Exhibit 2

Method claim: 1

US11899713B2	IBM Watson Beat (“The accused instrumentality”)
1. A method for selecting a song, comprising:	The accused instrumentality practices a method for selecting a song (e.g., recommending a musical score for the user specified mood). As shown below, the accused instrumentality is a cognitive cloud-based music program developed using AI and machine learning that uses musical notes to analyze moods and reproduce music based on the identified mood.  https://www.ibm.com/watson

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June 7, 2016 | Written by: Chris Nay

Categorized: IBM Research | IBM Watson

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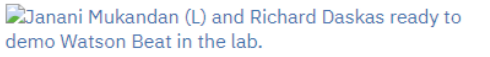
Together, they have taught Watson about the specifics of rhythm, pitch, and instrumentation, as well as the differences in genres. All of it combines in algorithms running through Watson's neural network to help artists create a original compositions.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https://www.ibm.com/blogs/think/2016/06/training-watson-to-be-your-musical-muse/

Listen and learn

Watson Beat then keeps learning from its users. In as few as eight bars or 15 seconds of input, it can churn out a multi-instrument, minutes-long track that can be adjusted according to the mood and genre any budding Beethoven chooses. Here is a sample of an original piece by Richard:

Richard only wrote it for, and played it on the piano. But he decided to amp it up – give it an up-tempo sound with a bass line, drum kit, and a Middle Eastern beat. With just the sample above, here is what Watson Beat banged out:

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Richard determined the upbeat style of the song, as well as the variation of the additional instruments, by introducing perturbations into Watson Beat's neural network. These adjustments, done via an app, tell the system how similar or different the collaborative composition should be, compared to the original. This sliding scale of cognitive computing influence can come in especially handy for those whose last piano lesson stopped with Mary Had a Little Lamb!

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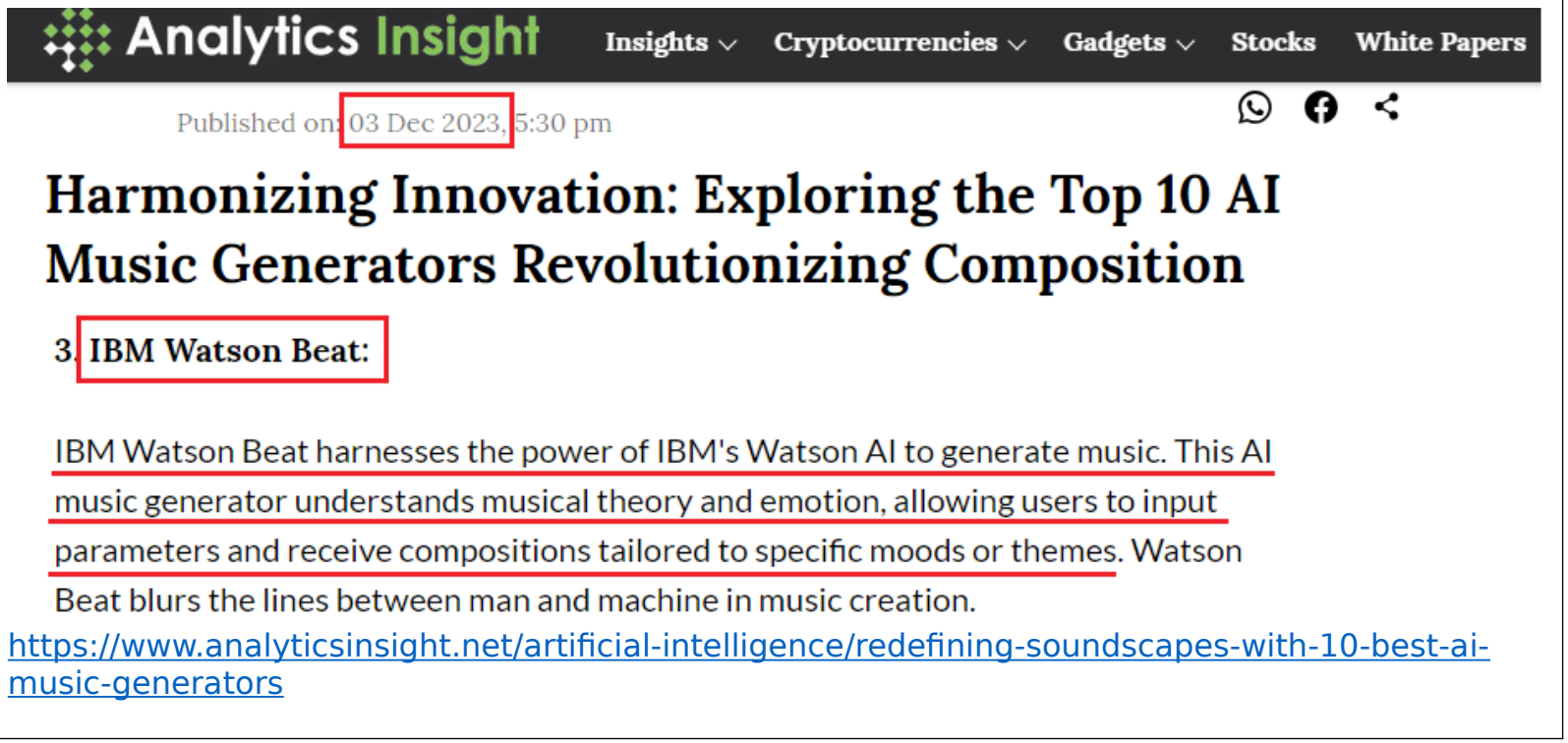

