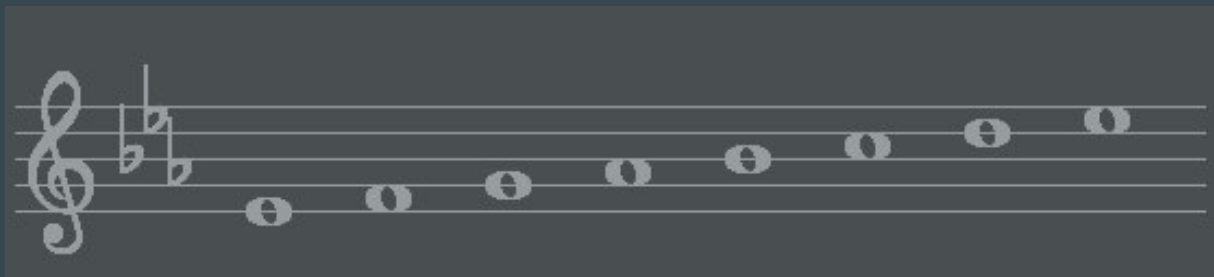


# Music Box



By Phoebe Piercy and Elina Sendonaris

# Overview

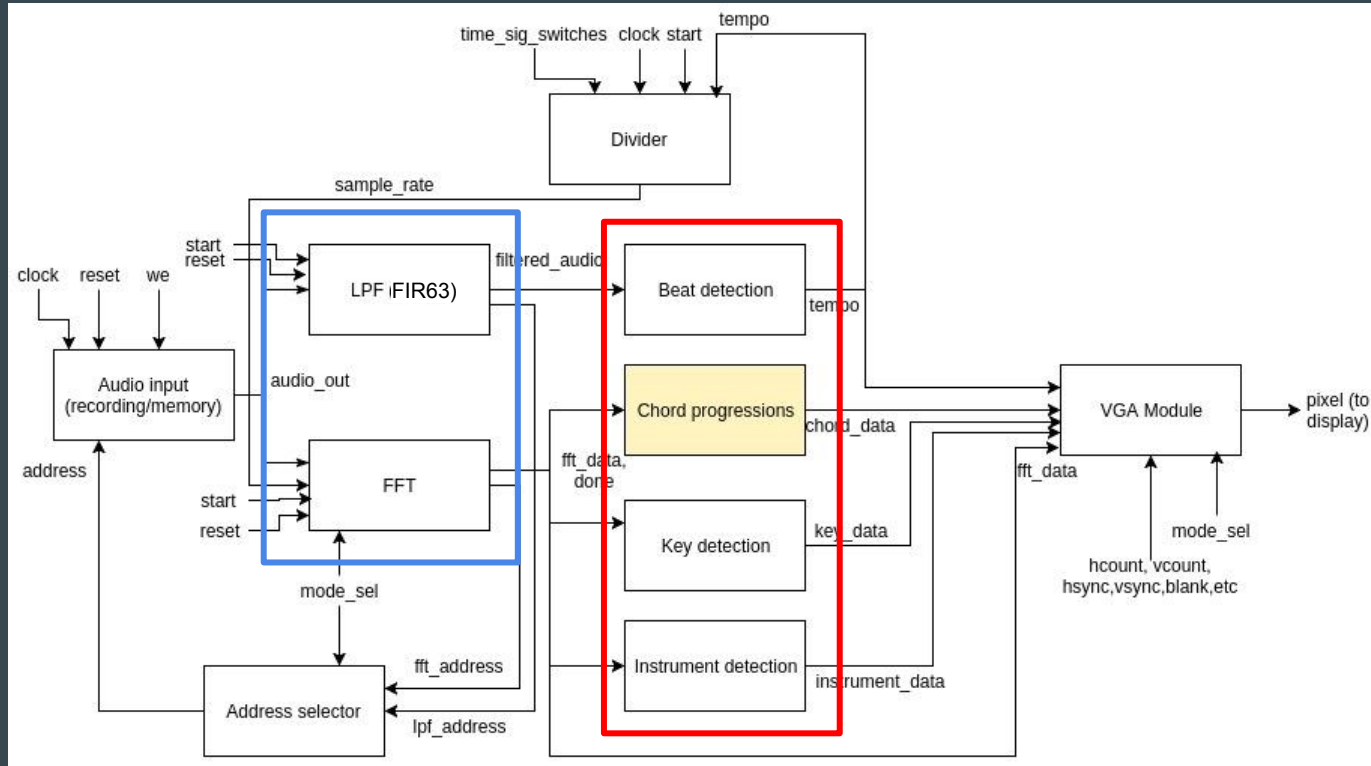


The Music Box™ is a system to analyze pieces of music for their basic components:

