jSymbolic and ELVIS

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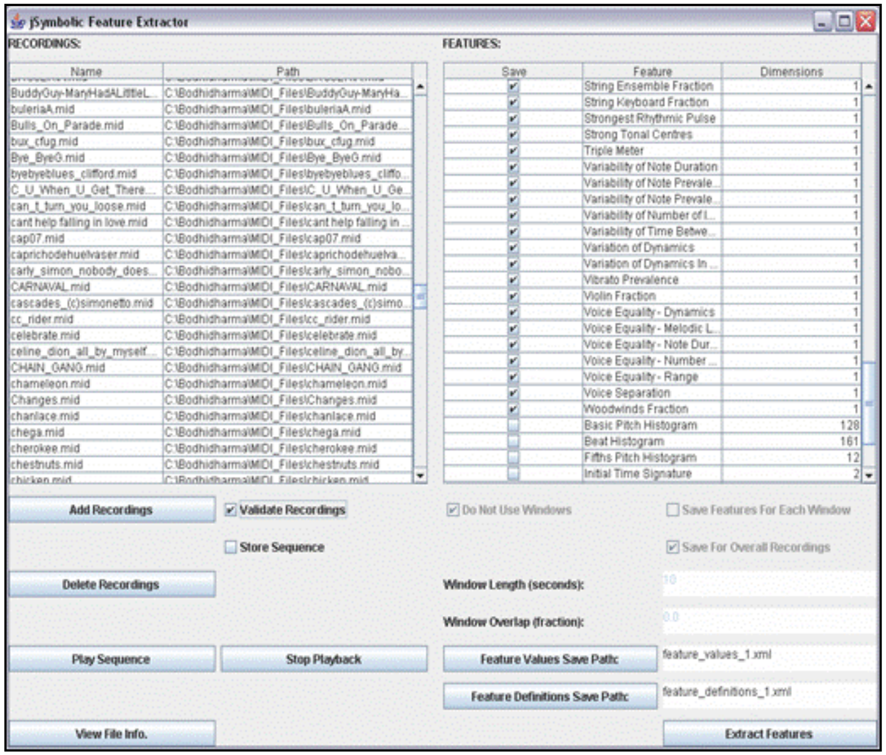
What is jSymbolic?

- 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)



jSymbolic Feature Extractor

RECORDINGS:

Name	Path
BuddyGuy-MaryHadALittleL...	C:\Bodhidharma\MIDI_Files\BuddyGuy-MaryHa...
buleriaA.mid	C:\Bodhidharma\MIDI_Files\buleriaA.mid
Bulls_On_Parade.mid	C:\Bodhidharma\MIDI_Files\Bulls_On_Parade...
bux_cfug.mid	C:\Bodhidharma\MIDI_Files\bux_cfug.mid
Bye_ByeG.mid	C:\Bodhidharma\MIDI_Files\Bye_ByeG.mid
byebyeblues_clifford.mid	C:\Bodhidharma\MIDI_Files\byebyeblues_cliffo...
C_U_When_U_Get_There...	C:\Bodhidharma\MIDI_Files\C_U_When_U_Ge...
can_t_turn_you_loose.mid	C:\Bodhidharma\MIDI_Files\can_t_turn_you_lo...
cant help falling in love.mid	C:\Bodhidharma\MIDI_Files\cant help falling in ...
cap07.mid	C:\Bodhidharma\MIDI_Files\cap07.mid
caprichodehuelvaser.mid	C:\Bodhidharma\MIDI_Files\caprichodehuelva...
carly_simon_nobody_does...	C:\Bodhidharma\MIDI_Files\carly_simon_nobo...
CARNAVAL.mid	C:\Bodhidharma\MIDI_Files\CARNAVAL.mid
cascades_(c)simonetto.mid	C:\Bodhidharma\MIDI_Files\cascades_(c)simo...
cc_rider.mid	C:\Bodhidharma\MIDI_Files\cc_rider.mid
celebrate.mid	C:\Bodhidharma\MIDI_Files\celebrate.mid
celine_dion_all_by_myself...	C:\Bodhidharma\MIDI_Files\celine_dion_all_by...
CHAIN_GANG.mid	C:\Bodhidharma\MIDI_Files\CHAIN_GANG.mid
chameleon.mid	C:\Bodhidharma\MIDI_Files\chameleon.mid
Changes.mid	C:\Bodhidharma\MIDI_Files\Changes.mid
chanlace.mid	C:\Bodhidharma\MIDI_Files\chanlace.mid
chega.mid	C:\Bodhidharma\MIDI_Files\chega.mid
cherokee.mid	C:\Bodhidharma\MIDI_Files\cherokee.mid
chestnuts.mid	C:\Bodhidharma\MIDI_Files\chestnuts.mid
chicken.mid	C:\Bodhidharma\MIDI_Files\chicken.mid