https://www.analyticsinsight.net/artificial-intelligence/redefining-soundscapes-with-10-best-ai-music-generators

Watson Beat – discover how Watson can analyze your personal music taste

Artists can collaborate with Watson music to inspire the hit making process from volumes of data. Watson gives artists the tools they need to see inspiration in places they never could before. The ability to turn millions of unstructured data points into emotional insights helps artists and producers to create a new kind of music. Watson Beat can look at the composition of songs to find useful patterns between various keys, chord progressions, and genres completing an emotional fingerprint of music. As Watson Beat started out a research project, I am happy to announce the API of this functionality will be available on IBMs Cloud platform for everyone to use after the summer.

https://www.ibm.com/blogs/think/nl-en/2017/06/01/ibmattnw/

The Watson Tone Analyzer API then ingested more than 2 million lines of related social content to understand the emotional sentiment surrounding these themes. Combined, these APIs helped us to build the "emotional fingerprint" of each of the last five years.

Alex then tapped into Watson BEAT to examine and better understand popular musical trends. And Watson BEAT is more than your average music-suggestion engine. Today, music-recommending apps use genre terms and ratings to suggest similar songs we might like. For example – if you like Wiz Khalifa's 2015 hit "See You Again", you might also like Maroon 5's 2012, "Payphone" (featuring Wiz Khalifa). They recommend based on other songs, not how a person feels in the moment.

Using machine learning algorithms, Watson BEAT is capable of learning from songs by deconstructing a song's pitch, time and key signatures, note sequence, and note velocity (how hard a note was struck).

Combined with theories about emotional responses to music, Watson BEAT can generate completely new musical scores based on a variety of preferred moods (joyful, devastated, anxious etc.) or feelings (spooky, mysterious, cheerful, etc.).

