Music and Sensorimotor Coupling: What Music Is Groovy?

Zachary Brandt

Some music allows for synchronous rhythmic entrainment

- Toe tapping / head bobbing
- 148 Songs
- Tempo between 90 & 120
- High syncopation

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Sensorimotor Coupling in Music and the Psychology of the Groove

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The urge to move in response to music, combined with the positive affect associated with the coupling of sensory and motor processes while engaging with music (referred to as *sensorimotor coupling*) in a seemingly effortless way, is commonly described as the feeling of being in the groove. Here, we systematically explore this compelling phenomenon in a population of young adults. We utilize multiple levels of analysis, comprising phenomenological, behavioral, and computational techniques. Specifically, we show (a) that the concept of the groove is widely appreciated and understood in terms of a pleasurable drive toward action, (b) that a broad range of musical excerpts can be appraised reliably for the degree of perceived groove, (c) that the degree of experienced groove is inversely related to experienced difficulty of bimanual sensorimotor coupling under tapping regimes with varying levels of expressive constraint, (d) that high-groove stimuli elicit spontaneous rhythmic movements, and (e) that quantifiable measures of the quality of sensorimotor coupling predict the degree of experienced groove. Our results complement traditional discourse regarding the groove, which has tended to take the psychological phenomenon for granted and has focused instead on the musical and especially the rhythmic qualities of particular genres of music that lead to the perception of groove. We conclude that groove can be treated as a psychological construct and model system that allows for experimental exploration of the relationship between sensorimotor coupling with music and emotion.

Keywords: synchronization, beat, rhythm, popular music, emotion

Humans have a proclivity to move with music. Whether it is through the subtle marking of time by means of miniscule head bobs or toe taps or through elaborate dance moves, the engagement of people's motor systems while listening to music is commonplace and seems to have an almost automatic, irresistible quality to it. Moreover, engagement of the brain's action systems while listening to music appears to support a pleasing psychological state for the individual, the need to suppress urges to move in socially inappropriate settings notwithstanding. Because this sensorimotor coupling seems to be one of the most widespread ways in which people engage with and enjoy music—it is a common component of strong experiences with music (Gabrielsson & Lindstrom Wik, 2003)—there is a compelling case to be made for developing an empirical understanding of this phenomenon that spans multiple levels of analysis—from phenomenological to neural. Our goal is to establish this phenomenon as an object of study in psychology. To this end, we take a broad and integrative approach, described at the end of the introduction, to show that the basic principles of the phenomenon can be observed and quantified at several levels of analysis.

To discuss the phenomenon, it helps to give it a label. We refer to it as the *groove*. We recognize that the same underlying phenomenon might be described using a number of synonyms, but as we show later, the term *groove* exists in common parlance with a connotation that captures what we believe are critical elements of the phenomenon. The term has also existed within academic circles for some time, primarily within the musicology and ethnomusicology domains (Keil & Feld, 1994; Pressing, 2002); therefore, its exploration within psychology and neuroscience seems appropriate. Within the musicology and music theory domains, the term *groove* typically refers to rhythmic properties of pieces of music and/or the timing relationships of actions of individuals interacting with the music (Iyer, 2002; Keil & Feld, 1994; Pressing, 2002). For example, Keil and Feld (1994) regard *participatory discrepancies*—deviations from precise metronomic timing relationships—as a central source of groove. From a more psychological yet related perspective, Pressing (2002) described groove as "a kinetic framework for reliable prediction of events and time pattern communication" (p. 285), in which perceptual and productive rivalries are established against this framework. Finally, the psychological construal of groove as a sensorimotor phenomenon with an affective component has started to be examined (Madison, 2006), albeit mainly from a perceptual rather than experiential point of view, as has the closely related concept of *flow* (de Manzano, Theorell, Harmat, & Ullen, 2010).

