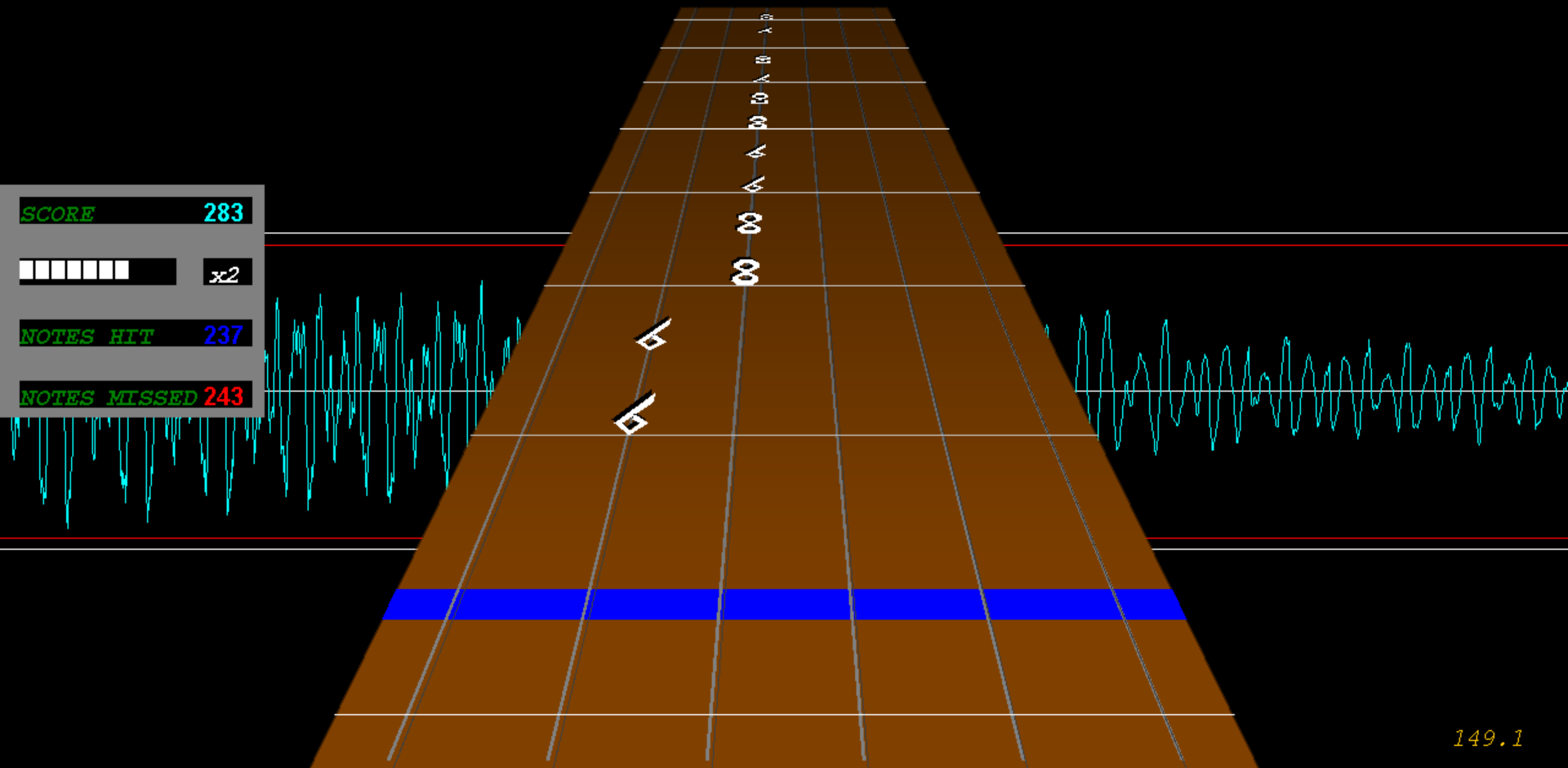


Guitar Geek!

