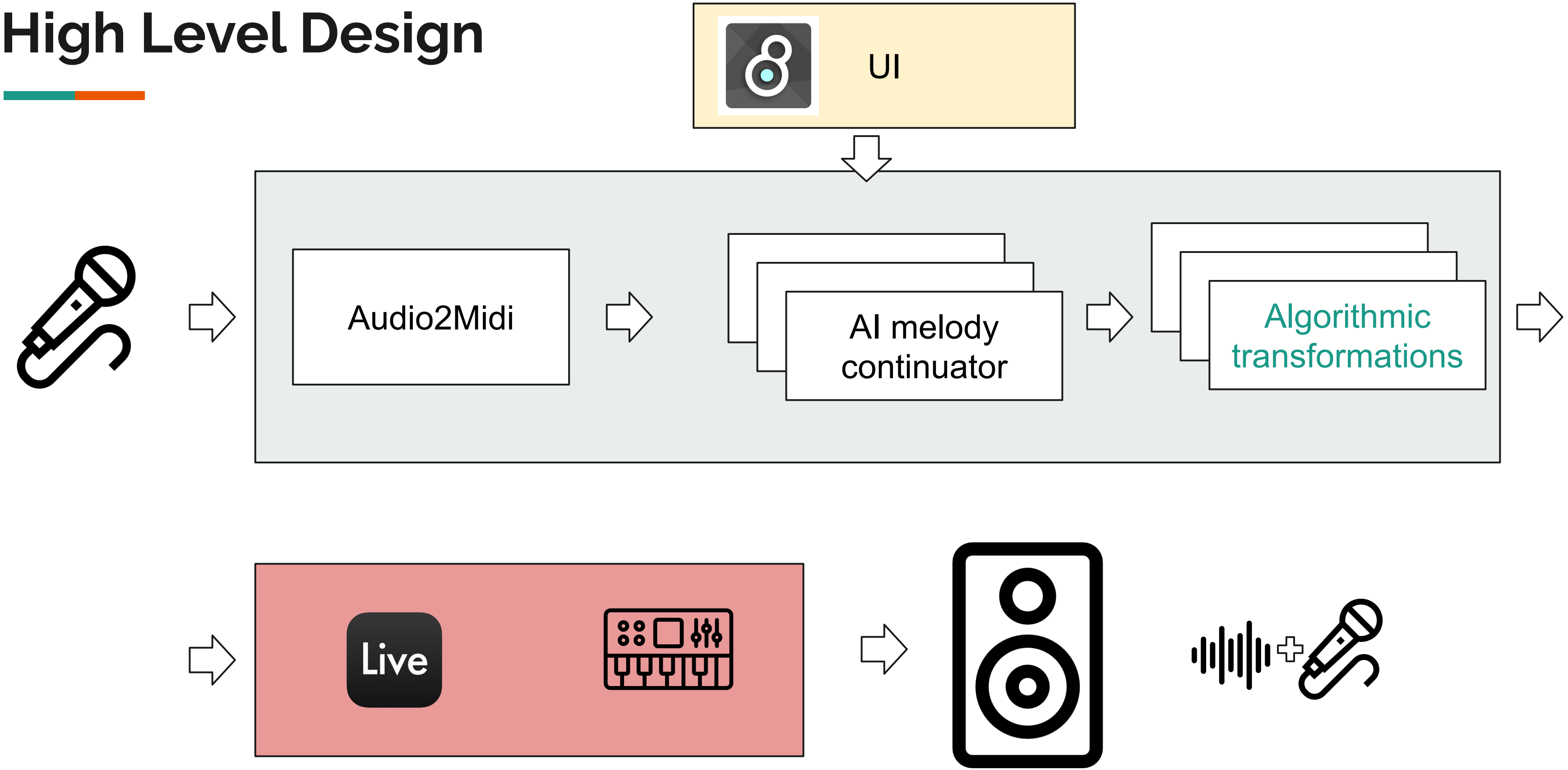
DUETable

Our goal

- Allow artist to improvise with AI in a conversational approach (question-answer)
- Answer is generated based on input melody
- Real Time interactive system
- Personalised and controllable pipeline for melody continuation

High Level Design



Audio2Midi

- Different implementations tested
  - basic pitch
  - aubio
  - essentia
- Not easy to use for real time application
- **Aubio** did the best results regarding processing time VS quality, ~72% accuracy

Melody continuation

- MuPT: LLM model trained on ABC notation
    - Controls: melody key, meter, n of bars, note length
    - Rich melodies
    - Hard to personalize
- Markov chain melody generator
- Mixed: executes and memorizes output from MuPT and then apply Markov chain on top
- Dummy: continuously listen environment to produce melody

