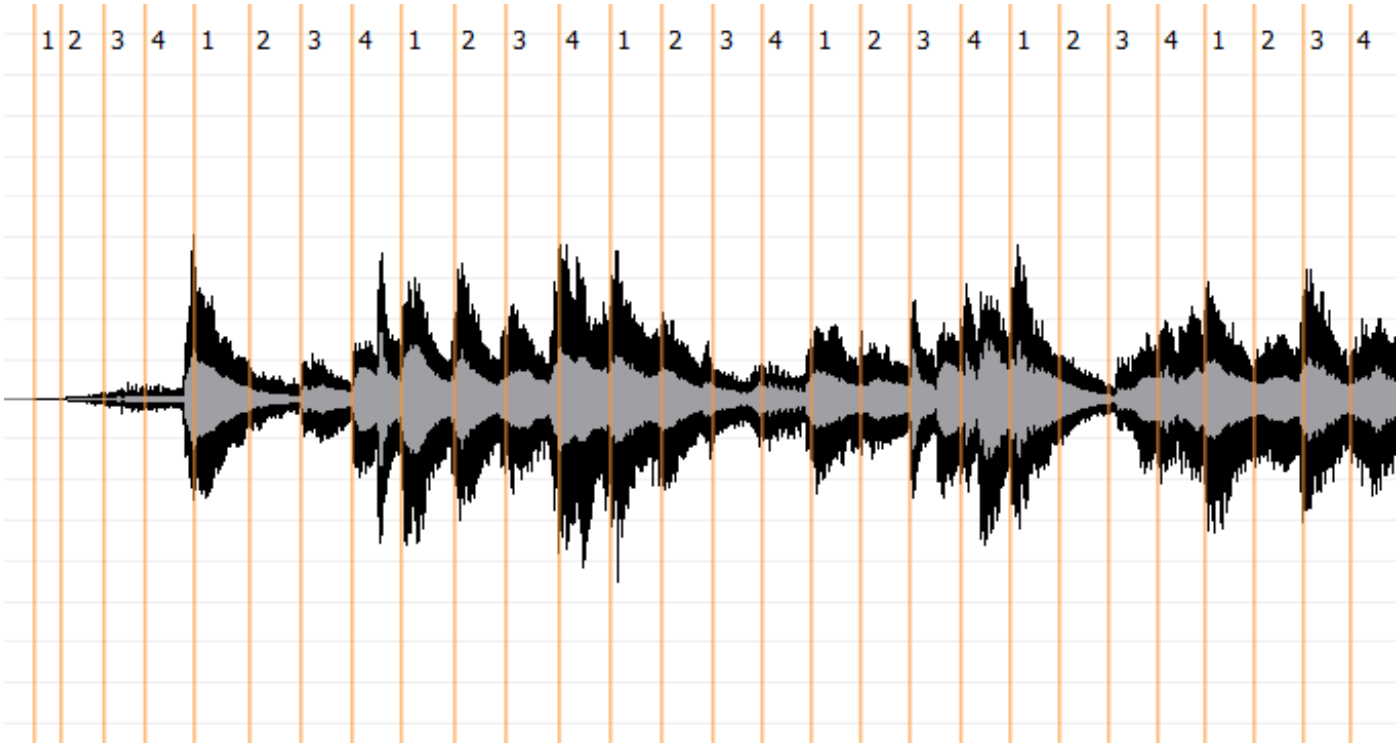
- Extracted using Chordino Vamp Plugin

Beats



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