INTERACTIVE TONAL ANALYSIS

GRFIA Workshop

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Melodic analysis
- prev interval, next interval, relative duration, strength, tied

Chords analysis
- harmony: non-harmonic
  • passing tone
  • neighbor tone
  • etc..

Tonal functions
- it filters out notes (removes nht) for chord analysis

Key analysis
- list of valid keys

Note names
- note features

Melodic function
- melodic function

Context
Academic tonal analysis

Melodic

Chords

Keys

Degrees

Tonal functions

sopr

calto

tenor

bass

IV  IV - V(VI) - VI - III - I - V - I - II - V9 — I - IV - I - V - I - II -
Am — DM — — — — — — — — CM -
SD — SD - SD - SD - SD — T - D - T - SD - D — T - SD - T - D - T - SD -
Task

* Given a sequence of notes tag each one as
  * harmonic (h)
  * non-harmonic
    * passing (pt), neighbor (n), pedal (p), suspension (s), anticipation (an), echapée (e), appoggiatura (ap)
* As PR approaches cannot reach the 100% success rate
* Use Interactive (IPR) solution
Approaches PR

- PR: classical approach
- SIMPLE: simple rules (if-then-else)
- EXPERT: expert system (48 rules)
- machine learning
  - rules: RIPPER, J48, ILP
  - statistical: HMM (supervised and unsupervised)
Current accuracies

SIMPLE < EXPERT < MACHINE LEARNING
Machine learning strengths

* Expert rules: too many rules not covering all cases
* Machine learning:
  * ILP: successor, predecessor relations
  * RIPPER: suitable for unbalanced training corpus
  * J48: best results by resampling
  * HMM: too small corpus, problems with multigaussians
ILP

- Inductive Logic Programming
- export features from music to prolog functions
- offline training that exports prolog rules
- convert those prolog rules to DROOLS rules engine format
Mixed approach

🔹 Add a-priori and a-posteriori rules

🔹 A-priori rules

🔹 well-known deterministic rules: if conditions met no classifier is applied

🔹 A-posteriori rules

🔹 avoid the violation of musical rules by removing non valid classifications (e.g. it is not valid to have two consecutive suspensions)
GUI

* (switch to desktop application)
IPR Approach

- User interaction: change note class
- Without prefix validation: musicologist approach
  - Propagate change: locate all notes with equal features and apply new class
  - Don’t change any previously user changed note
- Left-to-right: prefix validation
- In both cases: apply classifier to non user changed or propagated notes: some a-priori or a-posteriori conditions may change
Cannot have a passing tone (p) after an appogiatura (ap)

Correct ap, set h

The conditions have changed and the second error has been automatically solved

Besides, it is propagated to similar instances
Experiments

Setup:

- Bach’s harmonized chorals
- 10 works, 2528 notes manually tagged
- Work oriented
- Instance (note) oriented
- weka: all works mixed, best results, not realistic
Experiments IPR

- IPR
  - prefix-validation
  - without prefix-validation
  - random position interaction
Accuracy computation

- Success rate computed
- PR: \( (|\text{notes}| - |\text{errors}|) / |\text{notes}| \)
- IPR
  - \( (|\text{notes}| - |\text{interactions}| - |\text{errors}|) / |\text{notes}| \)
## Results

<table>
<thead>
<tr>
<th>Method</th>
<th>PR</th>
<th>IPR Prefix</th>
<th>IPR No Prefix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>85.6±3.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple</td>
<td>71.8±5.3</td>
<td>72.2±4.8</td>
<td>71.6±0.5</td>
</tr>
<tr>
<td>RIPPER</td>
<td>90.9±3.2</td>
<td>91.5±3.0</td>
<td>90.6±0.3</td>
</tr>
<tr>
<td>J48</td>
<td>91.1±3.5</td>
<td><strong>91.6±3.2</strong></td>
<td>90.1±0.3</td>
</tr>
<tr>
<td>J48 Resampling</td>
<td>81.7±5.8</td>
<td>84.3±6.5</td>
<td>82.1±0.7</td>
</tr>
<tr>
<td>ILP (to be checked)</td>
<td>87.2±0.7</td>
<td>Pending</td>
<td>Pending</td>
</tr>
</tbody>
</table>
Conclusions

- RIPPER and J48 generate the best results with meaningful rules
- Interactive pattern matching approach improves results better using prefix-validation
- To be investigated the accuracy differences between instance-oriented classification vs. work-oriented classification
Working...

* HMM
* Datasets
  * currently tagging 70 works
  * tagged by students but not checked 28 works
  * new genres (1 work each of: classical, romantic, 20th century, pop)
* ILP analysis
* Combine classifiers
* Next step: integrate with rest of system