9T2: Sound/music description

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Introduction: music information plane

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cognitive	emotion, music style, semantic concepts			
formal	melody, key, tonality	rhythmic patterns, tempo, meter	instrument, voice	articulation
perceptual	successive and simultaneous intervals	time (beat)	timbre (spectral envelope)	dynamics
sensorial	pitch	time	timbre	loudness
physical	frequency	duration (onset)	spectrum (centroid)	intensity
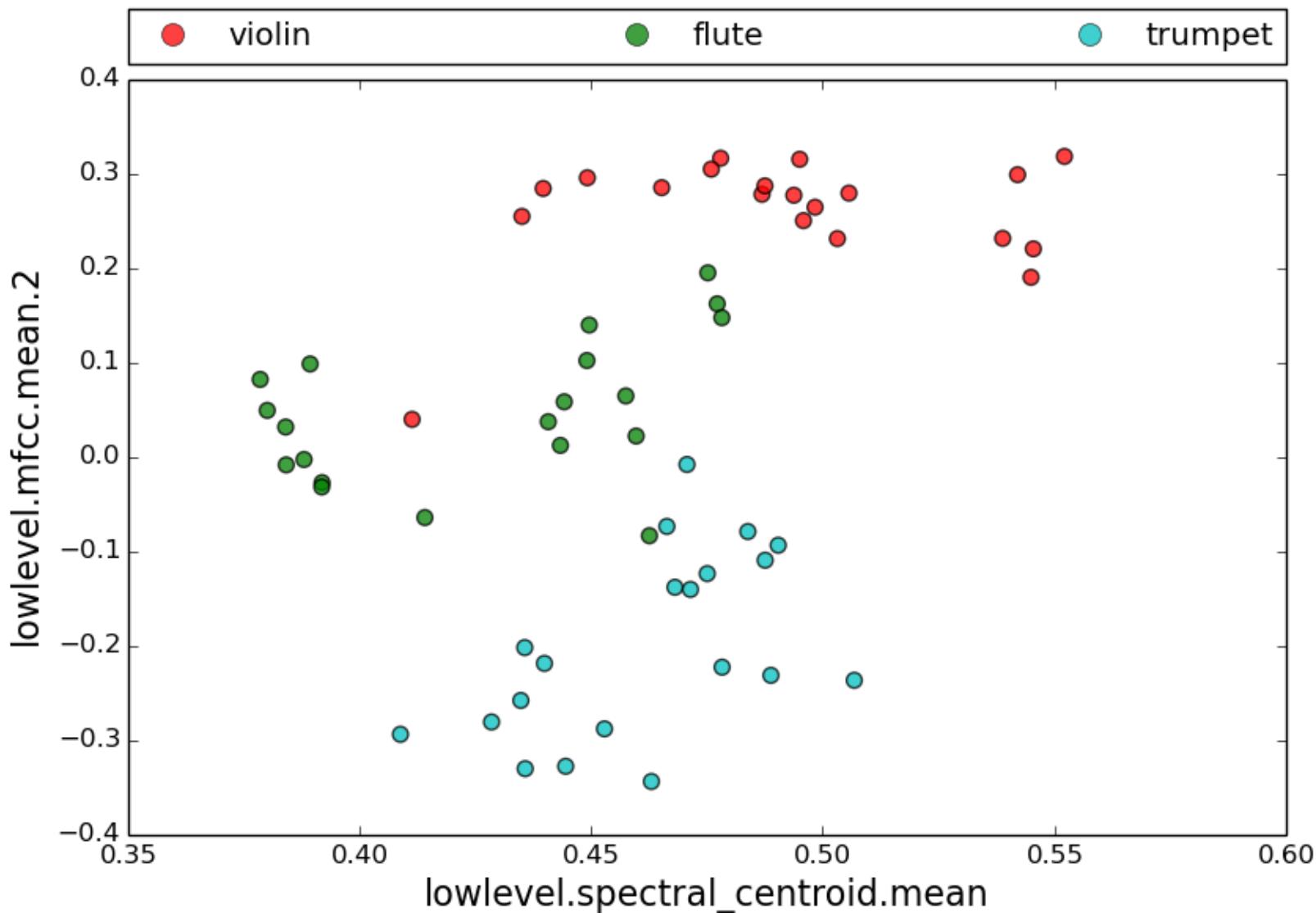
Description of sound recordings

- **Timbre related features**: *spectral centroid, MFCC, high-frequency content, spectral flux,* spectral flatness, spectral contrast, spectral entropy, ...