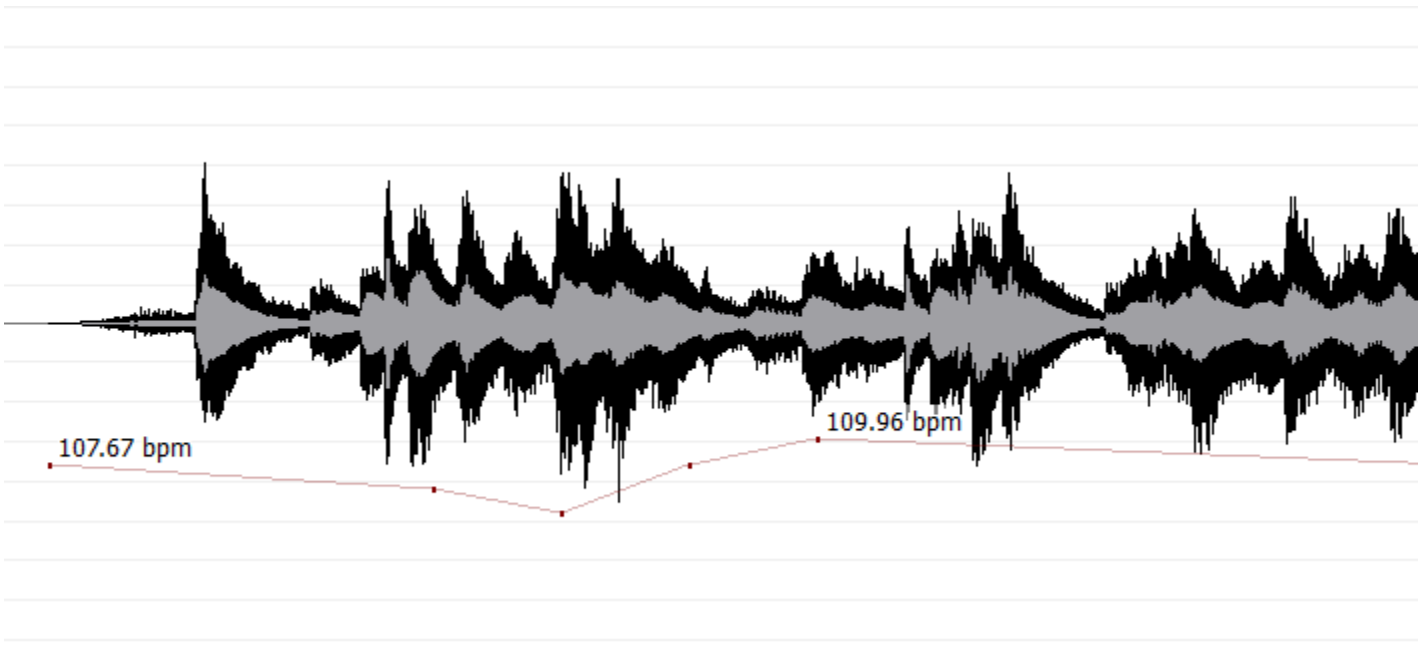
- Beat locations labelled with metrical position
- Extracted using Beatroot, Marsyas, Tempotracker Vamp Plugins

