# SIMSSA DB:
# Go Jump in the (Data) Lake

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# Topics

- Overview and goals of the SIMSSA DB
- Some highlights
  - Metadata
  - Auto-extracted, searchable features
  - Abstract works, sections and parts
  - Sources and provenance
- SIMSSA DB / LinkedMusic integration
- Live demo by Rebecca Mizrahi

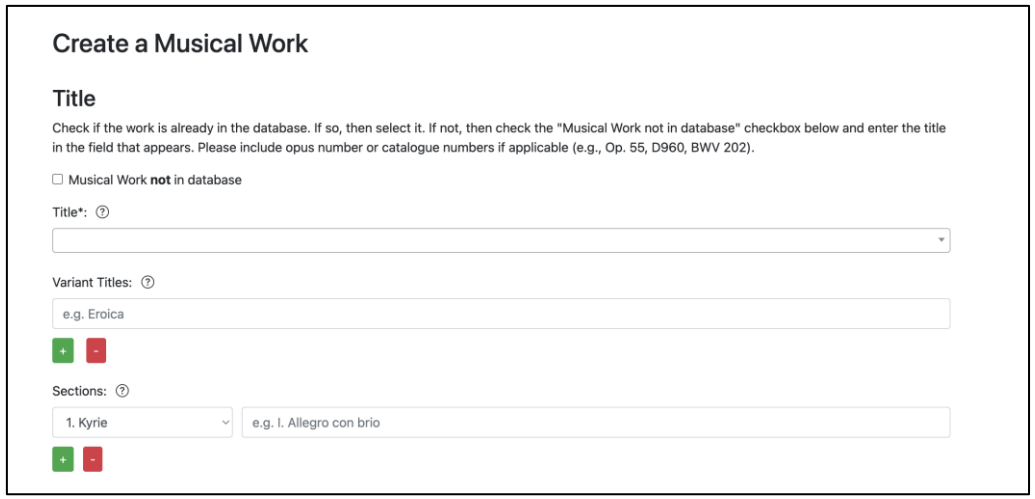
# What is the SIMSSA DB?

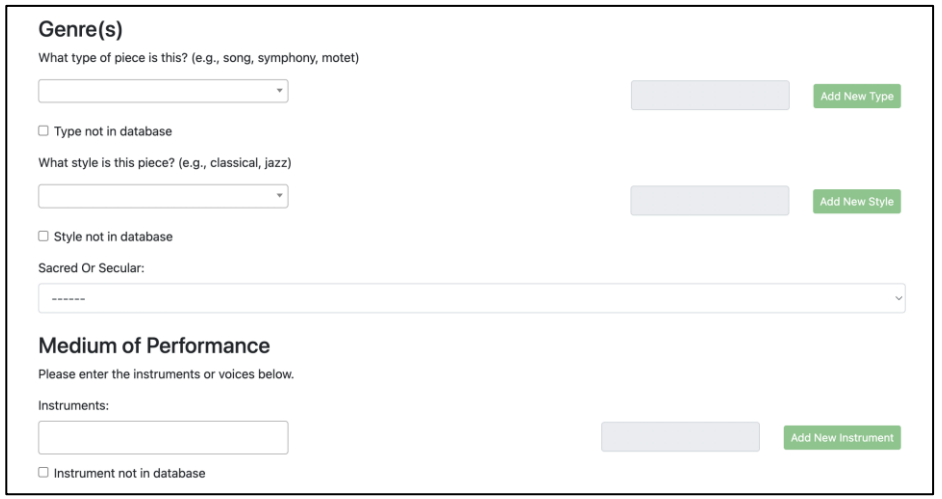
- Collaborative database prototype infrastructure for holding and accessing symbolic music files, associated auto-extracted content-based feature values, and musicologically-focused metadata
  - With a web Django-based browser interface
- Populated by:
  - **Now:** Samples from research datasets we have constructed
  - **Medium-term:** Import existing open symbolic datasets that musicologists, libraries and others have already constructed
    - We can import such datasets, or users can contribute them directly
  - **Long-term:** Auto-population via (verified) OMR
- Focused (for now) on early music

