Self-Organizing Maps for Content-Based Music Clustering

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Outline

- Motivation and goals
- Algorithm
  - Feature extraction
  - Self-organizing map (SOM)
- Experiments
- Conclusions

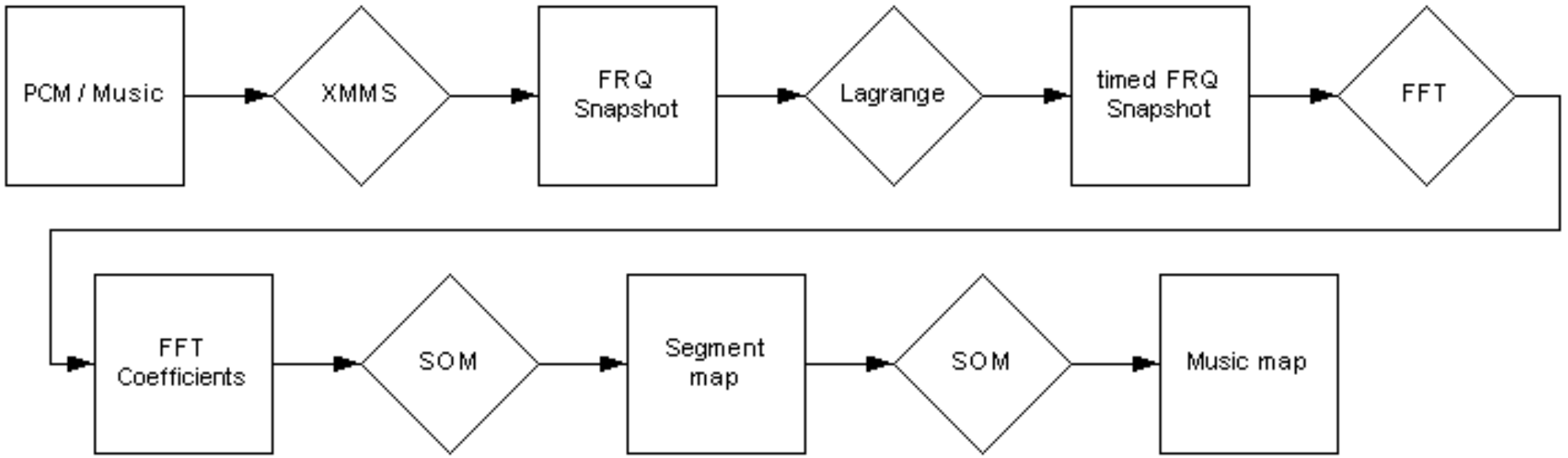
Music Data Today

- Increasing amount of music data (MP3)
- Well suited for e-commerce distribution
- Conventional interfaces lack functionality (browsing)
- Need ways to group music by „Genre“
- Manual classification