Tempo



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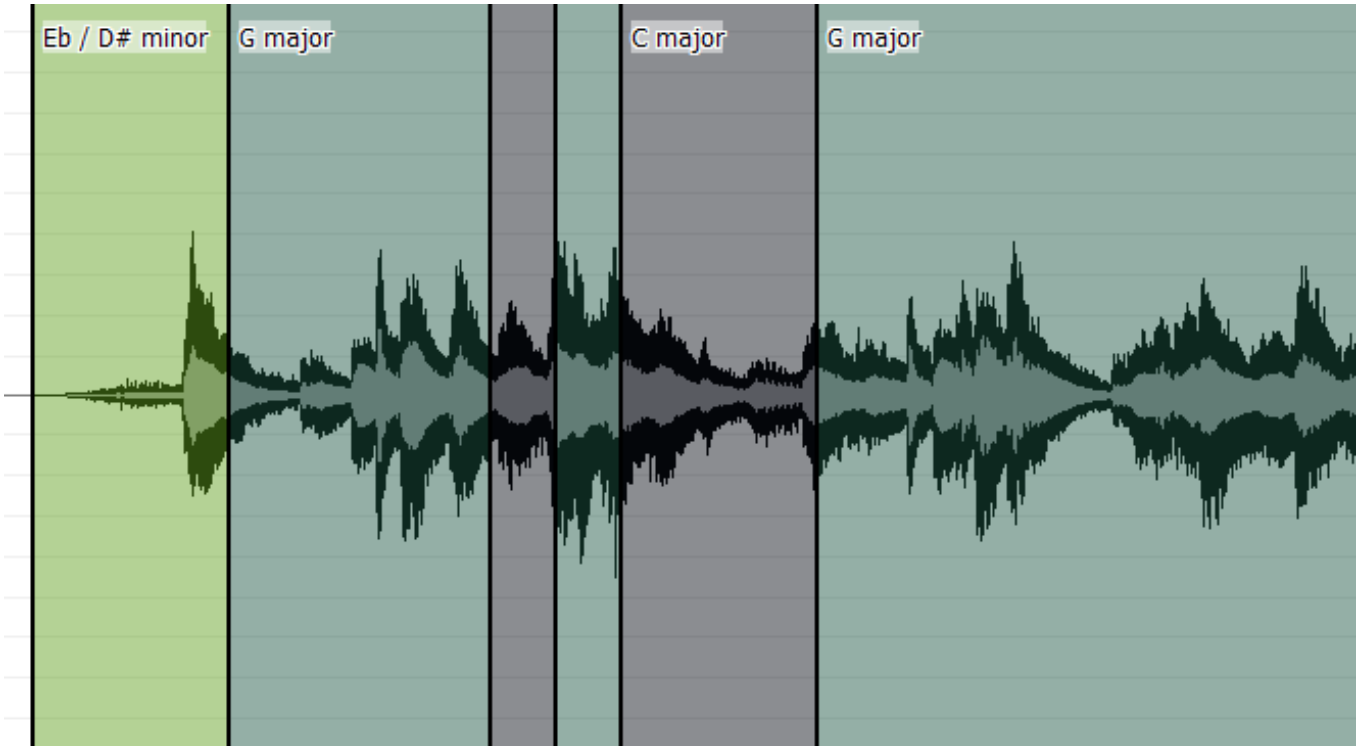
- Estimated based on onset/beat information
- Extracted using Tempotracker and Tempogram Vamp plugins

Key



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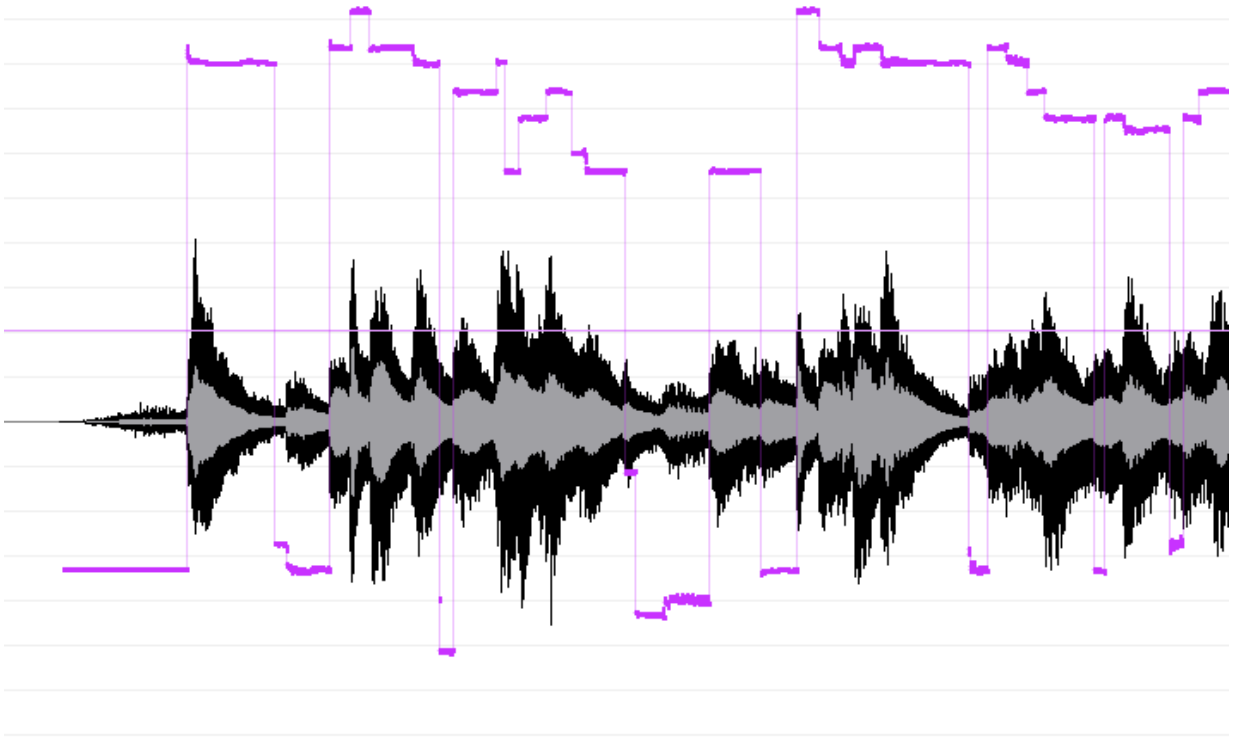
- Extracted using QM Key Vamp plugin (supports major/minor keys)