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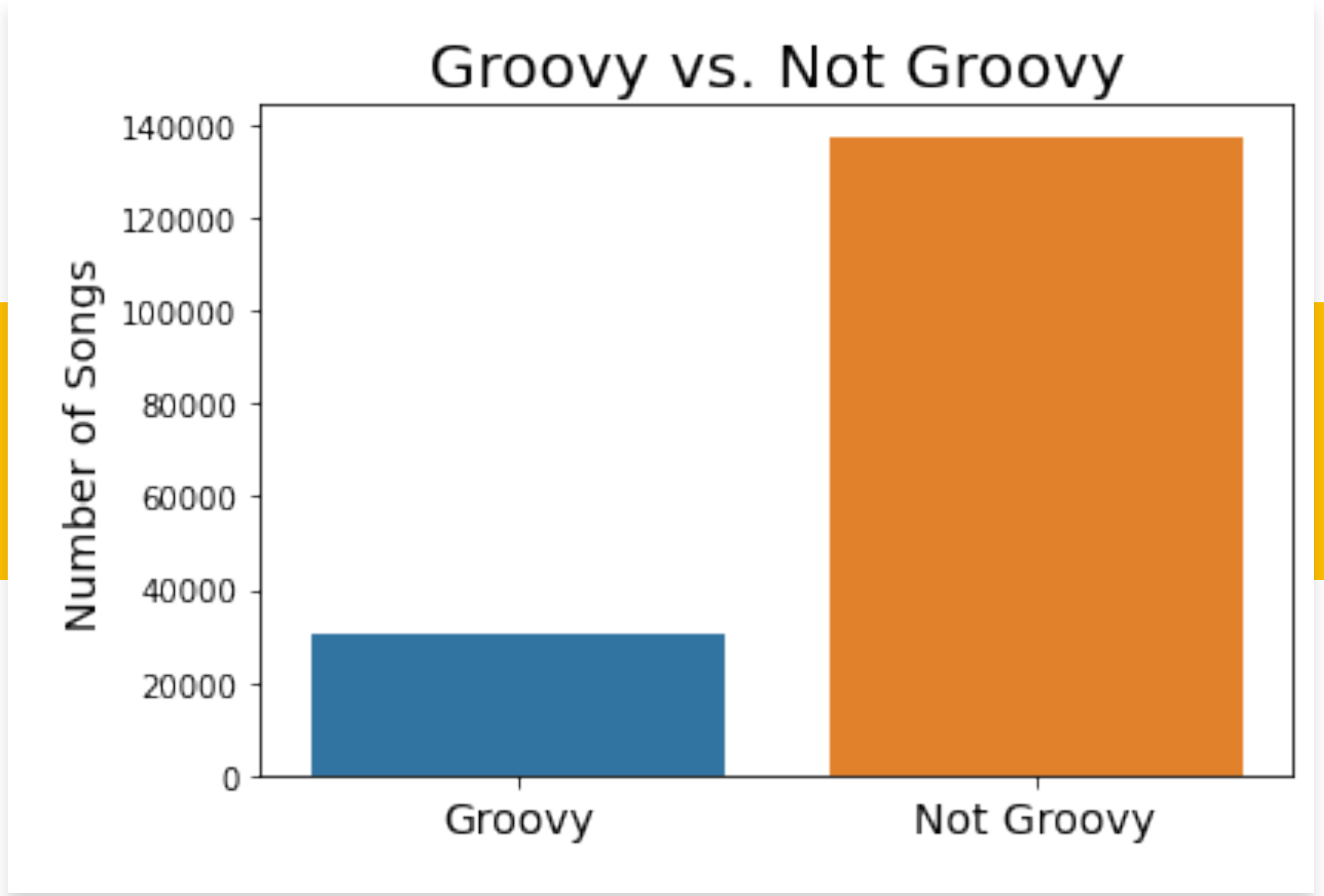
Applying Groovy Classification to Spotify Database Using API

