UNDERSTANDING MUSIC WITH HIGHER ORDER NETWORK

CSSS 18

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QUESTION

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

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, re-index each note relative to the tonal note

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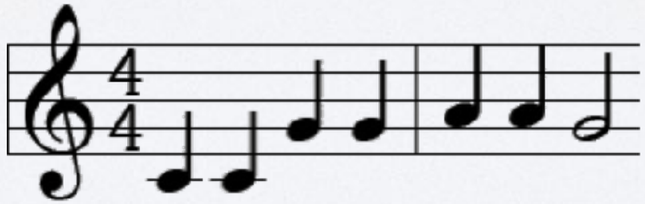

Snippet of *Twinkle, Twinkle Little Star*

Original coding: 60 60 67 67 69 69 67
Relative coding: 0 0 7 7 9 9 7

HIGHER ORDER NETWORK (HON)

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

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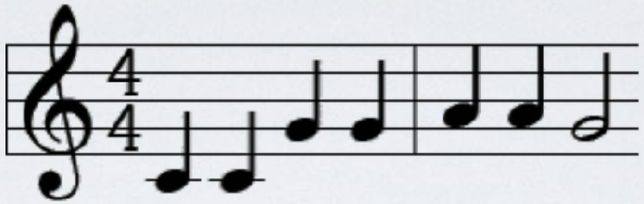

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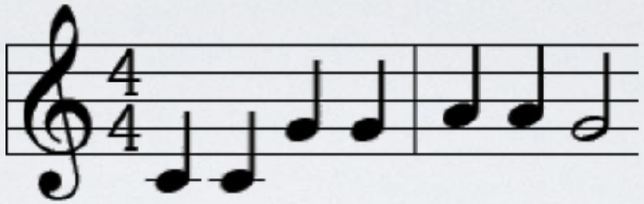

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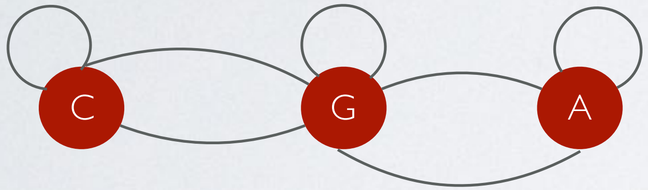

Simple Network

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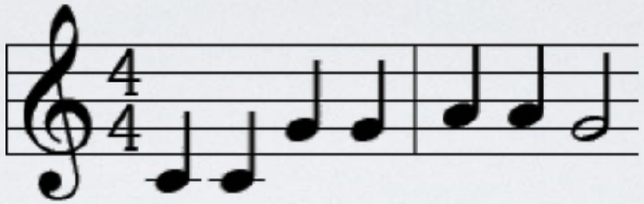

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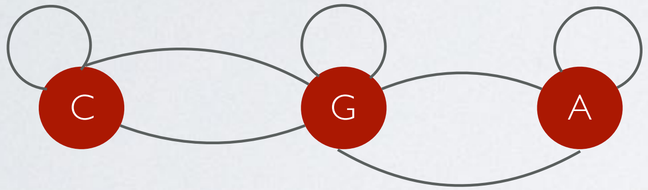

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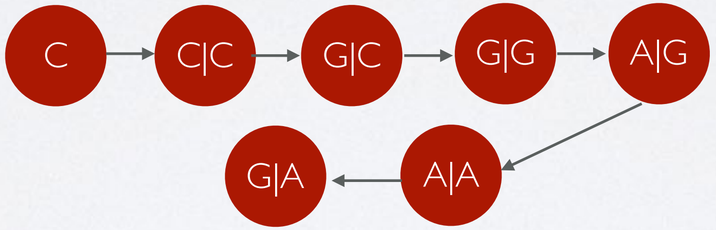

Two-order Network

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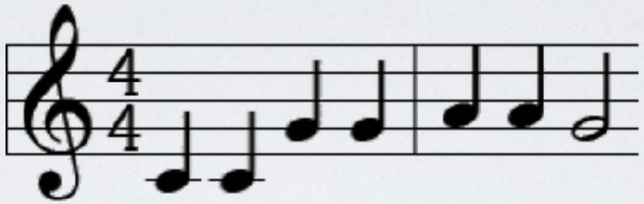

