

JASON WANGSADINATA

---

# NETWORKS IN MUSIC



september - Tracks

28 4 1 74 122 C maj 4/4

### Library



Afro-Cuban Piano

Search Library

- World ▾
- Keyboard ▸ Afro-Cuban Piano
- Percussion ▸ Polka Accordion
- Stringed ▸ Tango Accordion
- Voice ▸
- Woodwinds ▸

Edit Functions View

1		M S R		Afro-Cuban Piano	Ch1			untitled	01
2		M S R		Fingerstyle Bass	Ch1			untitled	33
3		M S R		Steel String Acoustic				untitled	25
4		M S R		Reverse Engineering				untitled	80
5		M S R		Classic Electric Piano				untitled	04
6		M S R		Picked Bass	Ch1			untitled	36
7		M S R		Classic Electric Piano				untitled	04
8		M S R		British Stack Synth Lead				untitled	20
9		M S R		Roots Rock	Ch1			untitled	26
10		M S R		Steinway Grand Piano				untitled	
11		M S R		Full Brass	Ch1			untitled	61
12		M S R		Trumpets	Ch1			untitled	56
13		M S R		Saxophone	Ch1			untitled	65
14		M S R		Trombones	Ch1			untitled	57
15		M S R		String Ensemble	Ch1			untitled	48

Revert
Delete
Save...

## MOTIVATION

- ▶ Use well-known network analysis techniques to further understand the relations between musical notes.
- ▶ Visualize the similarity and differences of the range of the different musical instruments.