- **Dynamics related features**: *loudness*, average level, ..

- **Pitch related features:** *pitch, pitch salience, ...*

- **Morphological features**: envelope, onset rate, ...

Description of sound collections

- Similarity between sounds

- Clustering of sounds

- Classification of sounds

Sound collections
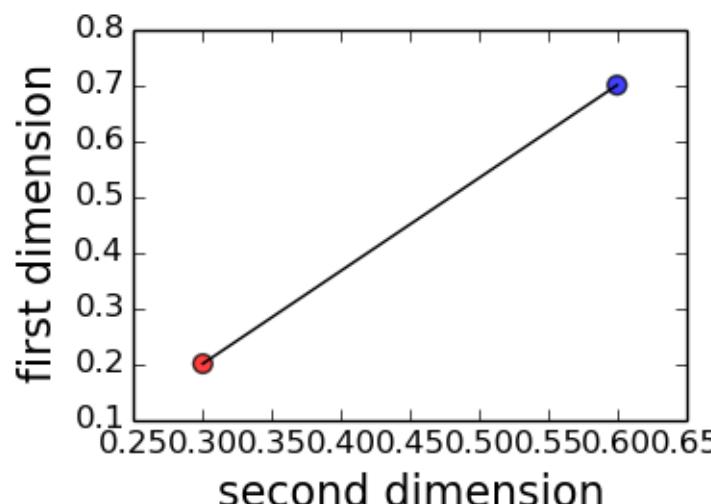
Similarity between sounds

- Euclidean distance

$$d(p,q) = \sqrt{\sum_{i=1}^{n} (q_i - p_i)^2}$$

where

$$p = (p_1, p_2, ..., p_n) \text{ and } q = (q_1, q_{2,...}, q_n)$$

are two points in Euclidian n-space
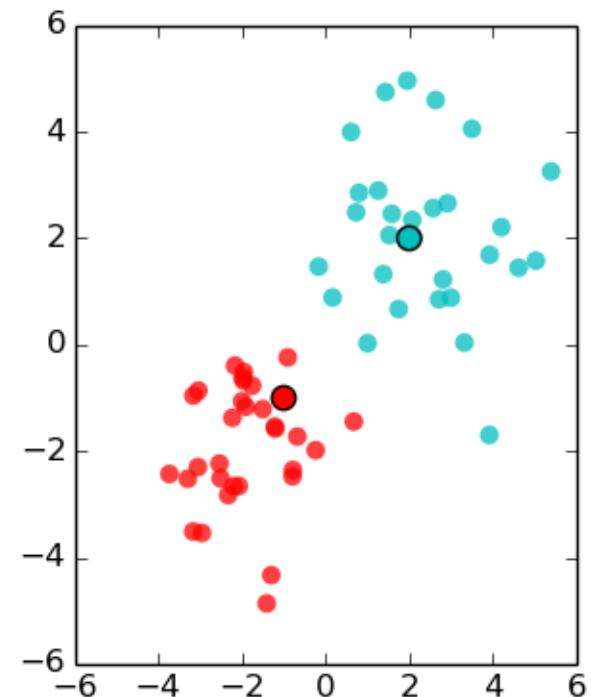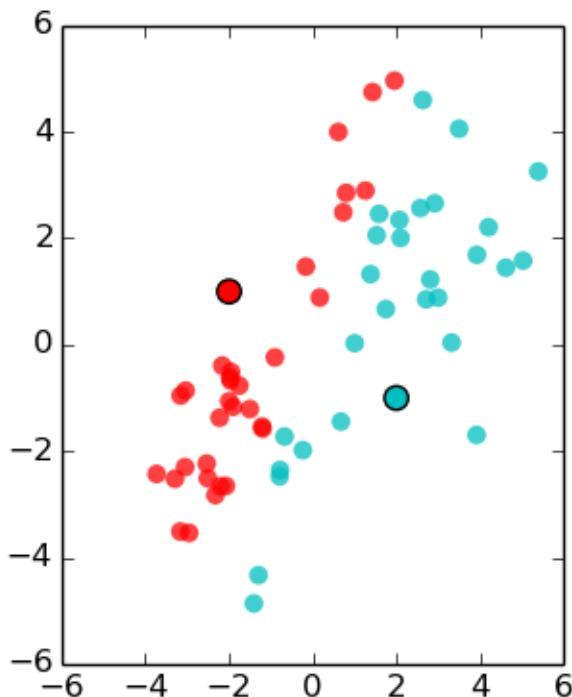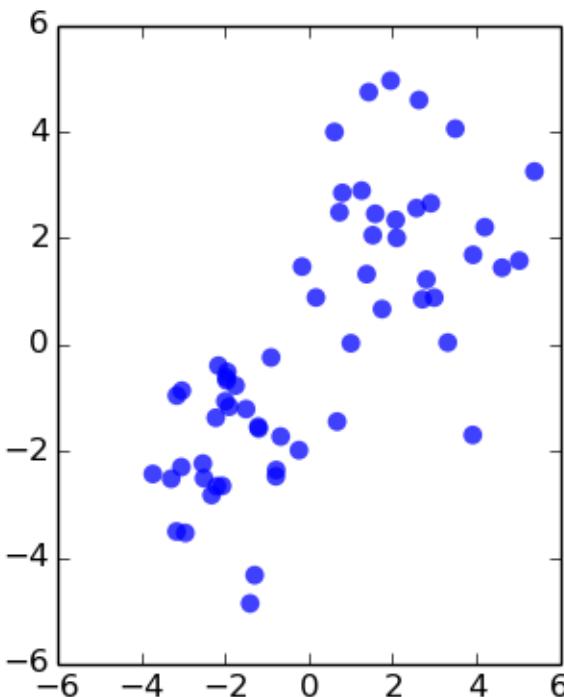
Clustering of sounds