Boys of Summer
Don Henley



149.1

Inspiration: Guitar Hero

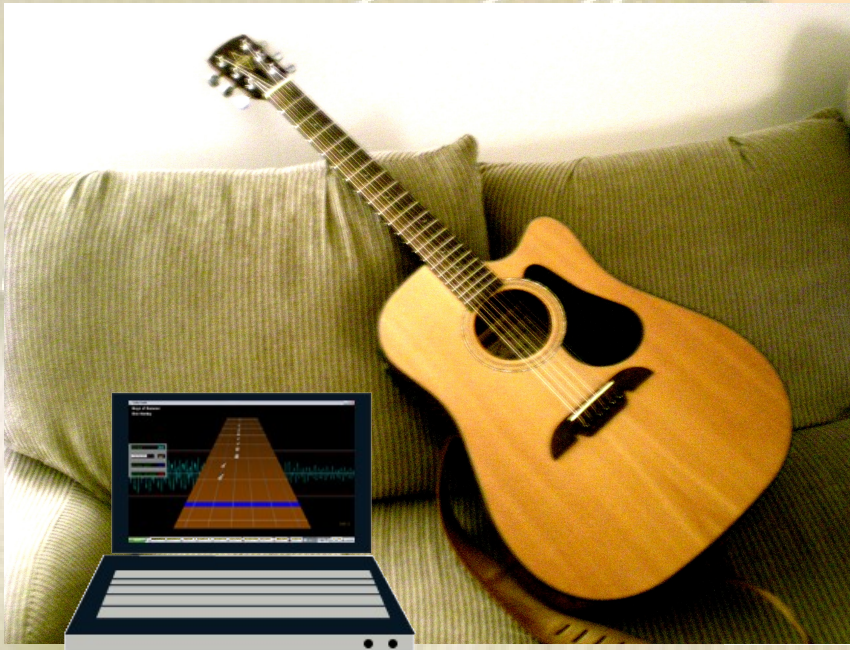
- Guitar Geek is a video game based on the popular, yet unrealistic, rhythm game Guitar Hero.
- In Guitar Hero, the player scores points by pushing colored buttons on a guitar-shaped controller at the right time.



Guitar Geek vs. Guitar Hero

- Real guitar
- 6 strings and 20+ frets
- Teaches people how to play songs on guitar

- Plastic controller
- 5 fret buttons
- Zero strings
- “Beating Guitar Hero doesn’t mean you play guitar!” – MC Lars



Gameplay of Guitar Geek

- Display shows tablature numbers scrolling down along a conveyer belt, representing chords that are played on the guitar.
- When the bottom of the tab numbers reach the line, the player is supposed to play the chord represented by the tab numbers.
- Player scores points by hitting the correct chords at the correct time.

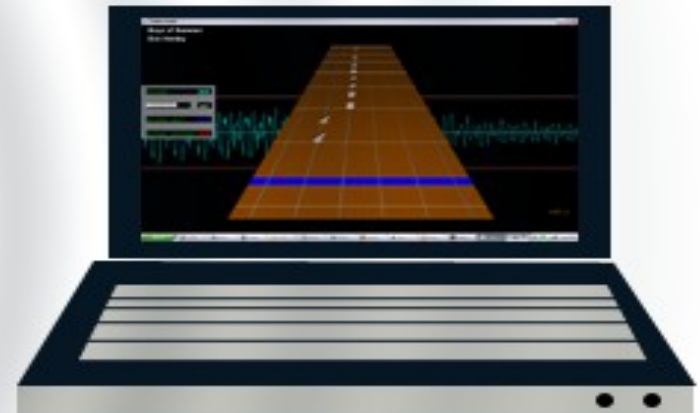
Some musical terminology

- Pitch: a frequency of oscillation.
- Note: an instance of playing a particular pitch.
- Chord: a group of notes played simultaneously.



How it works

- By plucking the strings on the guitar, a mechanical vibration occurs.
- This vibration is converted into an analog electrical signal through either a pickup or a microphone.
- The analog signal is converted to digital in the computer's sound card

