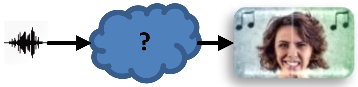
29.06.2015

Music Mood Classification: From a Music Piece to a Computed Mood



Seminar SS15: Topics in Computer Music

Supervisor: Prof. Paolo Bientinesi

High Performance and Automatic Computing
RWTH Aachen University
Germany

RWTH AACHEN UNIVERSITY

Overview

- Motivation
- State of the Art
  - Music Mood Classification
  - Emotion Models
  - Music Features
  - Ground Truth
  - Supervised Machine Learning
  - Different Types of Labeling
- Exemplary Approach
  - Idea
  - Methods
  - Results & Review
- Conclusion

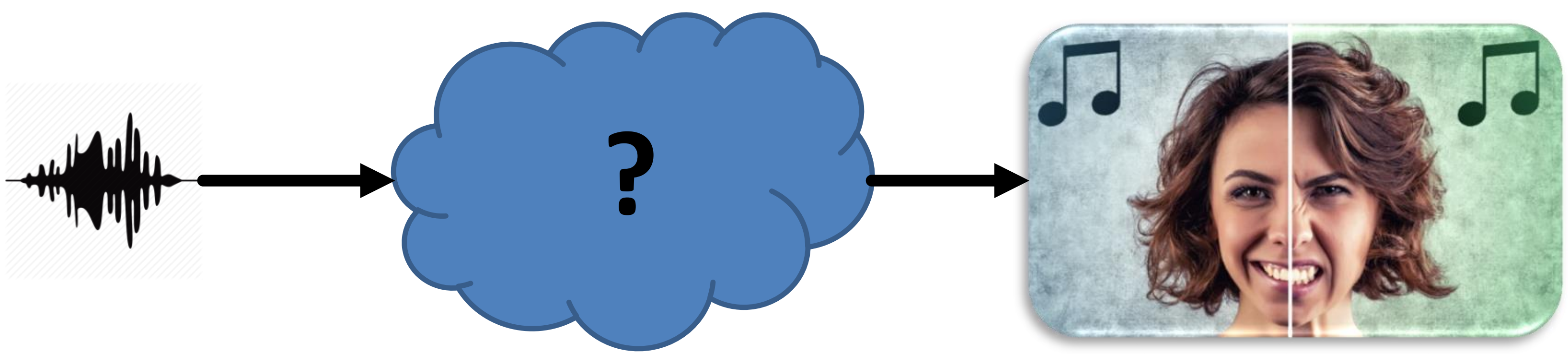
➢ Motivation

- State of the Art
- Exemplary Approach
- Conclusion

Game Development

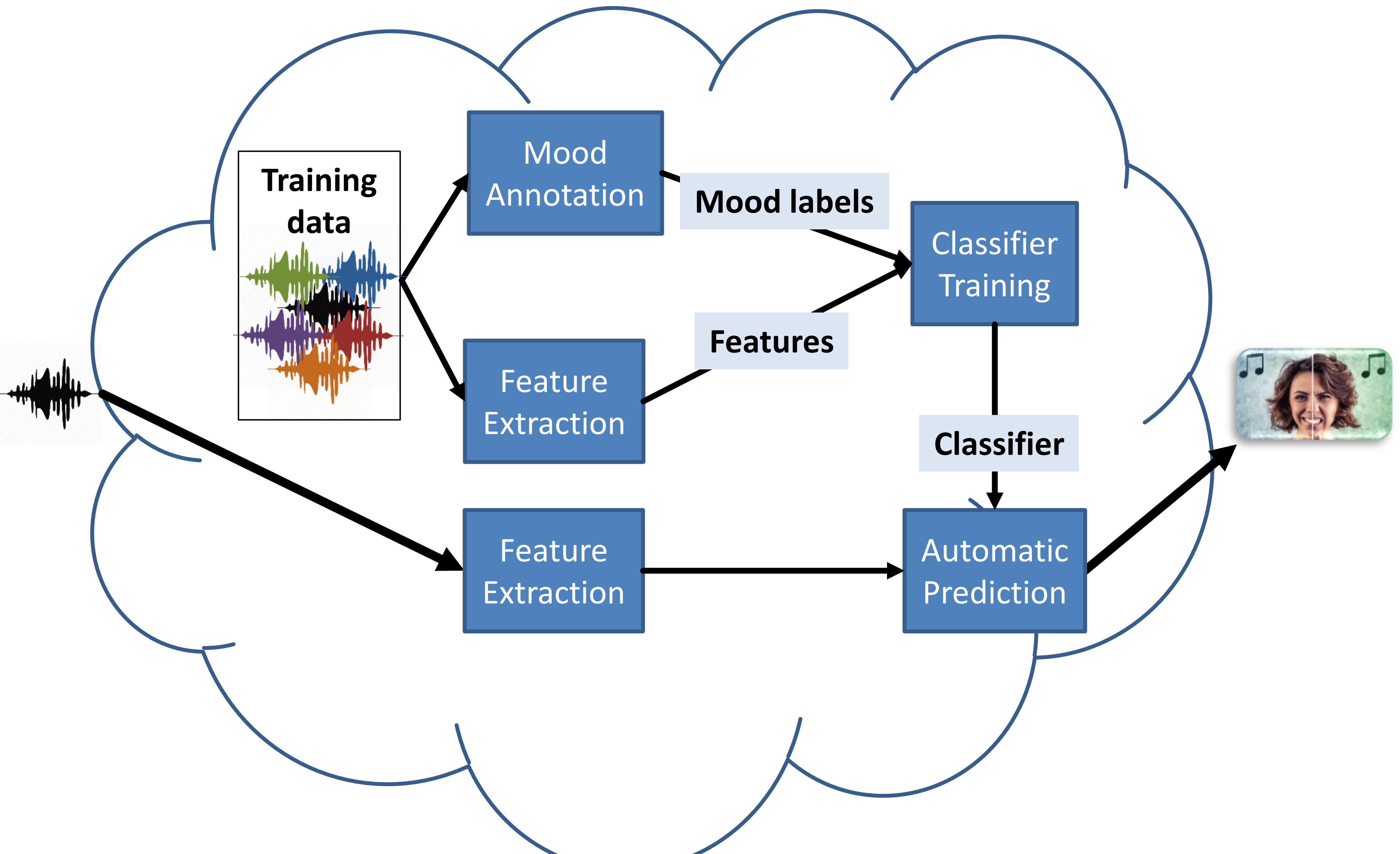
Suitable music
to a specific situation …