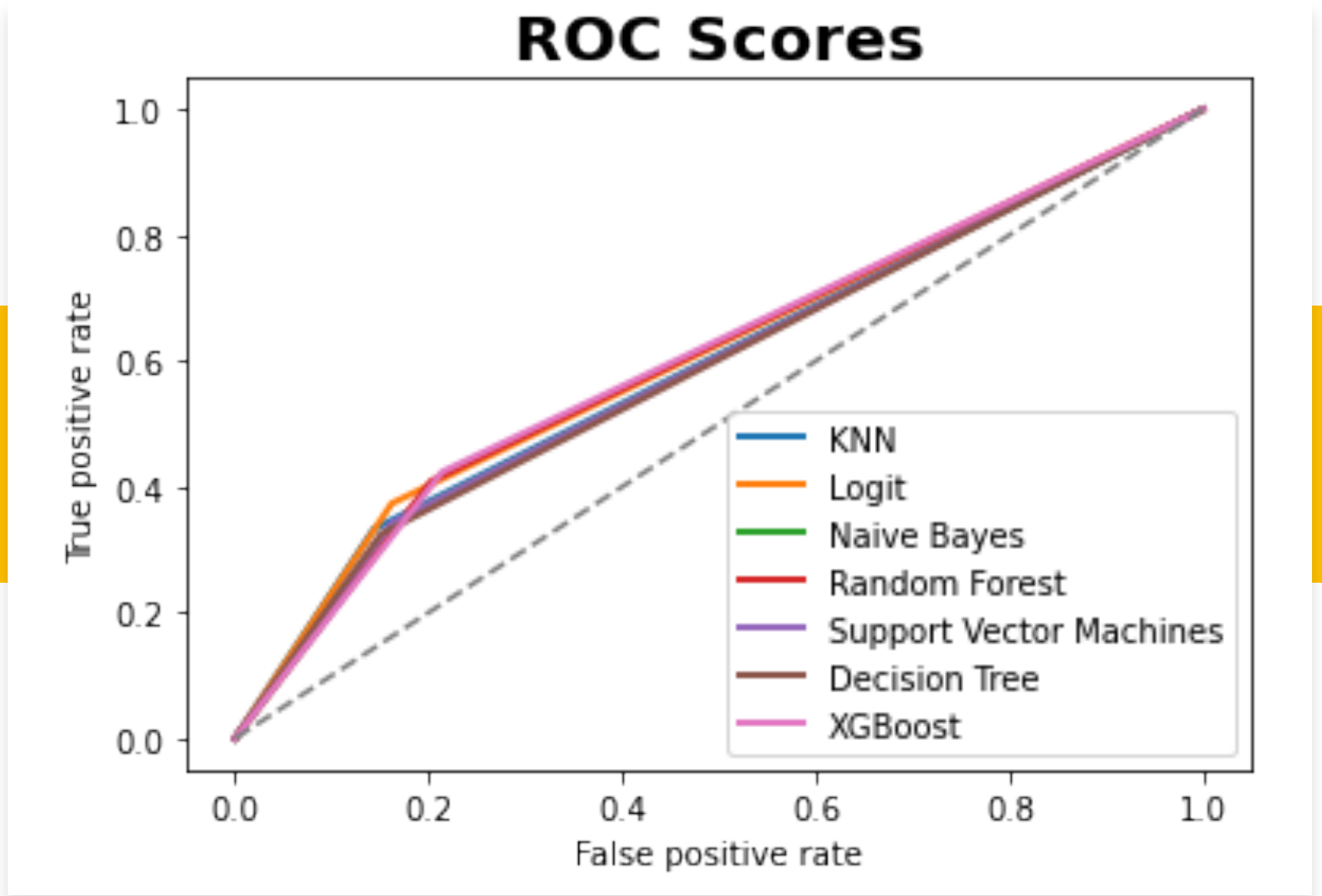
- 160,000+ Songs
- Target Created from Thresholding Existing Features

- Features
  - Duration
  - Instrumental-ness
  - Acoustic-ness
  - Live-ness
  - Release year
  - Major / minor
  - Happy / sad
  - Explicit / not