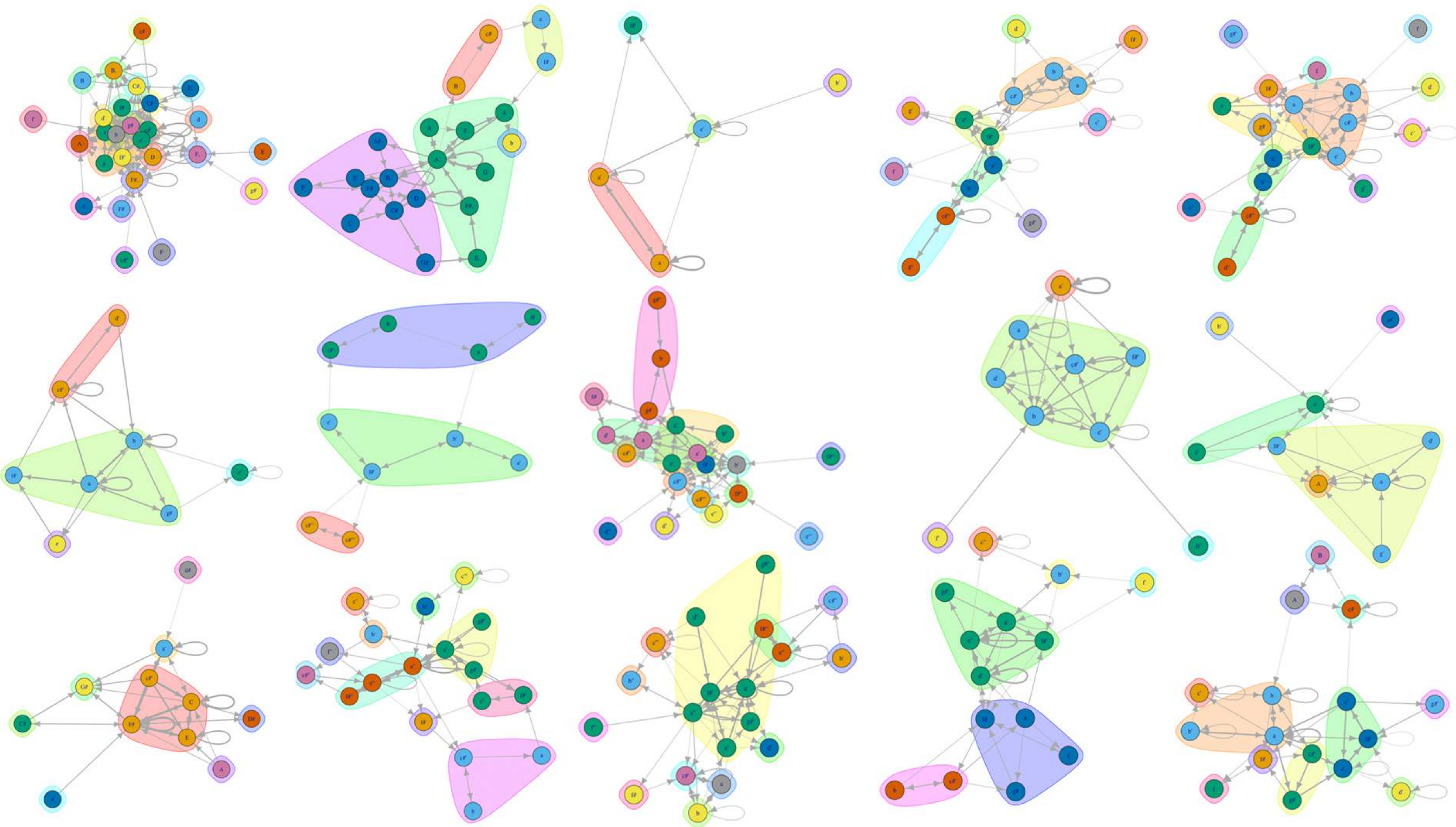
## DATASET

- ▶ MIDI data of the song September by Earth, Wind and Fire.
- ▶ Contain time, length, track, channel, note, note name and velocity information.
- ▶ 15 different tracks, labelled by channel 0 - 14.

	time	length	track	channel	note	notename	velocity
1	384	24	1	0	38	D	85
2	384	24	1	0	50	d	108
3	384	0	1	0	57	a	86
4	384	0	1	2	57	a	110
5	384	0	1	0	61	c#'	103
6	384	24	1	5	61	c#'	111
7	384	0	1	9	61	c#'	75
8	384	24	1	0	66	f#'	83
9	384	0	1	2	69	a'	115
10	384	24	1	7	69	a'	73
11	384	0	1	9	69	a'	66
12	408	24	1	2	57	a	79
13	408	0	1	2	69	a'	85
14	408	0	1	7	69	a'	57
15	432	24	1	0	38	D	62
16	432	24	1	0	50	d	77
17	432	0	1	0	57	a	73
18	432	0	1	2	57	a	95
19	432	0	1	0	61	c#'	71
20	432	0	1	5	61	c#'	90
21	432	24	1	0	66	f#'	72
22	432	0	1	2	69	a'	94
23	432	24	1	7	69	a'	70
24	432	0	1	9	69	a'	39