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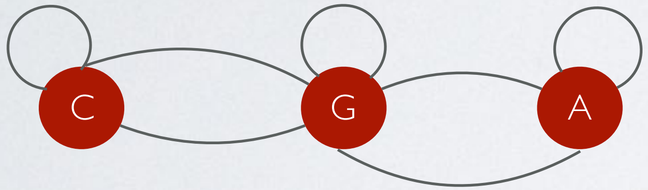

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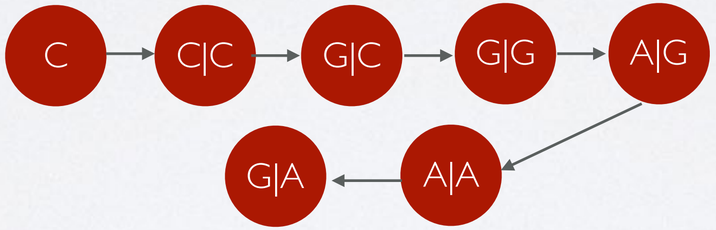

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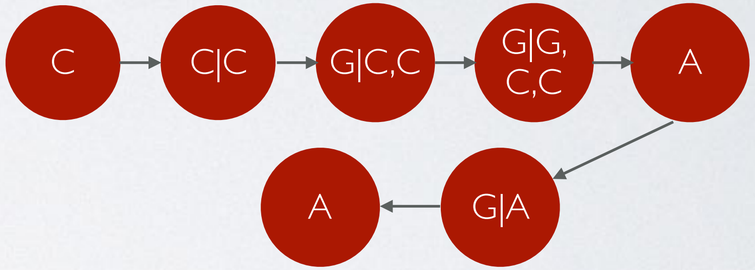

Higher-order Network

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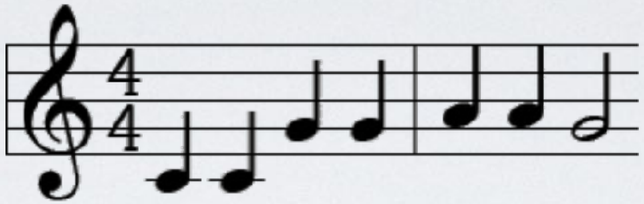

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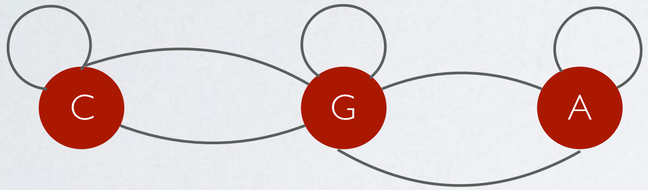

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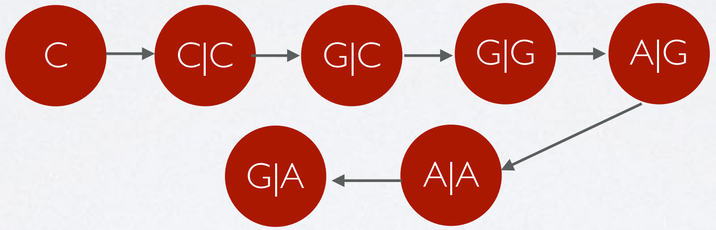

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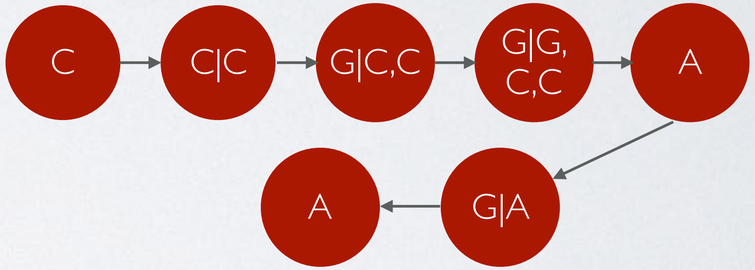