… but too much to handle manually!



- ✓ Motivation
- ➢ **State of the Art**
- Exemplary Approach
- Conclusion

State of the Art – Music Mood Classification



- Active topic in psychology research *[1]*
- Categorical vs. Dimensional

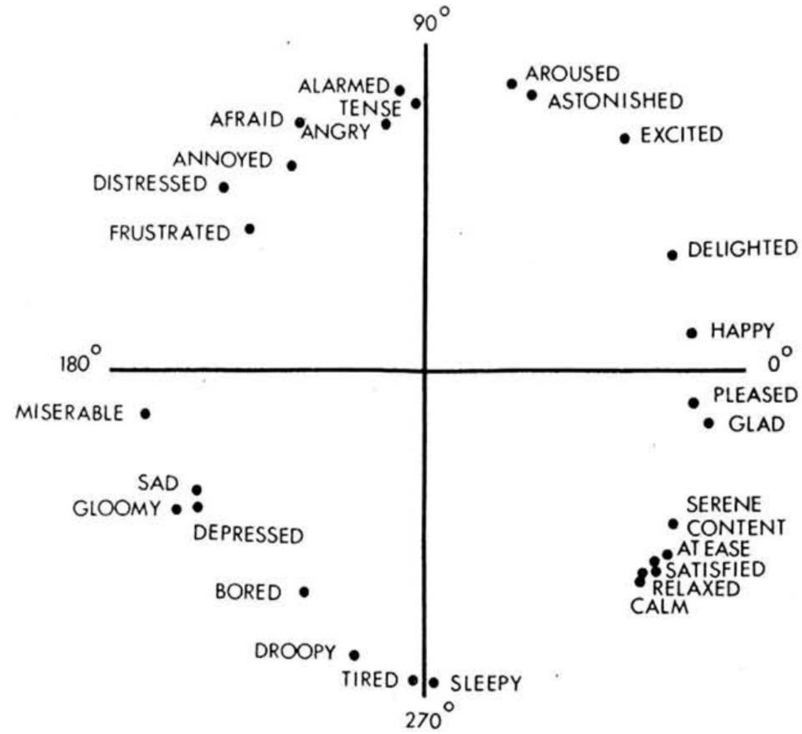
Group 1
satisfying
quiet
…

Group 3
dreamy
sentimental
…

Group 6
happy
cheerful
…

…

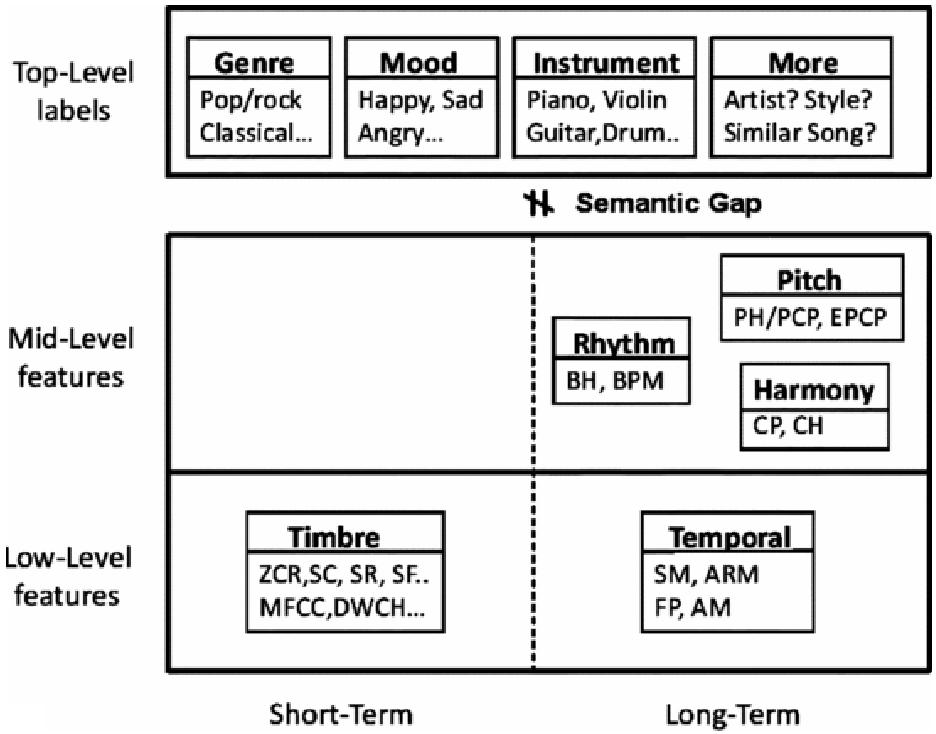
Hevner's adjective checklist [2]



