

Procedural Music

McKade Umbenhowe, Robert Randolph, Taylor Bleizeffer

COSC Senior Design, University of Wyoming

Introduction

Project Goal:

- Generate music based on an input

Project Questions:

- Can an algorithm produce listenable music?
- Can Wave Function Collapse make the music?

Benefits and Uses:

- Inspire music creation
- Original music to listen to
- Music for games, videos, podcasts, etc.
- Recreate pieces similar to others

Tools Used:

- Java
- JMusic – Open source music programming library

Project Challenges:

- Determine a good sample feature set
- Find a similarity balance between inputs and outputs

Related Work

Wave Function Collapse:

- Texture Synthesis
- Model Generation

Other procedural music:

- Markov Chains
- Cellular Automata

References:

Brown, Andrew R. JMusic – Computer Music Composition in Java.
explodingart.com/jmusic/.
mxgmn, "mxgmn/WaveFunctionCollapse,"
GitHub, 14 Nov. 2018.
github.com/mxgmn/WaveFunctionCollapse.
WolframTones, Wolfram Research, Inc., 2018,
tones.wolfram.com/about/how-it-works/.

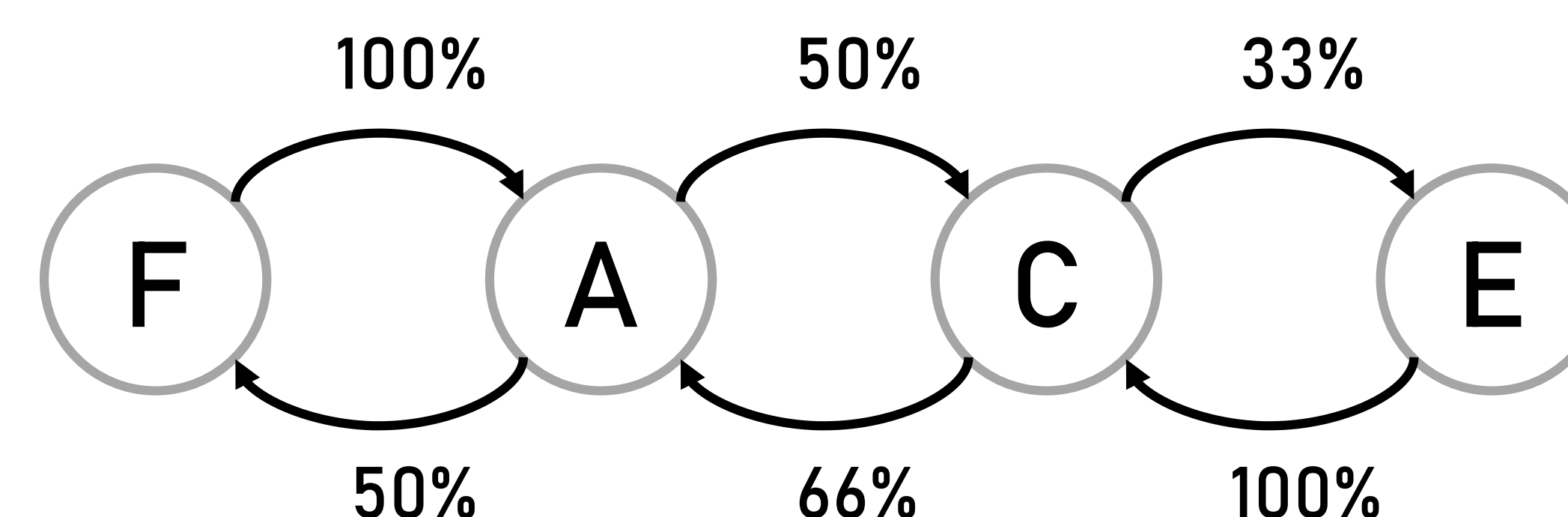
Implementation

- Input a sample

Midi File					
E	0			0	
C		0		0	0
A			0		0
F				0	

- Generate Markov Tables/Markov Chains

Markov Table					Markov Chains				
	E	C	A	F		E	C	A	F
E	-	2	-	-	E	-	100%	-	-
C	1	-	2	-	C	33%	-	66%	-
A	-	2	-	2	A	-	50%	-	50%
F	-	-	2	-	F	-	-	100%	-



- Apply Wave Function Collapse (WFC)

Super Position of all Notes										
E	.	.	.	.	.	.	.	.	.	.
C	.	.	.	.	.	.	.	.	.	.
A	.	.	.	.	.	.	.	.	.	.
F	.	.	.	.	.	.	.	.	.	.