- K-means
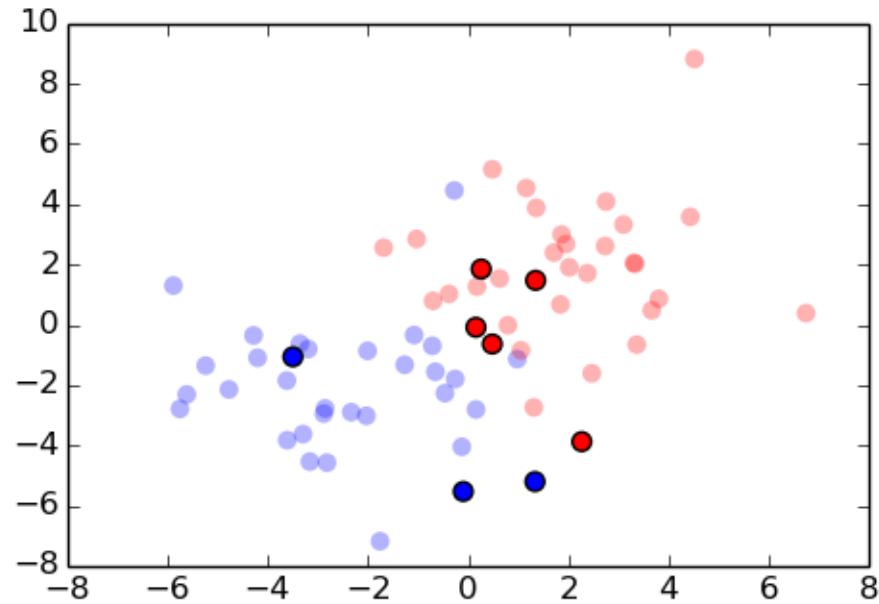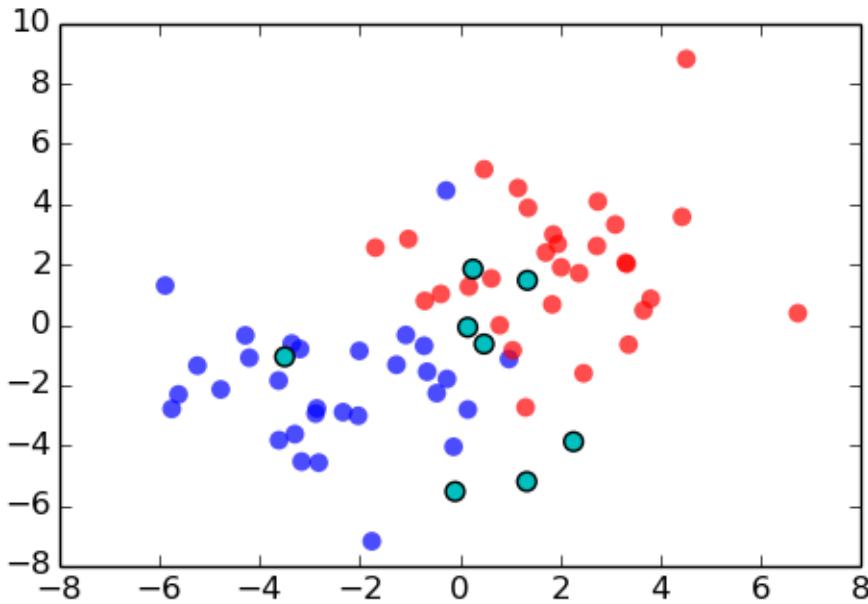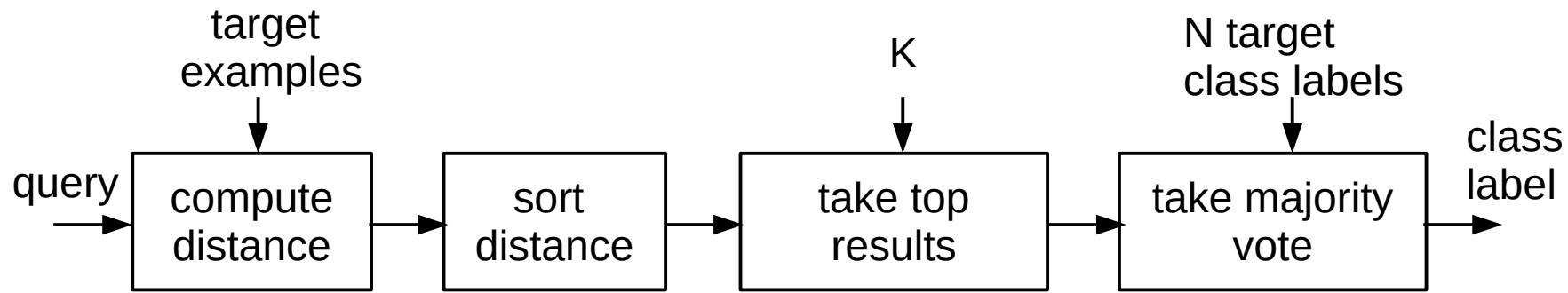
$$arg\min_S \sum_{i=1}^{k} \sum_{x \in S_1} \|x - \mu_i\|^2$$