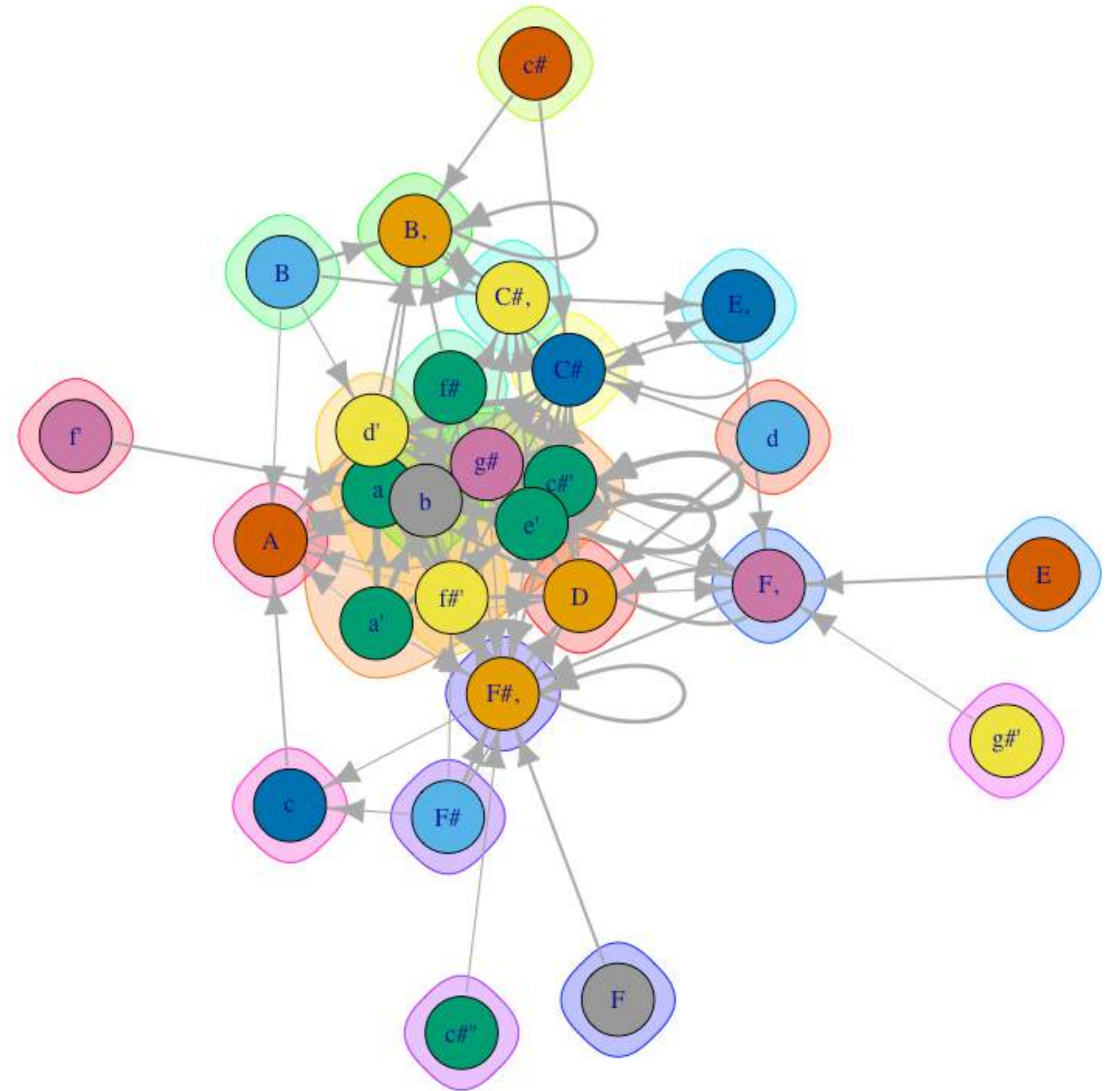
## ANALYSIS

- ▶ Use `tuneR` package to obtain a data frame from MIDI data.
- ▶ The musical notes are vertices, and directed edges are constructed when a note moves to another note.
- ▶ Use Girvan-Newman Algorithm (`cluster_edge_betweenness`) which is an algorithm that form clusters based on the edges that are most likely between communities.



## MAIN PIANO

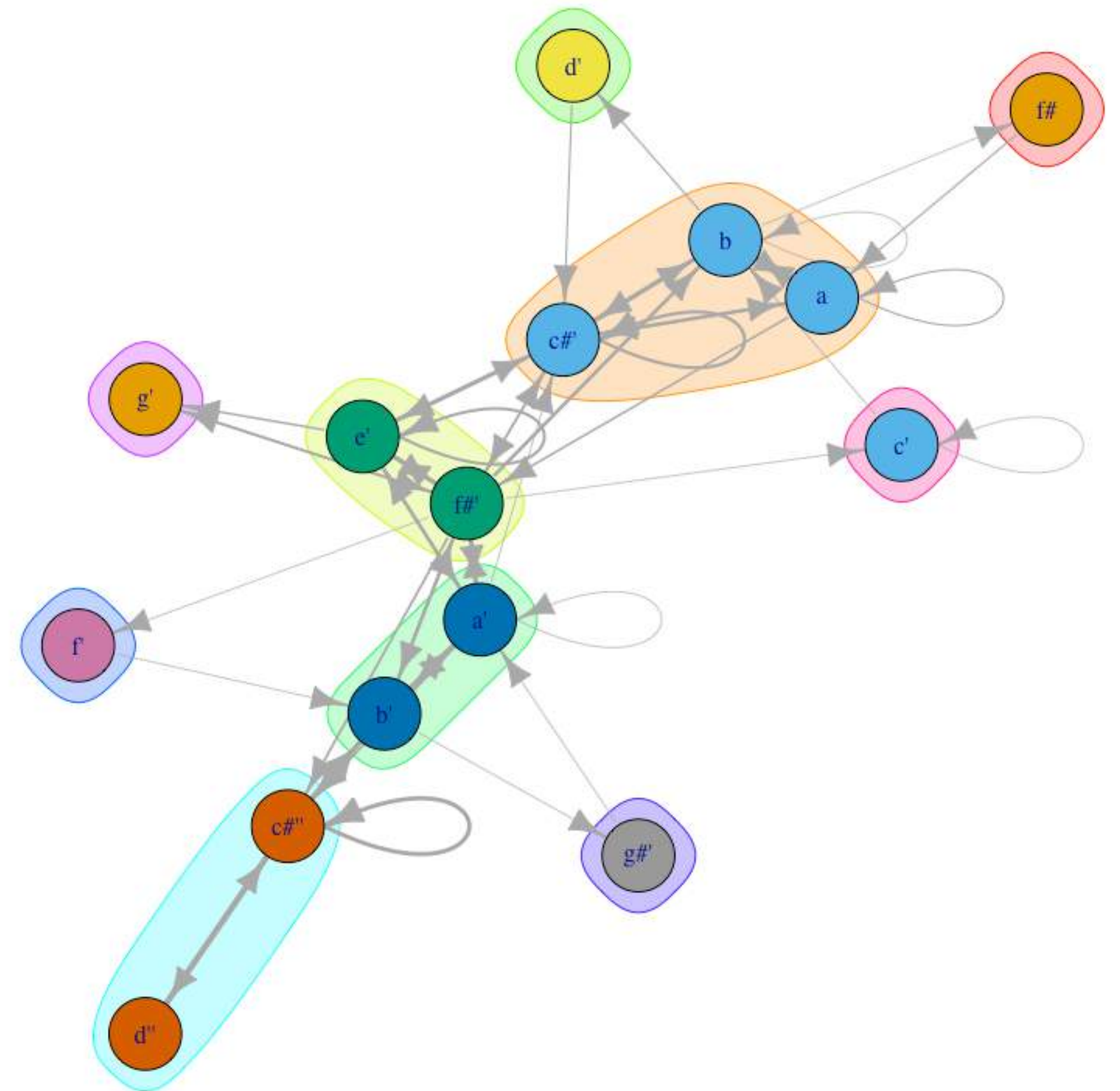
- ▶ The graph was constructed from connecting two adjacent chords.
- ▶  $Fm^7$  ( $F^\sharp$ ,  $A$ ,  $C^\sharp$ ,  $E$ )  $\rightarrow$   $Bm^7$  ( $B$ ,  $D$ ,  $F^\sharp$ ,  $A$ ) means there is a link from  $F^\sharp \rightarrow B$ ,  $F^\sharp \rightarrow D$ ,  $F^\sharp \rightarrow F^\sharp$ ,  $F^\sharp \rightarrow A$ , and so on.
- ▶ The graph has 23 different communities, which is labelled in the different colors.
- ▶ The color of the nodes represent the membership.