Collapsing on Super Position Note										
E	.	.	.	.	.	.	.	.	.	.
C	.	.	.	.	0	.	.	.	.	.
A	.	.	.	.	.	.	.	.	.	.
F	.	.	.	.	.	.	.	.	.	.

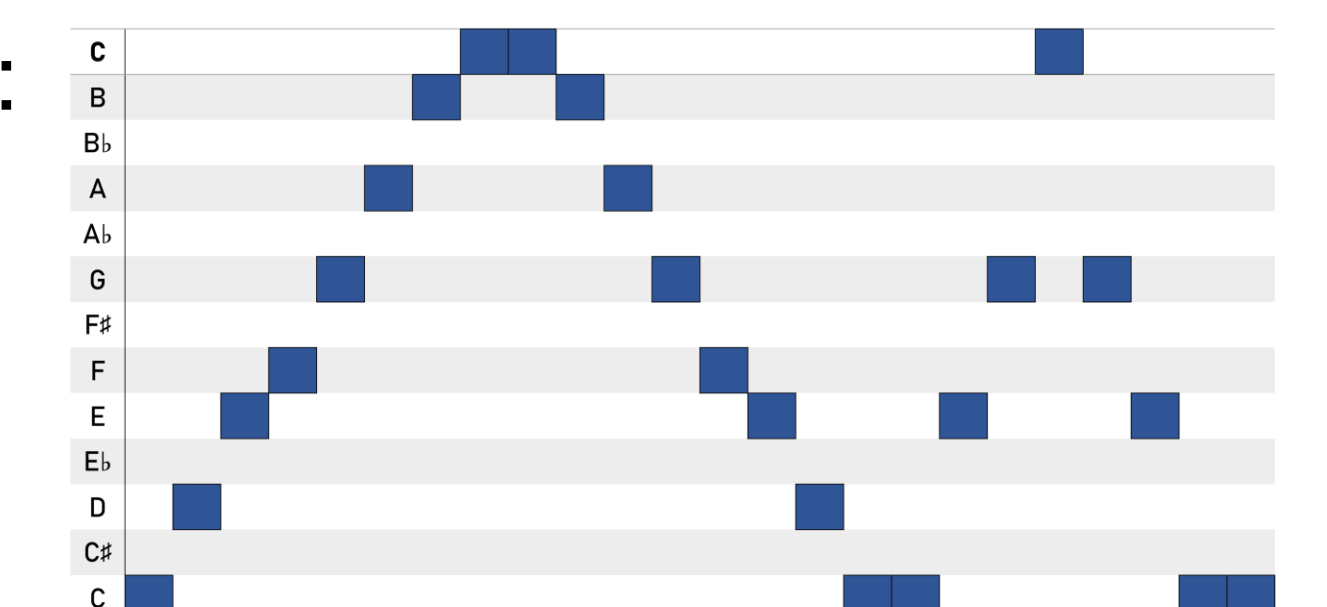
Constraint Propagation										
E	.	.	.	.	.	.	.	.	.	.
C	.	.	.	0	.	.	.	.	.	.
A	.	.	.	.	.	.	.	.	.	.
F	.	.	.	.	.	.	.	.	.	.