Melody



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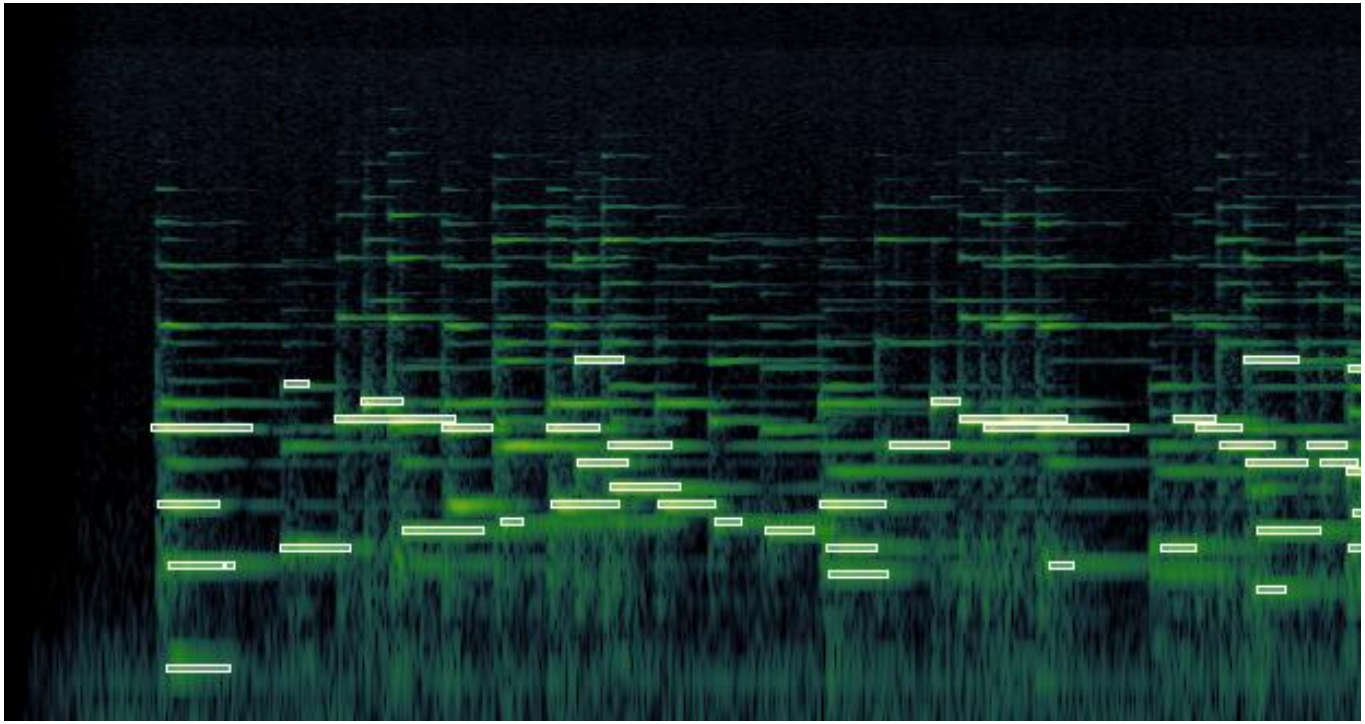
- Or more precisely: "Sequence of fundamental frequency (F0) values corresponding to the perceived pitch of the main melody."
- Extracted using MELODIA Vamp plugin