FEATURES:

Save	Feature	Dimensions
☑	String Ensemble Fraction	1
☑	String Keyboard Fraction	1
☑	Strongest Rhythmic Pulse	1
☑	Strong Tonal Centres	1
☑	Triple Meter	1
☑	Variability of Note Duration	1
☑	Variability of Note Prevale...	1
☑	Variability of Note Prevale...	1
☑	Variability of Number of I...	1
☑	Variability of Time Betwe...	1
☑	Variation of Dynamics	1
☑	Variation of Dynamics In ...	1
☑	Vibrato Prevalence	1
☑	Violin Fraction	1
☑	Voice Equality - Dynamics	1
☑	Voice Equality - Melodic L...	1
☑	Voice Equality - Note Dur...	1
☑	Voice Equality - Number ...	1
☑	Voice Equality - Range	1
☑	Voice Separation	1
☑	Woodwinds Fraction	1
□	Basic Pitch Histogram	128
□	Beat Histogram	161
□	Fifths Pitch Histogram	12
□	Initial Time Signature	2

☑ Validate Recordings

□ Store Sequence

☑ Do Not Use Windows

□ Save Features For Each Window

☑ Save For Overall Recordings

Window Length (seconds): 1.0

Window Overlap (fraction): 0.0

Feature Values Save Path: feature_values_1.xml

Feature Definitions Save Path: feature_definitions_1.xml

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 . . .

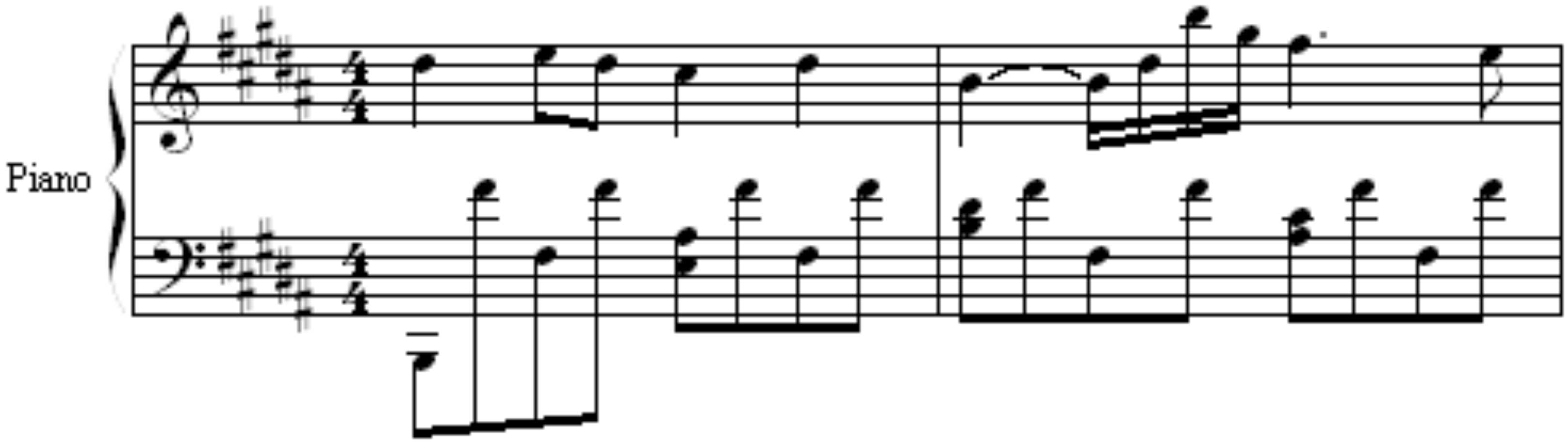
Which features? (2/2)

- 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 sooon):
  - 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