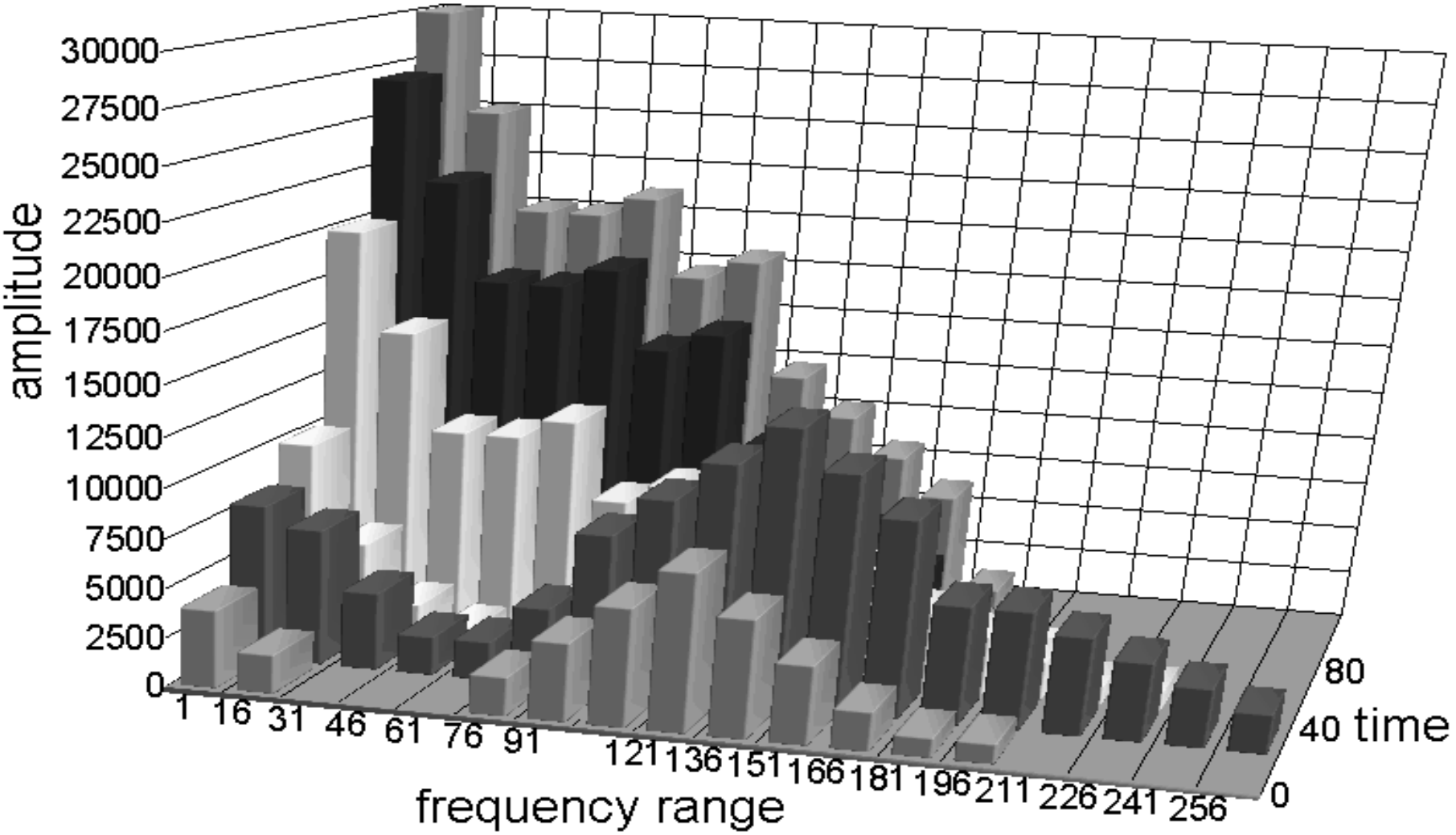
Goals

- Automatically organize music by „Genre“
- „Genre“ has many facets
  (sound characteristics, dynamics,...)
- Combined with:
  - Database search (composer, title,...)
  - Melody search (tune)
- Intuitive representation
- All kinds of music (instrumental, vocal)

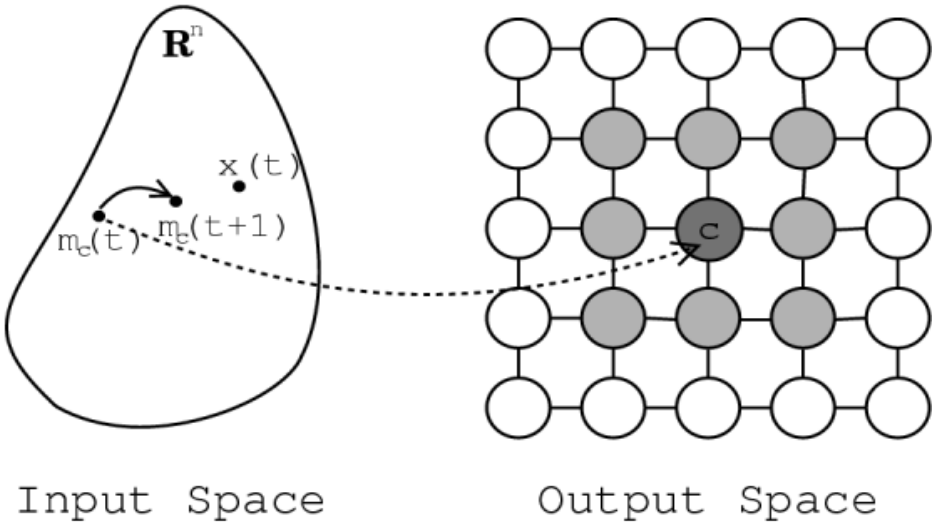
Algorithm


PCM / Music
XMMS
FRQ Snapshot
Lagrange
timed FRQ Snapshot
FFT
FFT Coefficients
SOM
Segment map
SOM
Music map