- Target
  - Groovy or not Groovy



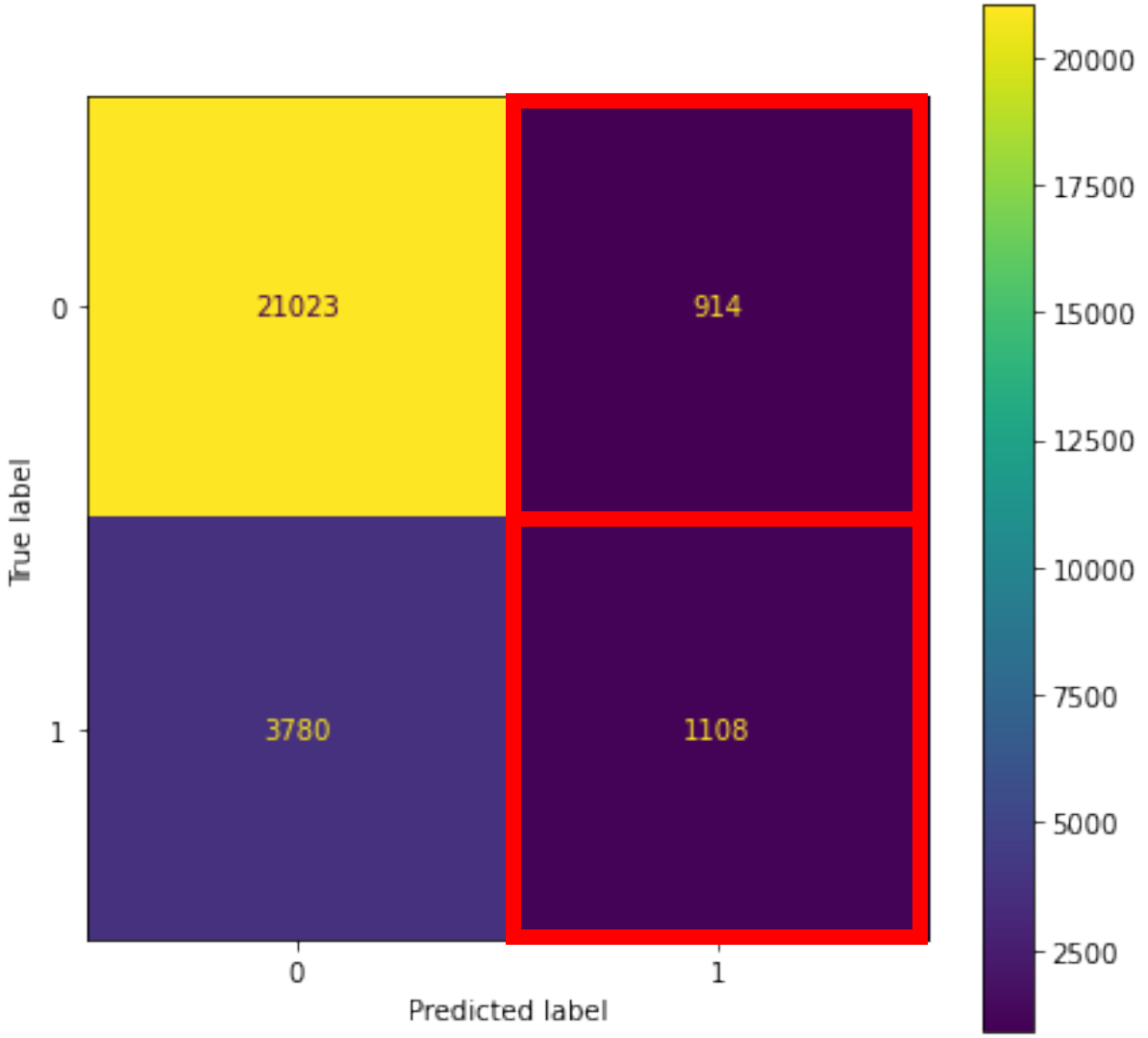
About 20% of the Spotify Data Set is “Groovy”