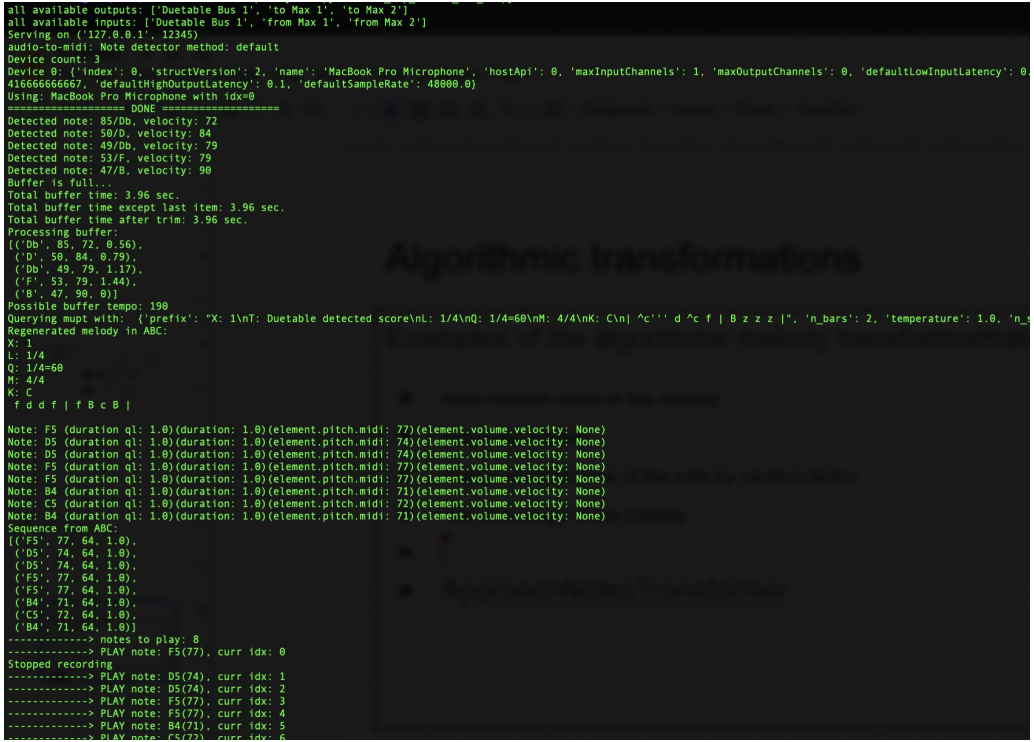
Algorithmic transformations

Examples of the algorithmic melody transformation:

- mute random notes in the melody
- transpose notes in melody
- change duration time of the note by random factor
- clip midi range of the melody, or define ranges for parts of it
- create a half step ascend to each note in melody