- tempo
- time signature (stretch goal)
- key signature
- instrument
- chord progressions (stretch goal)

We will split these functionalities into different modes

# Block Diagram



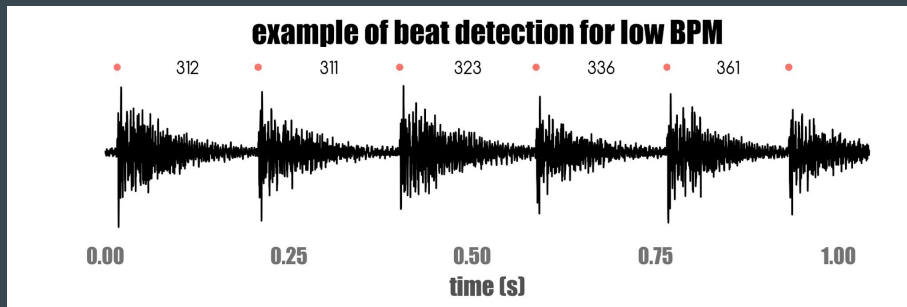
# Low Frequency Signal Analysis

## 63-tap low pass filter at 100Hz for beat detection

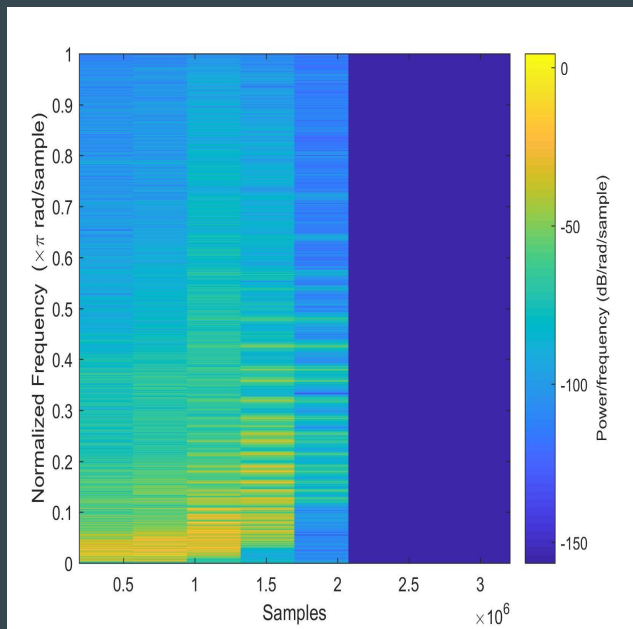
- traditionally, beats are heavier in the bass
- Filter coefficients from MATLAB
- Use peak detection to see at which time each beat happens

## STRETCH GOAL: Time Signature detection

- Stronger beats at start of measure



# FFT Analysis

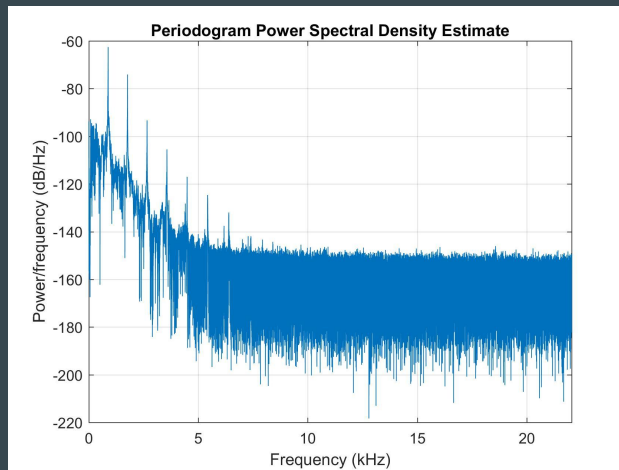


- Short time
  - FFT data on a single note
  - Chord progressions, instrument sampling
- Long Time
  - FFT data on a series of notes
  - Key detection
- Sample Rate
  - Nyquist's Theorem
  - Up to A8 (7040Hz), sample at a minimum of 14.08kHz
  - 48kHz clock, downsample by 3