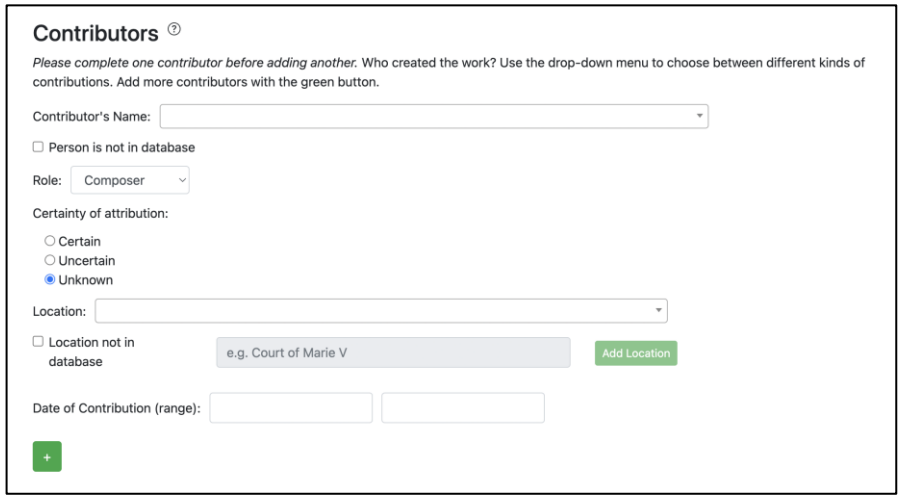
# An infrastructure, not a corpus

- The SIMSSA DB is not intended just as a repository of music we have transcribed ourselves
  - Although are seeding it with datasets we have made, such as JLSDD (Cumming et al. 2018), Florence 164 (Cumming & McKay 2018), etc.
- Rather, it is a general unified infrastructure to which it is hoped other scholars can contribute and share symbolic music files (and more) that they have used in their own work

# SIMSSA DB prototype contribution form



# Data quality

- Focus on high-quality data
- Quality of individual documents is especially important in early music:
  - Individual details very important to domain experts
    - e.g. a single cadence or even a single note
  - Few extant sources, so limited training/testing data will ever be available, and there is limited room for statistical noise
- Problem: Ensuring high-quality structured data requires expertise and effort on the part of contributors and validators
  - One of the reasons the SIMSSA DB is designed primarily for use by musicologists and, to a lesser extent, MIR researchers
- This tension between quantity vs. quality is not yet fully resolved; we may choose to find a different balance between them in the future
  - In terms of both the amount of data and in the amount of structuring and annotation

# Core focus: Symbolic music files

- Research-grade symbolic music files are surprisingly difficult to access
- Most existing scholarly music repositories focus on references to physical sources, to images or audio recordings
  - Many repositories do not reference symbolic music files at all
  - Most of those that do reference symbolic music typically:
    - Treat them as an afterthought, rather than as valuable digital objects worthy of careful consideration
    - Neglect essential issues like provenance and documentation of essential editorial and encoding decisions that are fundamental to conducting proper computational musicological research
    - Limit the range of symbolic formats available, contrary to the needs of researchers who in practice will need music available in a range of different formats (and who know that naïve automatic translation can bias or otherwise compromise research results)