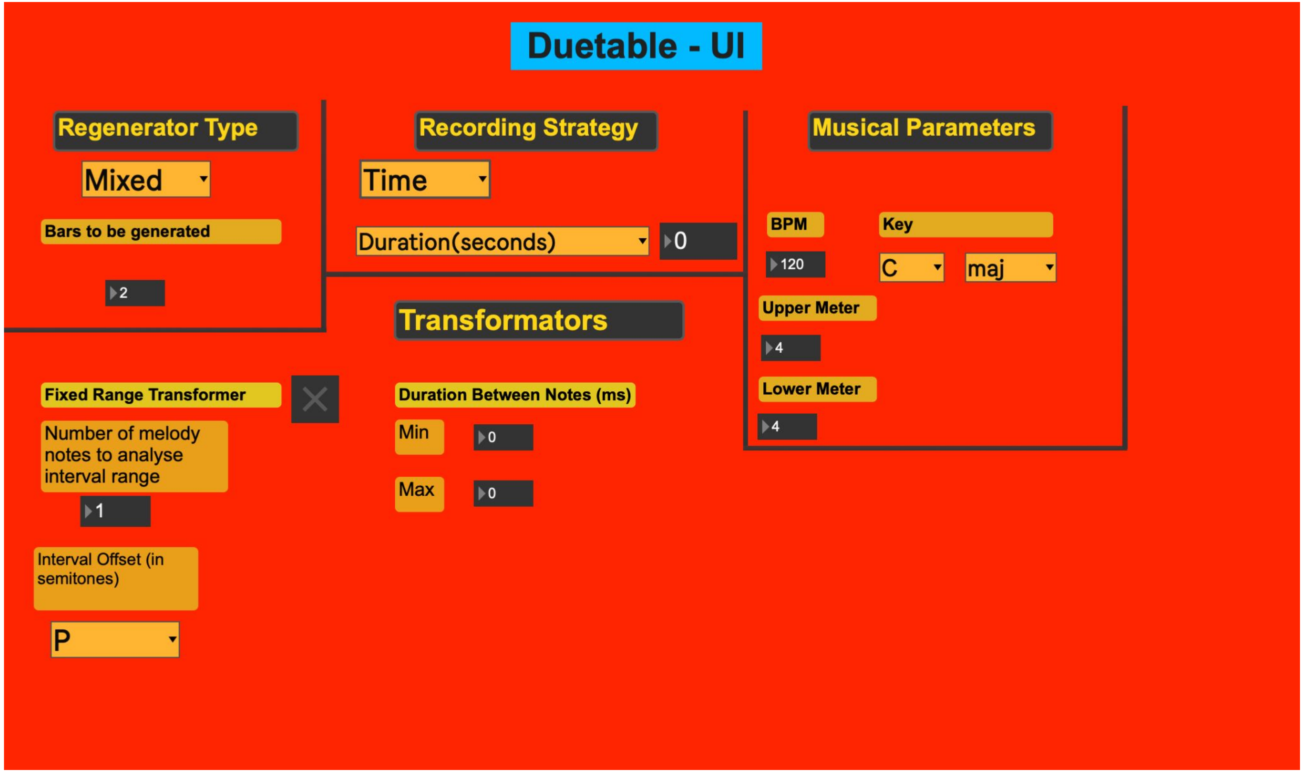
Implementation

- Python 3.11
- Poetry
- PyAudio
- NumPy
- MidiToolKit
- Music21
- Mido
- Python Osc
- Max MSP



```
all available outputs: ['Duetable Bus 1', 'to Max 1', 'to Max 2']
all available inputs: ['Duetable Bus 1', 'from Max 1', 'from Max 2']
Serving on ('127.0.0.1', 12345)
audio-to-midi: Note detector method: default
Device count: 3
Device 0: {'index': 0, 'structVersion': 2, 'name': 'MacBook Pro Microphone', 'hostApi': 0, 'maxInputChannels': 1, 'maxOutputChannels': 0, 'defaultLowInputLatency': 0.
416666666667, 'defaultHighOutputLatency': 0.1, 'defaultSampleRate': 48000.0}
Using: MacBook Pro Microphone with idx=0
=================== DONE ===================
Detected note: 85/Db, velocity: 72
Detected note: 50/D, velocity: 84
Detected note: 49/Db, velocity: 79
Detected note: 53/F, velocity: 79
Detected note: 47/B, velocity: 90
Buffer is full...
Total buffer time: 3.96 sec.
Total buffer time except last item: 3.96 sec.
Total buffer time after trim: 3.96 sec.
Processing buffer:
[('Db', 85, 72, 0.56),
 ('D', 50, 84, 0.79),
 ('Db', 49, 79, 1.17),
 ('F', 53, 79, 1.44),
 ('B', 47, 90, 0)]
Possible buffer tempo: 190
Querying mupt with:  {'prefix': "X: 1\nT: Duetable detected score\nL: 1/4\nQ: 1/4=60\nM: 4/4\nK: C\n| ^c''' d ^c f | B z z z |", 'n_bars': 2, 'temperature': 1.0, 'n_s
Regenerated melody in ABC:
X: 1
L: 1/4
Q: 1/4=60
M: 4/4
K: C
 f d d f | f B c B |

Note: F5 (duration ql: 1.0)(duration: 1.0)(element.pitch.midi: 77)(element.volume.velocity: None)
Note: D5 (duration ql: 1.0)(duration: 1.0)(element.pitch.midi: 74)(element.volume.velocity: None)
Note: D5 (duration ql: 1.0)(duration: 1.0)(element.pitch.midi: 74)(element.volume.velocity: None)
Note: F5 (duration ql: 1.0)(duration: 1.0)(element.pitch.midi: 77)(element.volume.velocity: None)
Note: F5 (duration ql: 1.0)(duration: 1.0)(element.pitch.midi: 77)(element.volume.velocity: None)
Note: B4 (duration ql: 1.0)(duration: 1.0)(element.pitch.midi: 71)(element.volume.velocity: None)
Note: C5 (duration ql: 1.0)(duration: 1.0)(element.pitch.midi: 72)(element.volume.velocity: None)
Note: B4 (duration ql: 1.0)(duration: 1.0)(element.pitch.midi: 71)(element.volume.velocity: None)
Sequence from ABC:
[('F5', 77, 64, 1.0),
 ('D5', 74, 64, 1.0),
 ('D5', 74, 64, 1.0),
 ('F5', 77, 64, 1.0),
 ('F5', 77, 64, 1.0),
 ('B4', 71, 64, 1.0),
 ('C5', 72, 64, 1.0),
 ('B4', 71, 64, 1.0)]
-------------> notes to play: 8
-------------> PLAY note: F5(77), curr idx: 0
Stopped recording
-------------> PLAY note: D5(74), curr idx: 1
-------------> PLAY note: D5(74), curr idx: 2
-------------> PLAY note: F5(77), curr idx: 3
-------------> PLAY note: F5(77), curr idx: 4
-------------> PLAY note: B4(71), curr idx: 5
-------------> PLAY note: C5(72), curr idx: 6
```



