WHAT MAKES BACH BACH?

Understanding Music with Higher Order Network

CSSS 18

Josefine Bohr Brask
Ricky Laishram
Carlos Marcelo
Xindi Wang

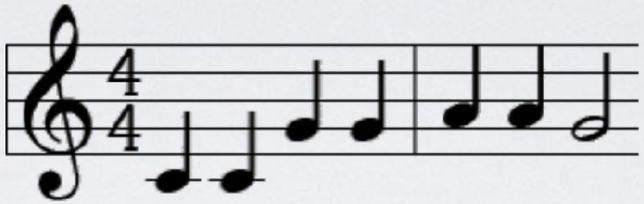
QUESTION

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

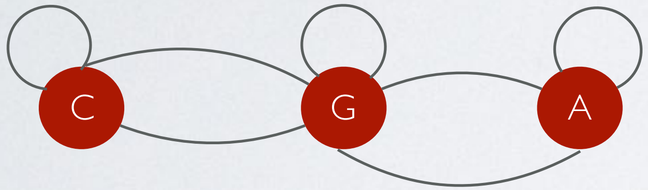
DATA AND PROCESSING

- 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.

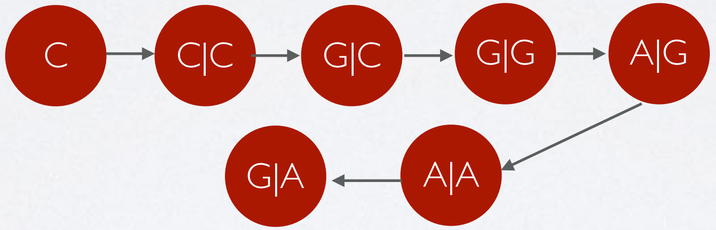
HIGHER ORDER NETWORK (HON)



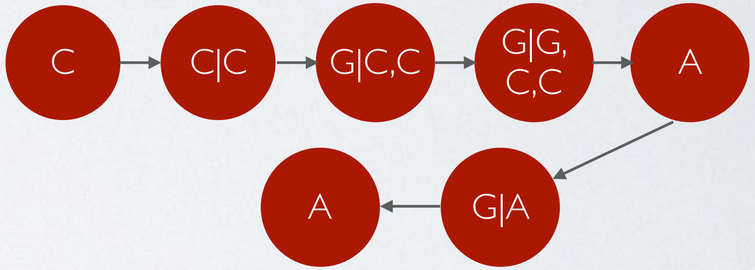
Snippet of *Twinkle, Twinkle Little Star*



Simple Network



Two-order Network



Higher-order Network ("fake")

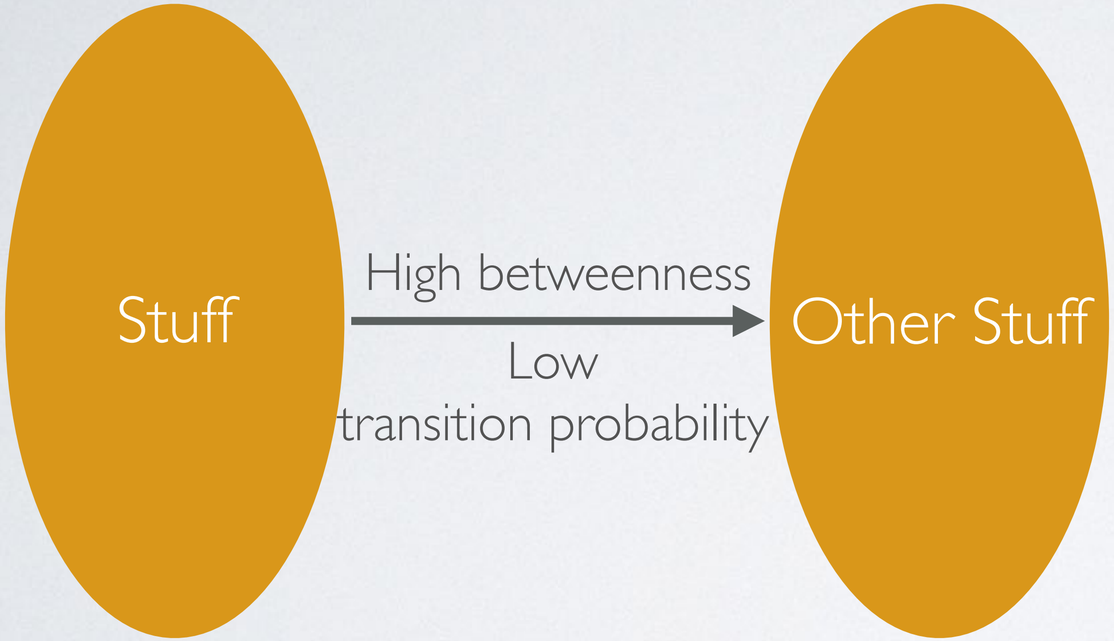
Xu, Jian, Thanuka L. Wickramarathne, and Nitesh V. Chawla. "Representing higher-order dependencies in networks." *Science advances* 2.5 (2016): e1600028.