Circumplex Model [3]

- Problems
  - No standards
  - Oversimplification / Ambiguity
  - Distinction

- "*Any classification system is only as good as the features that it receives.*" *[4]*

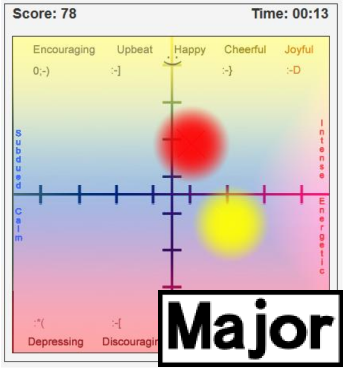


Characterization of audio features [5]

State of the Art – Ground Truth

- Problems
  - Emotional perception (subjectivity)
  - Emotion annotation (labor-intensive, time consuming)
  - Different mood models and (small) datasets

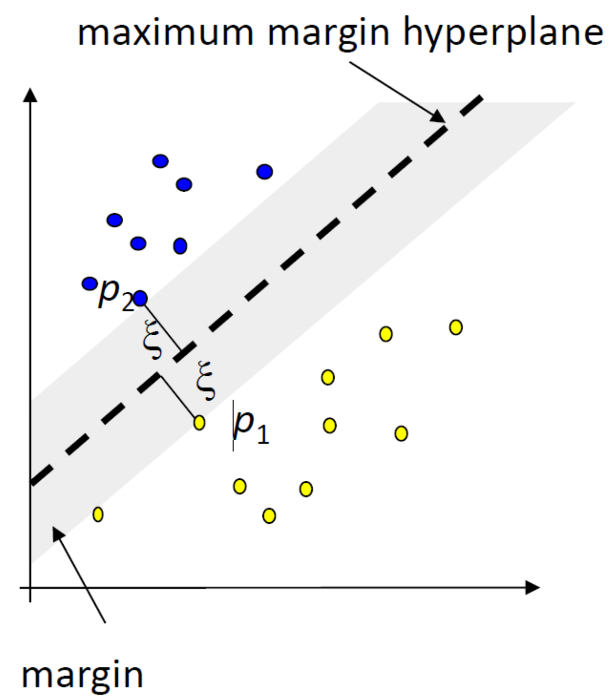
- How is it done?
  - Experts
  - Social Tagging
  - Annotation Games



Supervised Machine Learning

- General Problem:
  - Classifier needed to predict labels for unseen data
  - Mapping from feature space to output mood labels
  - Training with ground truth data

- Most popular classifier:
  - Support Vector Machine (SVM)



Support Vector Machines: Principle [6]

Different Types of Labeling

Single-**class** labeling

Multi-**class** labeling

Single-**modal** labeling

Multi-**modal** labeling

Variety of approaches!

- ✓ Motivation
- ✓ State of the Art
- ➢ **Exemplary Approach**
- Conclusion

- "Exploiting Online Music Tags for Music Emotion Classification" [7]