- Repeat WFC until all notes are collapsed

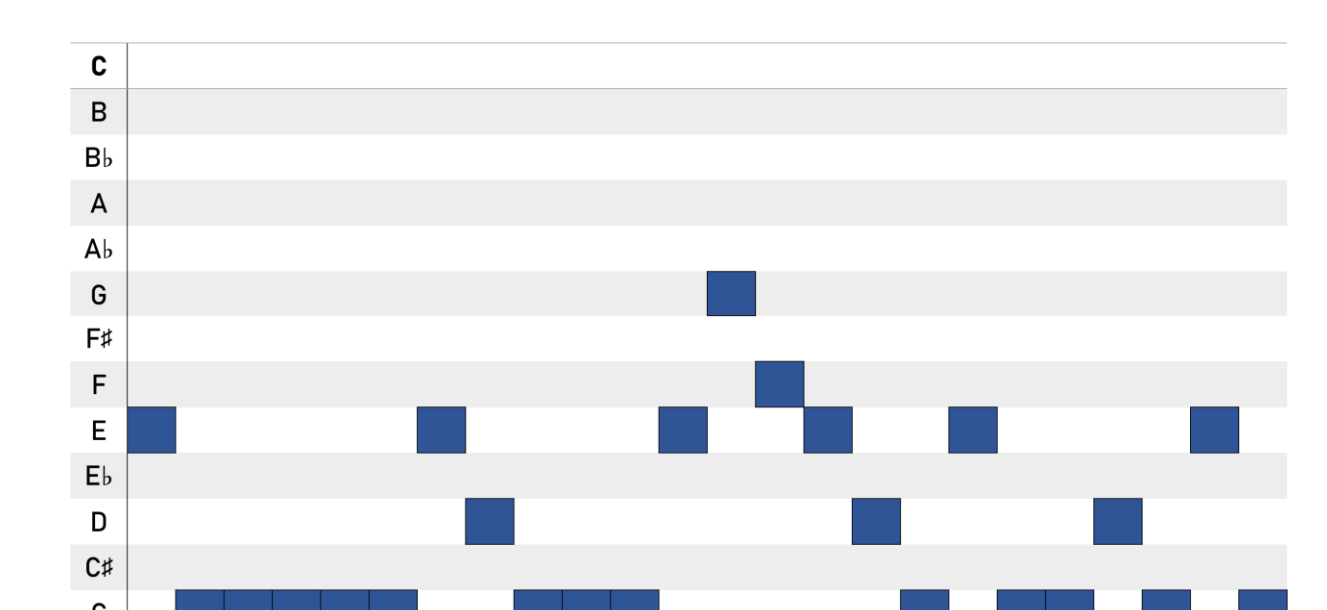
Results

Current music productions:

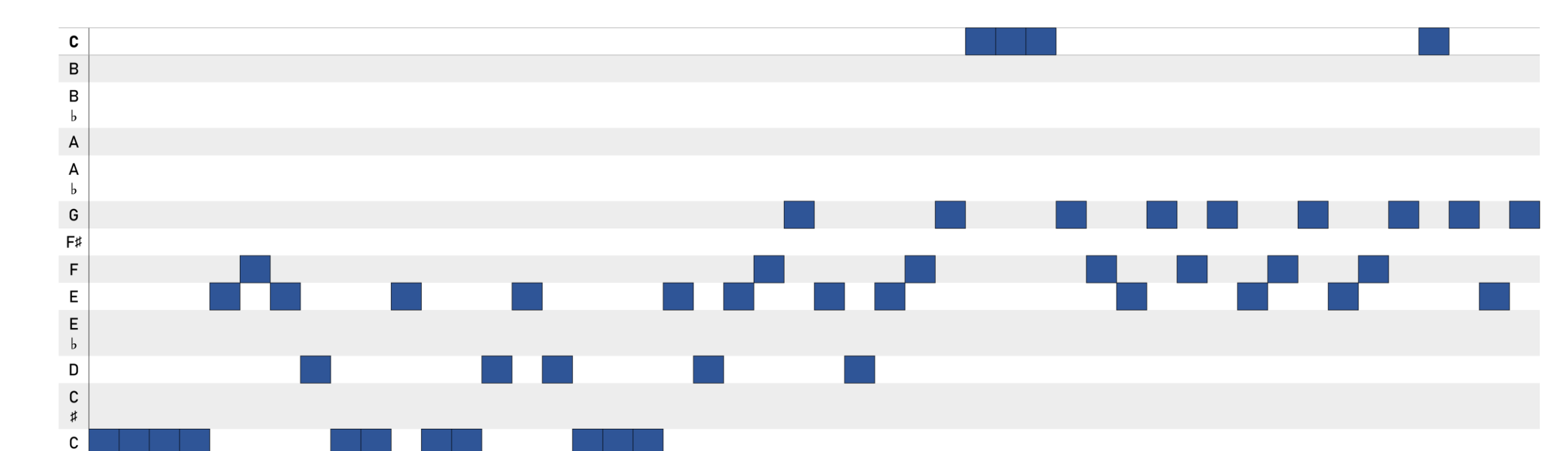
- Input a simple sample with fixed-length notes
- Output a locally similar, original piece
- Unique output every run
- Controllable output length



Example input sample



Short example output



Longer example output

Takeaways:

- Good proof on concept
- Lots of room for improvement
- Lots of feature tuning needed

Future Work

User interface:

- Add a GUI
- Add note visualization
- Options to toggle sampling features
- Input/Save music

Improving the music:

- Note length
- Chords
- Phrasing
- Multiple Parts
- Noise