Dynamic of Sounds



Self-Organizing Map

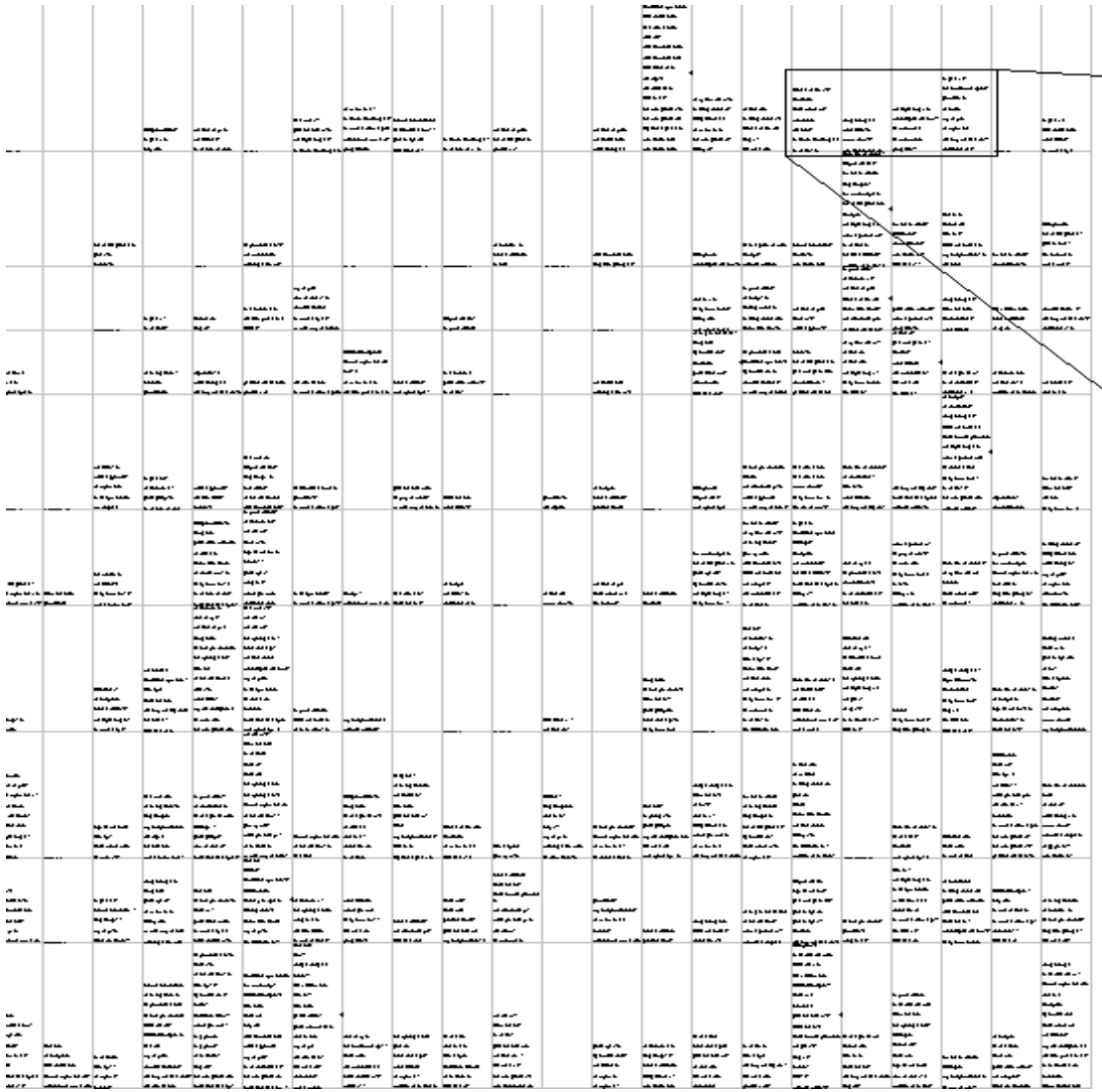


- Unsupervised Neural Network
- Topology preserving
- Training:
  - Activation calculation
  - Winner determination
  - Winner adaptation
  - Neighbourhood adaptation

