**Popularity**

Spotify defines the popularity of a track based on the number of plays and how recent those plays are. The popularity of a track is a value between 0 and 100, with 100 being the most popular. Here’s a more detailed breakdown of how Spotify calculates this metric:

### **Popularity Calculation**

* **Play Count:** The number of times a track has been played is a significant factor. More plays generally indicate higher popularity.
* **Recency of Plays:** Recent plays are weighted more heavily than older plays. A track that is frequently played recently will have a higher popularity score compared to a track that was frequently played in the past but not as much recently.
* **Algorithm:** Spotify uses a proprietary algorithm to compute the popularity score, which balances play count and recency to reflect current trends.
* **Relative Measure:** The popularity score is relative to other tracks. Therefore, a track's popularity can change not only due to changes in its own play counts but also due to changes in play counts of other tracks.

**Artist Popularity**

Spotify defines the popularity of an artist in a similar manner to how it defines the popularity of a track. The artist popularity score is a value between 0 and 100, with 100 being the most popular. The popularity of an artist is determined by a combination of factors including the popularity of the artist's tracks, the recency of plays, and other engagement metrics.

### **Artist Popularity Calculation**

* **Track Popularity:** The popularity of an artist is influenced significantly by the popularity of their individual tracks. If an artist has multiple tracks that are frequently played, their popularity score will be higher.
* **Recency of Plays:** Recent activity and engagement with the artist's tracks are weighted more heavily. An artist whose tracks have been played more recently will have a higher popularity score.
* **Engagement Metrics:** Other engagement metrics such as the number of followers, playlist inclusions, and overall engagement with the artist’s profile also contribute to the artist's popularity score.
* **Algorithm:** Similar to track popularity, Spotify uses a proprietary algorithm to compute the artist popularity score, balancing various metrics to reflect current trends and user engagement.

### **Danceability**

Spotify defines "danceability" as a measure of how suitable a track is for dancing. This attribute is calculated based on several musical elements, including tempo, rhythm stability, beat strength, and overall regularity. The danceability score is a value between 0.0 and 1.0, where a higher value indicates that the track is more danceable.

### **Factors Contributing to Danceability**

* **Tempo:** The speed of the track, measured in beats per minute (BPM).
* **Rhythm Stability:** The consistency and regularity of the rhythm.
* **Beat Strength:** The presence and prominence of the beat.
* **Overall Regularity:** How consistent and predictable the track is

### **Energy**

Spotify defines "energy" as a perceptual measure of intensity and activity in a track. This metric is designed to capture the dynamic and energetic aspects of a song, ranging from 0.0 to 1.0, where higher values indicate more energetic tracks. Energy is influenced by several factors, including tempo, loudness, and timbre.

### **Factors Contributing to Energy**

* **Tempo:** Faster tempos often contribute to higher energy scores.
* **Loudness:** Tracks with higher overall loudness are perceived as more energetic.
* **Dynamic Range:** Tracks with significant variations in loudness and intensity can be perceived as more energetic.
* **Timbre:** The quality of sound that distinguishes different types of sound production, instruments, or voices.

### **Key and Mode**

Spotify defines "key" in their dataset as the key of the track, which is the musical key in which the track is composed. The key is represented as an integer that corresponds to the standard pitches of the chromatic scale.

The **mode** field in the audio features object indicates whether the track is in a major or minor key:

* 0 = Minor
* 1 = Major

Together, the **key** and **mode** fields provide a full description of the track's musical key. For example, a **key** value of **7** (G) combined with a **mode** value of **1** indicates G major, while the same **key** value combined with a **mode** value of **0** indicates G minor.

### **Loudness**

Spotify defines "loudness" in their dataset as the overall average loudness of a track in decibels (dB). Loudness is measured on a logarithmic scale and provides an indication of the track's volume level relative to a standardized reference level. The value is expressed as a floating-point number, typically ranging from around -60 dB (very quiet) to 0 dB (very loud).

### **Key Points about Loudness**

* **Average Level:** The loudness value represents the average loudness of the track over its entire duration.
* **Decibel Scale:** Loudness is measured in decibels (dB), which is a logarithmic unit used to describe the ratio of a sound's pressure relative to a reference level.
* **Dynamic Range:** Tracks with a wider dynamic range may have greater variations in loudness, but the loudness value in Spotify's dataset averages these variations to provide a single representative figure.

Loudness is primarily an inherent property of a track, determined by how it was recorded, mixed, and mastered. However, the perception of loudness can also be influenced by how it is played back, which includes Spotify's playback settings and any dynamic range compression or normalization processes they might apply.

### **Inherent Property of a Track**

* **Recording:** The way instruments and vocals are recorded, including the microphone placement, the acoustics of the recording environment, and the recording equipment, affects the track's loudness.
* **Mixing:** During the mixing process, individual tracks (instruments, vocals, etc.) are combined, and their levels are adjusted relative to each other. Effects like compression and equalization are applied to control the dynamic range and frequency balance, impacting the overall loudness.
* **Mastering:** The final step in music production, where the mixed track is processed to ensure it sounds good across all playback systems. Mastering often involves further compression and limiting to increase perceived loudness.