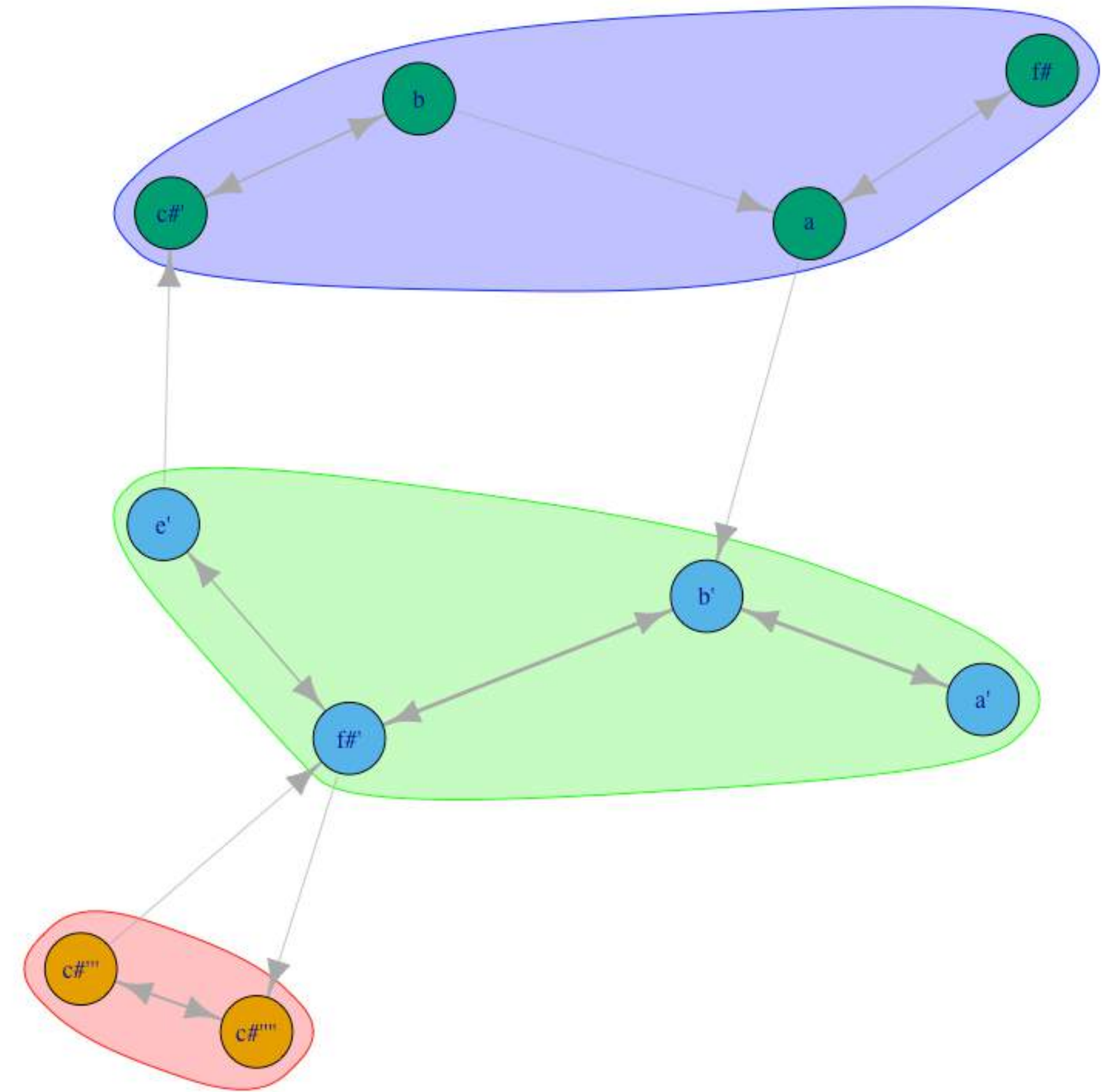
## MAIN MELODY

- ▶ Network reveals the melody movements.
- ▶ Thickness of edges represent frequency of the particular note movements.
- ▶  $f\#$ ,  $d'$ ,  $f'$ ,  $g\#'$  are used as a passing note.
- ▶ This network is also shows separation of the verse and chorus of the song.