Modeling Is Not Great at Accurately Classifying, but Better than Nothing

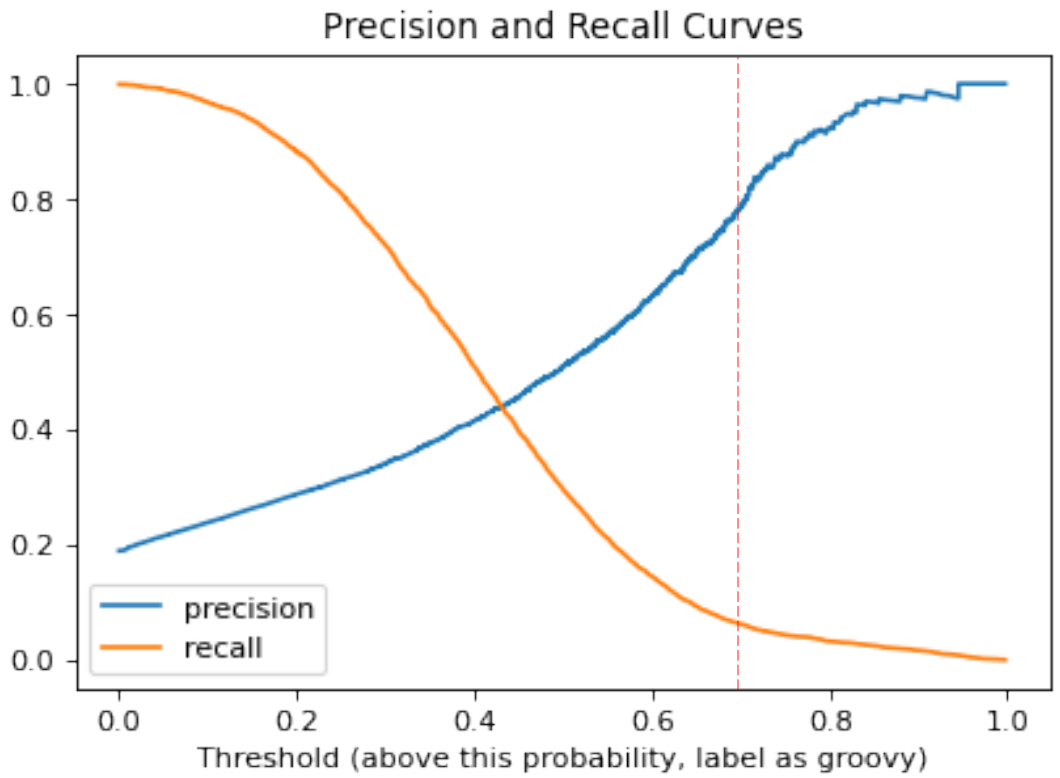
Random Forest Is Strongest Model for Accuracy on Test Data