### **Spotify's Influence on Loudness**

Spotify applies certain processing techniques that can affect the playback loudness of tracks:

* **Normalization:** Spotify uses loudness normalization to ensure a consistent listening experience across different tracks. This means that tracks with different inherent loudness levels are adjusted to play back at a similar perceived loudness.
  + **Normalization Levels:** Spotify uses different normalization levels for different contexts (e.g., mobile, desktop, loud environments).
  + **Implementation:** Spotify adjusts the playback gain based on the track's loudness as measured in LUFS (Loudness Units relative to Full Scale).
* **Dynamic Range Compression:** While Spotify's primary method of controlling playback loudness is normalization, dynamic range compression may also be used during encoding to ensure that tracks are suitable for various playback environments.

**Speechiness**

Spotify defines "speechiness" as a measure of the presence of spoken words in a track. This metric helps distinguish tracks that are primarily composed of spoken words from those that are primarily musical. The speechiness score is a value between 0.0 and 1.0, with higher values indicating a higher presence of speech.

### **Speechiness Score Interpretation**

* **Values below 0.33:** Tracks with low speechiness values are likely to be more musical, with fewer spoken words.
* **Values between 0.33 and 0.66:** These tracks might have a mix of music and speech, such as rap music or tracks with both lyrical content and spoken word segments.
* **Values above 0.66:** Tracks with high speechiness values are likely to be more speech-like, such as talk shows, podcasts, or audiobooks.

**Acousticness**

Spotify defines "acousticness" as a measure of the extent to which a track is acoustic. The acousticness score is a value between 0.0 and 1.0, where higher values indicate a higher probability that the track is acoustic. Acoustic tracks typically feature traditional instruments such as acoustic guitar, piano, or other non-electric instruments and have a more natural sound.

### **Acousticness Score Interpretation**

* **Values close to 0.0:** Indicate a low probability that the track is acoustic. These tracks are likely to be electronic, heavily produced, or feature electric instruments.
* **Values close to 1.0:** Indicate a high probability that the track is acoustic. These tracks are likely to feature acoustic instruments and have a more natural, unprocessed sound.

**Instrumentalness**

Spotify defines "instrumentalness" as a measure of the extent to which a track is instrumental, meaning it lacks vocals. The instrumentalness score is a value between 0.0 and 1.0, where higher values indicate a higher likelihood that the track contains no vocals. Tracks with high instrumentalness scores are more likely to be purely instrumental pieces, while tracks with lower scores are more likely to contain vocals.

### **Instrumentalness Score Interpretation**

* **Values close to 0.0:** Indicate that the track is unlikely to be instrumental and probably contains vocals.
* **Values close to 1.0:** Indicate a high probability that the track is instrumental and contains little or no vocal content.
* **Threshold:** Tracks with an instrumentalness score above 0.5 are intended to represent instrumental tracks, but even tracks with scores above 0.9 may contain some minimal non-vocal sounds.

**Liveness**

Spotify defines "liveness" as a measure of the presence of an audience in the recording of a track. This metric estimates the likelihood that the track was recorded with a live audience, such as during a concert or a live performance. The liveness score is a value between 0.0 and 1.0, with higher values indicating a greater probability that the track was recorded in a live setting.

### **Liveness Score Interpretation**

* **Values close to 0.0:** Indicate that the track is unlikely to have been recorded with a live audience. These tracks are more likely to be studio recordings.
* **Values close to 1.0:** Indicate a high probability that the track was recorded with a live audience. These tracks are more likely to be live recordings.
* **Threshold:** A liveness score above 0.8 typically indicates a strong presence of live performance characteristics in the track.

**Valence**

Spotify defines "valence" as a measure of the musical positiveness conveyed by a track. This metric describes the emotional tone of the music, indicating whether a track sounds more positive (happy, cheerful, euphoric) or more negative (sad, depressed, angry). The valence score is a value between 0.0 and 1.0, where higher values correspond to more positive emotions.

### **Valence Score Interpretation**

* **Values close to 0.0:** Indicate tracks that sound more negative, sad, or angry.
* **Values close to 1.0:** Indicate tracks that sound more positive, happy, or euphoric.
* **Middle values:** Tracks with values around 0.5 might have mixed emotional tones or be more neutral.

**Tempo**

Spotify defines "tempo" as the speed or pace of a given piece of music, measured in beats per minute (BPM). In musical terms, tempo is the speed at which a piece of music is played and is one of the fundamental aspects that defines the character and feel of the music.

**Time Signature**

Spotify defines "time signature" as an estimated overall time signature of a track. The time signature, also known as meter, is a notational convention used in Western music to specify how many beats are in each measure (or bar) and which note value constitutes one beat. It provides the rhythmic structure of the track.

### **Time Signature Representation**

In the context of the Spotify API, the time signature of a track is represented as an integer indicating the number of beats in each bar. Common time signatures include 3/4, 4/4, and 6/8.

* **3:** Indicates a time signature of 3/4, meaning there are three beats per measure.
* **4:** Indicates a time signature of 4/4, meaning there are four beats per measure.
* **5:** Indicates a time signature of 5/4, meaning there are five beats per measure.
* **6:** Indicates a time signature of 6/8, meaning there are six beats per measure, often grouped into two beats.