Same genre

↓

Same performance technique

↓

Same moods

bridge semantic gap

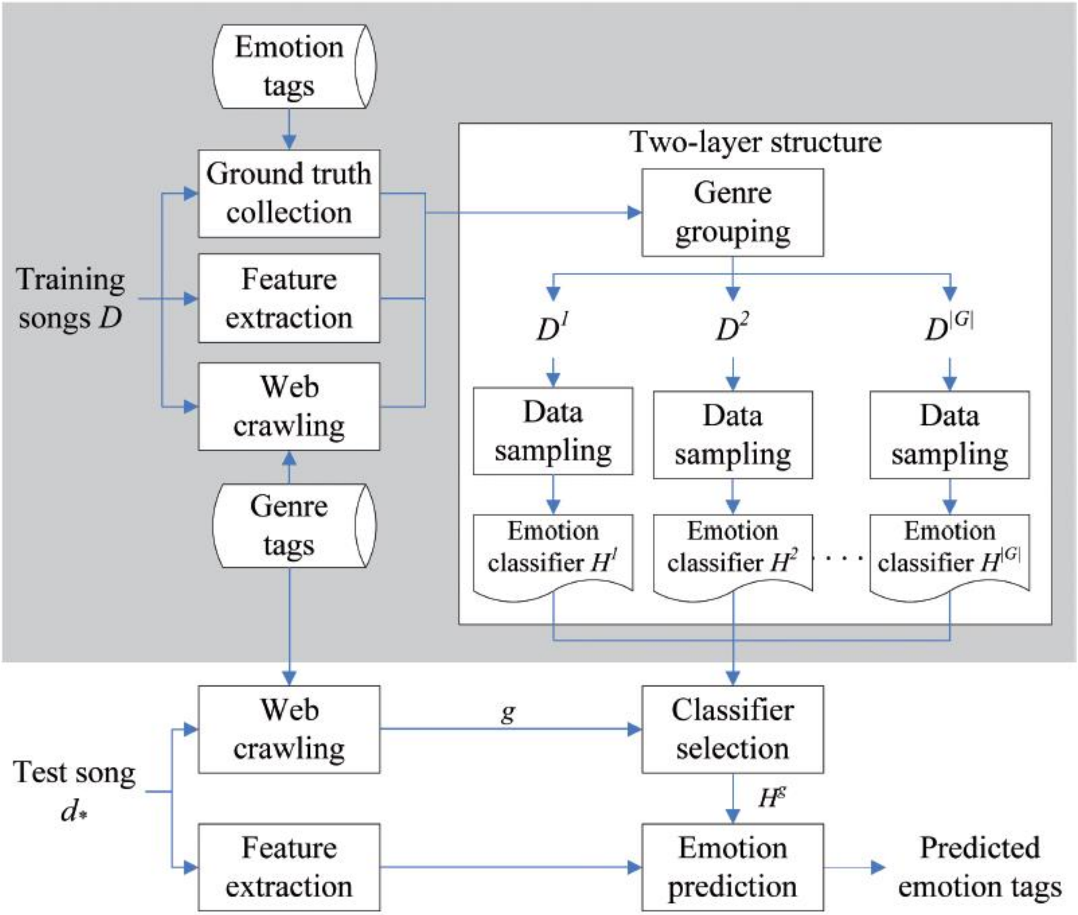
Multi-class labeling

Multi-modal labeling

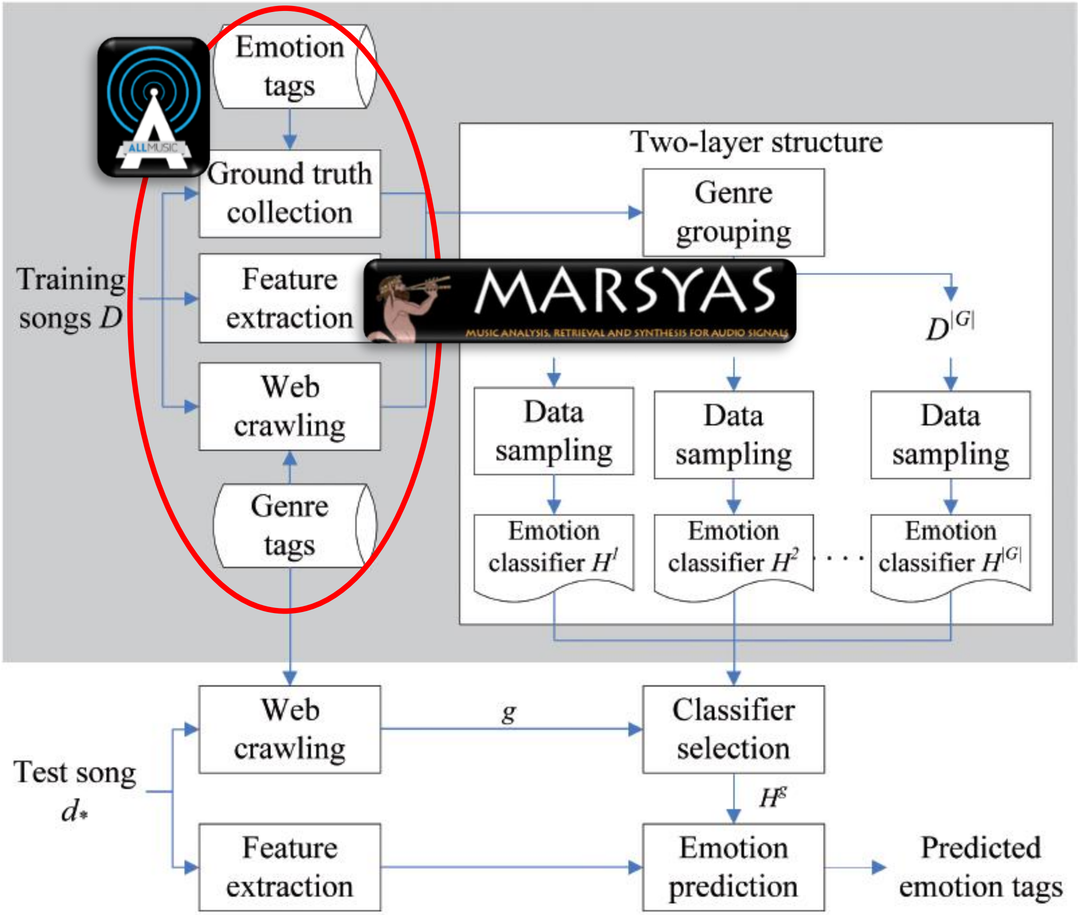
Two-layer structure

- Genre grouping
- Music mood classification

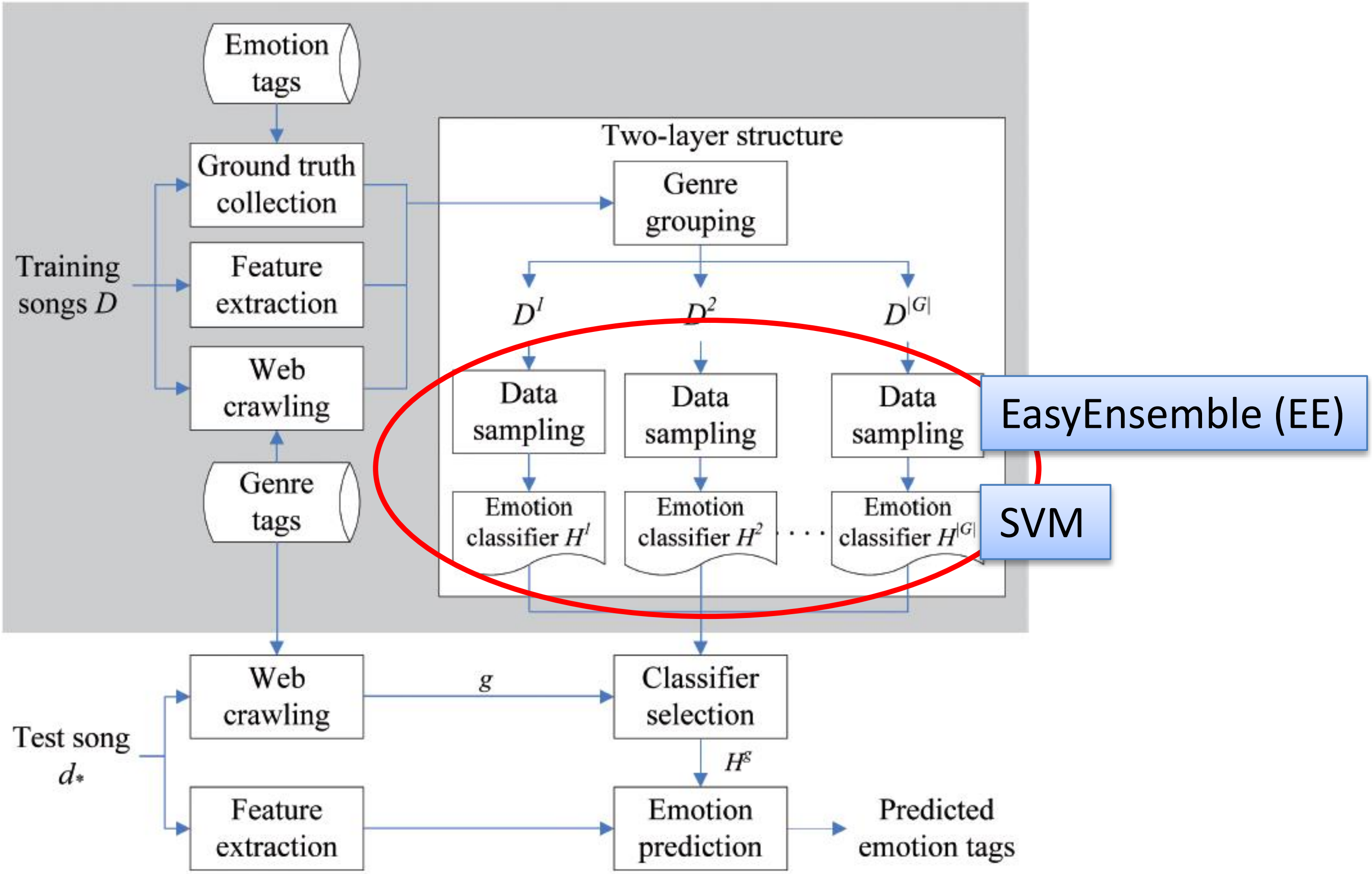
 # Methods: System Overview



System diagram [7]


Emotion tags
Ground truth collection
Training songs D
Feature extraction
Web crawling
Genre tags
Two-layer structure
Genre grouping
MARSYAS
D|G|
Data sampling
Data sampling
Data sampling
Emotion classifier H1
Emotion classifier H2
Emotion classifier H|G|
Test song d*
Web crawling
g
Classifier selection
Hg
Feature extraction
Emotion prediction
Predicted emotion tags

Exemplary Approach – Methods: Sampling and Classification



Results & Review

- Genre-specific characteristics of songs (similarity)
- Improvement of the average F-score from 0.23 to 0.36

Accuracy

Genre specificity

Mood tag propagation

Music features

Data sampling

➡ One exemplary 'successful' approach with **lack of comparability**

- ✓ Motivation
- ✓ State of the Art
- ✓ Exemplary Approach
- ➢ **Conclusion**

Conclusion

- Need for computing moods from music pieces
- Variety of solutions
- Best systems use a combination of features and information from multiple domains
- Open issues regarding its multidisciplinary nature
- Research field is quite young

➡ **Great potential and basis for further research!**

References (1)

[1] Music Emotion Recognition: A State of the Art Review, Kim, Y. E., Schmidt, E. M., Migneco, R., Morton, O. G., Richardson, P., Scott, J., Speck, J. A. & Turnbull, D., 11th International Society for Music Information and Retrieval Conference, pp. 255-266, 2010

[2] Experimental Studies of the Elements of Expression in Music, Hevner, K., The American Journal of Psychology, Vol. 48, pp. 246-268, 1936

[3] A Circumplex Model of Affect, Russel, J. A., Journal of Personality and Social Psychology , Vol. 93, pp. 1161-1178, 1980

[4] Machine Recognition of Music Emotion: A Review, Yang, Y.-H. & Chen, H. H. ACM Transactions on Intelligent Systems and Technology (TIST), Vol. 3, pp. 40:1-40:30, 2012

References (2)