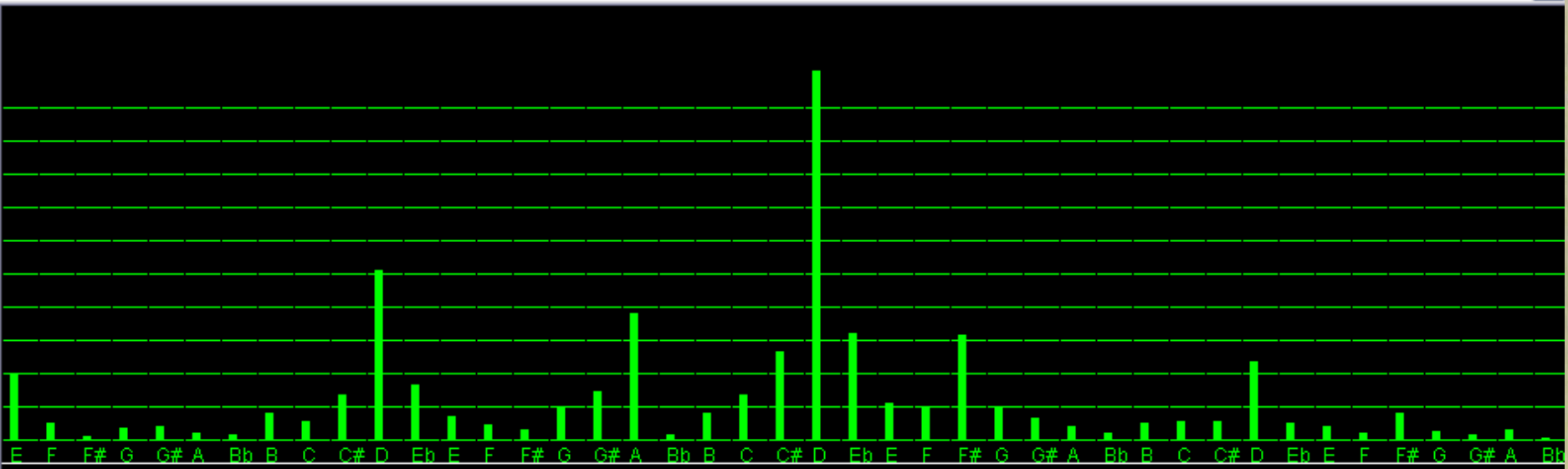


How it works

- The software takes in the digitized data, and must analyze the following:
 - Pitch determination: What chord or note is being played?
 - Rhythm determination: When was the chord or note played?
- If the right chord was hit at the right time, then the player scores points.

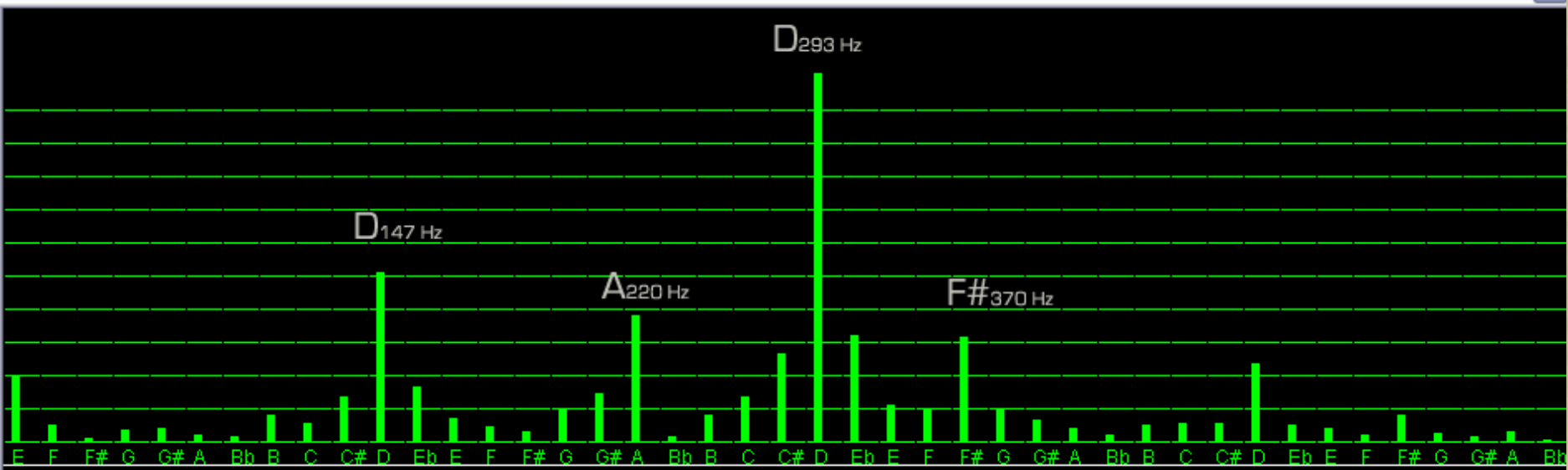
Pitch Determination

- A real-time Fast Fourier Transform is used for determining the note or chord being played. The following shows the FFT results for a D major chord (xx0232)