Higher-order Network

Node: rules
Edges: Transition Probability

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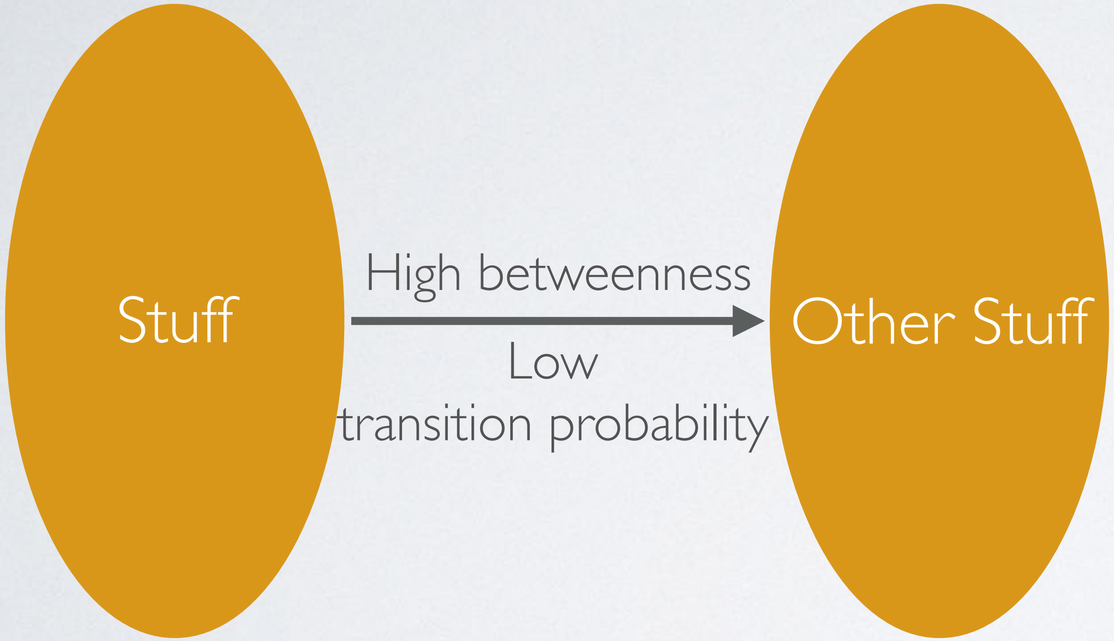
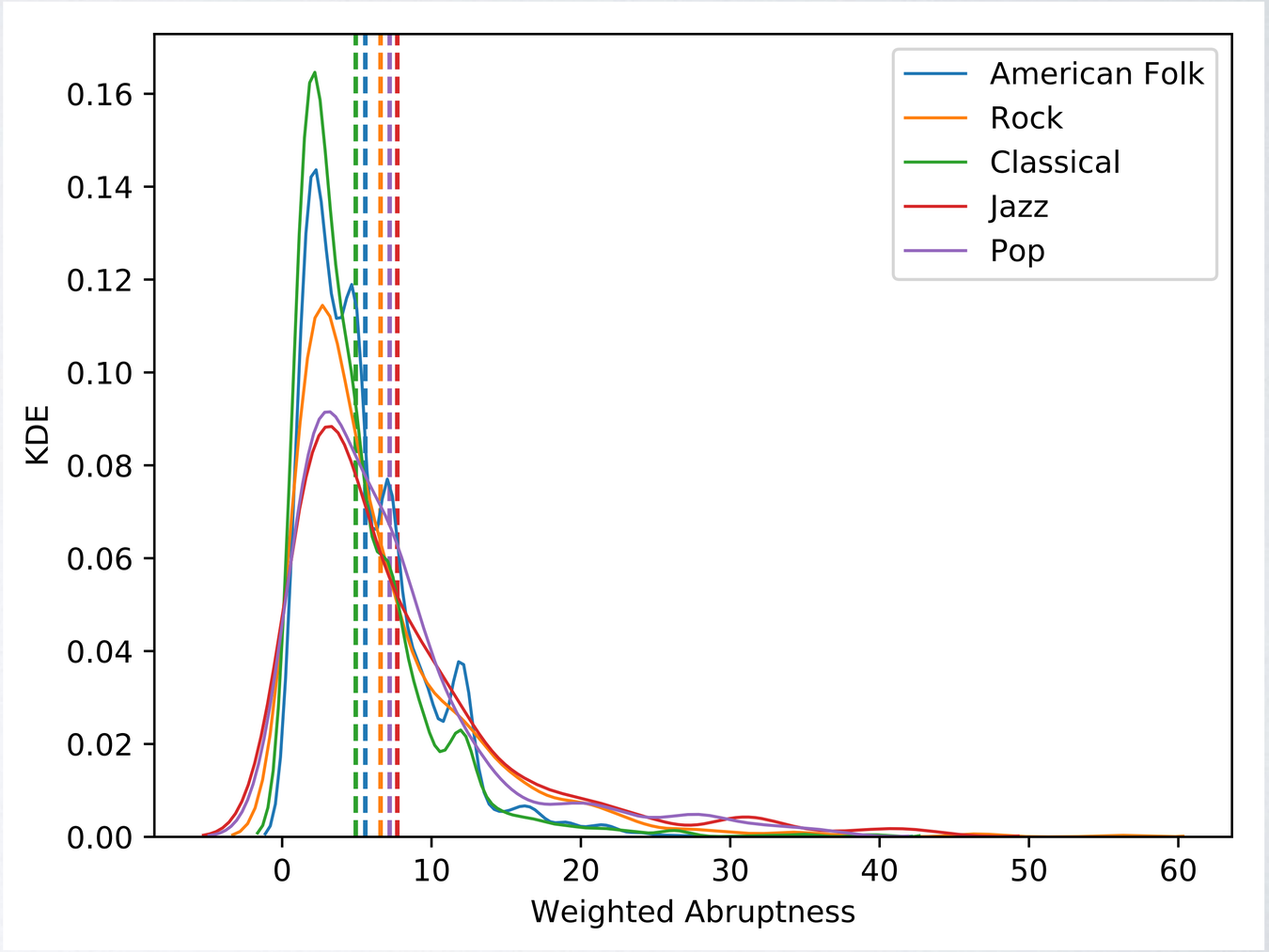
FEATURES FROM HON

