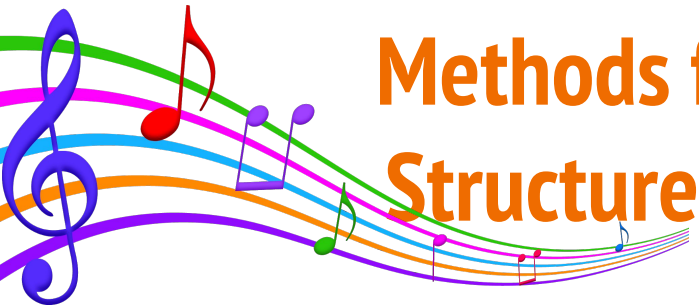


# Methods for Fitness and Language Structure for Musical Composition

Andrew Pozzuoli, Liam McDevitt

Kanae, Yu, Masami, Kazuki, 2015

# Overview

- The Music Problem
  - What is Music?
- How a Human Writes Music
  - Rules and Theory
- Music in GP
- Kanae et al., 2015
  - Model/GP Language
  - Fitness
  - Music Composition Process
  - Problems
  - Future Applications / Discussion

# The Music Problem

- What is music?
  - DUMB QUESTION
- How could we define music so that a computer can understand?
  - Series of frequencies?
    - Too Vague
  - Melody, Harmony, Rhythm?
    - What does that mean to a computer?
- Good start is to look at how people do it

# How a Human Writes Music

- Listen to music
  - Foundation of musical expectations
  - Different cultures have different music
  - Different people like different music
- Musical Language
  - Instrument
  - Scales
  - Chords
  - Rules
- Evaluate your music quality based on your own musical expectations
  - “Fitness”

# Music in GP (1)

- Need to create some goal
- “Make music” is highly abstract
- Fitness becomes difficult to evaluate
  - Need people to rate each individual
    - Tedious
    - Early generations don’t sound pleasing

# Music in GP (2)

- Could apply restrictions
  - Music theory
    - Scales
    - Chords
    - Time signature
  - Genre conventions
    - Blues
    - Electronic
    - Orchestral
  - Subgenre conventions
    - Jazz-blues
    - Dubstep
    - Classical

# Music in GP (3)

- Composer/Artist
  - Style
  - Techniques
- Restrictions give GP a possible language to work with
  - Theory and style inform melody and harmony
  - Genre conventions give a framework for fitness evaluation
    - Automatic fitness evaluation

# A Music Composition Model with GP

- Kanae et al., 2015
- Restrict GP language to a specific genre
  - Use Jazz-Blues conventions
  - Structure language from Jazz-Blues conventions
  - Evaluate based on those conventions
- Independent but cooperative models
  - Split parts up
    - Chord progression
    - Melody
    - Bassline

# Models & GP Language - Melody

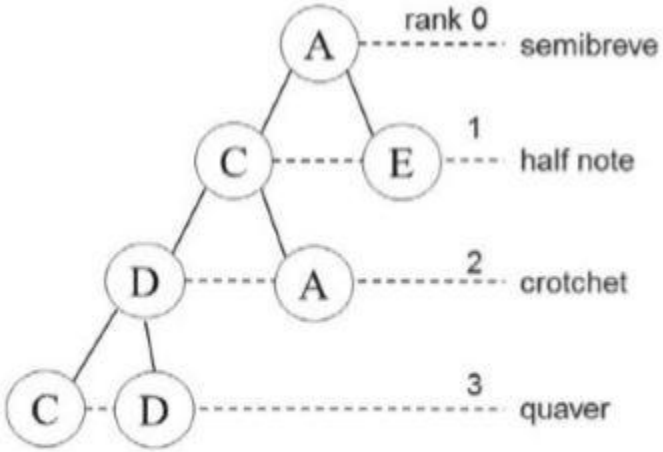



Fig. 2: An example of genetic individuals.

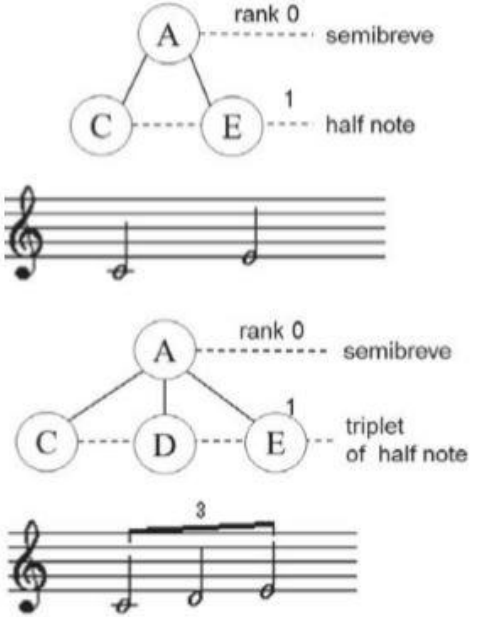



Fig. 3: Difference of expression by the number of branches.