# Metadata and feature searches

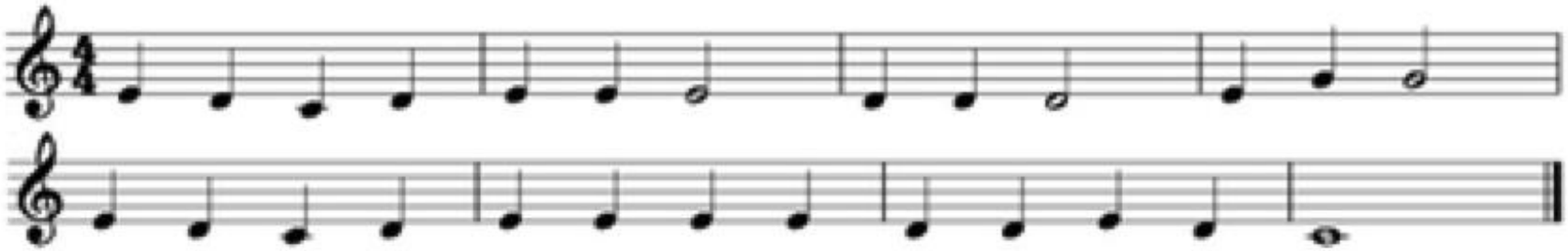
- SIMSSA DB may be searched using traditional metadata queries:
  - Free-text search
  - Faceted metadata filters, such as:
    - Contributor
      - Composer, arranger, author of text, transcriber, etc.
    - Instruments / voices
    - Sacred / secular
    - Genre / type of work
      - e.g. madrigal, motet, etc.
    - Etc.
- SIMSSA DB also permits content-based searches based on features

# Wait, what is a "feature?"

- Information that measures a characteristic of a segment of music in a simple, consistent and precisely-defined way
- Represented using numbers
  - Can be a single value, or can be a set of related values (e.g., a vector of histogram bin values)
- Provides a summary description of the characteristic being measured
  - Usually provides a macro rather than local view
- Usually extracted from pieces or distinct sections (e.g., mass movements) in their entirety
  - But can also be extracted from smaller segments of music

# Example: A simple feature

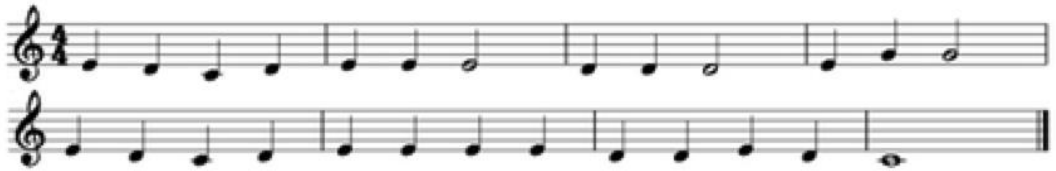
- Range: Difference in semitones between the lowest and highest pitches present
  - A 1-dimensional feature



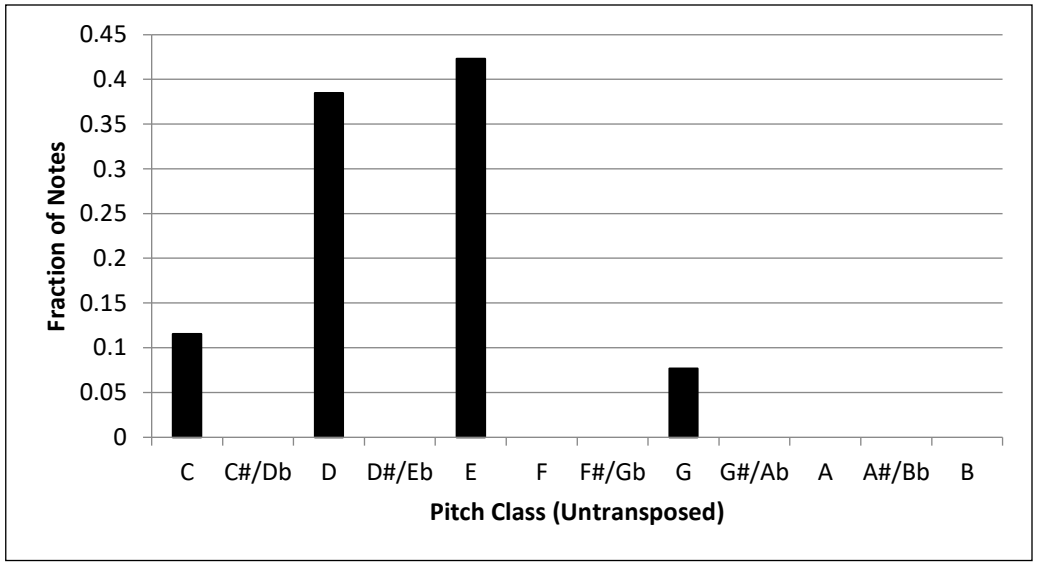
- Value of this feature for this music: 7
  - G - C = 7 semitones