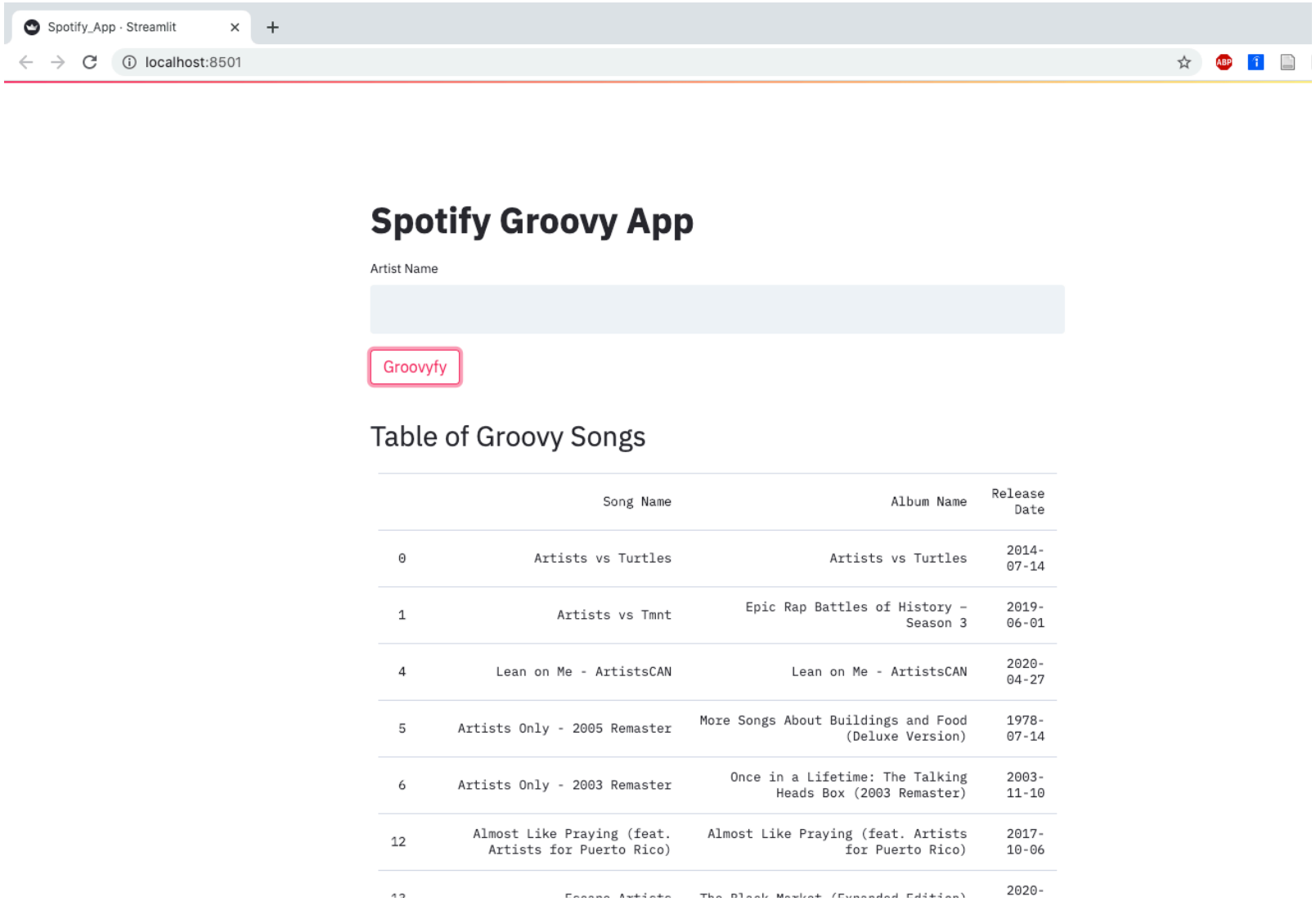
- Accuracy: 0.83
- Precision: 0.55
- Recall: 0.30



