We created an **app** so that musicians can learn **absolute pitch** and **relative pitch** by training **sound-color associations.**

Background

The world of music learning is vast and largely underdeveloped. Because of this, music teachers largely teach their students how to play instruments and not how to develop generalized music skills. At the same time, one of the most important aural skills, absolute pitch (AP), is thought to be unteachable and entirely genetic. Those of us who have this extremely rare ability are "destined" to be the next greatest musician, while others are doomed to study for years and never acquire it. Similarly, synesthetes are often said to be the next best artists and creatives. Interestingly, these genetic conditions may not be unteachable after all. If they can be taught in tandem to many millions of students around the world, this could potentially lead to a worldwide creative boom for music and the arts

Terms

- Synesthesia is a neurological condition where an individual experiences a cross-wiring of two or more senses (Rothen et al, 2014).
- Chromesthesia is one kind of synesthesia where each musical note in the octave most prevalent in music which they were exposed at an early age to has its own color. Because synesthetic experiences are automatic and consistent, this means that the colors that notes elicit are consistent as well (Bor et al, 2014).
- Relative pitch (RP) is a form of pitch memory where each note is known in relation to another note.
- Absolute pitch (AP) is a form of pitch memory where no reference note is needed to identify any other note.

Methodology

This study introduces Chroma, a mobile application with a novel approach towards music learning for worldwide use. Chroma is comprised of four main screens: The testing screen, the augmented reality (AR) screen, the color selection screen, and the data screen. Teaching music learners chromesthesia via this application may have a significant impact on their aural skills because it could lead to training absolute pitch (AP), a highly-coveted musical skill previously thought to be "unteachable" due to its genetic components. Because these color responses are automatic and consistent, the chromesthete may be able to identify any given note by its color.
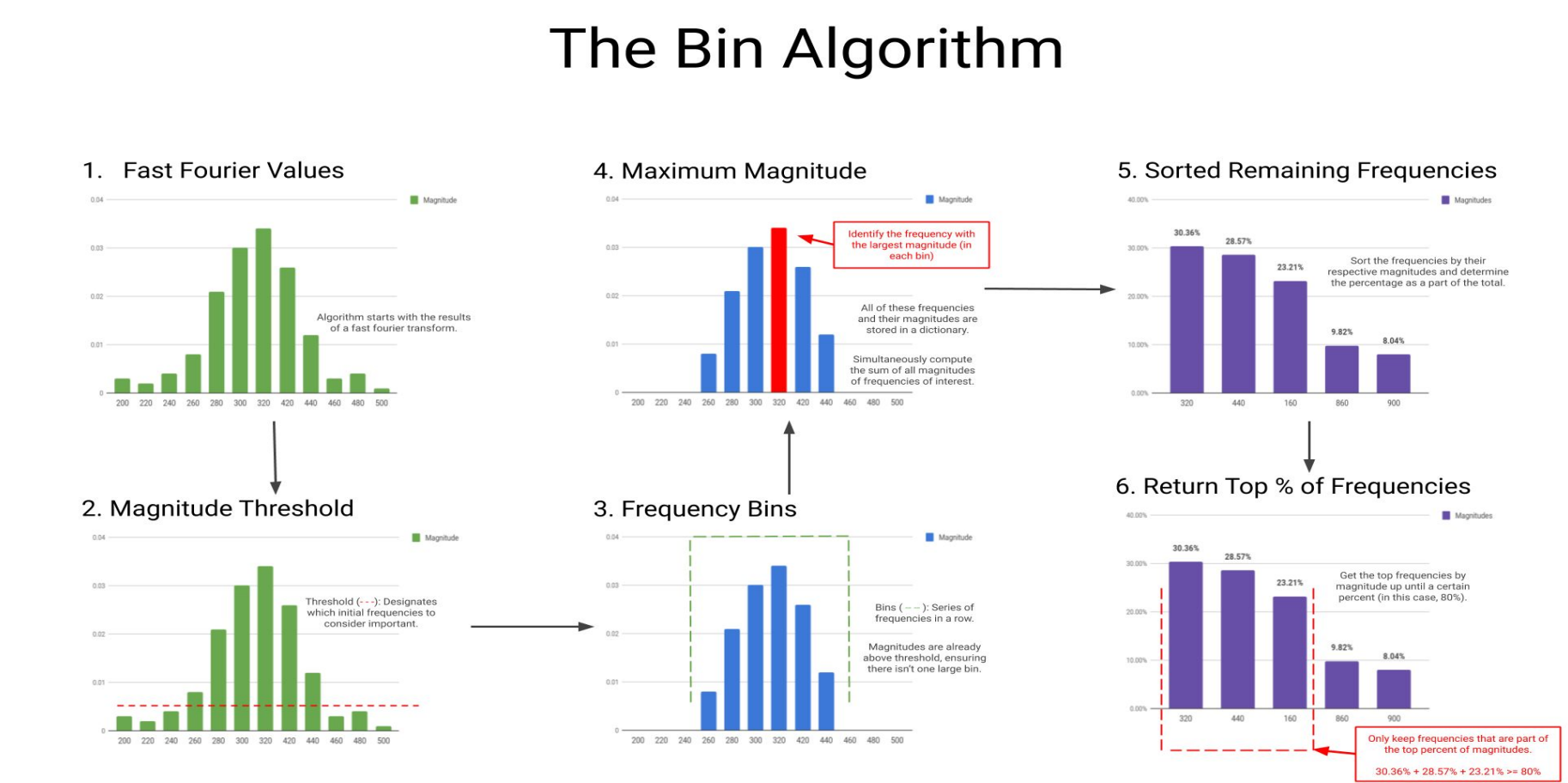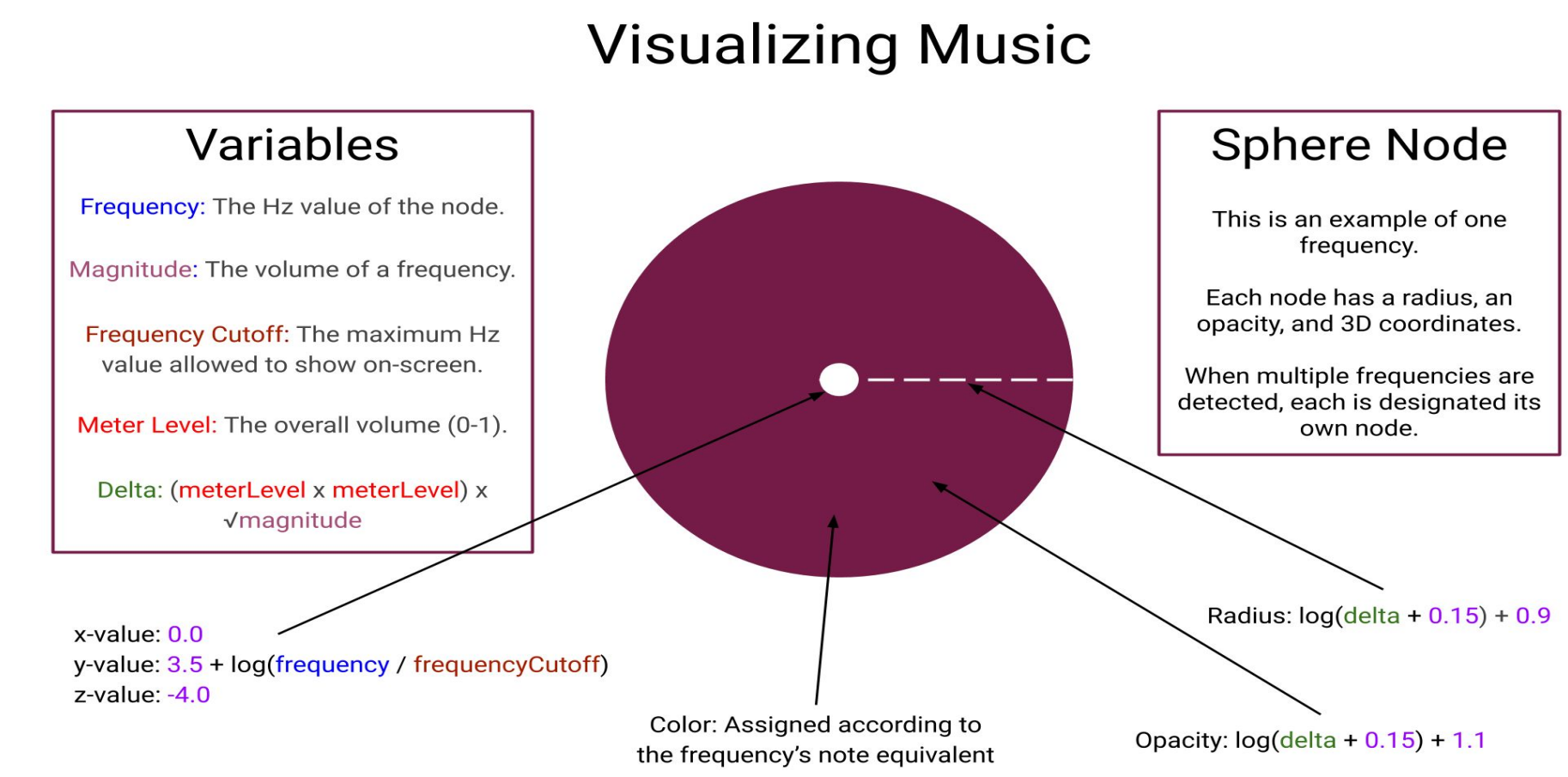