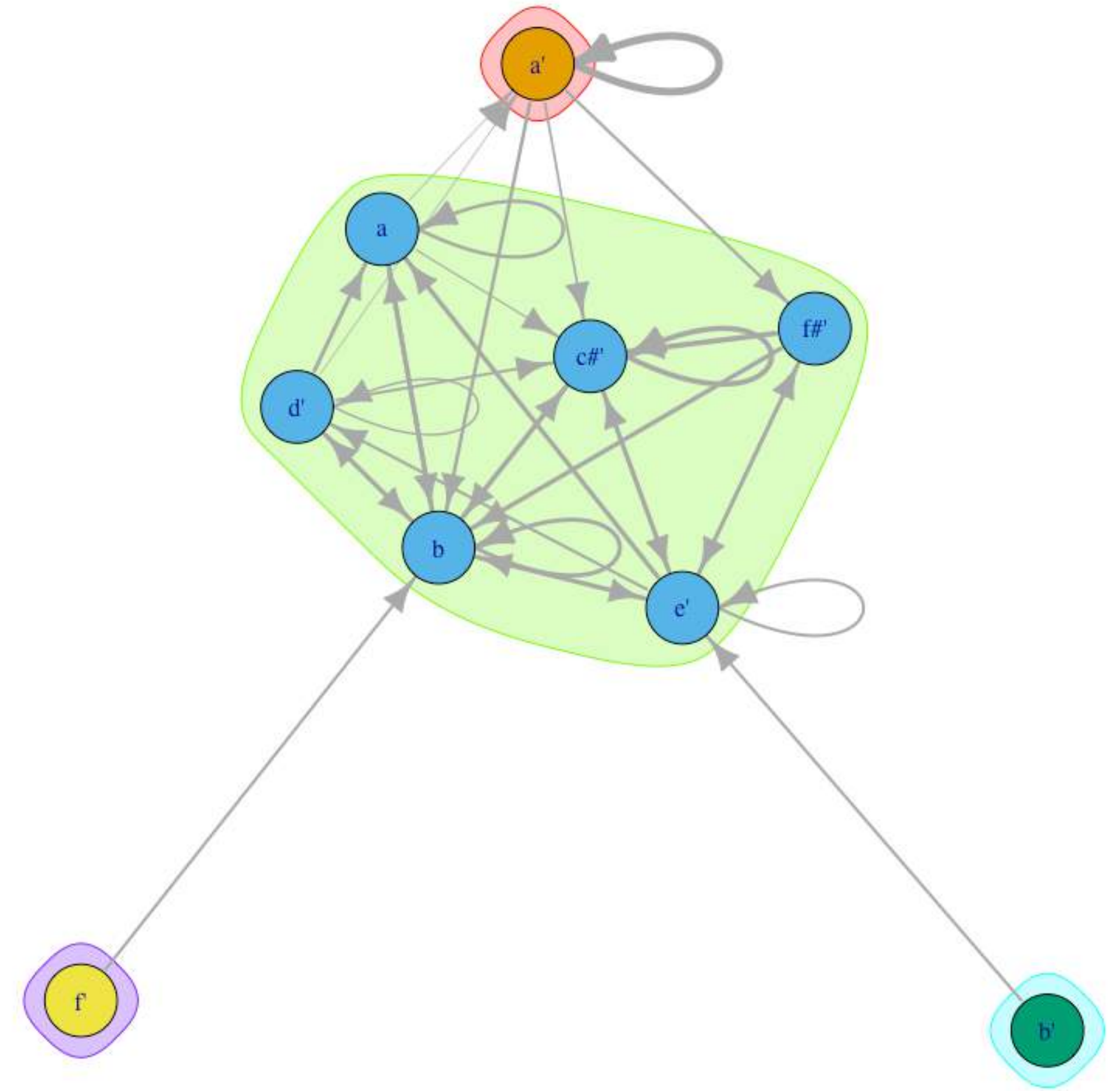
## KEYBOARD

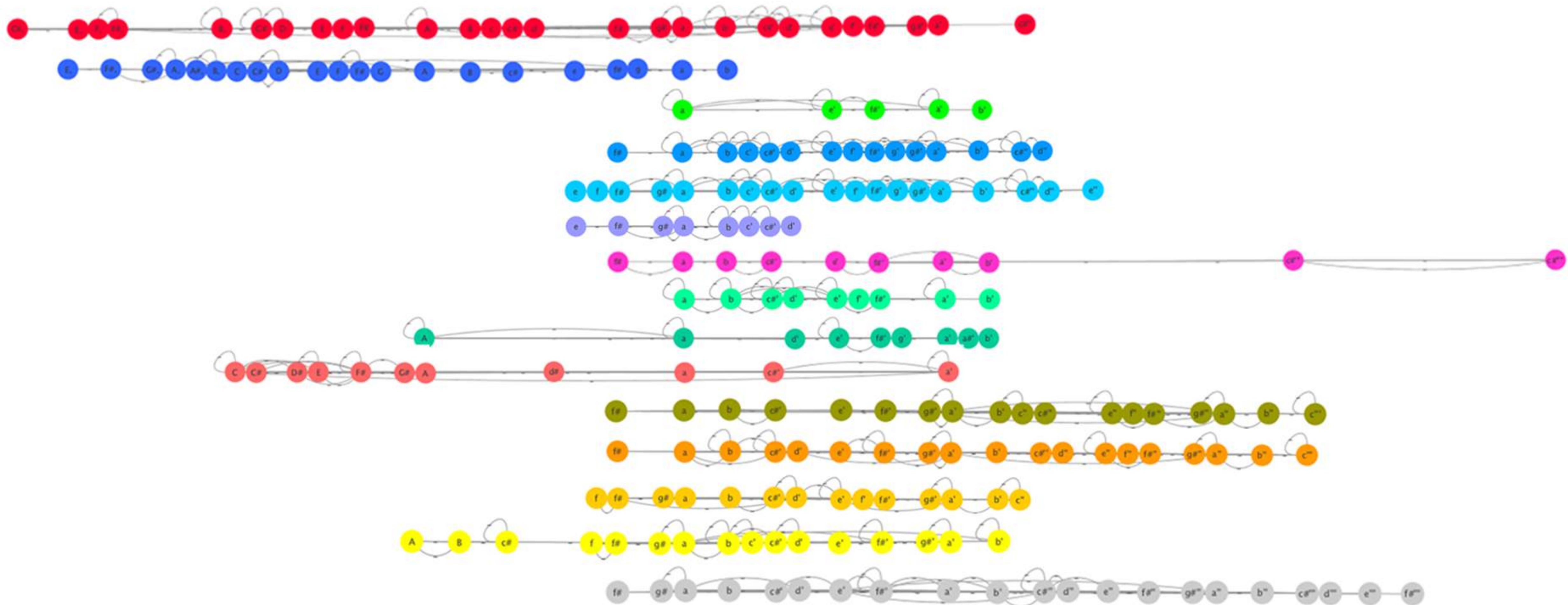
- ▶ Unique cyclic structure resembling an organic element.
- ▶ 3 different communities -> three different octave range.
- ▶ (e', a) are the exit points and (b' c#') are the entry points for the top two clusters.
- ▶ f#' is the only node connecting to the bottom cluster.



