User-Centric Algorithmic Composition

A CONSTRAINT SYSTEM AND GENETIC ALGORITHM HYBRID APPROACH

by Kayla Gray

What is Algorithmic Composition?

- A method of composing music using one or more algorithmic approaches
- Approaches may or may not use computers (Maurer)
- **Degree of human collaboration varies**

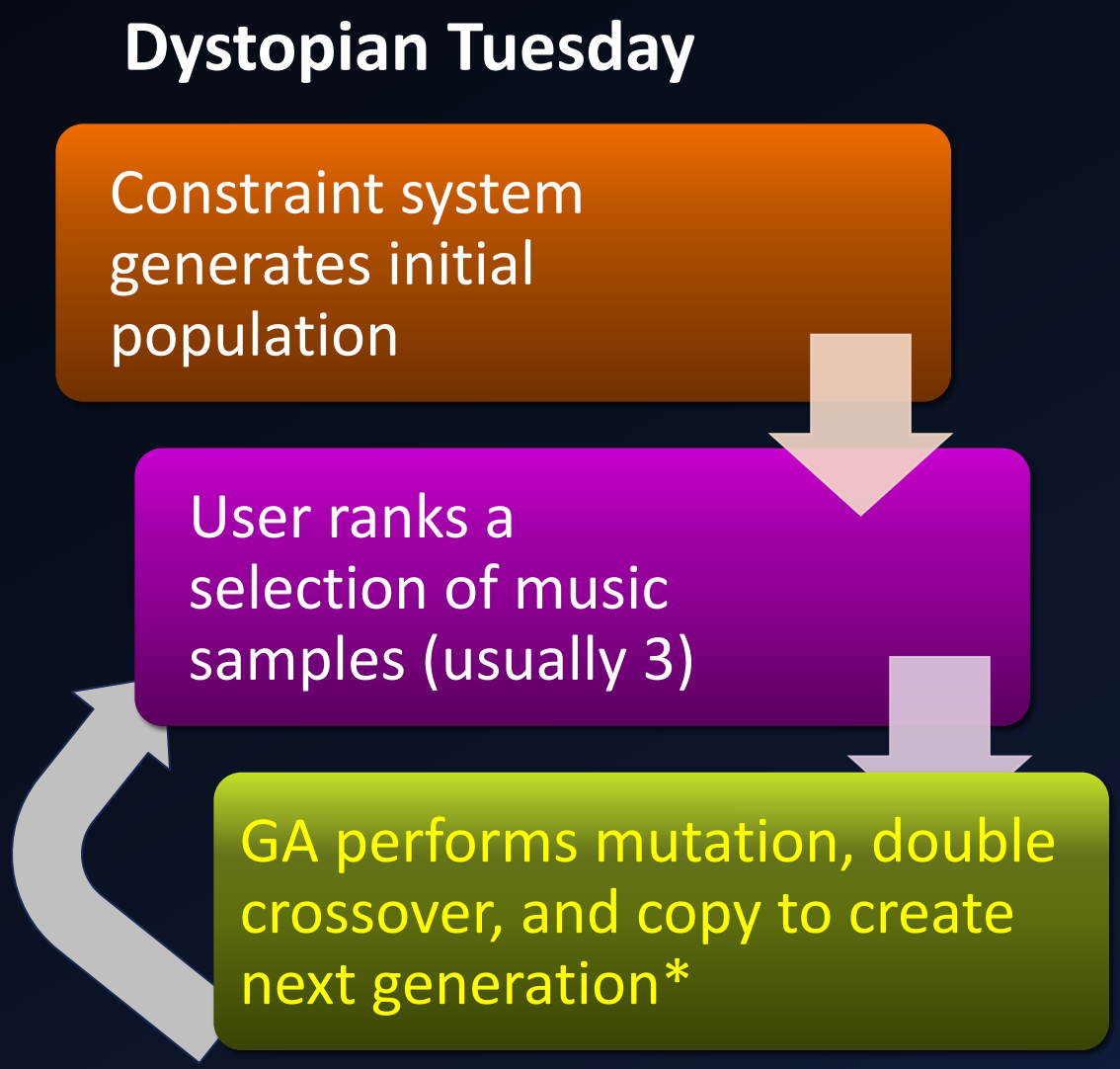
Project Inspiration

- “Algorithmic Music Composition Using Dynamic Markov Chains and Genetic Algorithms” by Chip Bell
  - Argues quality of music is subjective
  - Proposes a hybrid Markov chain and genetic algorithm system
  - Use user ranking as a fitness metric

Bell’s Proposed System

Project Overview

- Written in CLisp
- Hybrid constraint system and interactive genetic algorithm approach
- Output: Music samples with two melodies
  - Represented in ABC Notation
- Band name ⟶ Dystopian Tuesday



Music Sample Generation (Constraint System)

1. A list of note durations (integer values) are generated based on a defined number of beats.
2. A pitch is generated for each duration.
    a. For Melody 1:
        i. Pitches are randomly chosen from the C major scale.
    b. For Melody 2:
        i. Pitch generation is based on a random selection of one of the following choices:
            1. Harmonization
            2. Octave Harmonization
            3. Permutation
            4. Stepwise Bassline
            5. Random
3. The octave is randomly selected.
4. The previous results are combined into a list of “Note” objects.