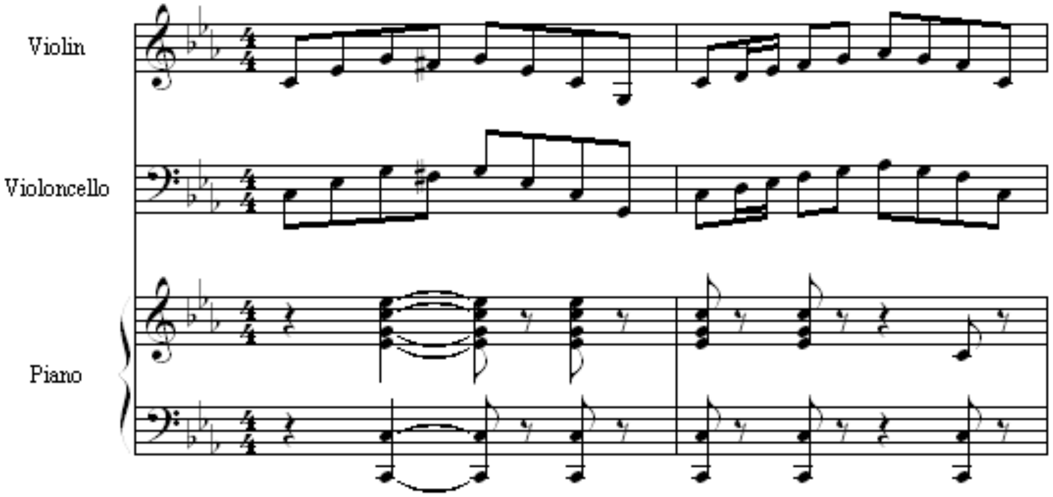
Chopin’s *Nocturne in B, Op. 32, No. 1*



- 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

	Nocturne	Trio
Average Note To Note Dynamic Change	**6.03**	1.46
Overall Dynamic Range	**62**	22
Variation of Dynamics	**16.40**	5.98
Note Density	3.75	**29.50**
Orchestral Strings Fraction	0.00	**0.56**
Variability of Note Duration	**0.293**	0.104
Chromatic Motion	0.077	**0.244**
Range	**48**	39

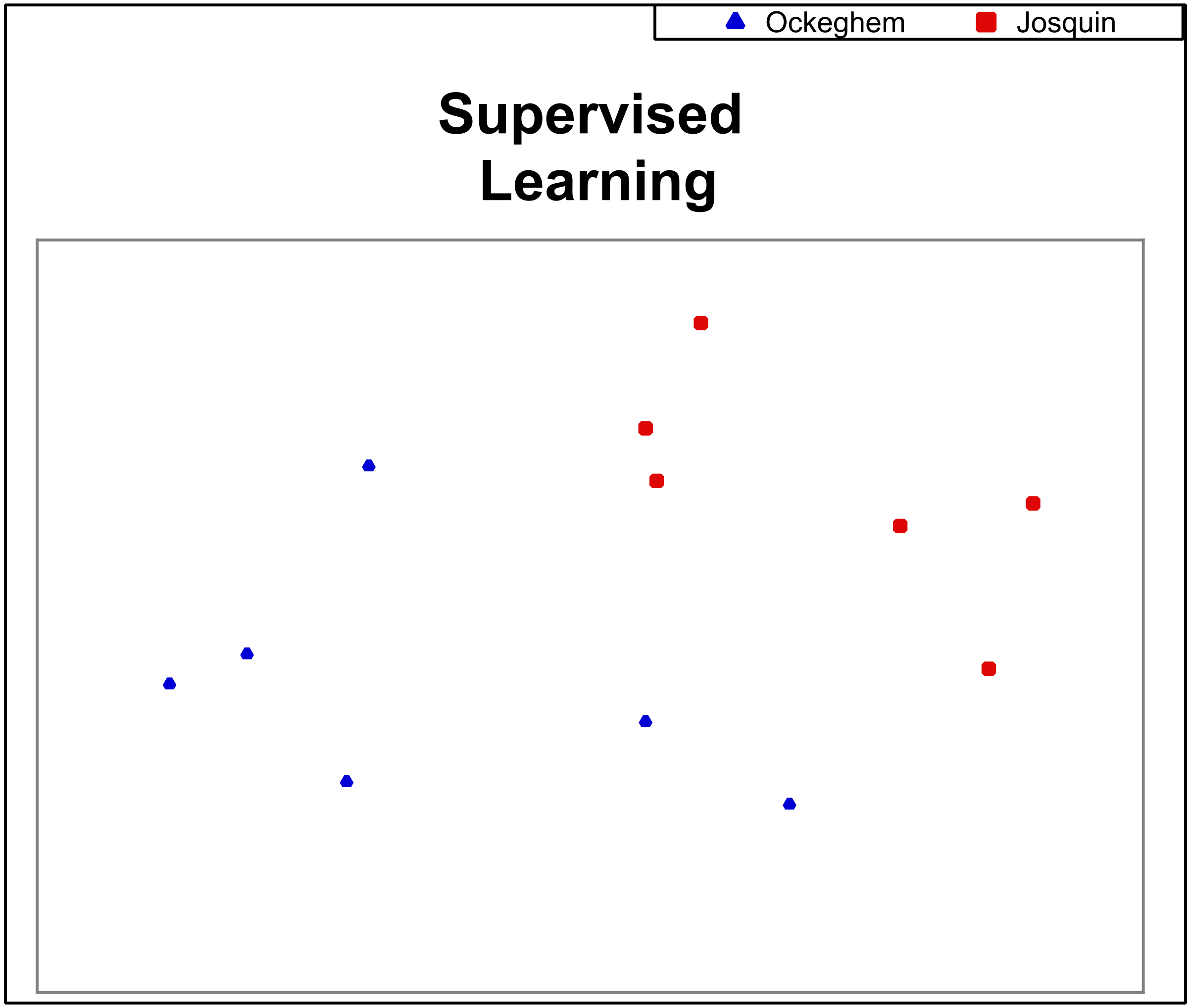
jSymbolic and ELVIS? (1/2)