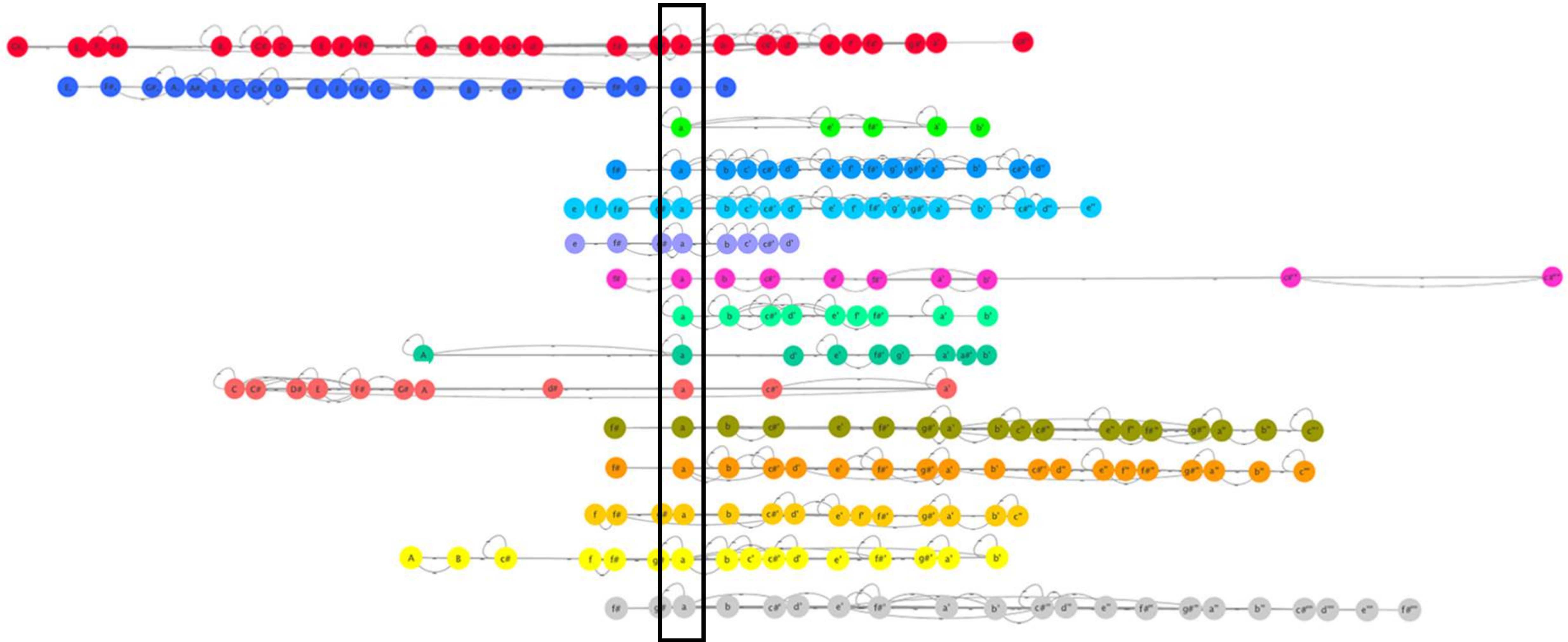
## DISTORTION GUITAR

- ▶  $a'$  -> repeated melody in the intro
- ▶ 4 different clusters, 1 big cluster with 6 elements, and three 1-element clusters.
- ▶  $b$  -> a target note for all the other nodes except for  $a'$  and  $b'$