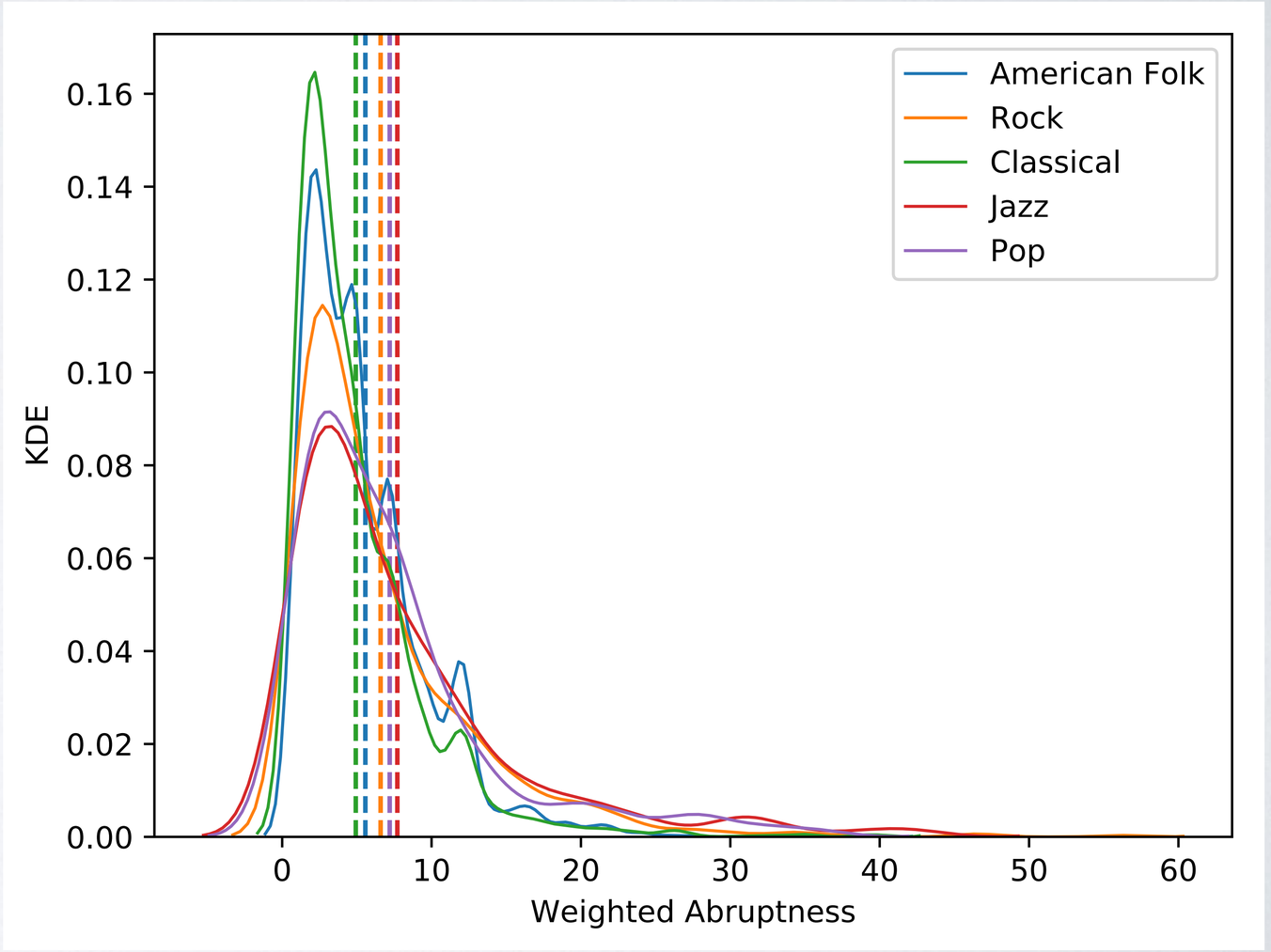
EIGENVALUES OF HON

FEATURES FROM HON

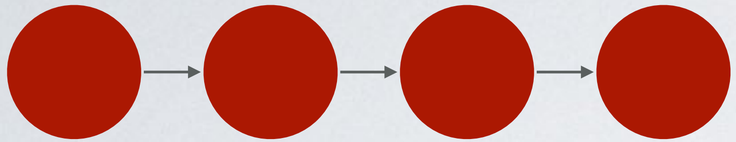
- Abruptness
- Branching
- Melodic
- …

ABRUPTNESS


Stuff
High betweenness
Low
