

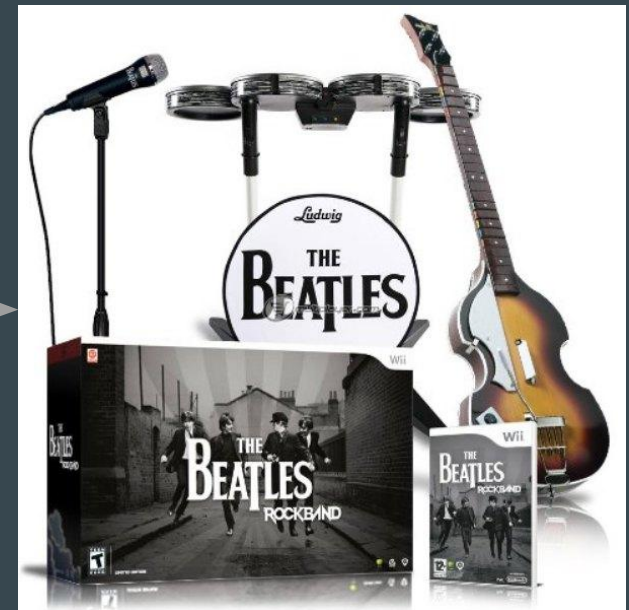
# Guitar Hero: Fast Fourier Edition



A 6.111 Final Project by Mitchell Gu and Ryan Berg

# The Guitar Hero Sensation

- Harmonix founded in 1995 at the MIT Media Lab and eventually developed the first Guitar Hero game
- The genre became wildly popular, resulting in a wide array of games.



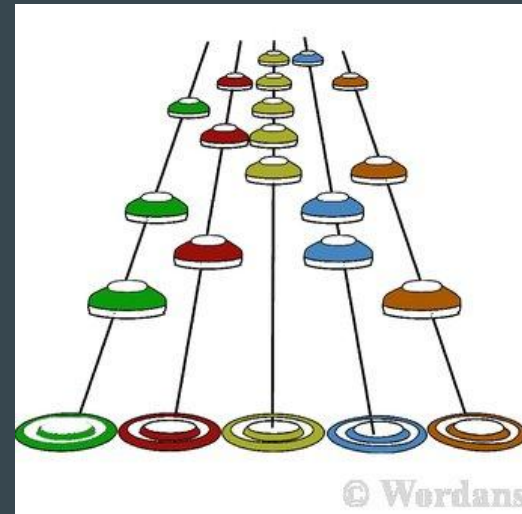
# Limitations of the old Guitar Hero model

- Lacking in realism
- Lacking in song flexibility
- Limited education value



# Why our idea solves these problems

- Uses an actual guitar, rather than a guitar-shaped controller
- Actual guitar tablature (a common form of writing music for guitar) is played, instead of an arbitrary 5-note model of music.
- The only difference between our game and actually playing a guitar is the addition of a graphic interface and scoring.



The interface for rhythm-based guitar games

	A min	A min maj <sup>9</sup>	A min	D	F maj <sup>7</sup>	G	A min						
RIFF 1													
E	5	5	7	7	8	8	2	2	0	0	3	0	0
B		5		5		5		3		1	1	1	3
G	5		6	5		5		2		2	1	1	2
D	7	7	6	6	5	5	0	0	3				0
A													2
E													3