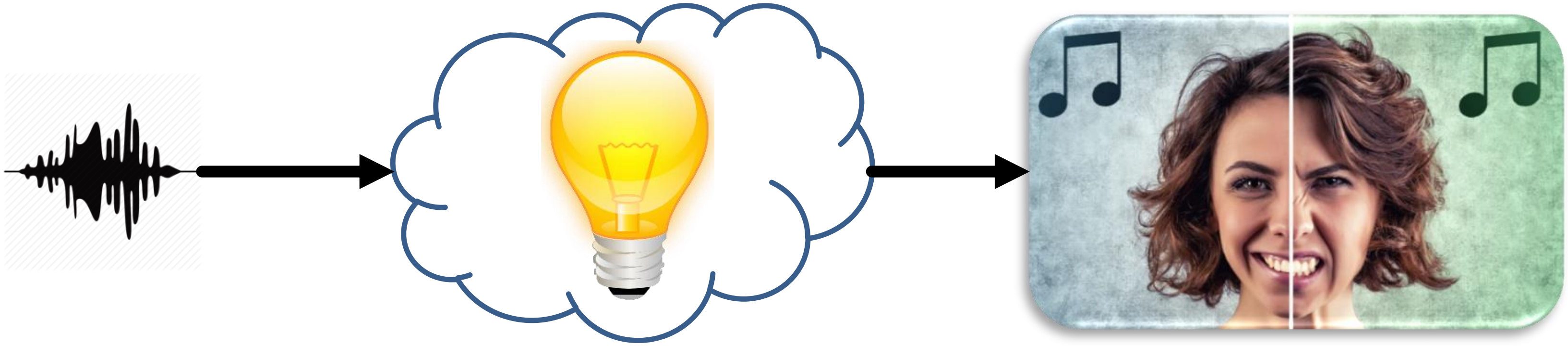
[5] A Survey of Audio-Based Music Classification and Annotation, Fu, Z., Lu, G., Ting, K. M. & Zhang, D., IEEE Transactions on Multimedia, Vol. 13 , pp. 303-319, 2011

[6] Data Mining Algorithms: Chapter 5, Sander, J. & Ester, M., Lecture Notes, RWTH Aachen University, Data Management And Exploration Group, Prof. Dr. rer. nat. Thomas Seidl, 2013

[7] Exploiting Online Music Tags for Music Emotion Classification, Lin, Y.-C.; Yang, Y.-H. & Chen, H. H., ACM Trans. Multimedia Comput. Commun. Appl., Vol. 7S, pp. 26:1-26:16, 2011

[8] Exploring Mood Metadata: Relationships with Genre, Artist and Usage Metadata, Hu, X. & Downie, J. S., Proceedings of the 8th International Conference on Music Information Retrieval, 2007, 67-72

Thank you for your attention!

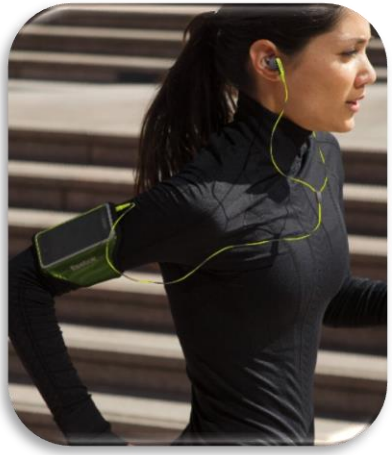


Outlook

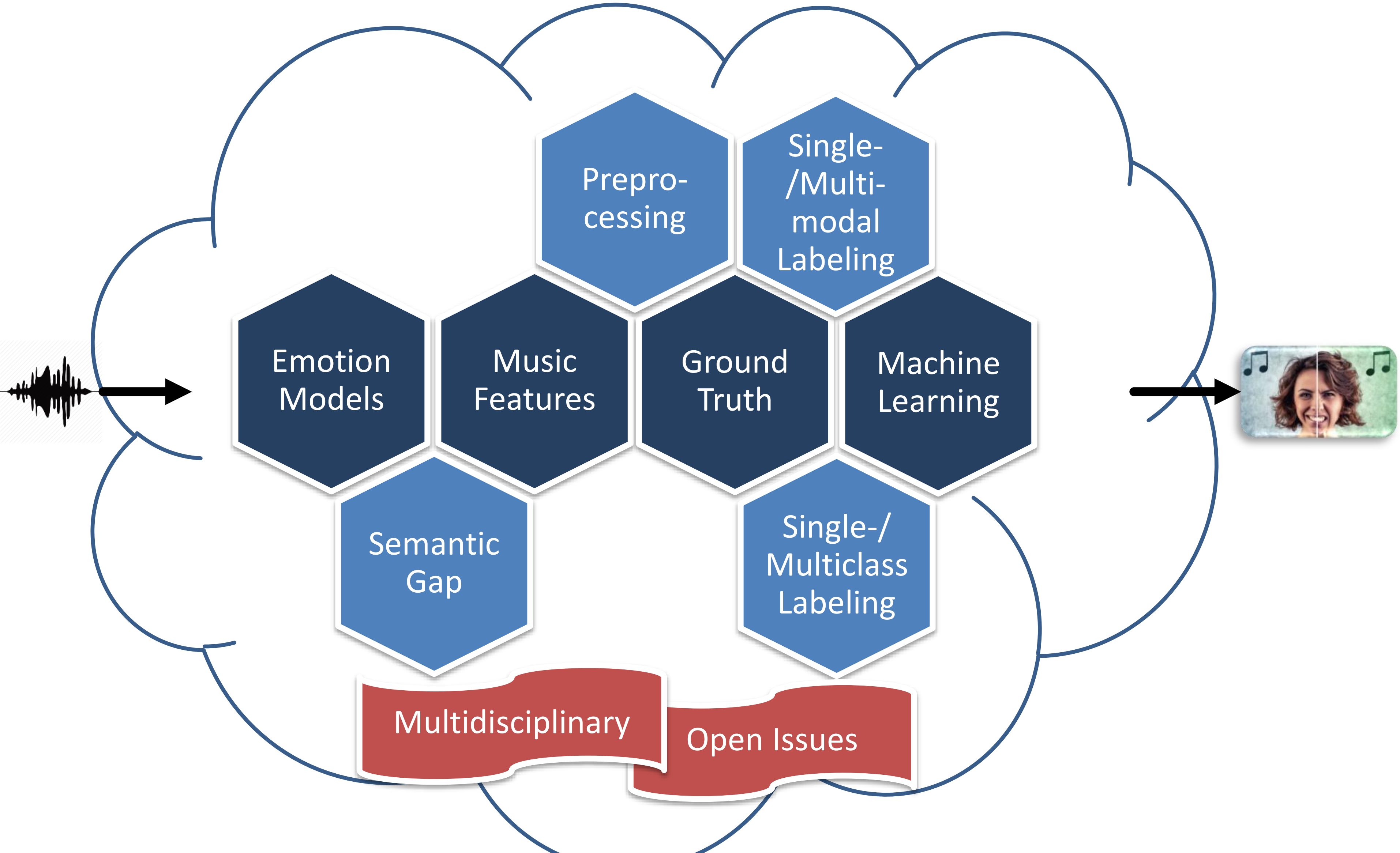
- Personalized systems with individual profiling