transition probability
Other Stuff

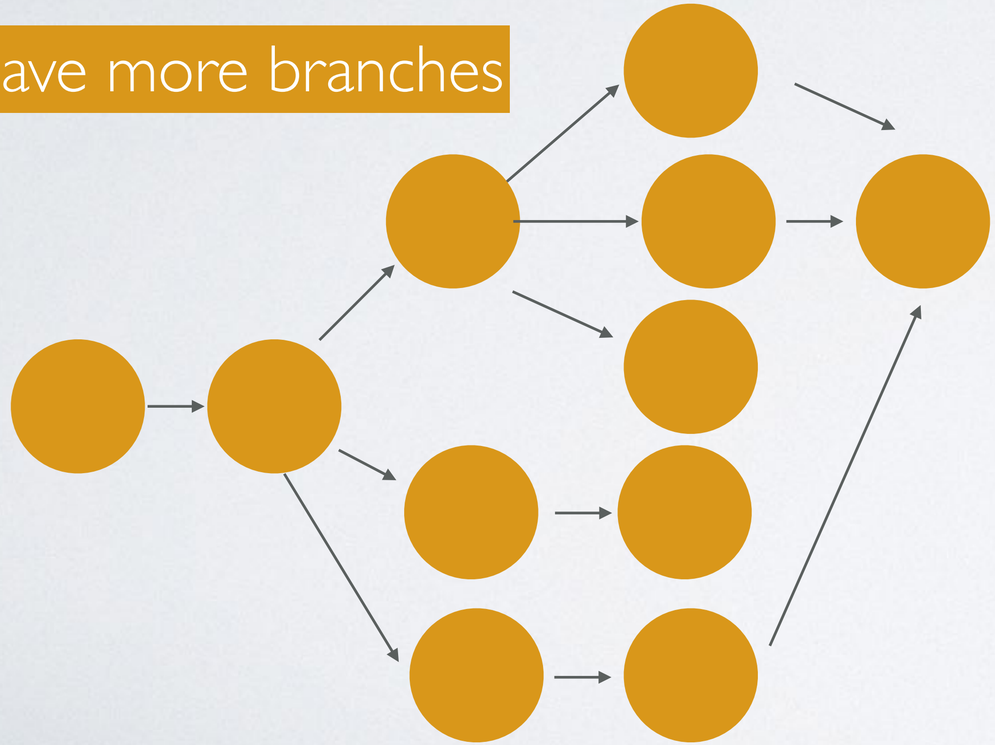

American Folk
Rock
Classical
Jazz
Pop
KDE
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
10
20
30
40
50
60
Weighted Abruptness