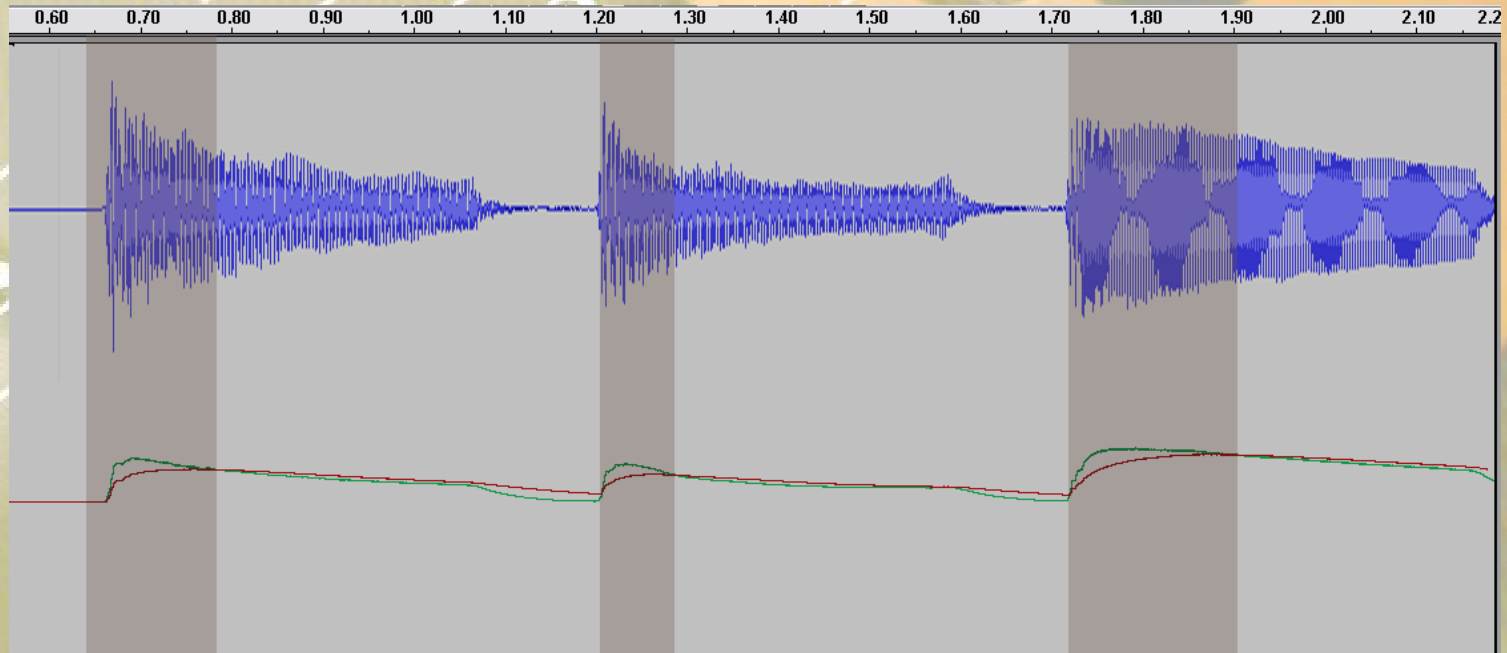
Pitch Determination

- A real-time Fast Fourier Transform is used for determining the note or chord being played. The following shows the FFT results for a D major chord (xx0232)
- Note that the peaks of this diagram correspond to the notes in the chord.



Rhythm determination

- The loudest part of a note is usually just after the string is plucked.
- My algorithm for determining when the note was played involves comparing two estimations of the RMS amplitude, one with a long latency, the other with a short latency.