An example of actual guitar tablature

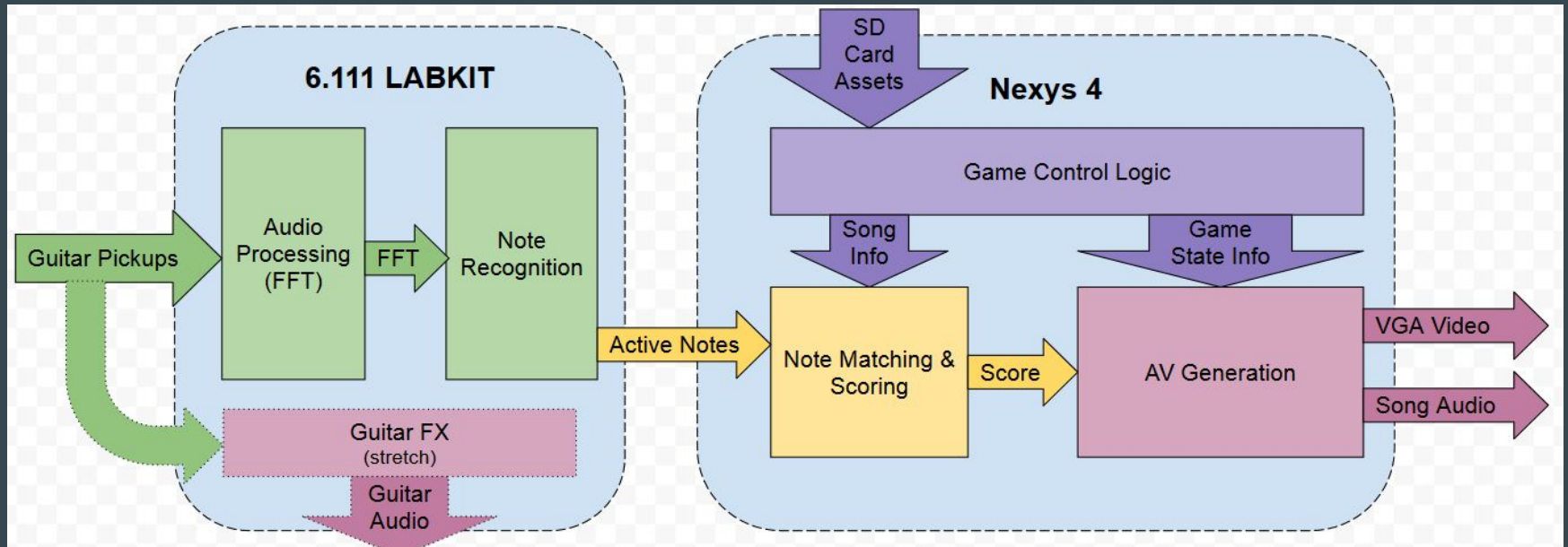
# Motivation

The two of us both love playing guitar and want to build on the entertainment value of current guitar-based rhythm games while also making guitar accessible to more people.

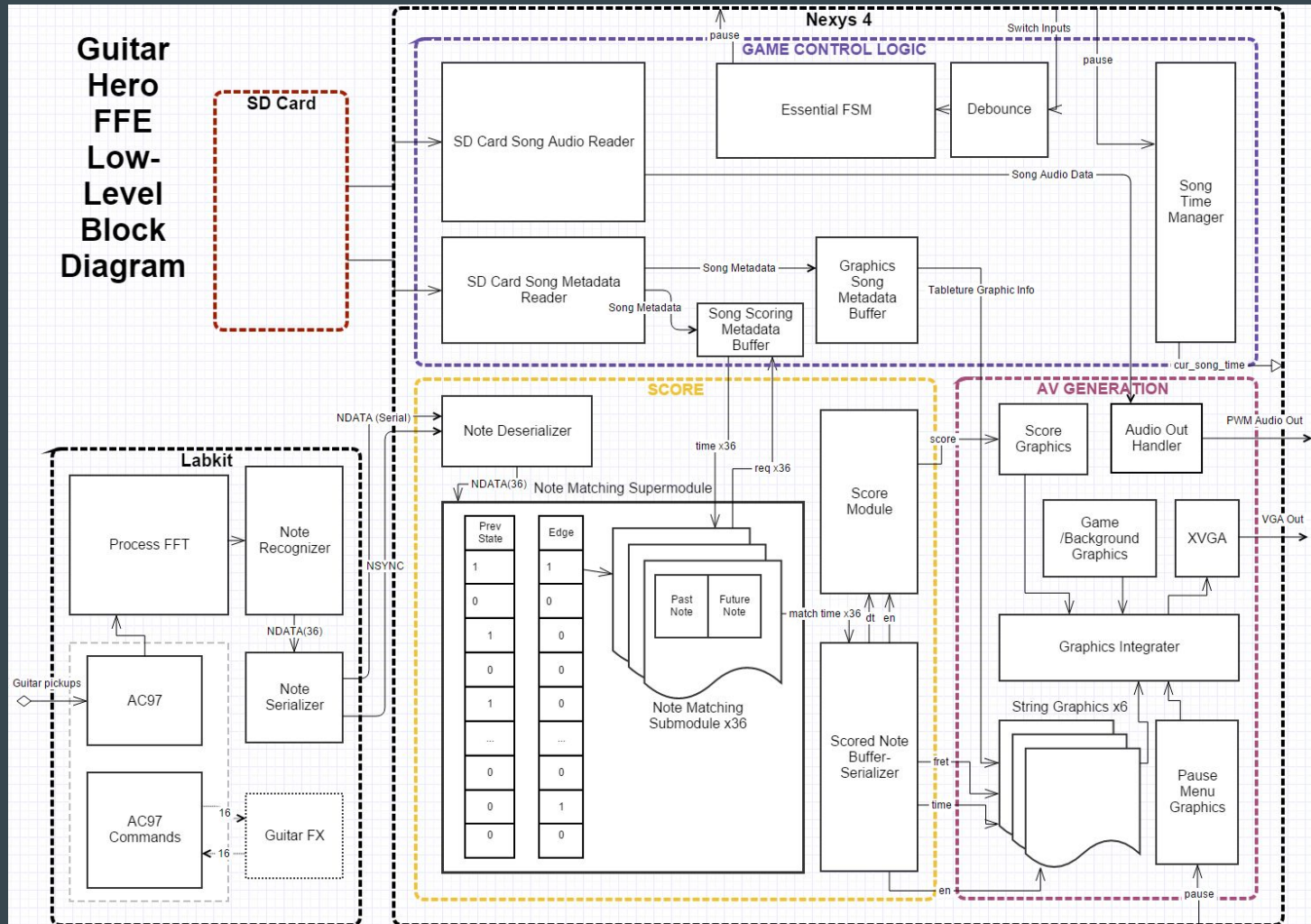
This project is also a great opportunity for us to learn about working in the frequency domain, developing concurrently, and integrating many systems together.