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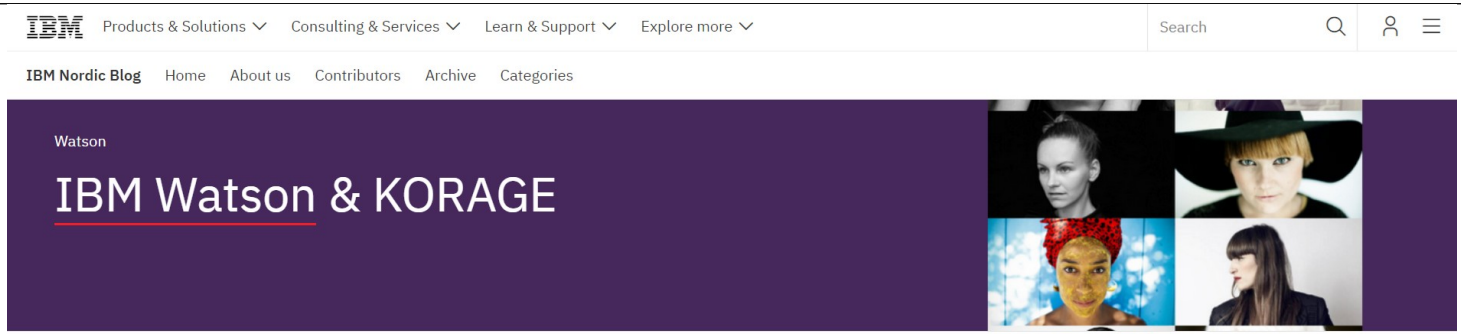

October 13, 2017 | Written by: Thomas Birck Christensen

Categorized: Watson

Share this post:

Experience the musical collaboration between IBM Watson and the newly established choir, KORAGE. The choir, which is made up of eight famous danish singers, has used **Watson Sentiment Analysis** and **Watson Beat** to create a whole new work of art and reach their shared DNA.

The eight female singers that are part of KORAGE are usually soloists: Pernille Rosendal, Sharin Foo, Hannah Schneider, Karen Mukupa, Josephine Philip, Rebek Louise Alenius Boserup as conductor. With the help from IBM's lab in Austin and local powers, Watson has managed to analyze lyrics and melodies from memb en them a new musical output. This has been done by the means of **Watson Beat** and **Watson Natural Language Understanding**.

Next month, we proudly invite you to **Watson Summit**, and here, the Watson created song will be revealed in the opening of the event.

https://www.ibm.com/blogs/nordic-msp/ibm-watson-korage/

Using machine learning algorithms, Watson BEAT is capable of learning from songs by deconstructing a song's pitch, time and key signatures, note sequence, and note velocity (how hard a note was struck).

selecting a song

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Using this technology, Alex could create new songs – even snippets of songs, like a bass line – until he found a sound that inspired him. And while "Not Easy" is an original work, Watson BEAT gave Alex many new ways to experience musical themes and human emotions.

To dive even deeper into the insights, the IBM team used the Cognitive Color Design Tool to create an interactive visualization of the data based on the images, album artwork and colors that inspire Alex. The tool blends together understanding of psychological effects of colors, the interrelationships between emotions, and image aesthetics to create a custom color palette, tailored to the individual.