where $(x_1, x_{2,\dots}, x_n)$ are the set of observations,
μ_i is the mean of points in a set S_i

Classification of sounds

- K nearest neighbors classifier (KNN)

Description of music recordings

- **Timbre related descriptors:** Instrument characterization; Instrumentation characterization; Remixing characterization, ...

- **Melody/harmony related descriptors**: Motive, phrase patterns; Tonic, chords, key, mode, raga, makam, ...

- **Rhythm related descriptors:** Rhythmic pattern; Beat, tempo, downbeat, measure, metric cycle,...

- **Structure related descriptors:** Sections, movements, ...

Description of music collections

- Musical facets similarity
  - Rhythm similarity
  - Instrumentation similarity
  - Melodic similarity
  - Harmonic similarity
  - Structural similarity
  - ...
- Classification based on musical concepts
  - Genre, style
  - Artists, school
  - ...

References and credits

- http://en.wikipedia.org/wiki/Music_information_retrieval

- http://en.wikipedia.org/wiki/Euclidean_distance

- http://en.wikipedia.org/wiki/K-means_clustering

- http://en.wikipedia.org/wiki/K-nearest_neighbors_algorithm

- Slides released under CC Attribution-Noncommercial-Share Alike license and code under Affero GPL license; available from https://github.com/MTG/sms-tools

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