Note Transcription – Semitone Resolution



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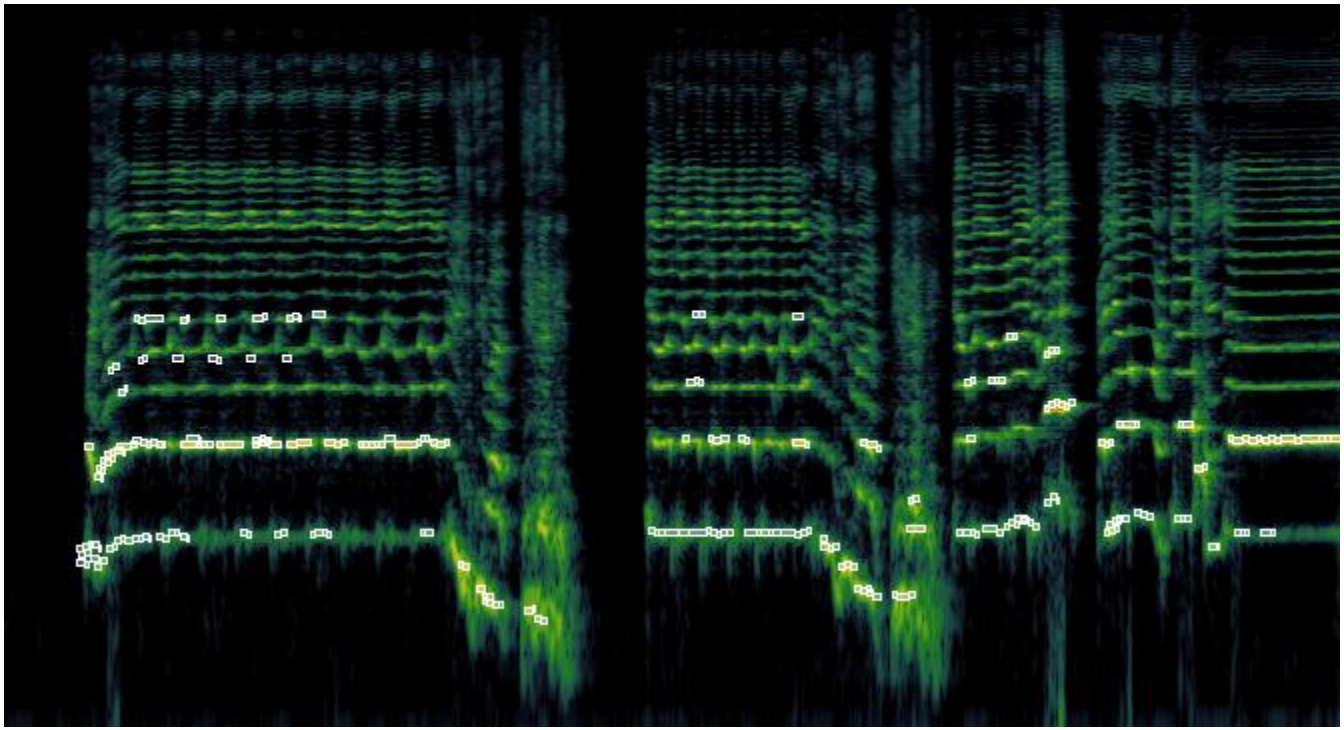
- Multiple-pitch detection (onset/offset/pitch/velocity)
- Extracted using Silvet Vamp plugin
- Synthesized transcription example:

Note Transcription – High Pitch Resolution



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- Multiple-pitch detection on a 20-cent resolution – useful for tuning/temperament analysis and analysis of non-Western music
- Extracted using Silvet Vamp plugin

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