Mathematically Generated Fife Tunes

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Introduction
Creative genius is essential for composing great musical masterpieces. By studying recurring patterns within music, it may be possible to capture the essence of the composer's genius and mathematically compose songs in the same style.

Fife Tunes!!
This project is based on a data set of nearly 200 fife tunes transcribed into abcd music notation. Abc music notation is a computer-based musical notation designed to also be readable by humans.

The tunes in the data set are predominantly in the key of G and in 6/8 meter. Those in other keys or meters are excluded by the model to improve results.

Example of a fife tune in regular music notation:

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<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>T: Quick Step. 17 Regt.</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>G2b A</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>M: 6/8</td>
</tr>
</tbody>
</table>
```

Finding Patterns
A Markov chain is a set of possible states and the probabilities that a given state will lead to any of the others. By letting a sequence of notes represent a state, a Markov chain is constructed to predict the probability of any given note coming next (which creates a new state and the process repeats).

Graphical Representation of one of the Markov chains for this Project:

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Adjustments to basic model
Musical composition can be approximated by a Markov chain, but when applied in this manner, this method cannot account for certain key elements.

Adjustments to rhythm:
In music, songs are divided into measures of equal length (separated by vertical lines. For this reason, note lengths had to be adjusted to make sure all the measures came out to have the same length.

Every phrase (which for simple fife tunes corresponds with a line) must end with a long note which punctuates the song like a period in writing. Without it, you get the musical equivalent of a run-on sentence!

Adjustments to notes:
Not nearly as many as you would think! The only change is to make the last note end on the tonic (the base note of the scale) which makes the song sound complete.

Where to next?
While "fife-tune-like" songs (if you will be so generous) can certainly be produced using a Markov chain with only slight modifications, the results are still not completely convincing.

Listening to the many attempts along the way, it becomes clear that each new model produces tunes that are closer to approximating the originals. One of the main differences remaining is that the original fife tunes are based on one main theme which usually repeats several times with slight variations. Instead of repeating, the current model simply creates a new theme.

Thus, for better or worse, a mathematical model is never completely finished. The current one has essentially exhausted the possibilities of composing music based on a Markov chain, but leaves plenty of room for some ambitious soul to begin a new project building off of this model.

Credits

The project
An independent study for the math department, supervised by Dr. Doug Drinen. A continuation of Math 332 Mathematical Modeling.

Data
Volume of fife tunes by James Aird (1782), transcribed into abc notation by Jack Campin (1999), http://www.purr.demon.co.uk.

The fife tune generator
Created start to finish by yours truly, using Perl (Practical Extraction and Report Language) to build a Markov chain from the data and generate new fife tunes in abc music notation. The Perl program was written using Crimson Editor.

Abc music notation
The computer music notation I used for this project. More information at http://abcnotation.org.uk

Listening to the fife tunes
During early stages of the project, I used the web-based ABC Convert-A-Matic to play the tunes and convert them to regular music notation. This can be found at http://www.concertina.net. Later on, I switched to a program called Five Line Skink so I would not be dependent on my internet connection. Skink can be downloaded for free from http://celticmusic.ca/

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Alchetron: The Free Social Encyclopedia