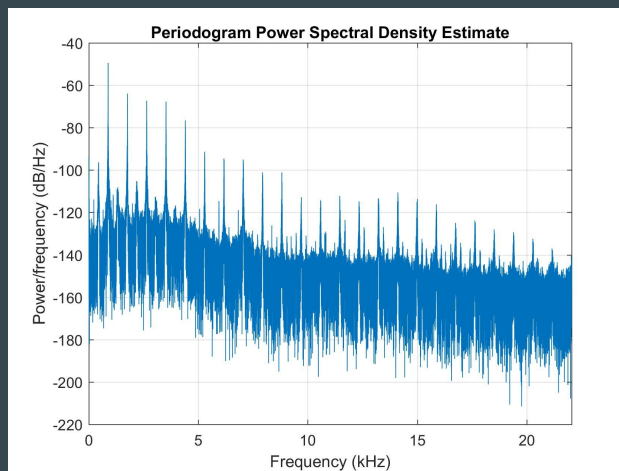
# Instrument Timbre

- **Peak detection:**
  - Number of harmonics
  - Pitch of fundamental
  - Broadly categorise into ‘types’ of timbre (e.g. woodwind, string, keyboard, brass etc.)
- **STRETCH GOAL:** Be able to distinguish between specific instruments.

Piano  
- clear  
timbre



Saxophone  
- woodwind  
timbre



# Stretch Goal - Chord Progression.

- Sample on every beat of the bar
- Small time period FFT
- Isolate fundamentals from harmonics through highest power peaks and predicted harmonics
- Compare to note database and output chord

				Fine	
:	C	Am	F	G7	:
C	F	C	F		
Am	G7	C	G7	C	
G7	C	D7	D7		
F	G7				D.C. al fine

# Display Output

## Beat detection

- display metronome mark, and time signature if applicable



## Key signature

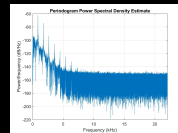
- display the most likely key, list the notes we identified in the piece

Key: A major  
Notes:  
A,C#,D,E,F#,G#

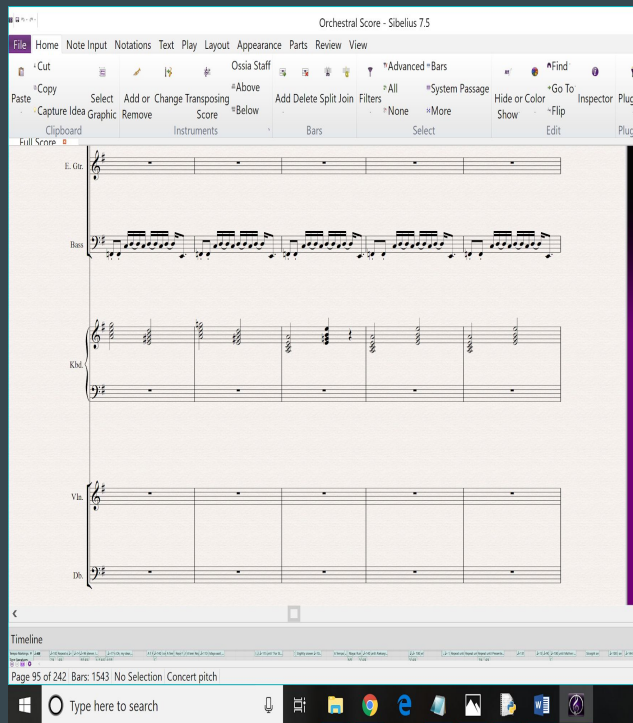
## Instrument

- instrument, FFT, and number of harmonics

Instrument:  
Piano  
# harmonics:  
6







# Testing

## Sibelius:

- Tempo detection: heavy beats
- Key detection: no modulations or accidentals
- Instrument detection: only one instrument

## MATLAB:

- Fourier transform function to debug

**STRETCH GOAL:** use with live instruments using microphone

# Timeline

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
11/12 CHECKLIST MEETING		Presentation			Revised Proposal (if necessary)		
11/19			FFT LPF	Thanksgiving			
11/26		Beat Detection	Instrument detection		Key		Display
12/03					Stretch Goals and polished		
12/10	Checkoff/ Video		Project Report				

**Thanks!**  
**Questions?**

