

Introduction to Artificial Intelligence

Assignment 2 report

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1 Manual for running program

In order to execute my application, the user must specify the input file location in line 13 (which contains a remark at the end of the line)

```
13      music = Music("input2.mid") # change it to the needed file
```

The user only needs to execute the application after entering the locations for the input files to hear the music in the file.

2 Key detection algorithm

I generated a table of well-sounding chords and then checked the line matches with the original melody so that each note of the melody entered the row of the table. But sometimes we have several possible keys. Then I take the following method to defining a correct music's key: the melody can end with any note of the key, but it is more popular to end with stable notes (tonic (I-st step), mediant(III-rd step) or dominant(V-th step)). If none of them is equal to the melody's last note, then the last note is can be one of the unstable notes (supertonic (II-nd step), subdominant (IV-step), submediant(VI-step) or leading tone(VII-tone)).

3 Detected keys for input files

Name of file	Detected key
barbiegirl_mono.mid	C#m
input1.mid	Dm
input2.mid	F
input3.mid	Em

4 Accompaniment generation algorithm

An Evolutionary algorithm contains four overall steps: initialization, selection, genetic operators, and termination.

4.1 Initialization

In order to begin our algorithm, we must first create an initial generation of solutions in the user-specified size. Also we can create the next generation based on the previous generation. To create the new one, it retrieves the list of chromosomes based on fitness function. Next, after genetic operators we will get a new generation

4.2 Selection

Once a population is created, members of the population must now be evaluated according to a fitness function. A fitness function is a function that takes in the characteristics of a member, and outputs a numerical representation of how viable of a solution it is. To define a fitness function I divided the melody into four beats and checked each of them:

The 1-st beat	
Chord root notes	+20
Chord other notes	+5
No chord notes	-10
The 2-nd beat	
Chord root notes	+8
Chord other notes	+5
No chord notes	+1
The 3-rd beat	
Chord root notes	+10
Chord other notes	+5
No chord notes	-1
The 4-th beat	
Chord root notes	+10
Chord other notes	+5
No chord notes	+1
All beats	
Chord is diminished/suspend2/suspend4	-20
Otherwise	+10

4.3 Genetic Operators

This step includes two sub-steps: crossover and mutation.

4.3.1 Crossover function

To crossover chromosomes we take the odd positions from chromosome 1 and the even positions from chromosome 2, and then we create a new chromosome that will be the required length for accompaniment.

4.3.2 Mutation

Mutation of chromosomes may not occur with probability $\mathbf{p} = \mathbf{0.5}$. If the gene's chord is diminished, no mutation will occur, others probabilities of mutation are shown in Table below:

Probability \mathbf{p}	Mutation to
0.3	first inversion
0.3	second inversion
0.2	suspended 2
0.2	suspended 4

4.4 Termination

Eventually, the algorithm must end. This occurs after n iterations of the evolution algorithm, where n is the user-defined number of generations.

5 Source Code

Python source code files, together with report and I/O files are available on my Github repository, the link: <https://github.com/akmchnkv/Music-Accompaniment> .