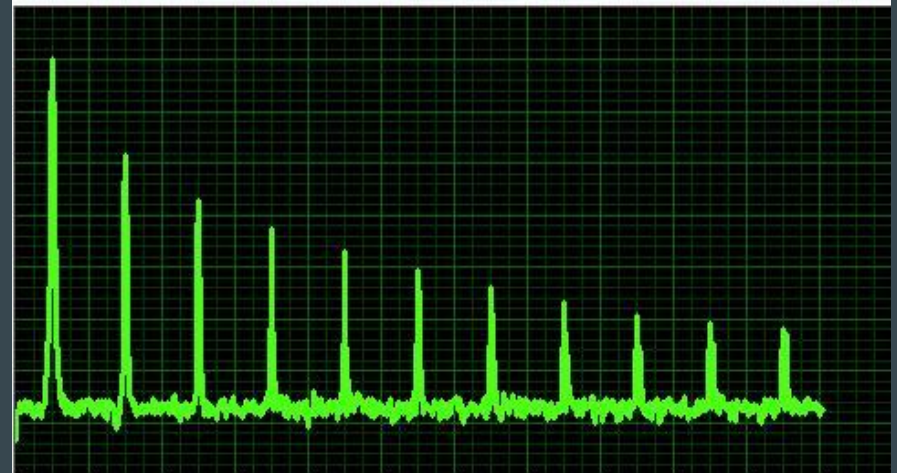
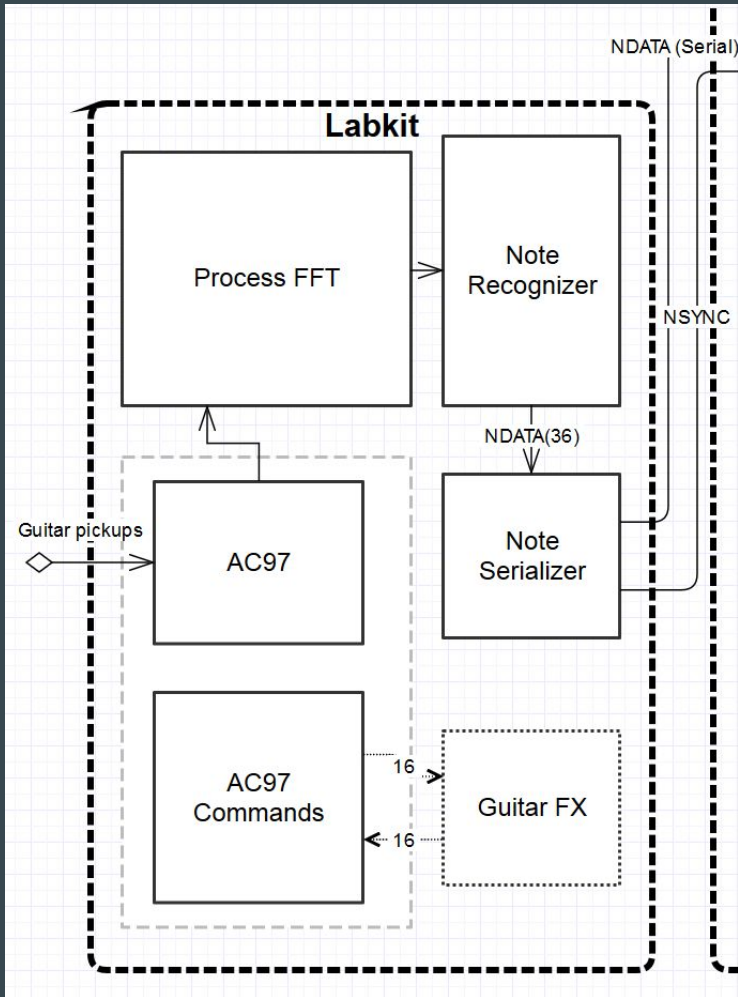
# High-level Project Design