- 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

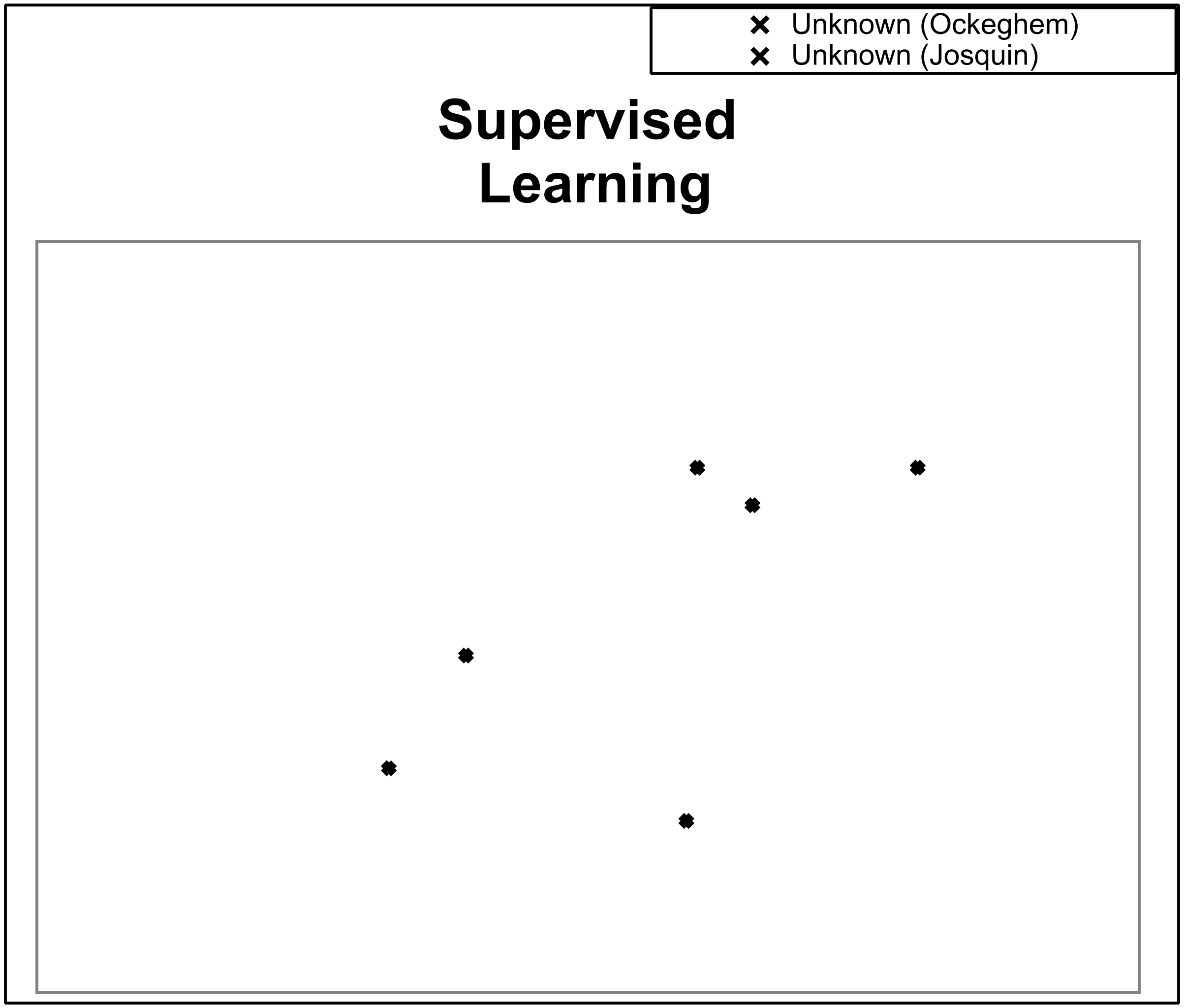
jSymbolic and ELVIS? (2/2)