- Abruptness
- Branching
- Melodic
- …

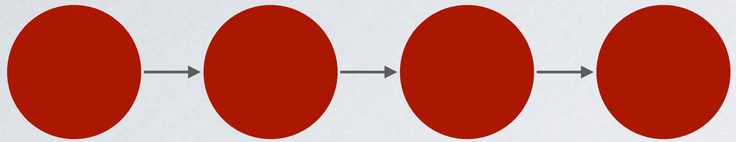
ABRUPTNESS



Abrupt if the note pitch change difference of the two end is large

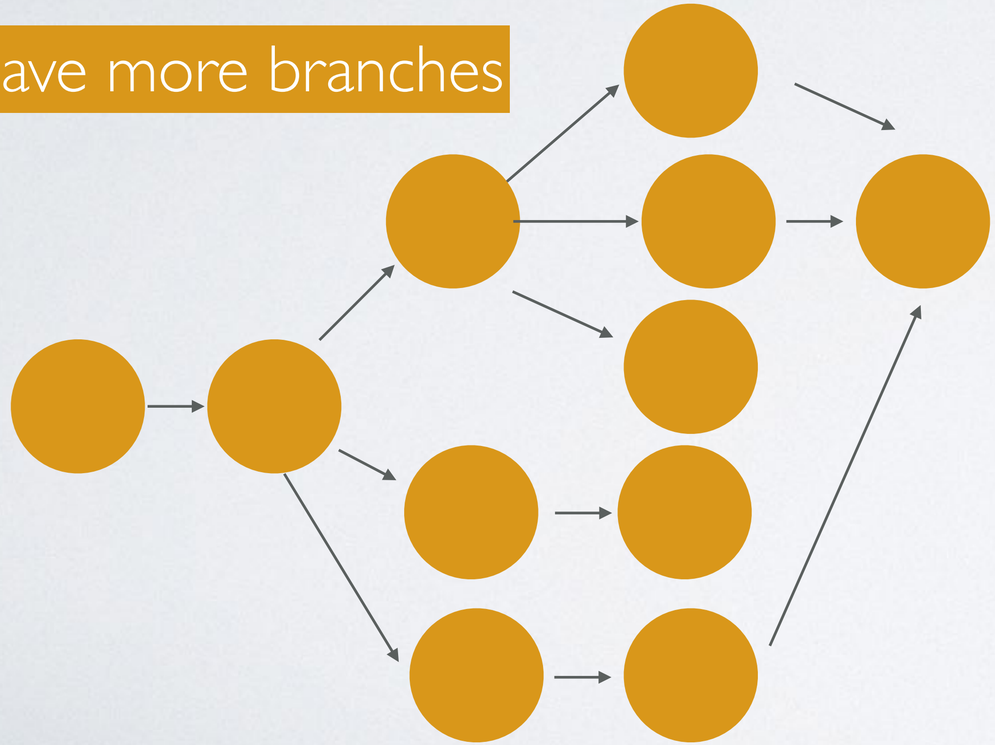


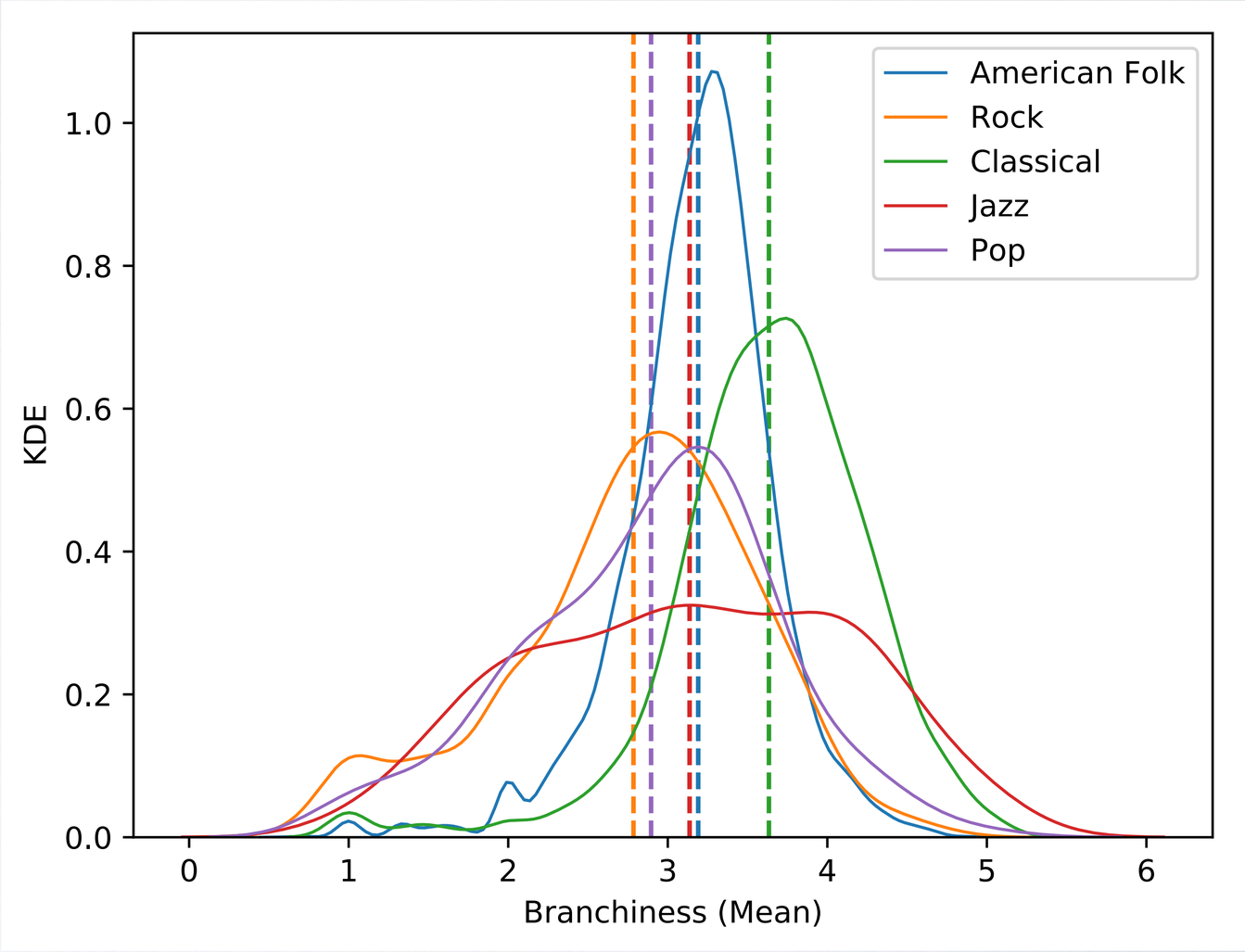
BRANCHING



"Chainly"