# Example: A histogram feature

- Pitch Class Histogram: Consists of 12 values, each representing the fraction of all notes belonging to an enharmonic pitch class

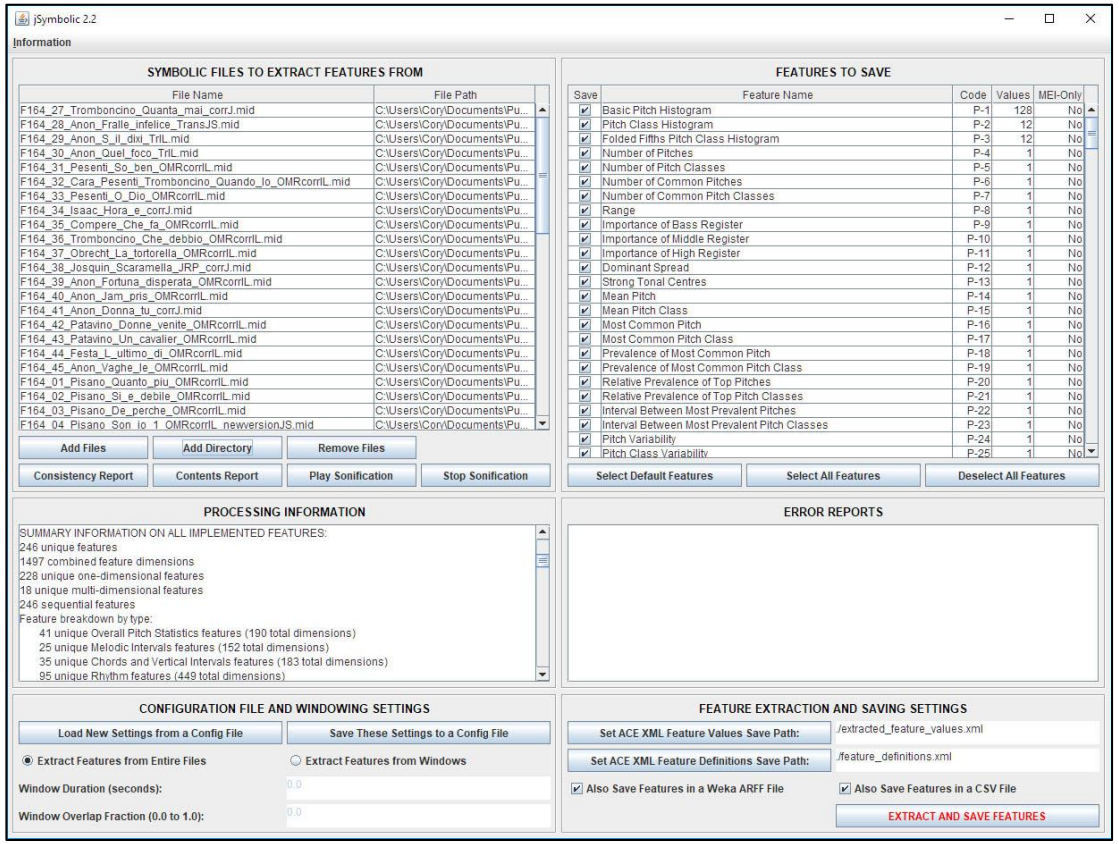


- Histogram graph on right shows feature values
- Pitch class counts:
  - C: 3, D: 10, E: 11, G: 2
- Most common note is E:
  - 11/26 notes
  - Corresponds to a feature value of 0.423 for E