# Models and GP Language - Chords

Table 2: An example of 4-way spread voicing

| | pattern1 | pattern2 |
|---|---|---|
| Top note | A tension note | A chord tone |
| Middle notes | 7th | 3rd |
| | 3rd | 7th |
| Bottom note | Root | |

# Fitness

- Melody
  - Note integrity with the previous 12 bars of melody (partial melody)
  - Rhythm integrity with the previous partial melody
  - Entropy function
    - 0 - Highly similar melody
    - 1 - Completely random melody
    - Considered similar if each note and note value from the previous partial melody appears the same number of times in the new melody
  - Used to avoid abrupt differences across partial melodies

# Fitness

- Chords
  - Percentage satisfying the blues chord progression
  - Integrity with partial melody
    - Want to avoid dissonant notes clashing with the melody
  - Integrity with previous partial chord progression
    - 0 - None of the notes change across the progression
    - 1 - Completely random notes in the new chord
    - Used to avoid abrupt changes in the chord progression inconsistent with previous partial chord progression
    - This is evaluated every 4 bars instead of every 12

# Fitness

- **Bassline**
  - **Integrity with partial chord progression**
    - **Bass notes chosen that belong to the chord played on strong beats are highly rewarded**
    - **Aims to avoid dissonant semitone interval between bass and chords**
  - **Integrity with previous partial bassline**
    - **Want to avoid abrupt changes in the bassline**
    - **This is evaluated every 4 bars instead of every 12**

# Overview of The Model

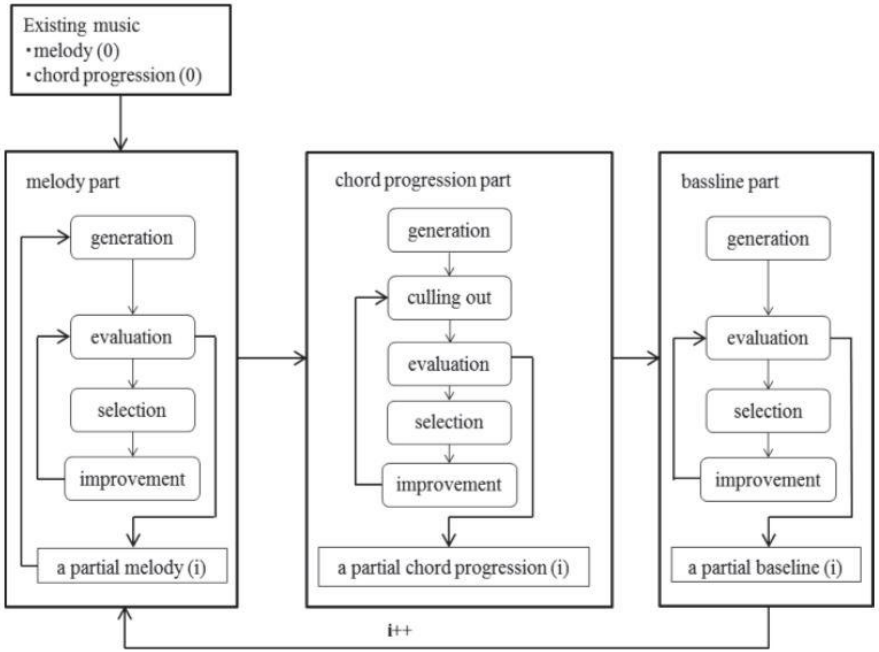



Fig. 4: Overview of the model.

- Individuals
  - 3 nodes at depth 0
  - Terminal nodes restricted to be deeper than depth 4
  - 4 bars/tree
  - 3 trees/individual
  - 12 bars/individual
- Chords
  - Half notes
- Bassline
  - Quarter notes

# Original Melody

- Billie's Bounce by Charlie Parker (1945)