- Consider

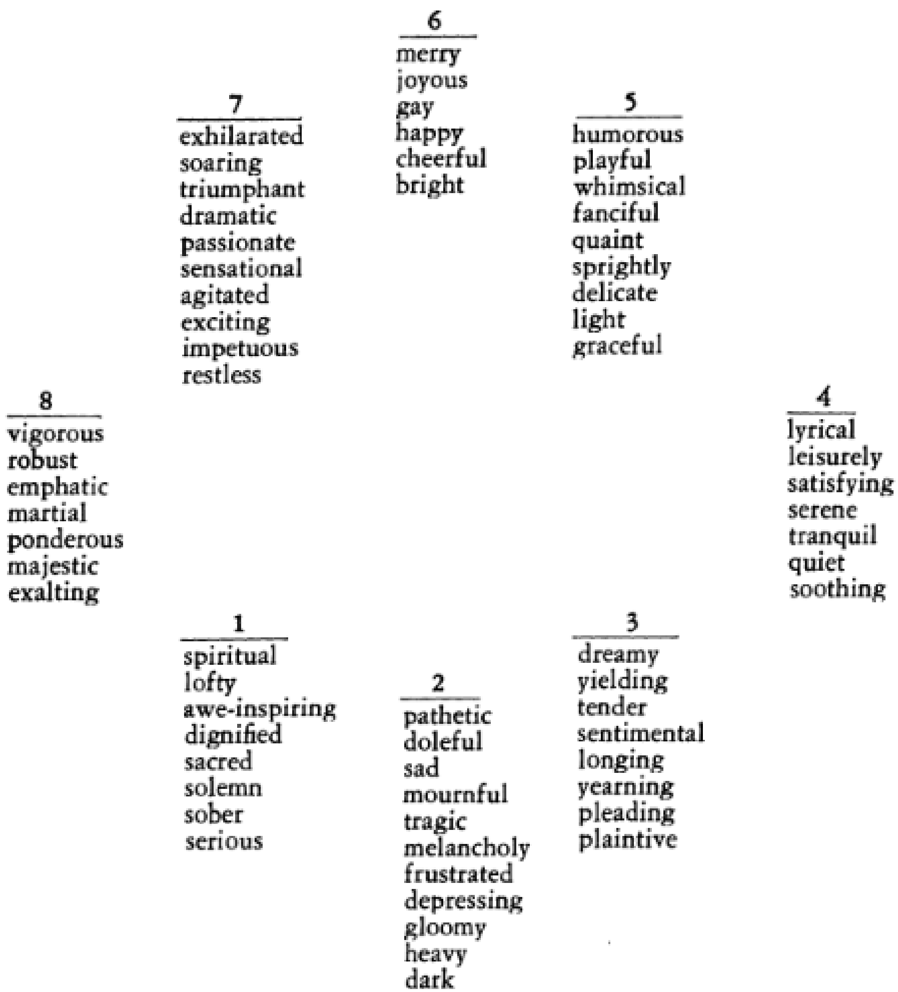
- Applications



Appendix – Music Mood Classification (Several Parts)



Appendix – Hevner's Emotion Model



Hevner's adjective checklist [2]

