haspie – A Musical Harmonisation Tool based on ASP

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Motivation

Musical teaching is still very traditional nowadays.

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Self-teaching of music theory is hard.

There are not many tools to aid and guide students and self-taught students.

Composition tools seek results assuming that the user knows musical theory.

There are intelligent composers: CHASP, Vox Populi, ANTON...

Example: Harmonisation

Harmony is a very important subject in music theory learning

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Exercises consist in choosing chords sequences and completing musical pieces

Already existing tools do not apply to this particular field

Goals

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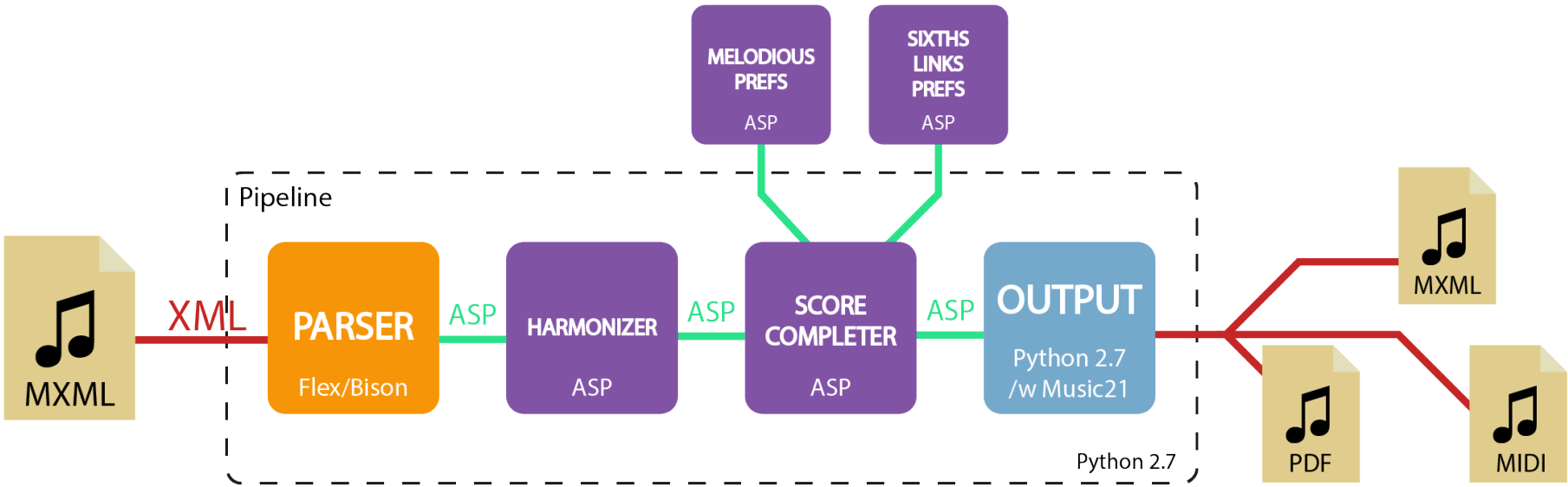
2. Given a certain harmonisation, be able to complete on purpose blank sections of any incomplete voice of the score
3. Add new voices that complement the voices already in the score

Overview

haspie's Architecture



haspie's Architecture

ASP Core

Answer Set Programming:

- Independent of the solving process and its heuristics
- The power and flexibility of ASP lays on this independence
- The problem only needs to be specified by rules and constraints

Harmonisation

Notes are converted to grades of the scale given the key and mode

```
octave(V,((N - base) / 12),T) :- note(V,N,T), N >= 0.
sem_tones(V,((N - base) \ 12),T) :- note(V,N,T), N >= 0.
grade(V,1,T) :- sem_tones(V,3,T).
grade(V,2,T) :- sem_tones(V,5,T).
grade(V,3,T) :- sem_tones(V,7,T).
```

Harmonisation

Notes are converted to grades of the scale given the key and mode
Chords are assigned to the harmonisable times of the score
Errors are computed and the solver determines the ttest chords for each section

```
1 { chord(HT,C) : pos_chord(C) } 1 :- htime(HT).
```

Score Completion

Only used if there are new voices or sections that need to be completed

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Melodious Preferences:

Checks the tendency of the voices in the score and tries to imitate the
Reduces the melodic jumps between notes and the amount of repeat consecutive sounds

Sixths Link:

Tries to nd common progressions in choral music
If able, continues these common progressions of chords

User Con guration

ASP optimization:

The style of the resulting scores produced by the tool is determined by the optimization of many predicates

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Users can de ne their own preferences by making use of con gurati les

```
#minimize[out_error(_,_) = chord_errorinstrongw
                @ chord_errorinstrongp].
#minimize[same_chord(_,_) = chord_samechordw
                @ chord_samechordp].
#minimize[out_error_weak(_,_) = chord_errorinweakw
                @ chord_errorinweakp].
```

haspie's Architecture

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Parser and Preprocessor

The project also included the development of a lightweight MusicXML parser

Written in C with the libraries Flex and Bison

Transforms the score in MusicXML to the ASP logic facts that the ASP module uses later

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Performs various tasks as:

- Subdivides notes to the length of the smallest gure in the score
- Detects most likely key from the score's clef
- Reads measure sizes
- Transforms chord names annotated on score to grades

haspie's Architecture

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Pipeline & Output Module

Written in Python with the toolkit Music21

Gives feedback to the user and allows the selection of the desired solution

Transforms the internal representation of the solution to a Music21 representation

Some supported formats are Lilypond, PDF, Musescore, MusicXML or MIDI

Overview

Conclusions & Future Work

About 200 ASP lines

Good results in terms of harmony

User still needs ASP knowledge to use it

Future Work:

Research about modulation and implement it in the tool

Reimplement preference-handling through asprin

Improve the diversity of the solutions

PhD Work

"Efficient Generation of heterogeneous solutions to optimization problems in ASP"

- Takes off from the work developed for haspie
- Looking for better ways of representing preferences (i.e asprin)
- Measure distances between solutions to use them during optimization
- Use music as test ground through haspie

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Source available at github.com/trigork/haspie

Thank you!