Experiments

- 14 hrs of well-known pieces of music (230 titles)
- Different genres (Classic, Pop, Jazz, Rap,...)
- Feature extraction:
  - Every second 5 sec segment from 17 freq. bands
  - 5022 vectors of music segments of dimension 4352
  - 22x22 Segment SOM
  - 230 vectors of pieces of music of dimension 484
  - 10x10 Music SOM

Map of Music Segments



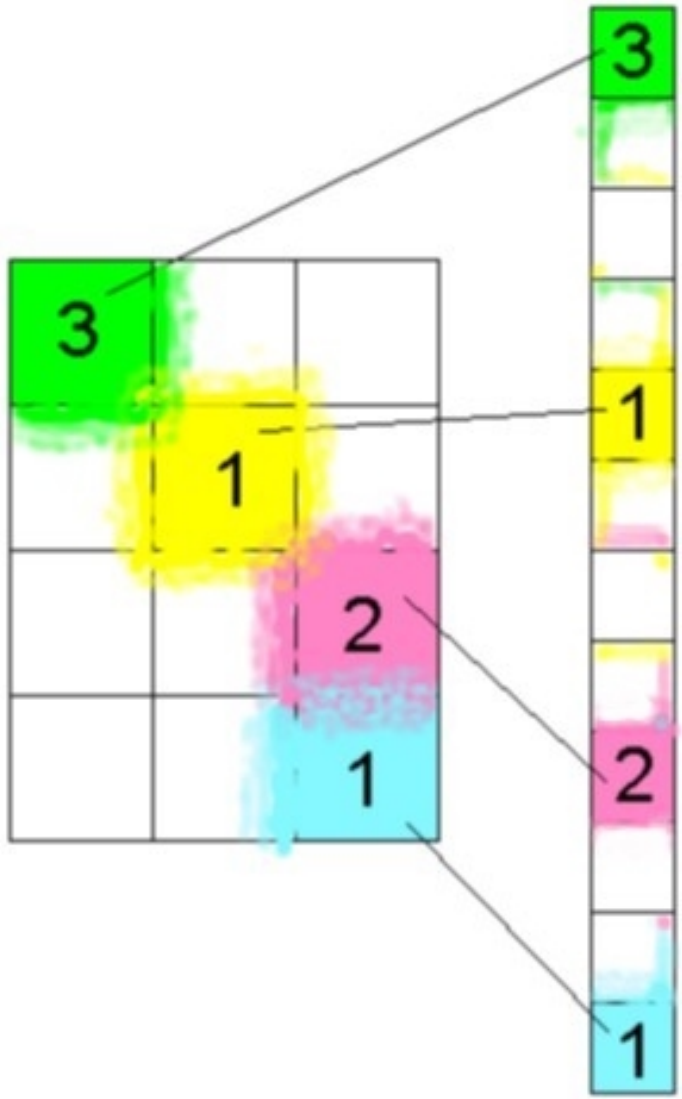
			angels.49
fatherandson.19			crashboombang.39
ironic.25			gowest.45
lovedwoman.21		madlydeeply.43	help.23
mond.33	bongobong.17	moonlightshadow.11	myway.3
radio.39	mindfiels.15	sexbomb.17	newyork.37
shoopshoopsong.27	mmmbop.19	sexbomb.35	readmymindstars.11
surfusa.13	wonderfulworld.3	yougotit.11	vivaforever.29

badblood.7
badblood.9
badblood.11
badblood.13
badblood.17
badblood.21
badblood.23
badblood.25
badblood.27
badblood.29
badblood.31
badblood.33
badblood.39
badblood.41
badblood.47
badblood.51