The GA - Mutation

```
Melody1 mutation
Melody2 mutation
Melody3 mutation

[2]> ( demo--mutation )
Melody 1: G' G/2' F2' C' A' C/2' G2' B' C/2' C2' F2' F2' B' C/2'
E/2' G2' A/2' C' D' B' D2' G'
Melody 2: B' C' F2' G' C' F2' D2' G2' F2' B' B' C/2' C/2' C/2'
G/2' G' C2' E/2' G2' A/2' D' A'
Melody 3: D2, F, A4, F, G, D4, A, E4, C, B4, F2, D,

-Mutation-
Melody 1: G' G/2' F2' C' A' C/2' G2' B' C/2' D' F2' F2' B' C/2'
E/2' G2' A/2' C' D' B' A/2' G'
Melody 2: B' C' F2' G' C' F2' A/2' G2' F2' B' B' C/2' C/2' C/2'
G/2' G' D' E/2' G2' A/2' D' A'
Melody 3: D2, F, A4, F, G, D4, A, E4, C, F4, F2, D,
```

Note: The first implementation has 3 melodies. For simplicity, I switched to 2.

The GA - “Double Crossover”

```
------------------MUSIC CROSSOVER TEST------------------
Mother:
E E/2 B/2 E A2 D D/2 B A/2 G/2 A2 G B/2 G A/2 B2 C2 E2 D B E/2
A2
Father:
D C/2 C E2 G2 D2 E/2 C G/2 A/2 C2 A2 B B2 D E2 D2 C
Child:
E E/2 B/2 E A2 D D/2 B A/2 G/2 A2 G B/2 G A2 B B2 D E2 D2 C
Mother:
F E/2 E G2 B2 F2 G/2 E B/2 E/2 E2 E2 F F2 F G2 F2 E
Father:
G4, F2, C4, E, C4, D, C2, A4, G2,
Child:
F E/2 E G2 B2 F2 G/2 E E, C4, D, C2, A4, G2,
```

Interaction Demo

EasyABC Interaction Demo

```
----------------Individual 26----------------
X:1
T:Individual 26
C:Dystopian Tuesday
M:4/4
L:1/4
Q:1/4=120
V:S clef=treble name=S
V:A clef=treble name=A
V:T clef=treble name=T
%%score [ ( S ) ( A ) ( T ) ]
K:C
V:S
%%MIDI program 0
G/2 D/2 G2 A/2 B G B/2 D2
V:A
B/2 F/2 B2 E/2 F B F/2 F2
V:T
E2, E2, D2, E2,
Melody 1 & 2 ranking (out of 10)? 2
Bassline ranking (out of 10)? 6
```

MuseScore Interaction Demo

```
----------------Selection---------------
X:1
T:Selection
C:Dystopian Tuesday
M:4/4
L:1/4
Q:1/4=120
V:S clef=treble name=Melody1 snm=Melody1
V:A clef=treble name=Melody2 snm=Melody2
%%score [ ( S ) ( A ) ]
K:C
%%MIDI program 0
V:S
F/2 B/2 B B/2 D/2 G/2 D E2 G F C C F/2 G F B2 D2 C/2 D2 F/2 z4
|]
V:A
B2, A, B4, A, G2, F4, E4, D2, z4 |]
V:S
D F/2 A2 E2 D/2 C C D/2 E2 F2 F/2 F/2 B F E2 G F G/2 z4 |]
V:A
E C2 A E2 A G G2 A2 A/2 G/2 D/2 C/2 D2 F2 D C z4 |]
V:S
F/2 D2 C B C/2 D2 G/2 D/2 C2 F2 C B E C E D E2 z4 |]
V:A
C C G/2 F/2 D2 E C/2 C E D D2 D/2 B F2 C2 B E2 z4 |]
[Sample 0] Melody 1 ranking (out of 10)? 5
Melody 2 ranking (out of 10)? 4
```

“Synthetic Soulscape” by Dystopian Tuesday

Song Name (courtesy of ChatGPT)	Test	Parameters
Artificial Awakening 	User ranks every other generation with an average population size	*beat-total* = 24 *nr-generations* = 10 *user-interation-g* = 2 *pc-m* = 50 *pc-c* = 40 *pc-x* = 60 *population-size* = 20 *selection-size* = 3
Neon Nightmares 	User ranks every generation with an average population size	*beat-total* = 24 *nr-generations* = 10 *user-interation-g* = 1 *pc-m* = 50 *pc-c* = 40 *pc-x* = 60 *population-size* = 20 *selection-size* = 3

“Synthetic Soulscape” cont.

Song Name (courtesy of ChatGPT)	Test
Machine Messiah	User ranks every other generation with a small population size (10)
Chaos Engine	User ranks every generation with a small population size
Rust in the System	No copies with small population size
Synthetic Siren	No user ranking
Electric Eden	User ranks every other generation with an average population size (20) for smaller music samples

Results

- **Dystopian Tuesday is user hostile**
  - Could be improved with a GUI for playback
  - Music sample should only have one ranking
- **The User Fatigue Problem**
  - Ranking every sample takes forever
- **The Variation vs. Convergence Conundrum**
  - Genetic algorithms are difficult to fine-tune
  - How much variation is too much?

Reflection

- I really enjoyed working on this project, despite its clunkiness!
- Future Directions?
  - Addressing User Fatigue
    - Use clustering/similarity metrics to pick sample for user ranking (Fernández and Vico 553)
    - Use neural network to approximate some rankings (Farooq and Siddique 48)
    - Monitor brain activity for ranking of music samples (Farooq and Siddique 50)
  - Addressing Lack of Variation
    - Switch to Markov chains in Bell's system – use linear algebra to populate next generation (Bell 102)
- I'd love to see more research efforts to expand collaborative algorithmic composition!

Sources

Bell, Chip. “Algorithmic Music Composition Using Dynamic Markov Chains and Genetic Algorithms.” *Journal of Computing Sciences in Colleges*, vol. 27, no. 2, Dec. 2011, pp. 99–107. *ACM Digital Library*, https://dl.acm.org/doi/10.5555/2038836.2038850. Accessed 2 May 2023.

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