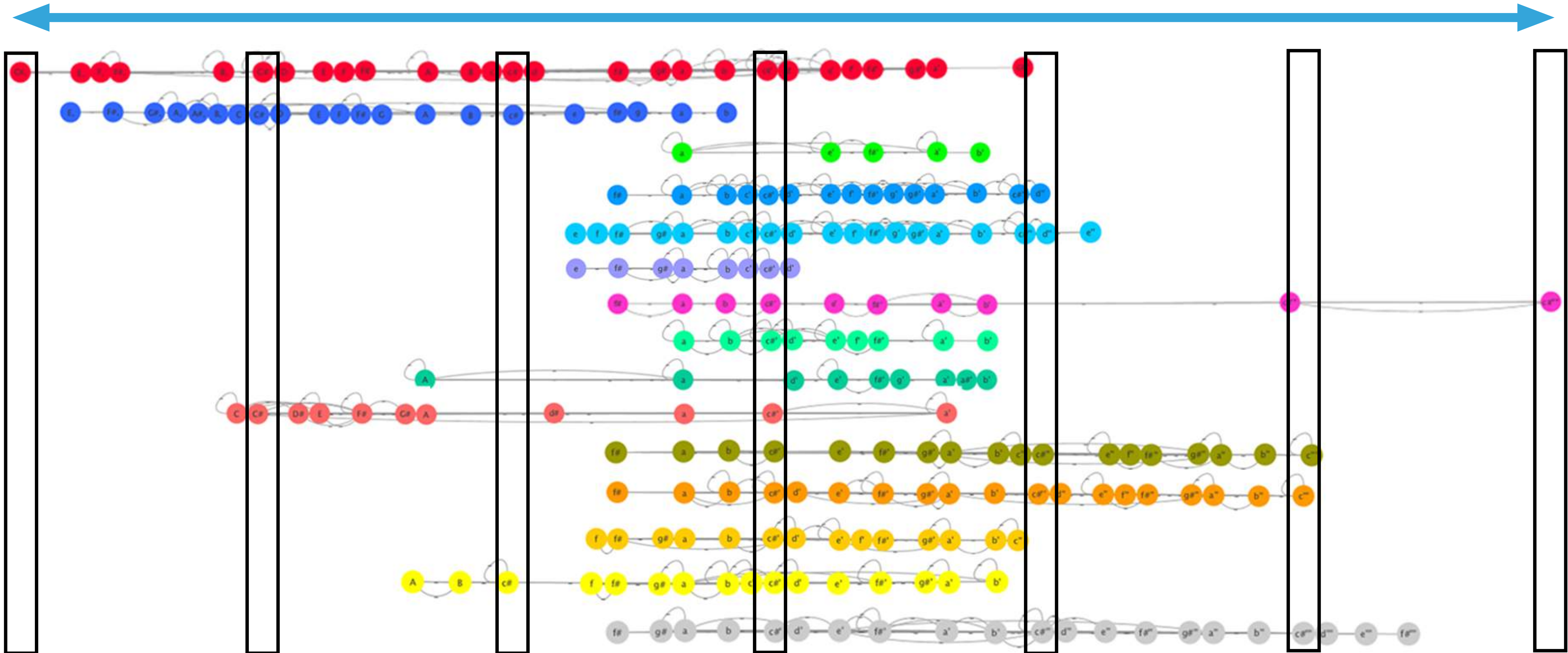




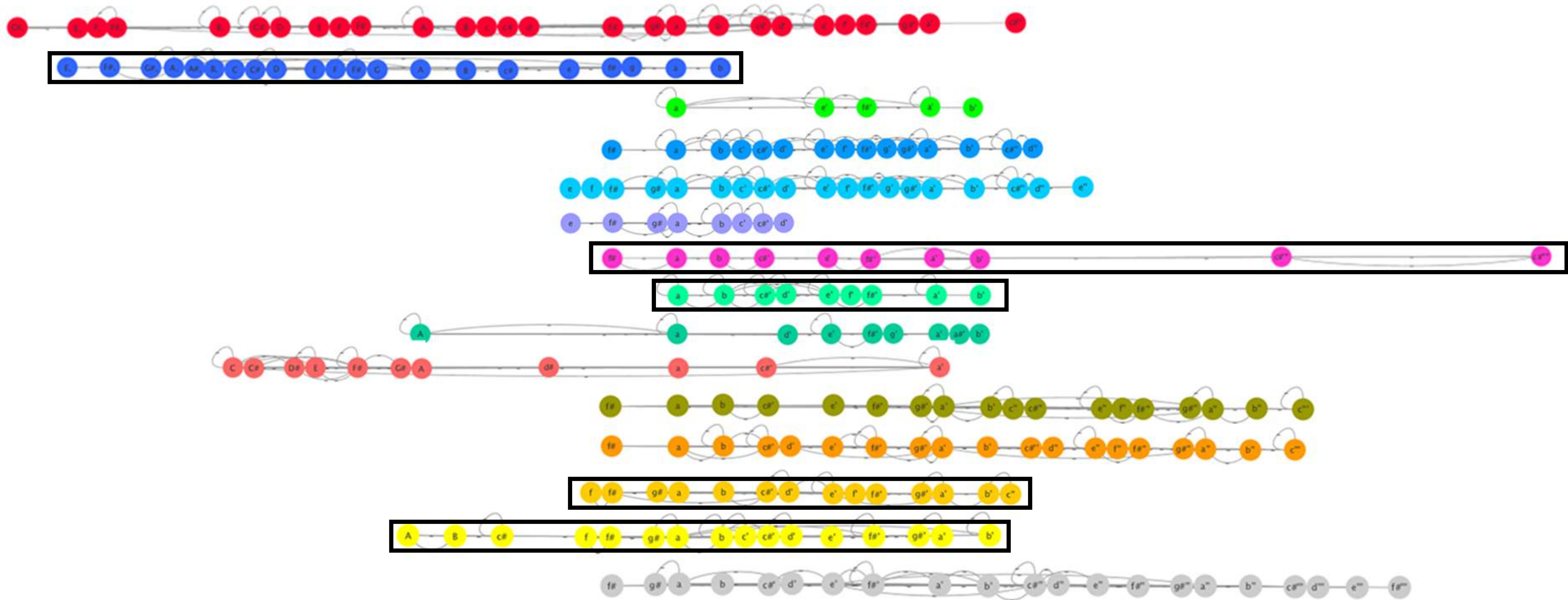
# COMMONALITY



# MUSICAL RANGE



# MUSICAL RANGE - CONTINUED



**THANK YOU**