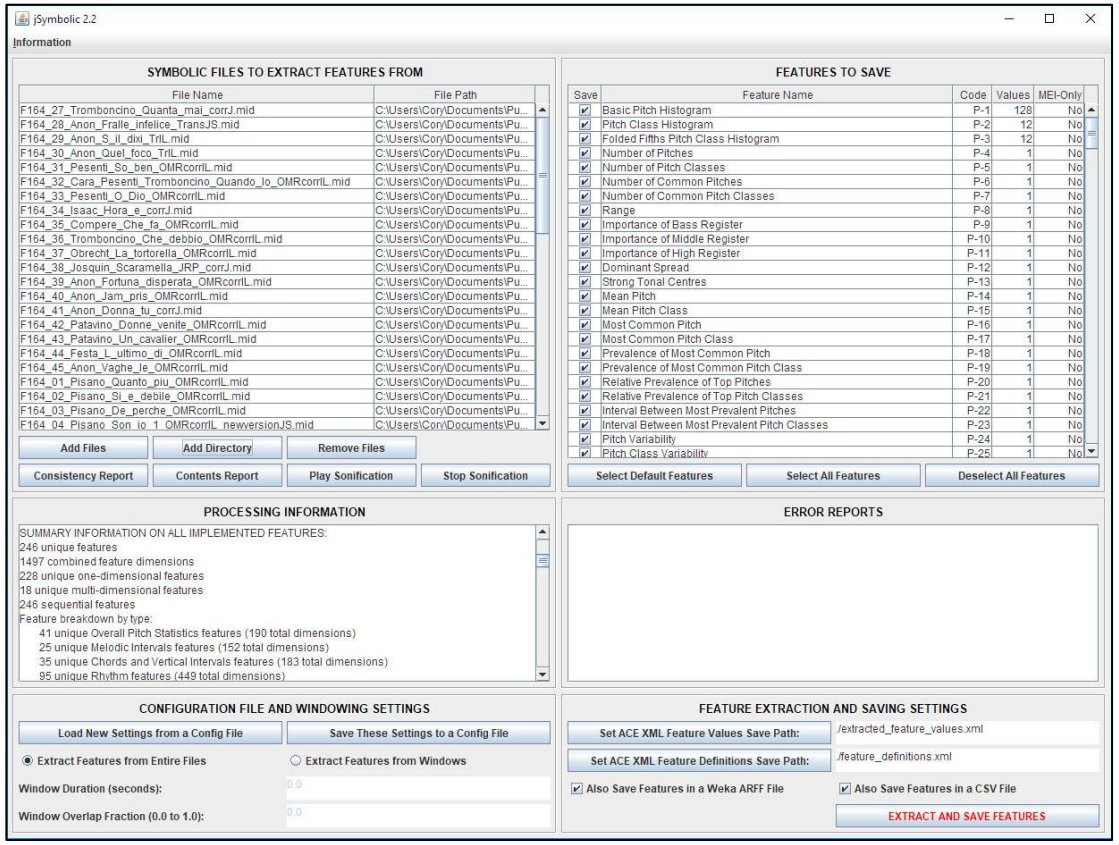
# How might one calculate features?

- The jSymbolic research software (McKay et al. 2018) can be used to automatically extract features from symbolic digital scores
  - Open source
  - Applicable to diverse musics
- Version 2.2 extracts 246 unique features
  - 1497 separate feature values, since many features a multi-dimensional (e.g. histogram vectors)
- The upcoming Version 3 extracts 533 unique features
  - 2040 feature values, including n-gram features