# Low-level Implementation

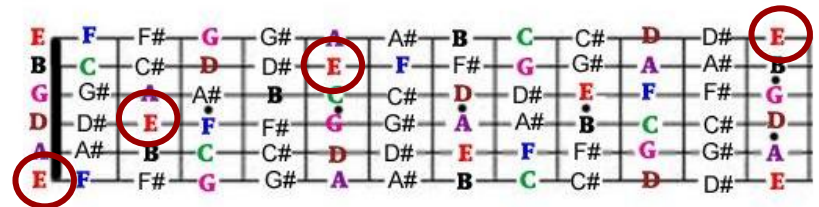


# Audio Processing + Note Recognition on the labkit



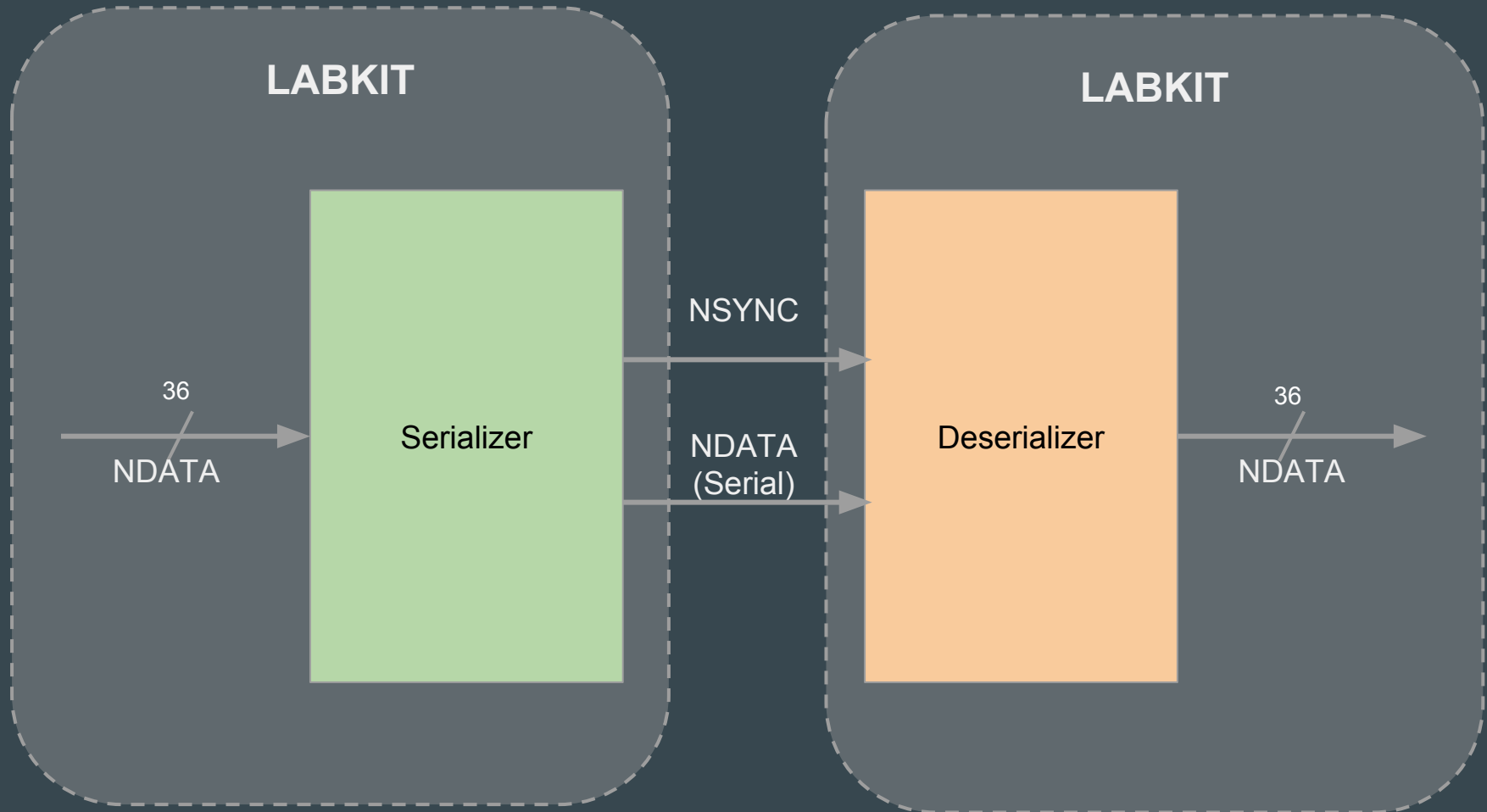
Target range: E2 to E5  
 (3 octaves, 12 half-step each for 37 total notes)  
 Corresponding frequencies: 87 Hz to 659 Hz