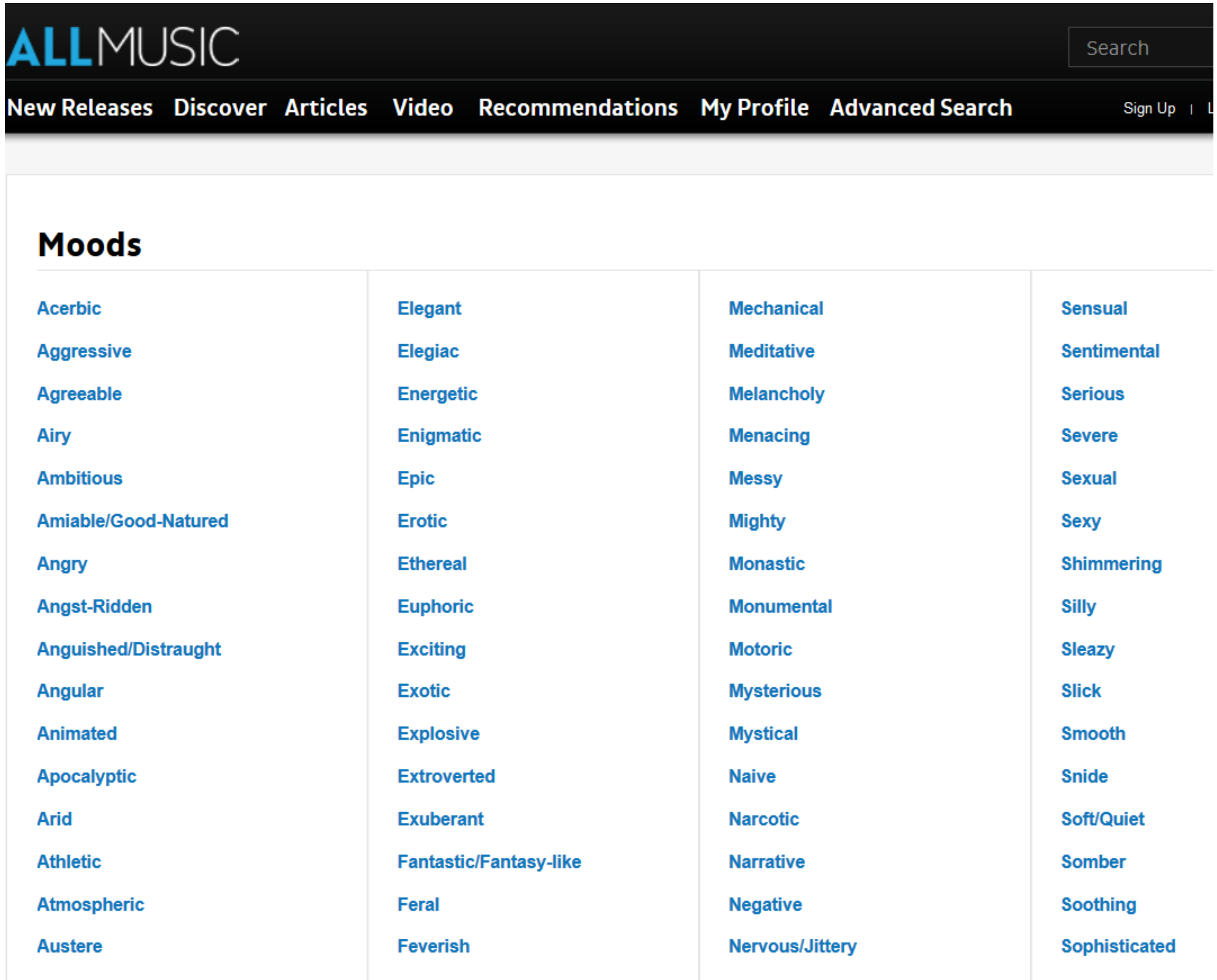
MIREX Mood Cluster

Cluster1	Cluster2	Cluster3	Cluster4	Cluster5
Rowdy	Amiable/ Good natured	Literate	Witty	Volatile
Rousing		Wistful	Humorous	Fiery
Confident	Sweet	Bittersweet	Whimsical	Visceral
Boisterous	Fun	Autumnal	Wry	Aggressive
Passionate	Rollicking	Brooding	Campy	Tense/anxious
	Cheerful	Poignant	Quirky	Intense
			Silly	

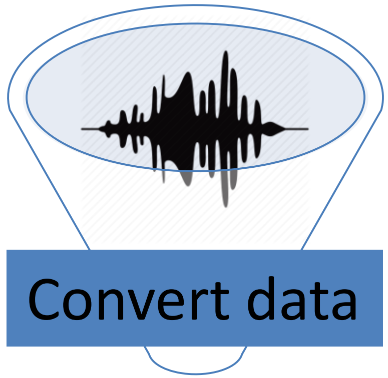
[8]

Appendix – Ground Truth: AllMusic.com

183 mood classes



Appendix – Before Extraction: Preprocessing



Convert data

22.05 kHz

16 bit precision

Mono channel

Normalized to same sound level

20-30s segment as representative

- Genre-specific characteristic of songs (similarity)
- Improvement of the average F-score

Classifier	# layer	Precision	Recall	F-score	# tags per album
Random guess	One	0.07	0.59	0.12	106.79
SVM		0.09	0.02	0.03	0.28
SVM+EE		0.12	0.63	0.20	69.24
SVM+EE+TS		0.30	0.19	0.23	7.57
SVM	Two	0.51	0.18	0.27	3.30
SVM+EE		0.14	0.59	0.23	54.75
SVM+EE+TS		0.38	0.35	0.36	11.21

Experimental Result for Classifying 183 Emotion Classes *[7]*

mirex

System	Precision	Recall	F-score
Random guess	0.39	0.54	0.45
One-layer	0.58	0.61	0.59
Two-layer	0.61	0.65	0.63

Classification Result for the Five-Class MIREX Emotion Taxonomy *[7]*