What is jSymbolic?

- Software that extracts statistical descriptors (called “features”) from symbolic music files
- Can read:
  - MIDI
  - MEI (soon)
- Saves extracted features as:
  - ACE XML
  - Weka ARFF (soon)
  - Something else?
- Can be used in three ways:
  - GUI (right)
  - Command line (for batch processing)
  - Java API (for using jSybolic via other software)
Which features? (1/2)

- 111 features are currently implemented
  - 49 more have been designed and are to be implemented soon
  - We also want to add new ones that you might find useful
- Histogram aggregators are used
  - e.g. beat histograms, pitch class histograms, etc.
- Features fall into 7 broad categories . . .
Which features? (2/2)

- Pitch Statistics:
  - What are the occurrence rates of different notes, in terms of both pitches and pitch classes? How tonal is the piece? What is its range? How much variety in pitch is there?

- Melody:
  - What kinds of melodic intervals are present? How much melodic variation is there? What kinds of melodic contours are used? What types of phrases are used and how often are they repeated?

- Texture:
  - How many independent voices are there and how do they interact (e.g., polyphonic, homophonic, etc.)? What is the relative importance of different voices?

- Chords (coming soon):
  - What vertical intervals are present? What types of chords do they represent? How much harmonic movement is there and how fast is it?

- Rhythm:
  - The time intervals between the attacks of different notes and the durations of each note are considered. What metrical structures and rhythmic patterns are present? Is rubato used? How does rhythm vary from voice to voice?

- Instrumentation:
  - What types of instruments are present and which are given particular importance relative to others? The importance of both pitched and non-pitched instruments is considered.

- Dynamics:
  - How loud are notes and what kinds of variations in dynamics occur?
Demo

- Using the GUI
  - Josquin des Prez: *Et incarnatus est*

- Looking at the results
  - Very ugly for people to look at
  - Breathtakingly beautiful for a computer
Chopin’s *Nocturne in B, Op. 32, No. 1*

- Average Note To Note Dynamics Change: 6.03
- Chromatic Motion: 0.0769
- Dominant Spread: 3
- Harmonicity of Two Strongest Rhythmic Pulses: 1
- Importance of Bass Register: 0.2
- Interval Between Strongest Pitch Classes: 3
- Most Common Pitch Class Prevalence: 0.433
- Note Density: 3.75
- Number of Common Melodic Intervals: 3
- Number of Strong Pulses: 5
- Orchestral Strings Fraction: 0
- Overall Dynamic Range: 62
- Pitch Class Variety: 7
- Range: 48
- Relative Strength of Most Common Intervals: 0.5
- Size of Melodic Arcs: 11
- Stepwise Motion: 0.231
- Strength of Strongest Rhythmic Pulse: 0.321
- Variability of Note Duration: 0.293
- Variation of Dynamics: 16.4
Mendelssohn’s *Piano Trio No. 2*

- Average Note To Note Dynamics Change: 1.46
- Chromatic Motion: 0.244
- Dominant Spread: 2
- Harmonicity of Two Strongest Rhythmic Pulses: 1
- Importance of Bass Register: 0.373
- Interval Between Strongest Pitch Classes: 7
- Most Common Pitch Class Prevalence: 0.39
- Note Density: 29.5
- Number of Common Melodic Intervals: 6
- Number of Strong Pulses: 6

- Orchestral Strings Fraction: 0.56
- Overall Dynamic Range: 22
- Pitch Class Variety: 7
- Range: 39
- Relative Strength of Most Common Intervals: 0.8
- Size of Melodic Arcs: 7.27
- Stepwise Motion: 0.439
- Strength of Strongest Rhythmic Pulse: 0.173
- Variability of Note Duration: 0.104
- Variation of Dynamics: 5.98
## Feature value comparison

<table>
<thead>
<tr>
<th>Feature</th>
<th>Nocturne</th>
<th>Trio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Note To Note Dynamic Change</td>
<td>6.03</td>
<td>1.46</td>
</tr>
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</table>
Searching (short-term)

- The set of feature values extracted from a piece serve to characterize and describe it.
- Users can thus search for all pieces whose features fall within constraints they define.
  - e.g. retrieve all scores where more than x% of motion is parallel, and where less than y% of melodic motion is stepwise.
- The actual searching and retrieval will be run using Apache Solr infrastructure.
  - Implementation details remain to be finalized.
Classification (long-term)

- Features can also serve as percepts for machine learning algorithms
  - i.e. their “sensory” input
- A model can then automatically be “trained” on previously classified pieces (“ground truth instances”), after which it can be used to map previously unseen pieces (based on their feature values) to categories of interest
  - e.g. train a model to identify probable composers of anonymous scores
- I have already written the ACE machine learning software to carry this out this sort of thing
- Artificial example with 2 features and 2 composers . . .
Features of training instances

Supervised Learning

Ockeghem
Josquin
Features of instances to classify

Supervised Learning

- Unknown (Ockeghem)
- Unknown (Josquin)
Classifying instances
Classification results

Supervised Learning

- Ockeghem
- Josquin
- Unknown (Ockeghem)
- Unknown (Josquin)
What’s next?

- Tristano is currently doing great work upgrading jSymbolic
- A priority is to get jSymbolic ready to read MEI neumes
  - Once MEI is fully neumified in a standard and stable way
- What would you like jSymbolic to do?