A Genetic Algorithm Approach for Guitar Riff Construction

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Introduction

We hope to utilize new understandings of computational music theory and a biologically inspired algorithms in order to form a new approach for music construction. By looking at the guitar, a popular instrument with known physical limitations and stylistic choices, we hope to employ a genetic algorithm that will be able to simply and efficiently produce pleasing musical arrangements with respect to both chord construction and chord progression.

The structure of the guitar fret board lends itself to a very wide range of notes and is capable of sounding very complex chords. But in an interest towards playable and music and easier computations, we will restrict our algorithm to the lowest 30 notes (E2 to A*b*4) and only allow 3 notes to sound concurrently. These parameters should allow us to extract a range of sound without sacrificing musical complexity in our outputs.

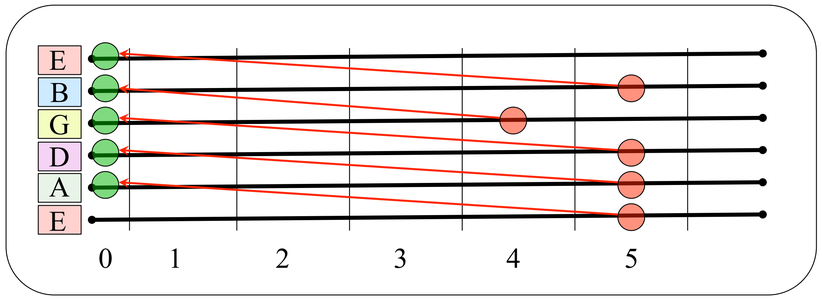

Fig 1. Fret Layout on a Standard Tuned 6-string Guitar

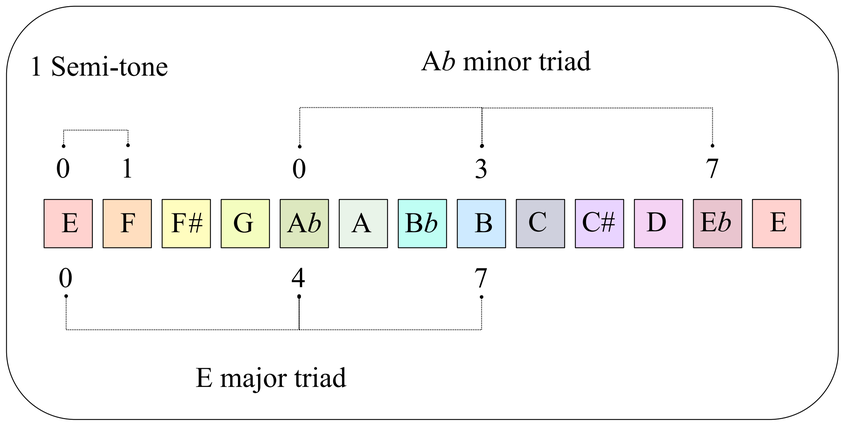

Fig 2. Full Octave Diagram and Two Triad Combs

In an effort to find a heuristic so to define chords as 'musical', we look to the definition of major and minor triads. These are defined by a root note and two other notes at set semi-tone intervals. Major and minor triads are 0-4-7 and 0-3-7 semi-tones from the root note respectively. When two or more notes are played within these triads simultaneously their frequencies align to produce constructive interference which sounds pleasing to the human ear.

We would like to score individual chords more for the addition of multiple notes that fit a specific triad, as it becomes more difficult to remain within a triad comb as filled. We would also like to score a full riff based on chord transitions. Favorable transitions having the root of the chord contained in the triad of the chord before it, whether they are the same chord or not. This is easier to achieve with lower chord complexity, so it selects against complex non-transitioning chords.