- 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 . . .

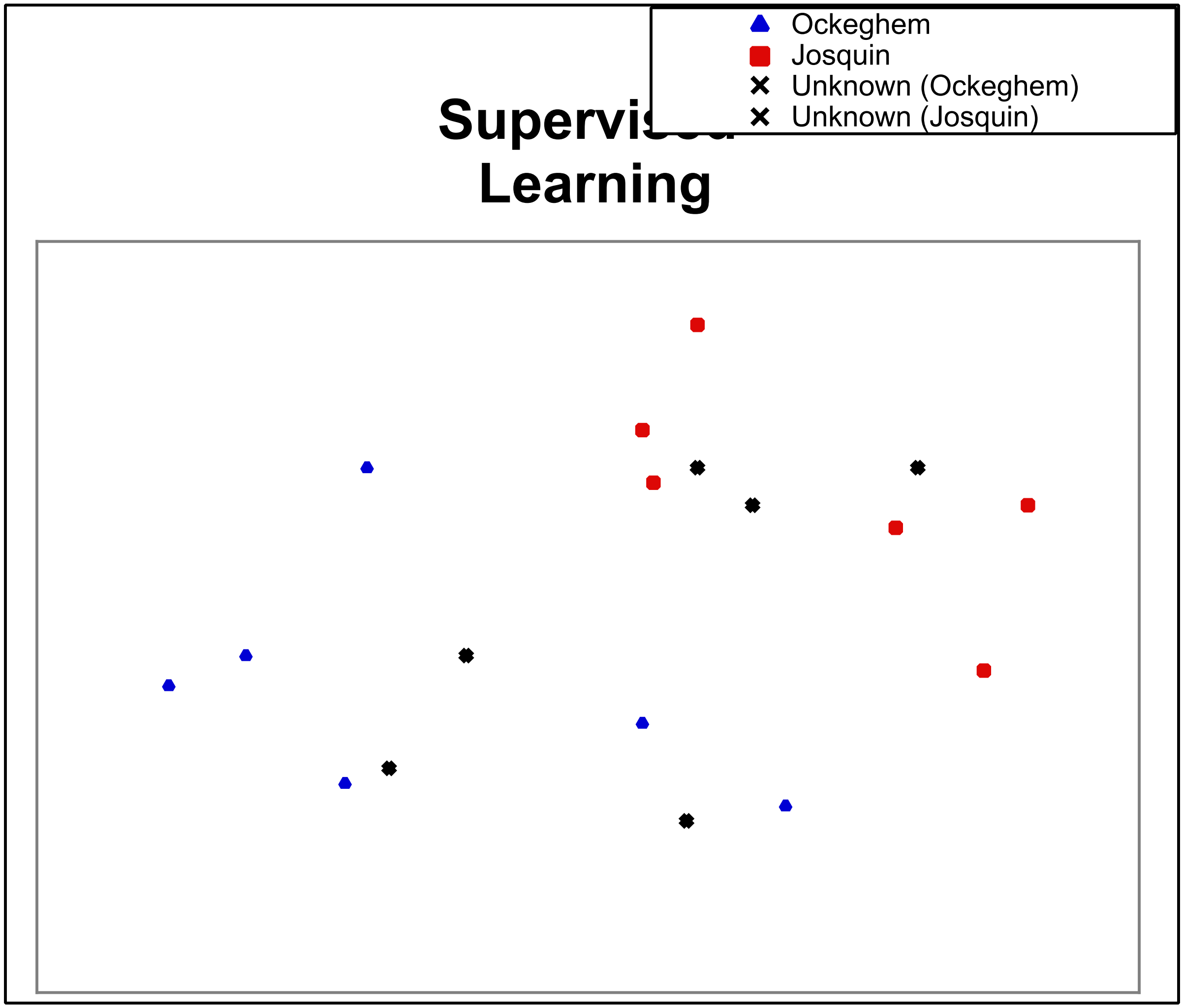
Features of training instances



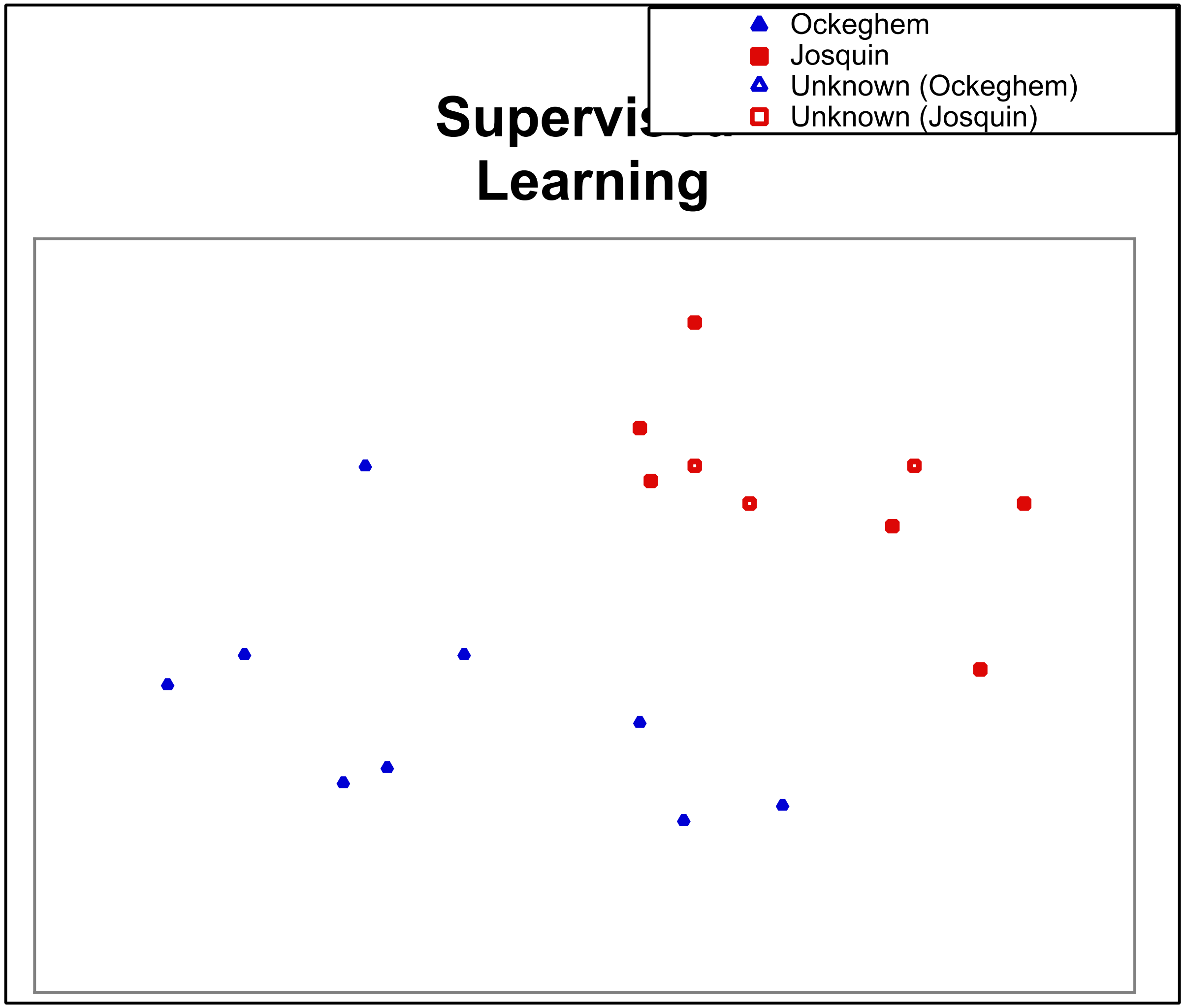
Features of instances to classify



Classifying instances



Classification results



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?