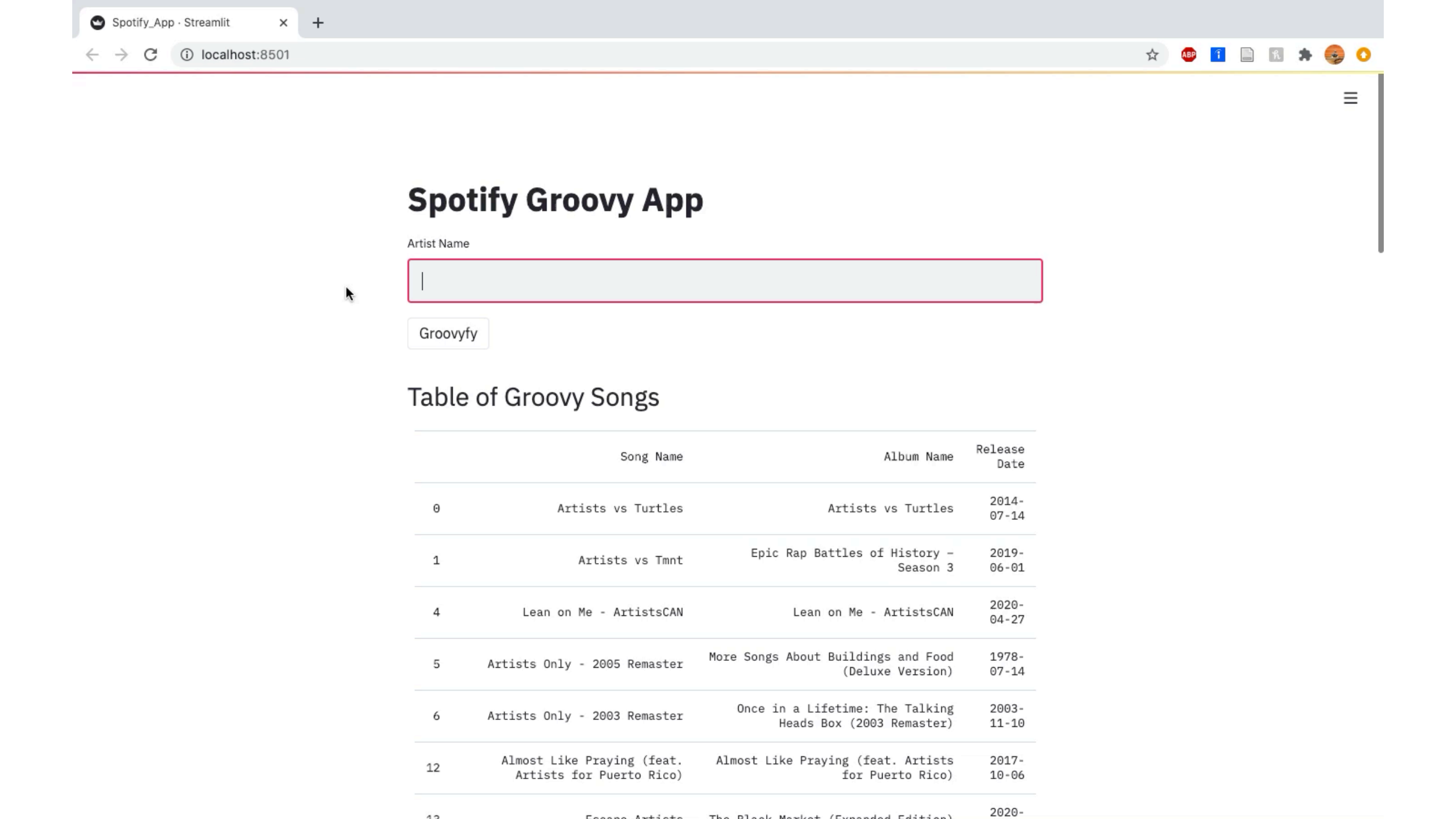
Want to Minimize False Positives, Focus on Precision

- Bad music kills atmosphere
  - DJs or business owners will want the model to be precise
- Can sacrifice recall
  - If only 200 songs, that is more than needed for a venue
  - 16 Hours of music





Created a WebApp that Returns a List of “Groovy” Songs by an Artist



	Song Name	Album Name	Release Date
0	Artists vs Turtles	Artists vs Turtles	2014-07-14
1	Artists vs Tmnt	Epic Rap Battles of History – Season 3	2019-06-01
4	Lean on Me - ArtistsCAN	Lean on Me - ArtistsCAN	2020-04-27
5	Artists Only - 2005 Remaster	More Songs About Buildings and Food (Deluxe Version)	1978-07-14
6	Artists Only - 2003 Remaster	Once in a Lifetime: The Talking Heads Box (2003 Remaster)	2003-11-10
12	Almost Like Praying (feat. Artists for Puerto Rico)	Almost Like Praying (feat. Artists for Puerto Rico)	2017-10-06
13	Escape Artists	The Black Market (Expanded Edition)	2020-

Future Considerations

Precision Provides Limited Number of Songs

Explore and Gather More Features

Improve WebApp

Playlists

Questions?