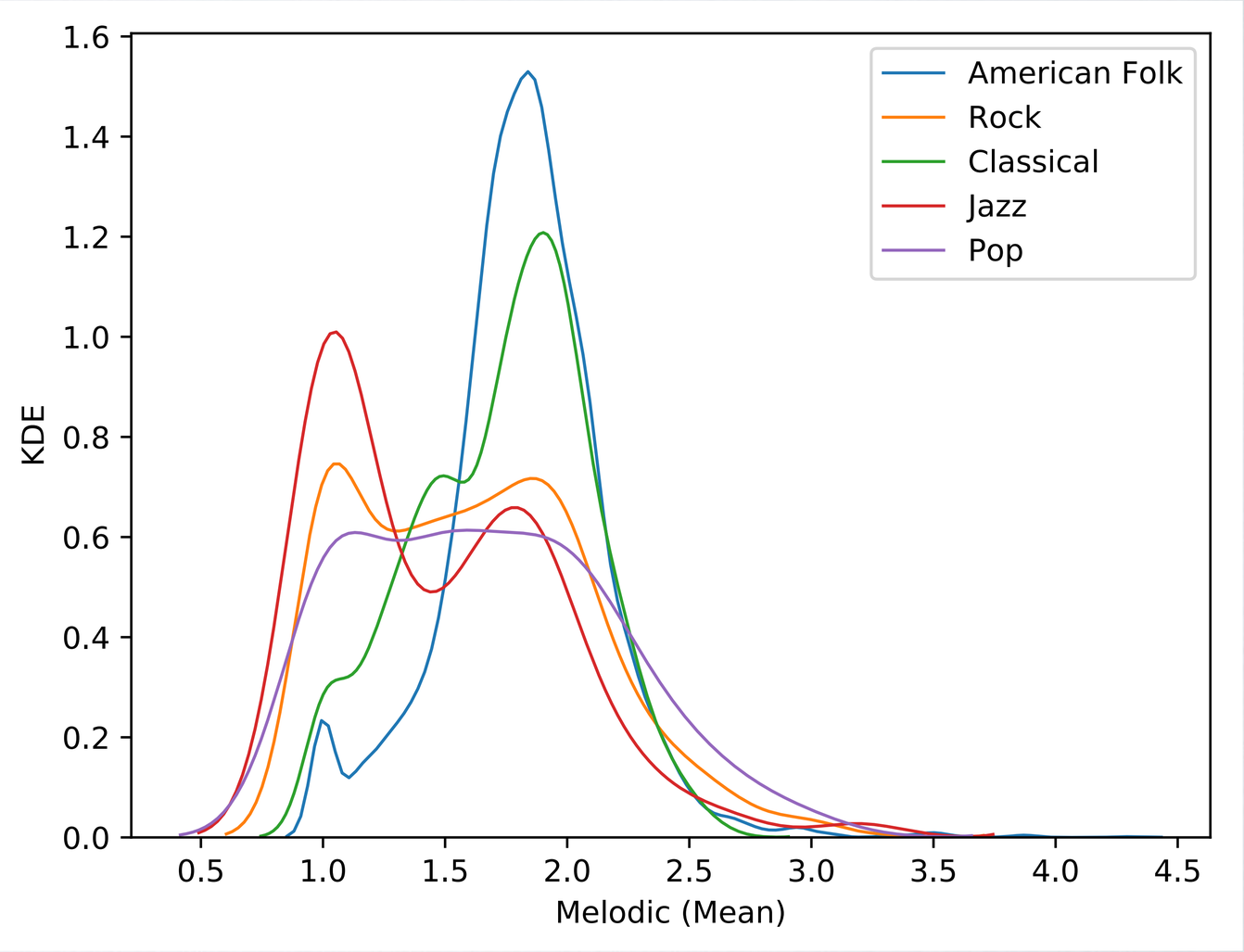
Have more branches



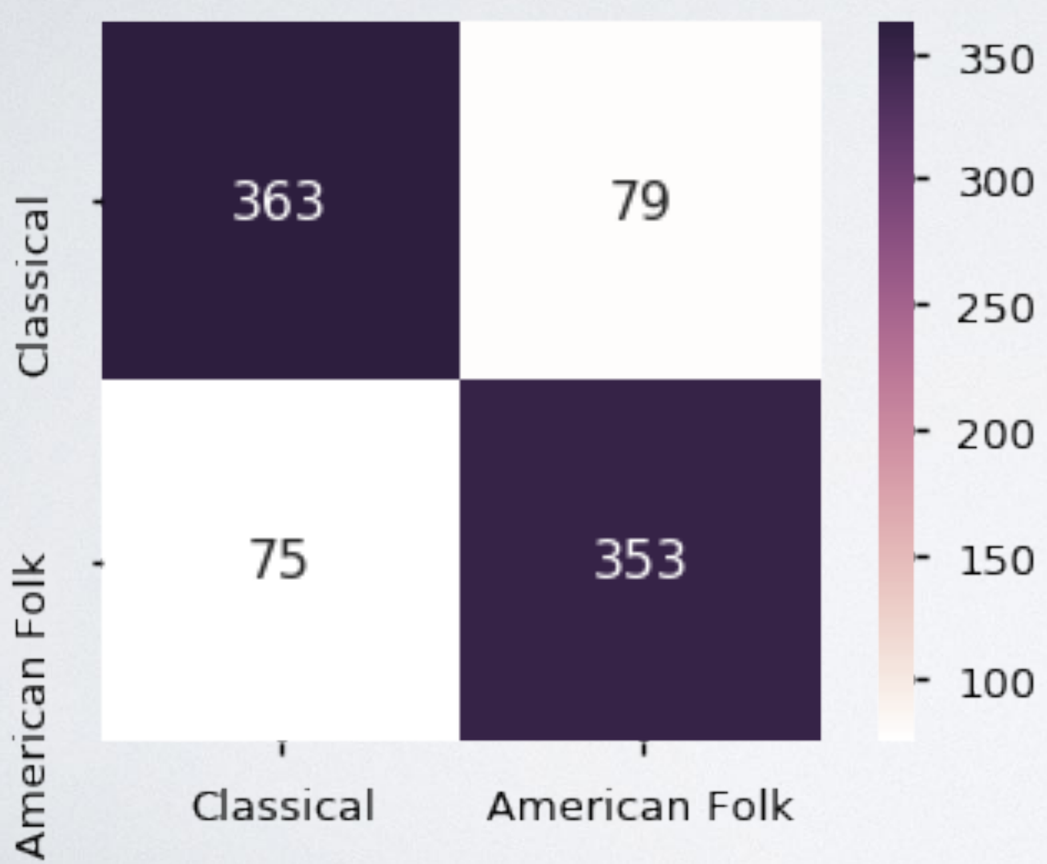


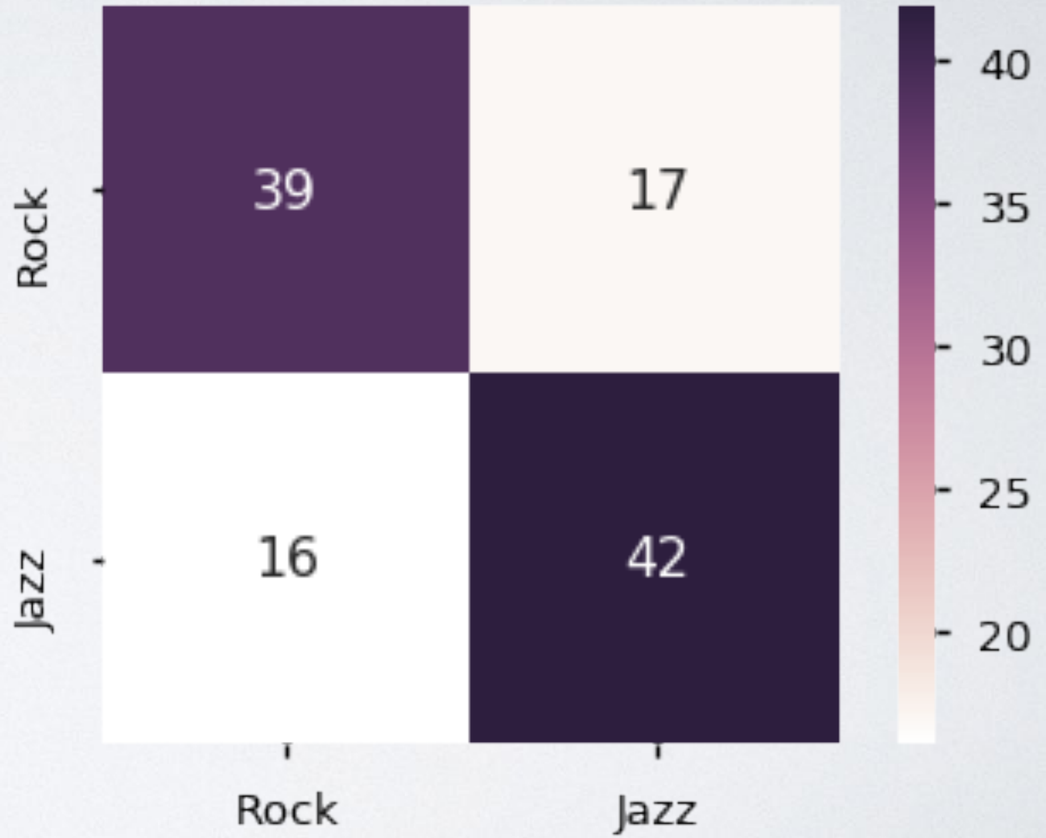
MELODIC

The length of extracted rules



REVERSE ENGINEERING