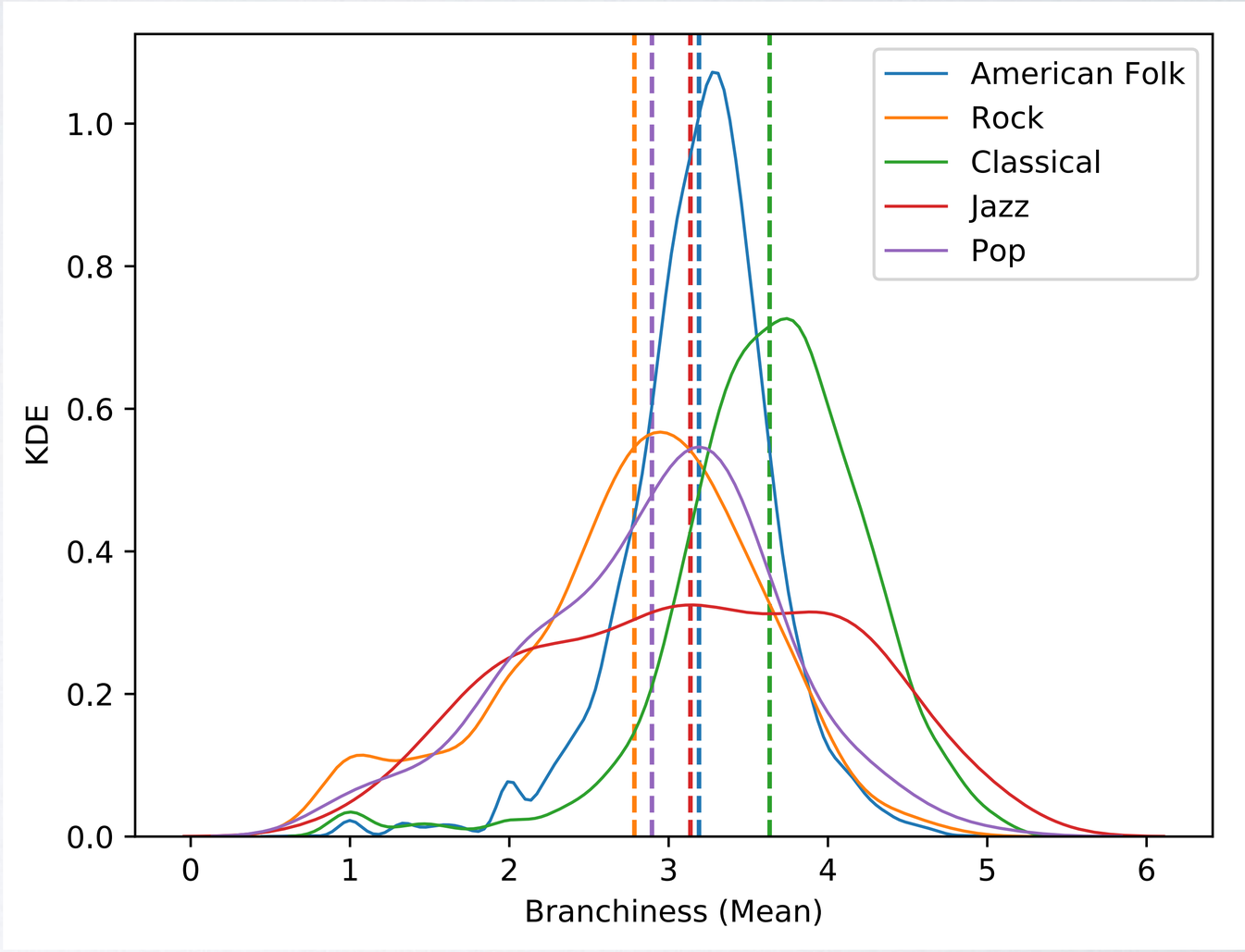
BRANCHING



"Chainly"