## Guitar Fretboard

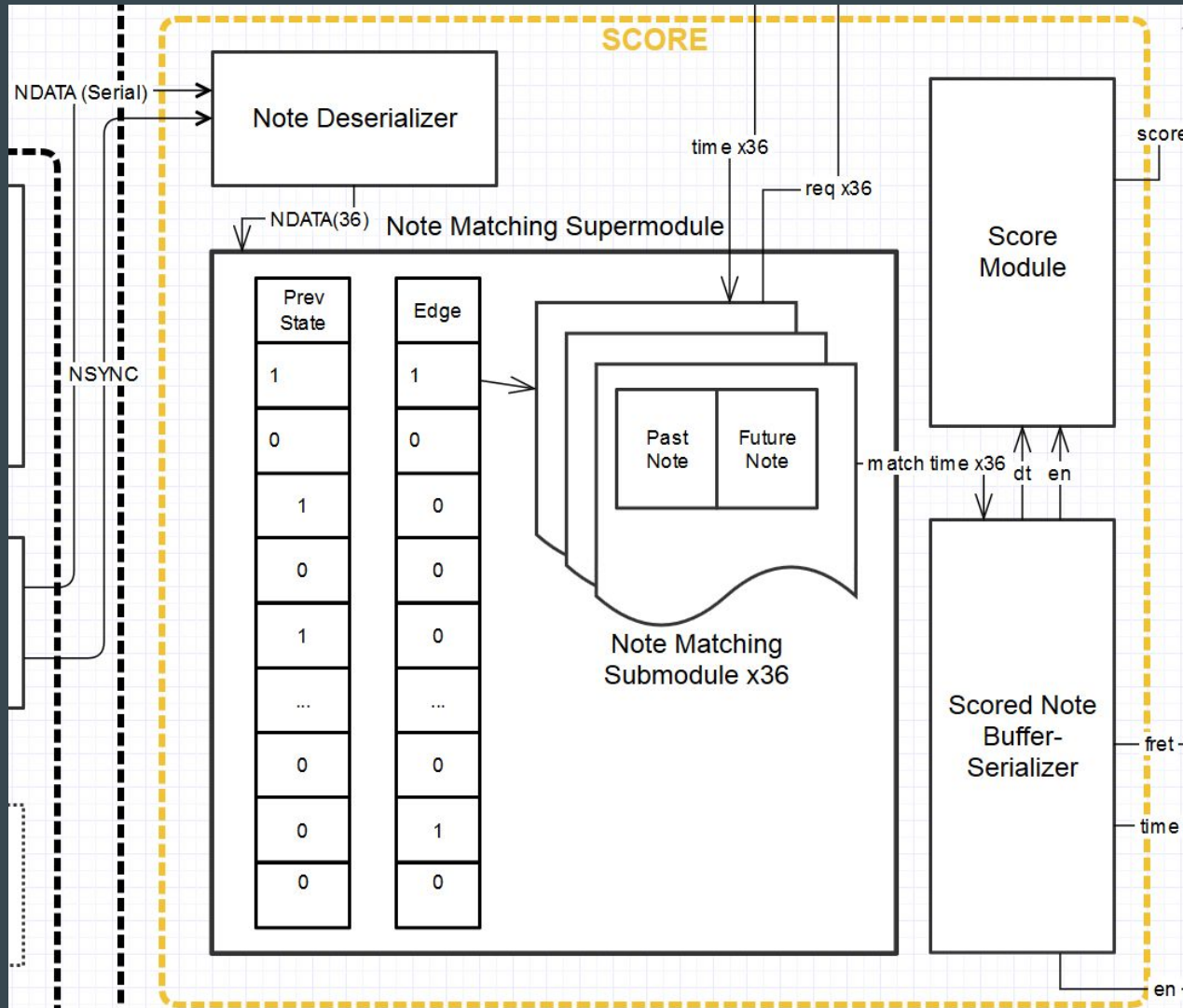




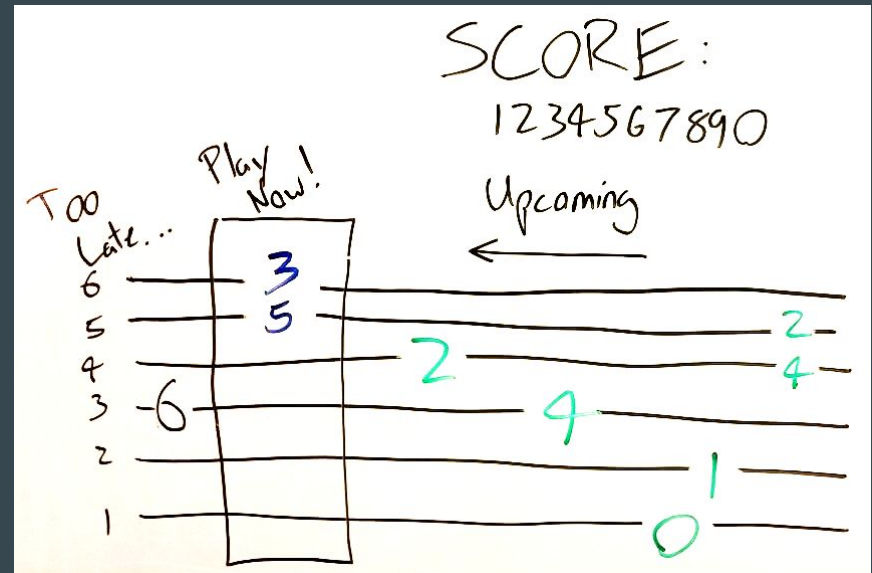
