WHAT MAKES BACH BACH?

Understanding Music as a Complex System

CSSS 18

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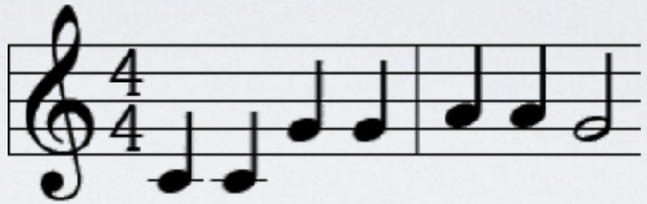
QUESTION

- What makes music different between different eras, composers and genres?
- Can we use machine to understand how music is composed and structured?

DATA AND PROCESSING

- MIDI files from "The Largest MIDI Collection on the Internet"
- MIDI coding: 0 - 127, 12 notes across 11 octaves
- Using music21 to detect the tonal note and set as a base, re-index each note relative to the base note.

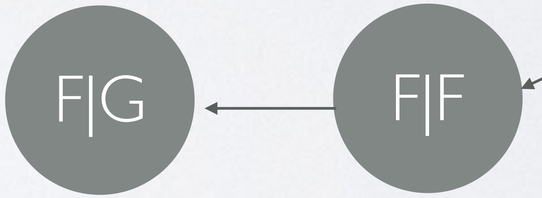
HIGHER ORDER NETWORK (HON)



Snippets of Twinkle, Twinkle Little Star

In Xu et al.'s algorithm, the order is not fixed. The algorithm will automatically detect rules with different orders.

Simple Network



Two-order Network

Xu, Jian, Thanuka L. Wickramarathne, and Nitesh V. Chawla. "Representing higher-order dependencies in networks." *Science advances* 2.5 (2016): e1600028.

EIGENVALUES OF HON

FEATURES FROM HON

- Abruptness: high betweenness, but low transition probabilities
- Repeatedness: longest path
- Branching: how complex the graph is
- Pitch Range: pitch within/between rules, whole piece
- Melodic: length of rules

REVERSE ENGINEERING
IDENTIFY GENRES USING FEATURES

CASE STUDIES

FUTURE PLAN

- Code the sequence better (difference in pitches, chord, etc.)
- Multilayer network to incorporate different instruments
- Add temporal information to capture rhythm
- and so much more!


Questions?

MIDI CODE TABLE

Note	Octave										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
C	0	12	24	36	48	**60**	72	84	96	108	120
C#	1	13	25	37	49	**61**	73	85	97	109	121
D	2	14	26	38	50	**62**	74	86	98	110	122
D#	3	15	27	39	51	**63**	75	87	99	111	123
E	4	16	28	40	52	**64**	76	88	100	112	124
F	5	17	29	41	53	**65**	77	89	101	113	125
F#	6	18	30	42	54	**66**	78	90	102	114	126
G	7	19	31	43	55	**67**	79	91	103	115	127
G#	8	20	32	44	56	**68**	80	92	104	116	
A	9	21	33	45	57	**69**	81	93	105	117	
A#	10	22	34	46	58	**70**	82	94	106	118	
B	11	23	35	47	59	**71**	83	95	107	119	