Credit: https://en.wikipedia.org/wiki/Chromesthesia
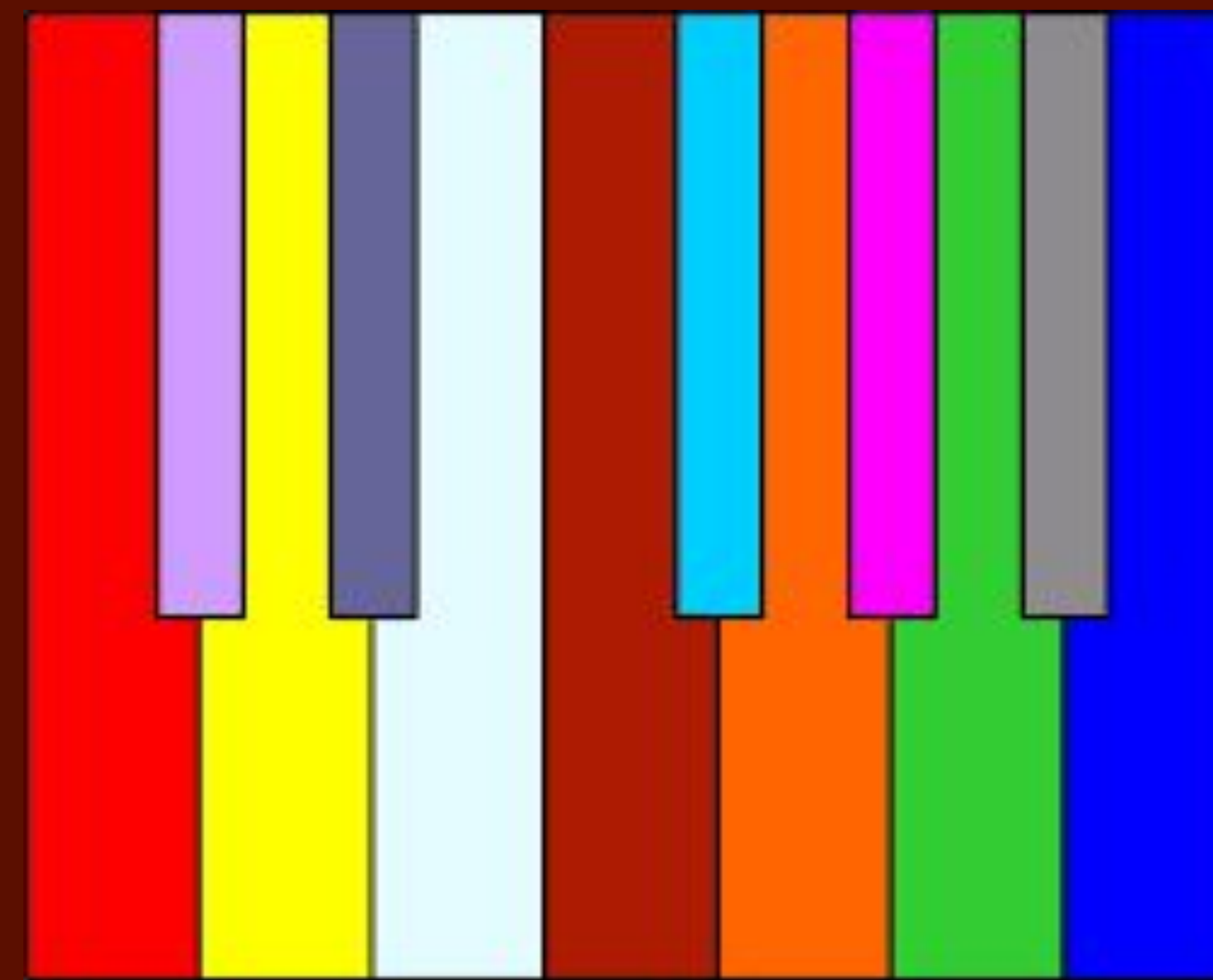
One representation of a chromesthete's sound-color associations visualized on a piano.

Notice that the colors are all different, but are *consistent* and *automatically* generated

Facts and Figures

Visualizing Music

Variables

Frequency: The Hz value of the node.

Magnitude: The volume of a frequency.

Frequency Cutoff: The maximum Hz value allowed to show on-screen.

Meter Level: The overall volume (0-1).

Delta: (meterLevel x meterLevel) x √magnitude

x-value: 0.0
y-value: 3.5 + log(frequency / frequencyCutoff)
z-value: -4.0

Sphere Node

This is an example of one frequency.

Each node has a radius, an opacity, and 3D coordinates.

When multiple frequencies are detected, each is designated its own node.

Radius: log(delta + 0.15) + 0.9

Color: Assigned according to the frequency's note equivalent

Opacity: log(delta + 0.15) + 1.1

The Bin Algorithm

Timeline

The app will be completed by the end of January. We plan to use our budget to purchase an Apple Developer license to publish the application to Apple's App Store, where the test groups will be able to download the app for free. We will begin with a pilot test of the application in the Spring of 2020. Our target sample for this study is Piano 1 students. We anticipate using the results to tune the app for the main test in Fall 2020, which will be targeted at the same demographic.

References

Bor, Daniel, et al. "Adults can be trained to acquire synesthetic experiences." Scientific reports 4 (2014): 7089.

Rothen, Nicolas, and Beat Meier. "Acquiring synaesthesia: insights from training studies." Frontiers in human neuroscience 8 (2014): 109.

Full list available upon request.

Developing a Mobile Application to Facilitate Aural Training and Synesthetic Experiences

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