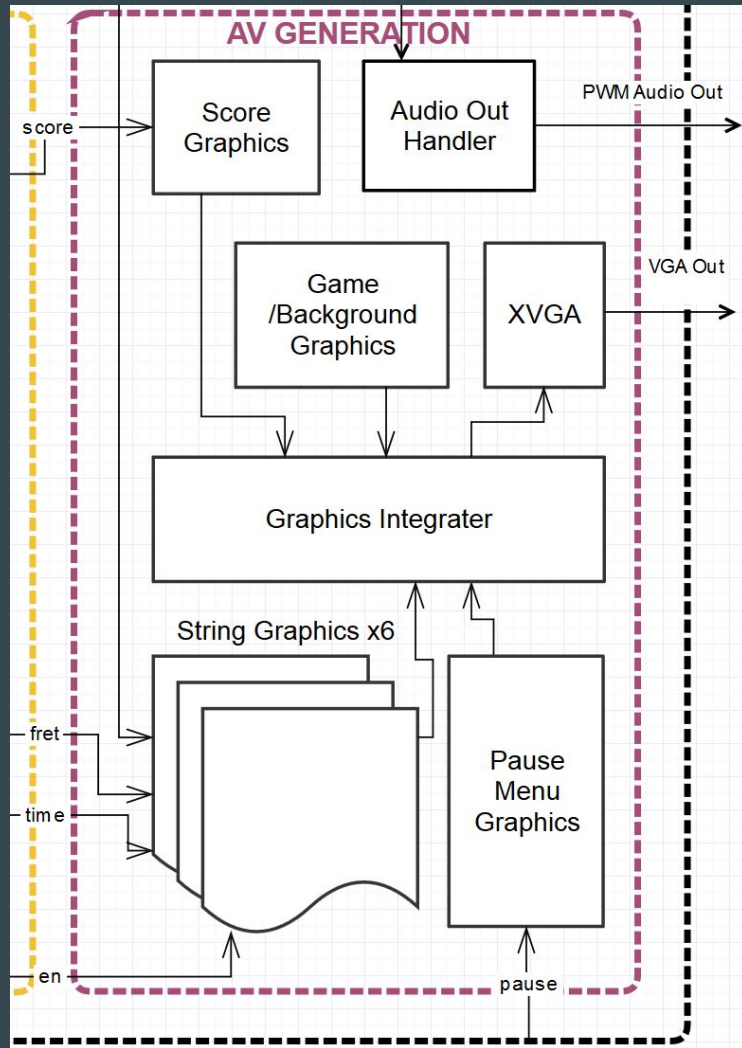
# Serialization and Deserialization: Labkit to Nexys4