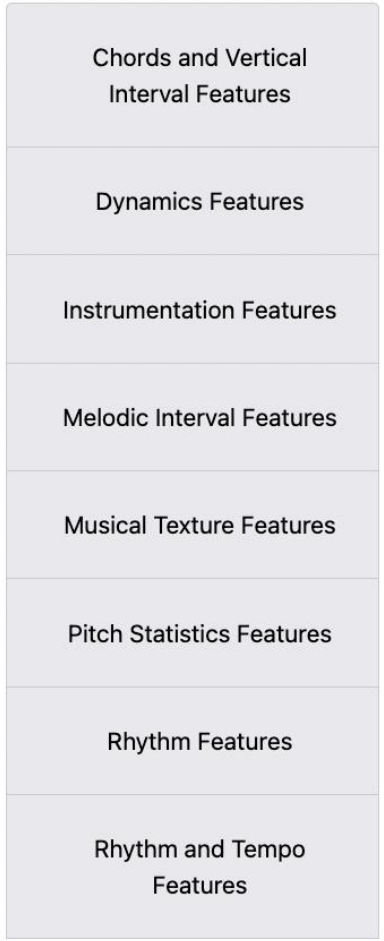
# jSymbolic 2.2's feature types

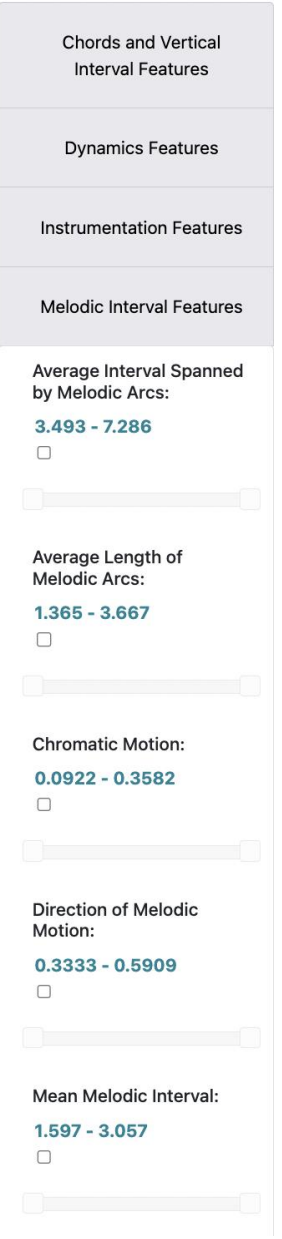
- Pitch statistics
  - e.g. Range
- Melody / horizontal intervals
  - e.g. Most Common Melodic Interval
- Chords / vertical intervals
  - e.g. Vertical Minor Third Prevalence
- Texture
  - e.g. Parallel Motion
- Rhythm
  - e.g. Note Density per Quarter Note
- Instrumentation
  - e.g. Note Prevalence of Unpitched Instruments
- Dynamics
  - e.g. Variation of Dynamics



# SIMSSA DB and features (1/2)

- jSymbolic 2.2 has been integrated into the SIMSSA DB
  - Whenever an extractable file is uploaded to the SIMSSA DB, features are automatically pre-extracted, stored and indexed
- Users can specify feature-range queries via a slider for each feature they are interested in