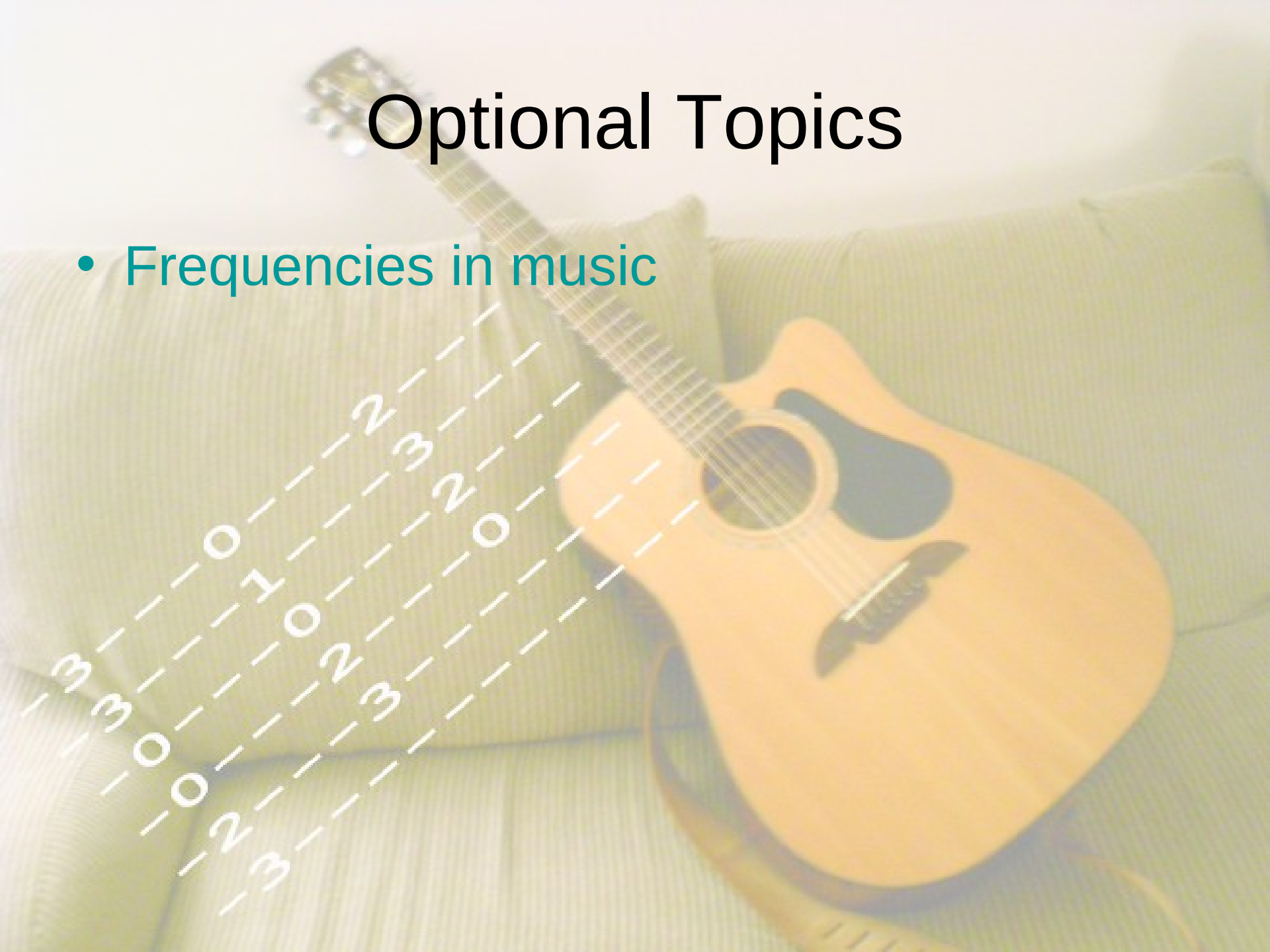


How it works (summary)

- By using the sudden increase in overall RMS value for determining the correct rhythm, and the resonance of the FFT to determine pitch, GG can determine whether or not the correct note is being played at the correct time.

Optional Topics

- Frequencies in music



Frequencies in Music

- Every note has a fundamental frequency. Other frequencies present in the note are considered “overtones”.
- On stringed instruments (such as the guitar), the overtone frequencies of a note are integer multiples of the fundamental frequency.
- Higher notes have a larger fundamental frequency than lower notes

Frequencies in Music

- In music, the frequencies of notes are usually represented by a logarithmic scale, wherein intervals are defined by the ratios of the frequencies, not by the differences of the frequencies.
- Two notes are one “octave” apart if the ratio between their frequencies is 2:1.
- One octave can be broken into 12 “semitones”
- The fundamental frequency of any given note is given by:

$$f = \left(\sqrt[12]{2} \right)^{p-57} * 440 \text{ Hz}$$

where p is measured in semitones.

- (the convention used in Guitar Geek is that p = 57 represents the first A above middle C, which is defined to be 440 Hz)

Frequencies in Music

- The positions of the frets on the guitar are placed such that stopping the string at a given fret will raise the pitch by one semitone.
- Therefore, the expected fundamental frequency of a note on the guitar is given by:

$$f_{fretted} = \left(\sqrt[12]{2} \right)^{fret} * f_{open}$$

- Where $f_{fretted}$ is the frequency of the fretted note, and f_{open} is the open frequency of the string, and $fret$ is the fret number