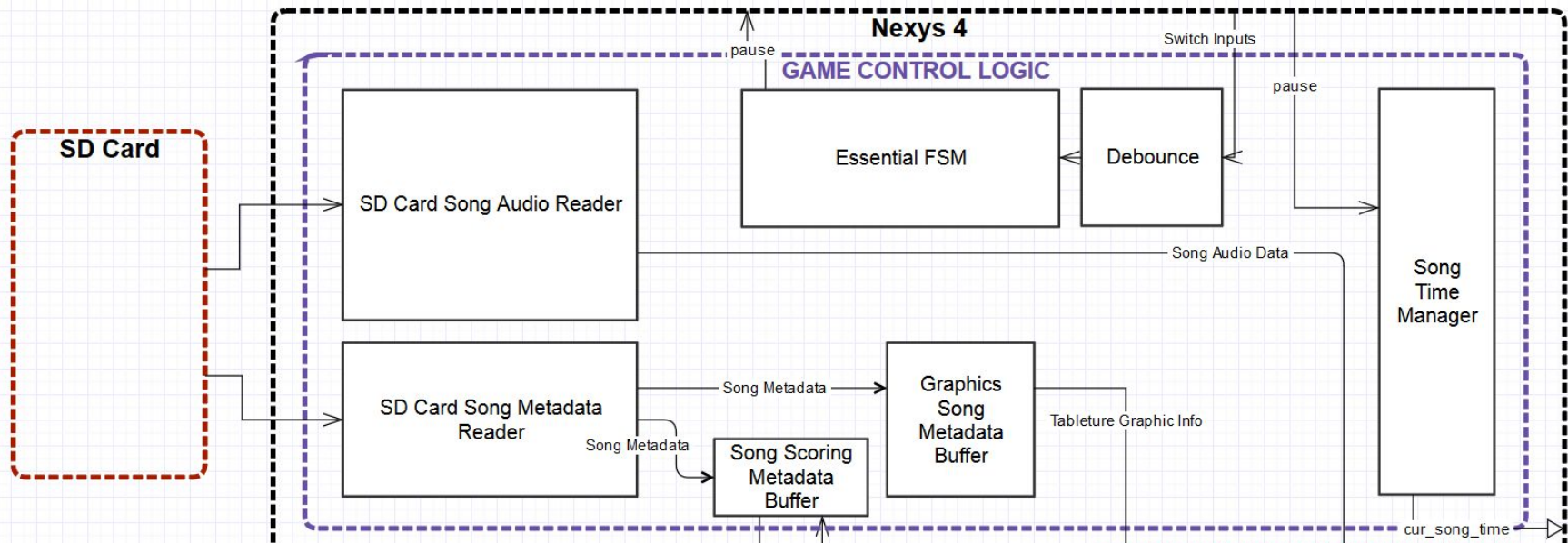
# Note matching on the Nexys 4



# Graphics modules on the Nexys 4



# Game Control Logic on the Nexys 4

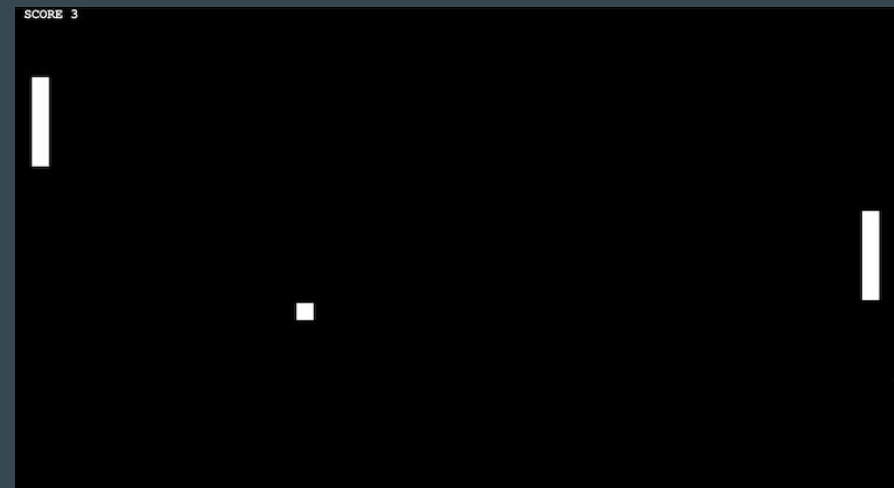
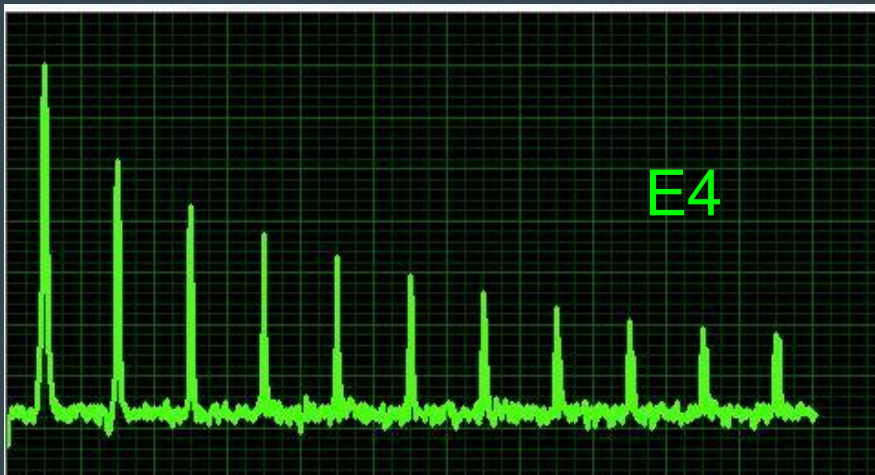
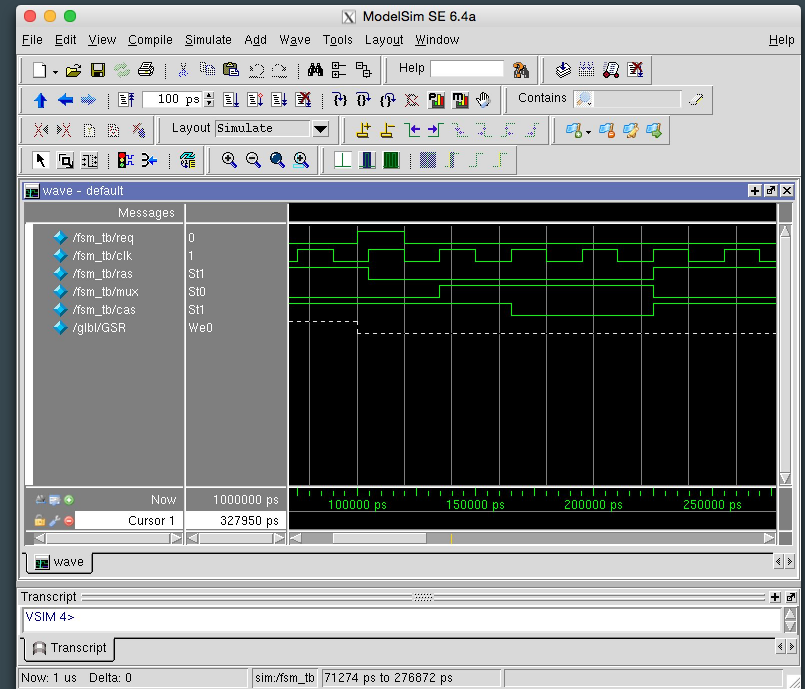


# Timeline

	11/2/2015	11/9/2015	11/16/2015	11/23/2015	11/30/2015	12/7/2015
1) Scoring Module	M	M				
2) FFT/Note Recognition	M	M	M			
3) Functional AV		R	R			
4) Serialization/deserialization			M			
5) Game Control Logic			R	R		
6) Integration, testing				A	A	
7) Completed SD Card Song/Metadata					R	
8) Buffer Time/ Stretch Goals					A	
9) Project demo, final checkoff						AAAHHH

# Testing

Since we are using both a labkit and a Nexys 4, we can concurrently develop modules and test each of them to be more time-efficient.



# Resources

We need two 3.5mm male -> 1/4in female audio connectors (~\$3 each on Newegg). We both already have guitars, amps, cables, etc.



We need the prebuilt Verilog for a Labkit FFT, for reading/writing to an SD card with the Nexys4, and for generating PWM audio output with the Nexys4.