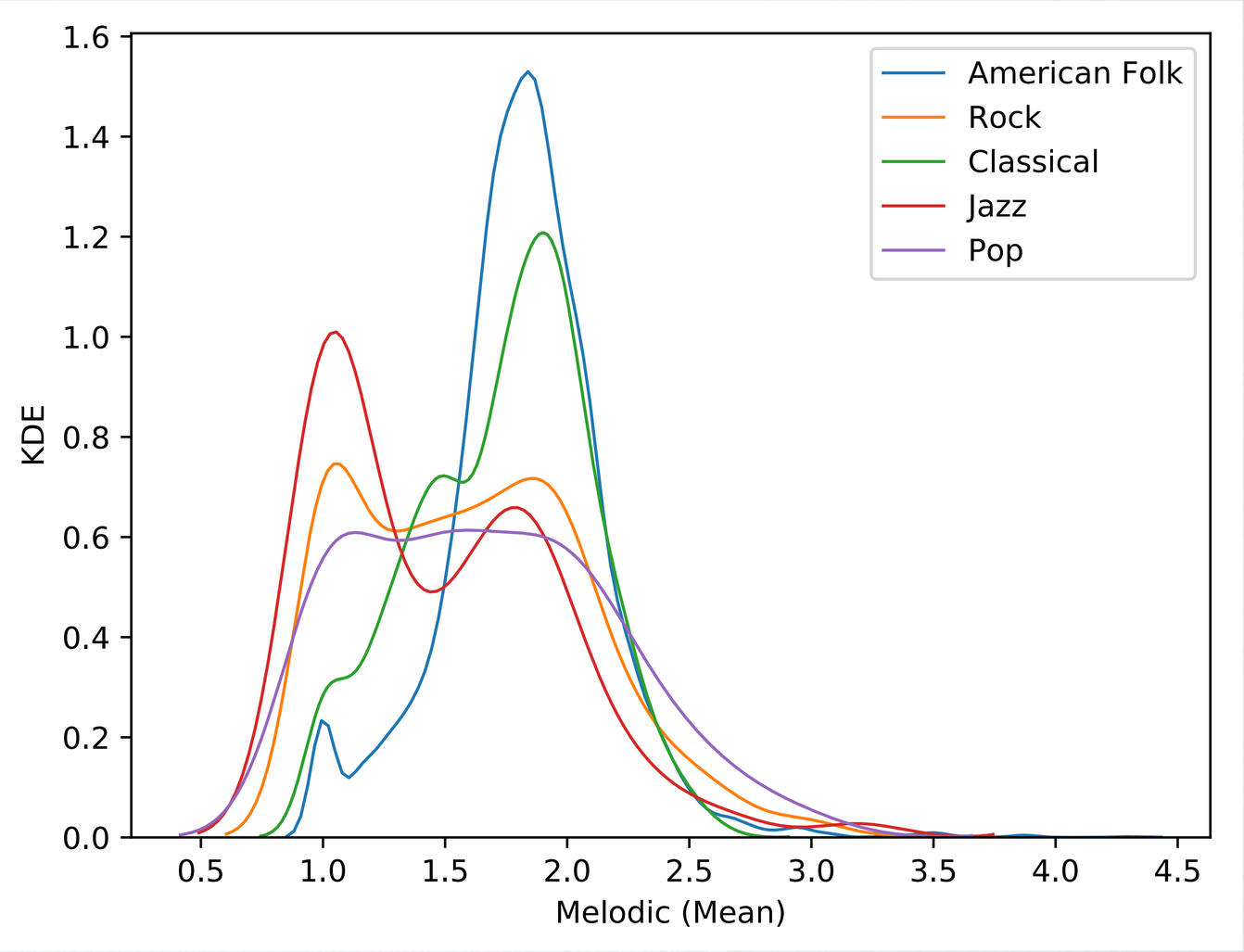
Have more branches





MELODIC

The length of extracted 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	

OTHER FEATURES FROM HON

- Repeatedness
- Pitch range
  - Pitch range within the piece
  - Pitch range between rules
  - Pitch range between adjacent rules