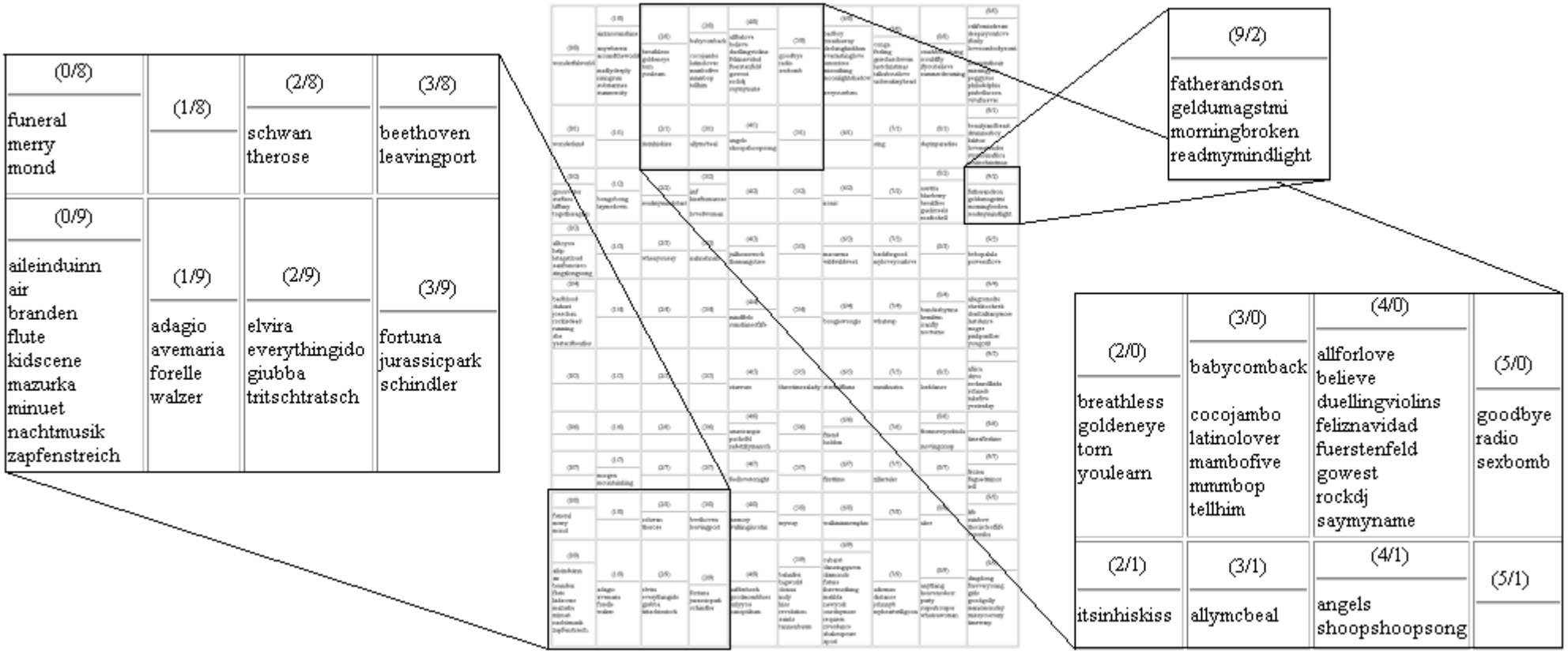
- 22x22 units of 5 sec segments
- Several characteristic clusters (Classic, Hardrock,...)
- Similar segments on same units

From Segments to Pieces of Music

- One piece of music consists of several segments
- Segments mapped onto different units (verse vs. chorus, main theme vs. intro/fade out,...)
- Create feature vector based on segment distribution
- 22x22 Segment SOM results in 484 dimensional vector



Map of Pieces of Music



(0/8)	(1/8)	(2/8)	(3/8)
funeral merry mond		schwan therose	beethoven leavingport
(0/9)	**(1/9)**	**(2/9)**	**(3/9)**
aileinduinn air branden flute kidscene mazurka minuet nachtmusik zapfenstreich	adagio avemaria forelle walzer	elvira everythingido giubba tritschtratsch	fortuna jurassicpark schindler

(9/2)
fatherandson geldumagstmi morningbroken readmymindlight

(2/0)	(3/0)	(4/0)	(5/0)
breathless goldeneye torn youlearn	babycomback cocojambo latinolover mambofive mmmbop tellhim	allforlove believe duellingviolins feliznavidad fuerstenfeld gowest rockdj saymyname	goodbye radio sexbomb
(2/1)	**(3/1)**	**(4/1)**	**(5/1)**
itsinhiskiss	allymcbeal	angels shoopshoopsong	

Conclusions

- Grouping of music by sound characteristics
- Exploration / browsing of music archives
- Fully automatic, no manual „Genre“ assignment
- Complement traditional approaches:
  - Database search
  - Melody search