Duetable - UI

Regenerator Type

Mixed

Bars to be generated

2

Recording Strategy

Time

Duration(seconds)

0

Musical Parameters

BPM

120

Key

C

maj

Upper Meter

4

Lower Meter

4

Transformators

Fixed Range Transformer

☒

Number of melody notes to analyse interval range

1

Interval Offset (in semitones)

P

Duration Between Notes (ms)

Min

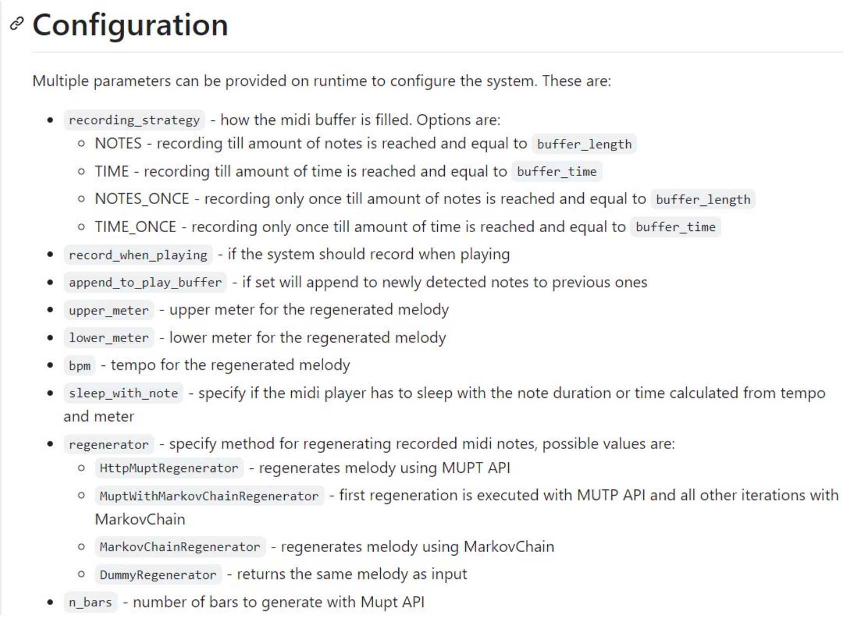
0

Max

0

Resources

Github repo: https://github.com/l11ama/duetable/



Configuration

Multiple parameters can be provided on runtime to configure the system. These are:

- `recording_strategy` - how the midi buffer is filled. Options are:
  - NOTES - recording till amount of notes is reached and equal to `buffer_length`
  - TIME - recording till amount of time is reached and equal to `buffer_time`
  - NOTES_ONCE - recording only once till amount of notes is reached and equal to `buffer_length`
  - TIME_ONCE - recording only once till amount of time is reached and equal to `buffer_time`
- `record_when_playing` - if the system should record when playing
- `append_to_play_buffer` - if set will append to newly detected notes to previous ones
- `upper_meter` - upper meter for the regenerated melody
- `lower_meter` - lower meter for the regenerated melody
- `bpm` - tempo for the regenerated melody
- `sleep_with_note` - specify if the midi player has to sleep with the note duration or time calculated from tempo and meter
- `regenerator` - specify method for regenerating recorded midi notes, possible values are:
  - `HttpMuptRegenerator` - regenerates melody using MUPT API
  - `MuptWithMarkovChainRegenerator` - first regeneration is executed with MUTP API and all other iterations with MarkovChain
  - `MarkovChainRegenerator` - regenerates melody using MarkovChain
  - `DummyRegenerator` - returns the same melody as input
- `n_bars` - number of bars to generate with Mupt API