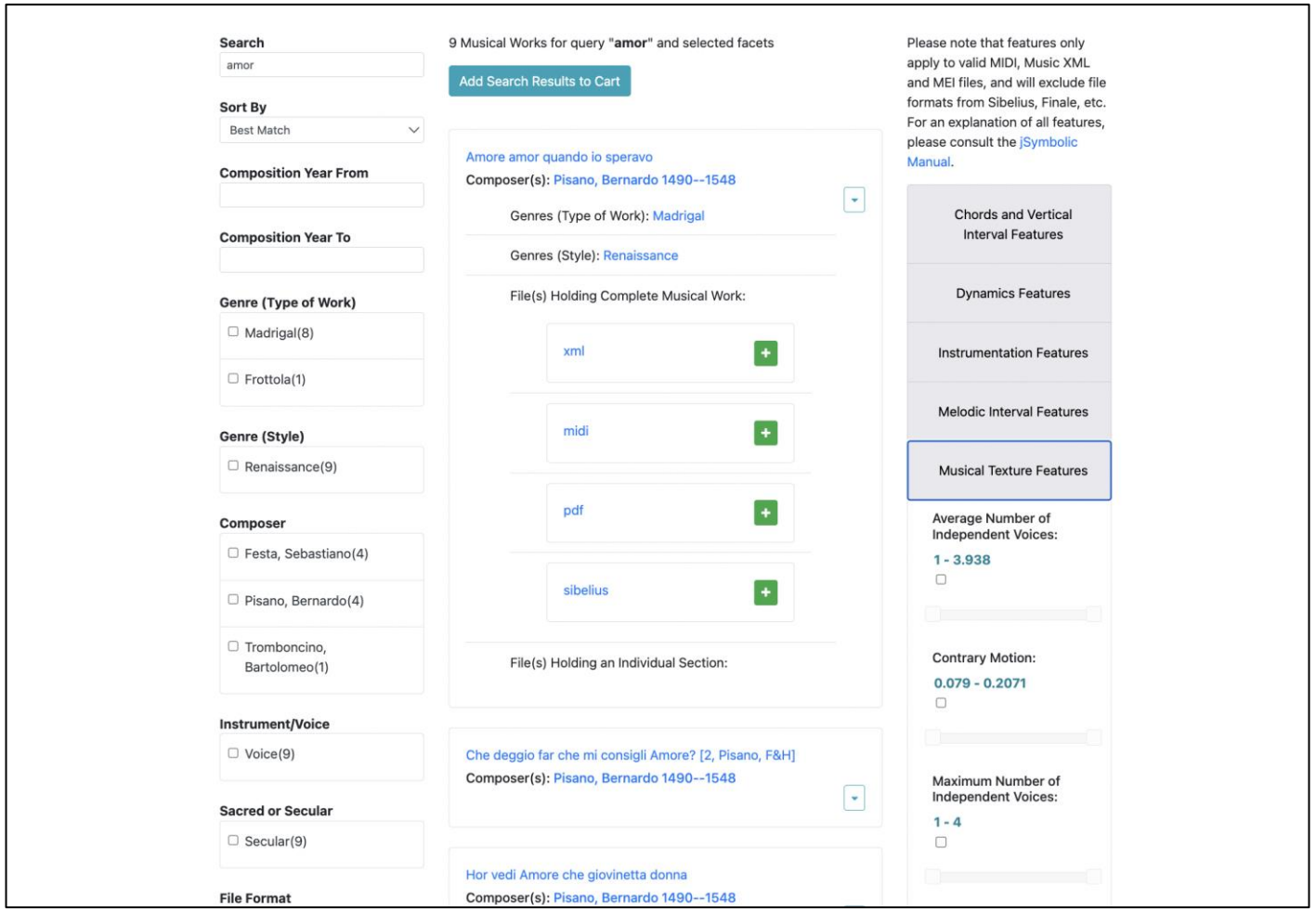



# SIMSSA DB and features (2/2)

- Can also download complete feature sets directly and use them as input to statistical analysis and machine learning tools (or analyze them manually)

- Feature searches can also be combined with metadata searches
  - e.g. retrieve all sacred pieces attributed to Josquin that contain parallel fifths

# Sample query combining metadata and features



# Abstract works, sections and parts (1/2)

- The SIMSSA DB maintains a conceptual separation between abstract musical works and particular instantiations of them (as expressed by particular symbolic files, for example)
- Multiple versions of the same abstract work can exist, and these should be both associated with and differentiated from one another
  - e.g. different editions, arrangements, etc. of a work
  - e.g. different digital symbolic encodings of the same manuscript
    - Could be in different formats (e.g., MIDI vs. MEI vs. MusicXML vs. kern vs. mscx)
    - Two versions could also use the same format, but be encoded differently (e.g., approach to *musica ficta*, base rhythmic note values, etc.)

