Automatic Trance Music Generation and Automatic Melodic Variation

as Aesthetic Music?

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Outline

Introduction

- generation of music in AI
  - musical rules
  - important for aesthetic understanding
- generation of Trance music with Armin
  - computer-aided Composition tool
  - melodic and rhythmic implementation using ASP
- automatic melodic variation with AIM
  - musical alteration of a given melody with ASP

Aesthetics of generated music: Musical Aesthetics

- aesthetic judgement:
  - finding elegance and novelty
  - minimization of incoherence and boredom
- tonal and rhythmic coherence
- stability of melodic contour
- balance of repetition and variety

Aesthetics of generated music: Genetic Algorithms

- origin: evolutionary biology
- new elements: combination of elements from successful outcomes
- mutation: changes for improvement
  - variation of melody
- evolutionary mutation: mutation for every generation
  - change of pitch for random note
  - split & merge for musical sections

Aesthetics of generated music: Comparison

Table. An overview of the results of assessment by aesthetic judgement.

Beginning state	Unprocessed	Fittest unmodified	Evolutionary mutations	Musical mutations	Combined mutations
Random	★	★	★	★★	★
Rule-based	★★★	★★★	★★	★★★★	★★★★

- comparable results for rule-based & mutated music
- well formed melodies
- evolutionary melody:
  - reduction of coherence of form
  - less gain in novelty

→ very little advantage for evolutionary music

Armin: Trance Music Composition: Computer-aided Composition

- computer-aided composition
  - algorithmic composition
    - ★ next note?
    - ★ duration of the note?
- rules for the music-genre

Armin: Trance Music Composition: Background of Trance Music

- electronic dance music with 130-140bpm
- time signature $\frac{4}{4}$
  - kick on the second beat
  - snare drum/clap on the fourth beat
- change of pace every second/fourth/eighth bar
  - with change of drum/instrument

  $\rightarrow$ progression
- breakdown: longer synthetic chords, slower pace

Armin: Trance Music Composition: Background of Trance Music

- Armin System
  - based on Anton
    - ★ harmonic, melodic, rhythmic composition system
  - musical sections chaining
    - ★ e.g. intro→verse, verse→chorus, chorus→breakdown, ...

Armin: Trance Music Composition: Assembler File

- *arminAssembler.lp*: definition of order and frequency of parts
- model over timestep T
  - *play the intro*

    ```
    playState(intro,2) :- part(intro).
    ```

  - *section for following timestep*

    ```
    1{playState(verse,T+1), playState(chorus,T+1),
      playState(breakDown,T+1)}1
      :-playState(P,T),timeScore(T),statesNumber(SN),T<SN-2.
    ```

  - *play the outro*

    ```
    playState(outro,SN) :- part(outro), StatesNumber(SN).
    ```

Assembler File

- model over timestep T
  - *no consecutive verses*

    ```
    :- playState(verse,T), playState(verse,T+1).
    ```

  - *no three consecutive played parts*

    ```
    :- playState(P,T), playState(P,T+1), playState(P,T+2).
    ```

Armin: Trance Music Composition: Rhythmic Component

- *time signature* $\frac{4}{4}$ *:* *32 pulses*

  ```
  pulseMeasureLimit(32).
  ```

- *whole note: 32 pulses,* *half note: 16 pulses*

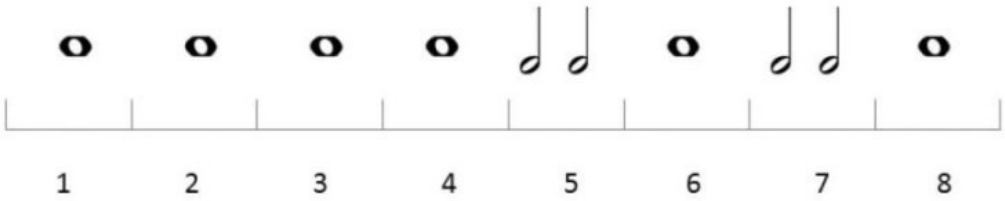
  ```
  longDurations(16;32).
  ```

- *melody contains 8 measures*

  ```
  lastMeasure(8).
  ```

Rhythmic Component: Example

- Example for an 8 bar configuration



- *a half or whole note can follow a whole note*

```
1{durationMeasure(0,D1,M+1,C+1): longDurations(D1)}1
 :- durationMeasure(0,DR,M,C), DR==32,
   lastMeasure(LM), M+1<=LM.
```

- *half notes must come in a pair*

```
1{durationMeasure(16,D1,M,C+1): longDurations(D1)}1
 :- durationMeasure(0,DR,M,C), DR==16.
```

- *a half or whole note can follow two half notes*

```
 1{durationMeasure(0,DR,M+1,C+1): longDurations(DR)}1
:-durationMeasure(16,16,M,C),durationMeasure(0,16,M,C-1),
  lastMeasure(LM), M+1<=LM.
```

Melodic Variation with ASP: Background

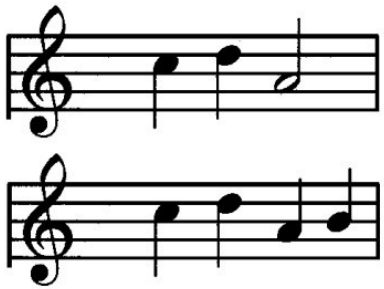
- what notes should be preserved, what notes can change?
- Alterations in Music (AIM)
  - based on Anton
  - rhythmic characteristics like in Armin
- input file with specifications
  - maximum value of notes to be changed
  - chosen note
  - duration of the note

Melodic Variation with ASP: Input File

```
partTimeMax(P,5).

numberOfNotesToChange(1).
toChangeNumber(1..CN) :- numberOfNotesToChange(CN).

choosenNote(1,25,1).
choosenNote(1,24,2).
choosenNote(1,22,3).
choosenNote(1,20,4).
choosenNote(1,22,5).

duration(1,16,1,1)
duration(16,8,1,2)
duration(24,8,1,3)
duration(1,16,2,4)
duration(16,16,2,5)
  ...
```

Melodic Variation with ASP: Melodic Variations Engine

- which notes keep the essence (and will not be changed)?
  - first note: indicates fundamental
  - second note: keeps progression of the first note
  - last note: preserves ending of the melodic line



- changing a note when choosen by
  - changing the pitch
  - splitting the note into equivalent halves
    - ★ first note remains, second note changes

Conclusion

- automatic generation of music:
  - rule-based
  - evolutionary methods

  $\rightarrow$ aesthetics of music?
    - ★ rule-based: valid music, less novelty
    - ★ with mutated iterations: not too much improvement

Conclusion

- Armin
  - noteworthy expansion of Anton with Trance genre
  - section chaining
  - rhythmic focus
- AIM
  - not a wide variety of musical alterations
    - ★ freedom of change for nearly every tone (regardless musical criteria)
  - multiple iterations: works like evolutionary musical mutation

Sources

- Georg Boenn, Martin Brain, Marina De Vos, John P. Fitch: Automatic music composition using answer set programming. TPLP 11(2-3): 397-427 (2011)
- Andrew R. Brown: An aesthetic comparison of rule-based and genetic algorithms for generating melodies (2004)
- Flavio Omar Everardo Pérez, Fernando Antonio Aguilera Ramírez: Armin: Automatic Trance Music Composition using Answer Set Programming. Fundamenta Informaticae 113 (2011) 79–96
- Flavio Omar Everardo Pérez: A Logical Approach for Melodic Variations. LA-NMR (2011)
- Link for Trance Music by Flavio Everardo

Thank you for your attention!