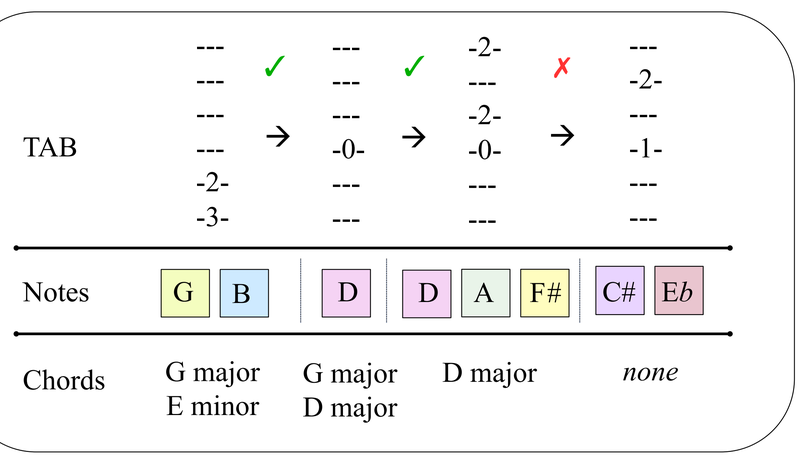

Fig 3. Example Riff with Chords and Transition Scoring

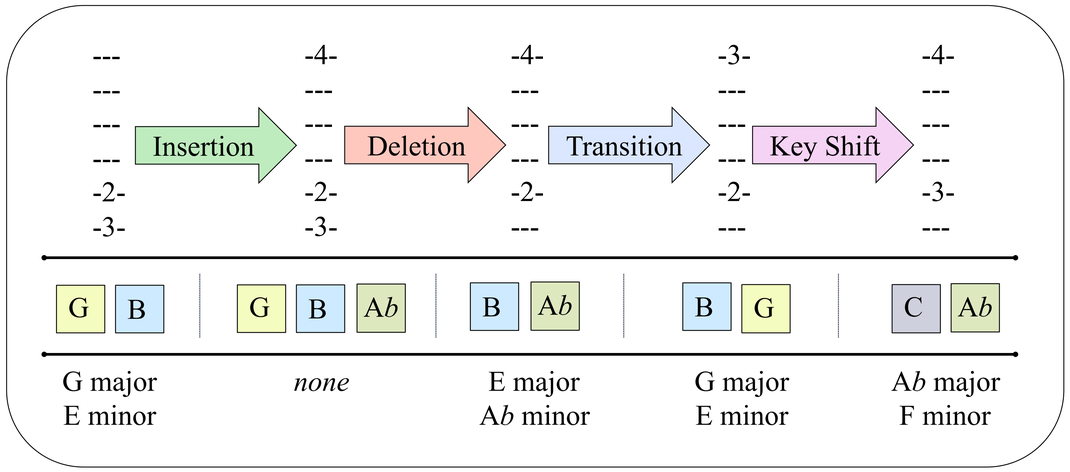

Fig 4. Single Chord Mutations

The initial population of riffs contains purely randomized chords, some of which will have higher fitness than others, but few to none will have a sequence that is both complex and properly transitioning. As we move from generation to generation, we would like to mutate our sequences both on a chord level, as in figure 4, but also on a riff level, as seen in figure 5. By modifying our descending populations, we should see selection for more musically complex sequences. By modifying the relative rates of mutation as the algorithm progresses, specifically lowering the mutation rate as the generation number increases, we hope to preserve the developed features while still allowing for fine improvements and potentially macroscopic increases in fitness via favorable full sequence mutations. Our selection feature would need to preserve some lower fitness riffs so as to maintain diversity in the final iterations of the solution set.

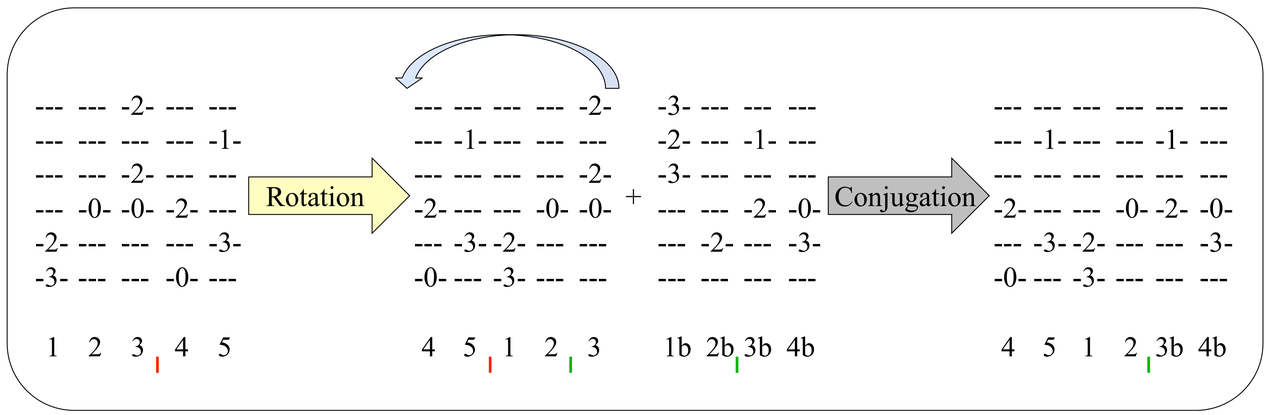

Fig 5. Full Riff Sequence Mutations

Further Work

Though the initial algorithm has been written as described, the balance for the scoring mechanism still needs further adjustment so as to not favor complexity over chord transitions. These numbers are still being worked out. We would also like to add user inputs to select for certain keys and types of transitions so to tailor riff solutions to specific song environments as the current model does not favor any particular key or transitionary model.

Acknowledgements

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