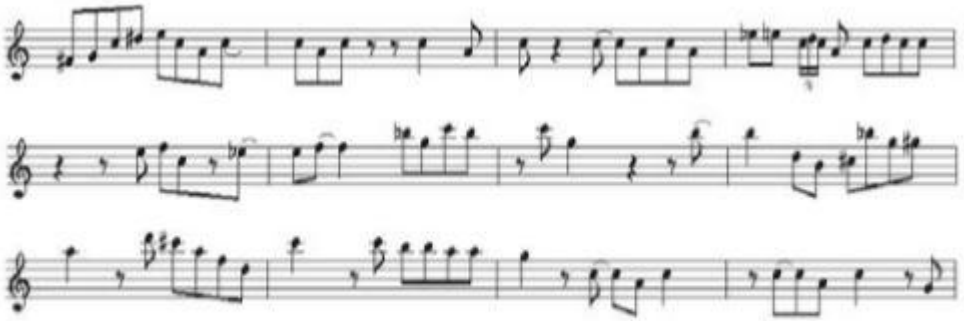
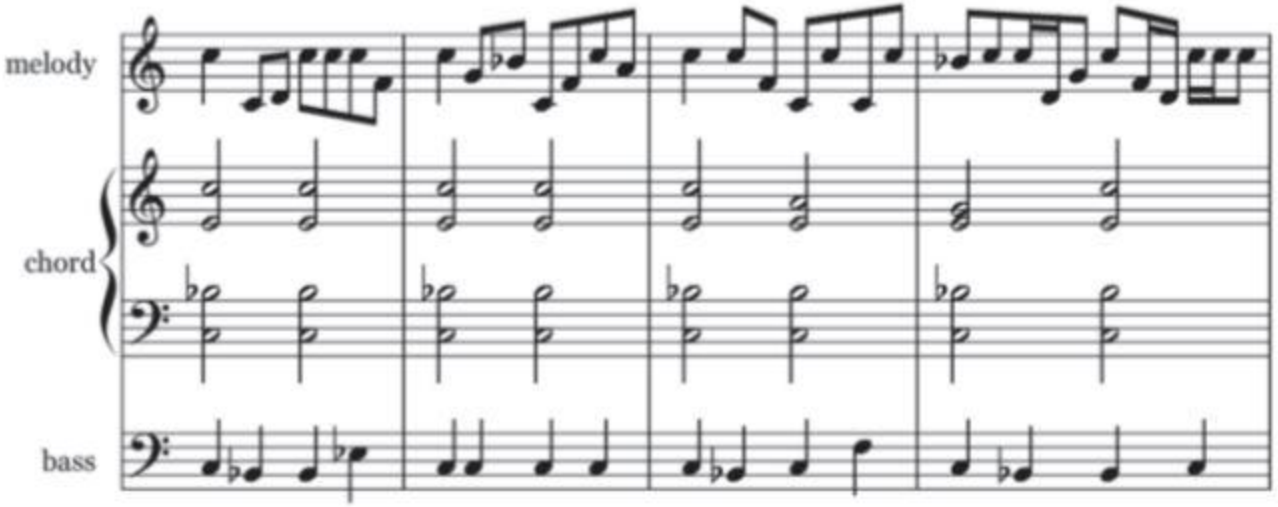
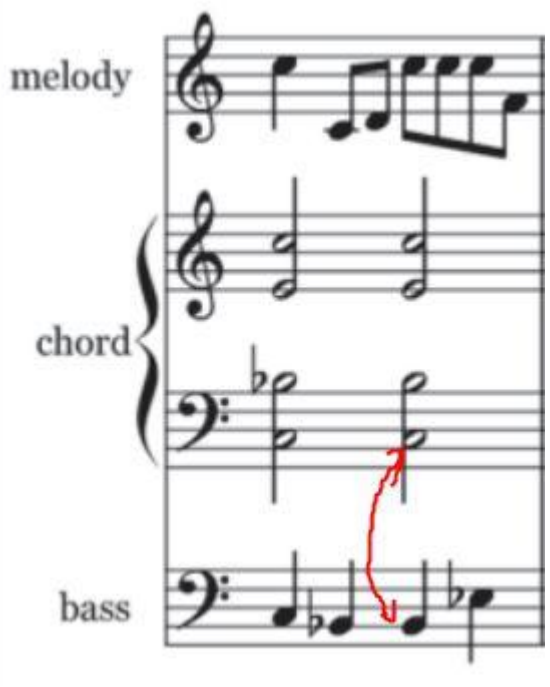


Fig. 5: Original melody

# First Four Bars of Example Partial Score



# Dissonant Halftone Collision Problem




- Due to the number of different fitness evaluations, impossible to avoid semitone collision
- Possible solutions:
  - Better fitness evaluation
  - Drop the bottom chord note (similar to human jazz players)

# Future Applications / Discussion

- Improvise in real time with human players
- Can’t be used to create new music
- Can be applied to other genres based on their own conventions
- No “general solution” or “ideal solution”
  - More of a structure for making music similar to other music
  - Fitness based on following genre rules rather than meeting a specific goal

# Questions?

# References

Kunimatsu, K., Ishikawa, Y., Takata, M., & Joe, K. (2015). A Music Composition Model with Genetic Programming-A Case Study of Chord Progression and Bassline. In *Proceedings of the International Conference on Parallel and Distributed Processing Techniques and Applications (PDPTA)* (p. 256). The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp).

Parker, C. (1945). Billie's Bounce [Recorded by Charlie Parker]