IDENTIFY GENRES USING FEATURES

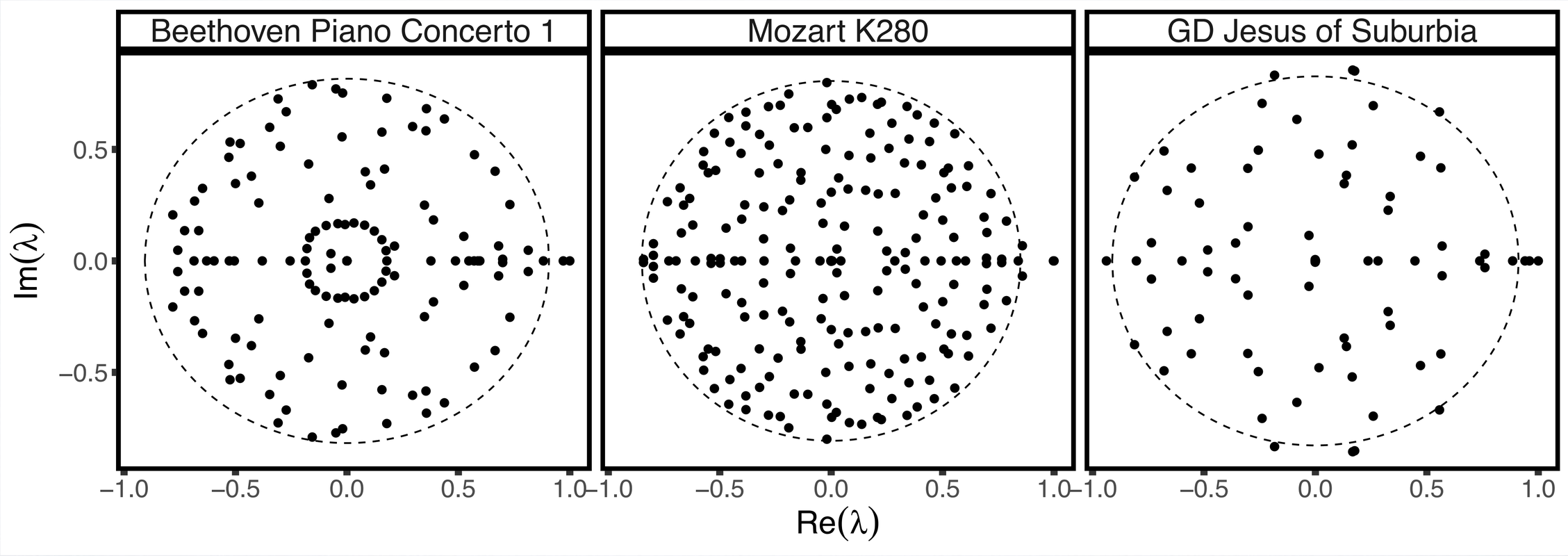




Classifier: Multilayer Perceptron

CASE STUDIES

EIGENVALUES OF HON



CONCLUSIONS

- Features from higher order network can capture characteristics across different music genres
- Eigenvalues of higher order network need further inspection

FUTURE PLAN

- Better understanding of higher order networks and its eigenvalues
- 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