Introduction to **Audio Content Analysis**

module 12.1: music similarity

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corresponding textbook section

section 12.1

- **lecture content**
  - music similarity and its relation to musical genre
  - clustering and visualization of feature space

- **learning objectives**
  - describe potential issues with algorithms for measuring music similarity
  - understand common approaches for timbre similarity

corresponding textbook section

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audio similarity
introduction

- **perception** of music similarity
  - multi-dimensional (melodic, rhythmic, sound quality, ...)
  - user dependent
  - associative, may also depend on editorial data
  - may be context dependent

- genres are **clusters of musical similarity**

$\Rightarrow$ genre classification is a *special case* of audio similarity measures

- instead of assigning (genre) labels, the similarity/distance between (pairs) of files is measured

audio similarity
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music similarity
introduction

- **commonalities** with genre classification
  - similar set of features
  - ambiguous 'ground truth'
  - unclear value/impact of low level and high level features
- **differences** to genre classification
  - distance/similarity measure instead of categorical classification
- **tasks**
  - playlist generation
  - music discovery

music similarity
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audio similarity
approaches

- **standard approach**
  - define set of features and aggregate them appropriately
  - use vector distance in latent space as similarity approximation
- **modern approach**
  - train 'meaningful' representation (e.g., VAE etc.)
  - use vector distance in latent space as similarity approximation

audio similarity

visualization in a 2D space

- **problem**
  - feature space is high-dimensional

  $\rightarrow$ cannot be visualized

- find **mapping** to 2D "preserving" (high-dimensional) distance metrics

  example:
  - Self-Organizing Maps

audio similarity
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  example:
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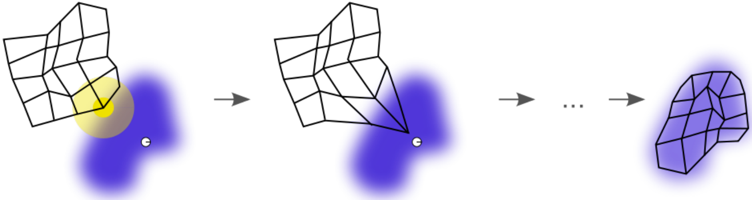
audio similarity
visualization example: SOM 1/2

1. create a map with 'neurons'
2. train
   - for each training sample find BMU (best matching unit)
   - adapt BMU and neighbors toward training sample

$$W_v(t+1) = W_v(t) + \theta(u,v,t)\alpha(t)\big(D(t) - W_v(t)\big)$$

- $\theta(u,v,t)$: depends on neighborhood distance from BMU
- $\alpha(t)$: learning restraint
- $D(t)$ training sample



https://en.wikipedia.org/wiki/Self-organizing_map

audio similarity
SOM 2/2

graph from[1]

[1] E. Pampalk, "Islands of Music," Diploma Thesis, Technische Universität Wien, 2001.

audio similarity
evaluation

- as the task is not clearly defined, it often can only be indirectly evaluated
  - evaluation through genre/artist/album labels
  - evaluation through listening surveys
  - qualitative evaluation (picking pairs of samples and discussing them)
- lack of ground truth and lack of established metrics

summary
lecture content

- **music similarity**
  - even less clearly defined than music genre
- **processing steps**
  1. extract features
  2. define some distance metric in feature space
- **clustering algorithms**
  - work to a certain degree with traditional features