# Abstract works, sections and parts (2/2)

- The SIMSSA DB makes it possible to divide music into abstract Works, Sections and Parts
  - Symbolic files sometimes contain whole pieces, and sometimes only subsets of pieces
- The makes it possible to keep track of complex abstract relationships
  - e.g., a single movement of a mass might be reused in another mass
  - e.g., an orchestral score and a keyboard reduction of it have different parts, but they are also different versions of the same abstract work

# Sources and provenance

- Keeping a record of provenance is musicologically essential
- Each digital object in the SIMSSA DB (e.g., a symbolic music file) is therefore linked to a Source
  - A “source” is a reference (ideally a URI) to a physical or digital document from which a digital object in the SIMSSA DB (e.g., a Music XML file) was derived
- Each source can in turn be linked to its parent source(s) through (eventually) chains of provenance
  - e.g., an MEI file transcribed from a printed score, derived from a hand-written copyist’s manuscript, derived from a hand-written original manuscript in the composer’s hand

# Other aspects of the SIMSSA DB

- Authority control
- Links to corpora
- Links to specific experimental studies
- Links to other types of data (text, audio, images, etc.)

# “Music researchers jumping into a lake” (according to Fotor and Deep AI)

# Basic metadata fields we would like LinkedMusic to make searchable and accessible

- Basic metadata fields
  - Title of work (including variants)
  - Title of section (including variants)
    - e.g., of a mass movement
  - Composer, author of text, arranger, transcriber, performer, improviser
    - With attribution certainty
  - Instrument / voice
  - Sacred or secular
  - Genre (Type of Work)
    - e.g., Motet
  - Genre (Style)
    - e.g., Renaissance
  - Dates
    - Precise or ranges
  - Locations
  - Source of item
  - File format
    - MusicXML, MEI, MIDI, kern, Sibelius, PDF, etc.

# Trickier things we would like LinkedMusic to make searchable and accessible

- Relationships and structures between entities
  - Work <-> Section <-> Part
  - Chains of provenance
  - Corpora found in
  - Experimental studies used in
  - Connections between related:
    - Symbolic music files
    - Audio files
    - Image files
    - Text files
- Feature values

# The SIMSSA DB, Cantus DB, The Session and MusicBrainz are serving as early “music research test subjects”

# Some tricky issues to think about

- How will fields with no easy Wikidata property mappings be made accessible?
  - e.g., jSymbolic3's 2040 feature values
  - Having each repository provide formally structured URI documentation for each of potentially hundreds or thousands of fields would be onerous, but not intractable
  - Alternatives, like basic unstructured text search for such situations?
- Musicologists have repeatedly stressed the essential value of having the option to enter free text values (when they need to)
  - As opposed to being exclusively limited to options suggested by authority controls, that have existing URIs associated with them
    - e.g. titles or names not recognized by authority controls, or qualifications about dates
  - Is auto-creating new corresponding URIs in such situations a good option?
    - Probably not ideal from the perspective of reconciliation
- Similar issues likely relevant to other LinkedMusic repositories too

# Credit to the deserving

- I (Cory) designed the original data model and provided high-level guidance to the project, along with Julie Cumming and Emily Hopkins
  - Andrew Hankinson helped get us started with insights from DIAMM and elsewhere
  - Informal discussions with a range of musicologists have also been immensely valuable in guiding priorities
- Ichiro Fujinaga generously hosted SIMSSA DB development in his lab
  - Gustavo Polins Pedro and Yaolong Ju implemented the first version
  - Rebecca Mizrahi recently resurrected the DB implemented substantial improvements
  - Hong Van Pham has worked on deployment and towards LinkedMusic integration

# Live demo by Rebecca Mizrahi

- Staging version of SIMSSA DB:
  - db.staging.simssa.ca
  - May only be accessed via the McGill network
  - New contribution submission is currently enabled for data security
  - Please try it while you're here

- Production version of SIMSSA DB:
  - db.simssa.ca
  - Publicly accessible
  - New contribution submission is currently disabled for data security

# Thanks for your attention!

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