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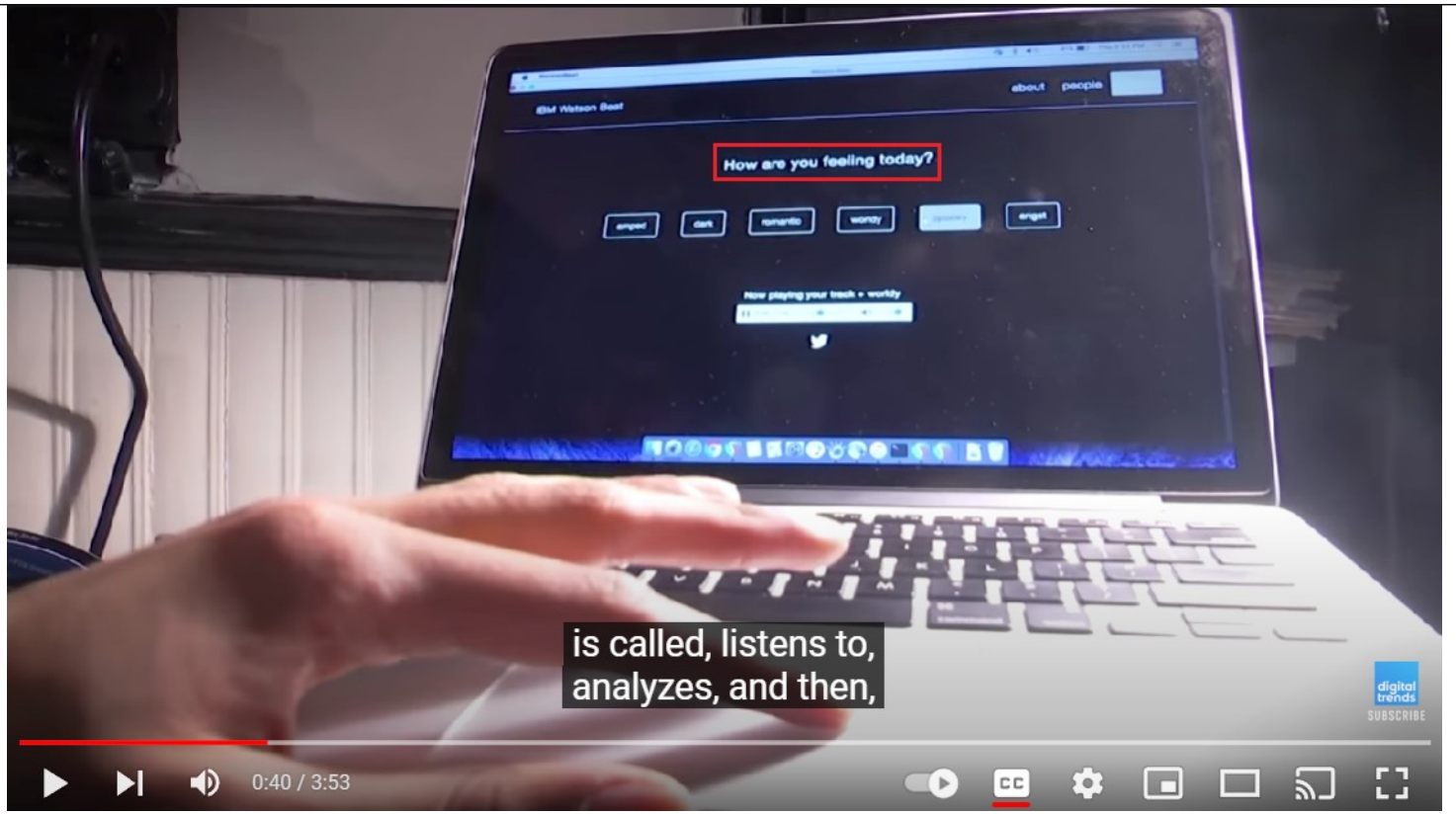
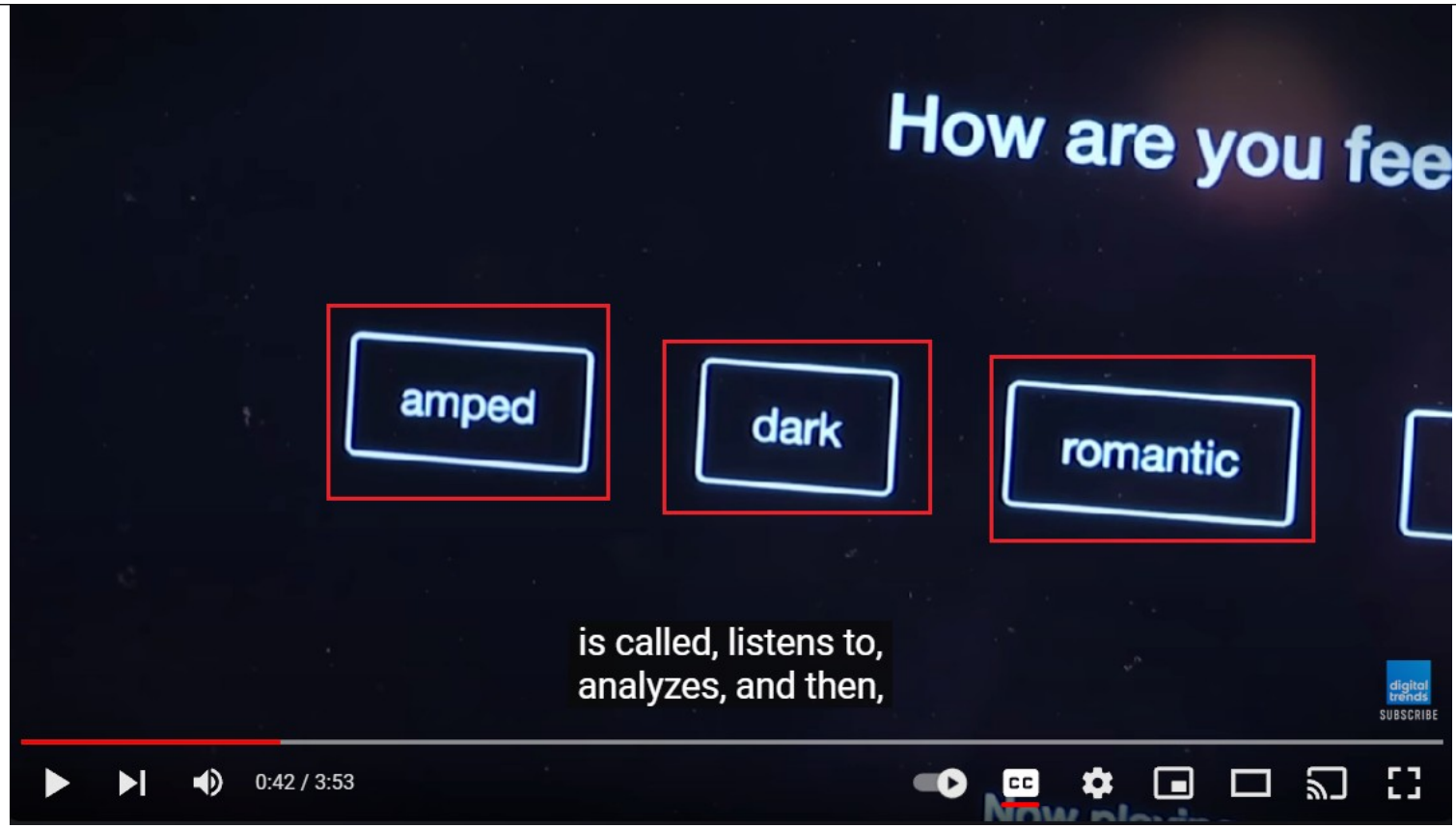


https://www.youtube.com/watch?v=bx6_aEn-Ij8

	 https://www.youtube.com/watch?v=bx6_aEn-Ij8
selecting the song based on a computer-derived comparison between a representation	The accused instrumentality discloses selecting the song (e.g., recommending a musical score for the user-specified mood) based on a computer-derived comparison (e.g., AI and machine learning algorithms) between a representation of the song (e.g., frequency characteristics of the songs, etc.) to known similarities in representations (e.g., frequency characteristics of the songs, etc.) of other songs (e.g., other songs in the database). As shown below, the accused instrumentality is a cognitive cloud-based music program

of the song to known similarities in representations of other songs,	developed using AI and machine learning that uses musical notes to analyze the moods and reproduce music based on the identified mood. Each song is analysed to create a representation which includes frequency characteristics of the song such as pitch, tone, etc. to infer the mood of the song. When a user searches a song specific to moods, the accused instrumentality compares the representation of the desired song to the known similarities in representations of other songs in the database. These known similarities are informed by the machine learning model, which is trained to understand how different frequency characteristics correlate with specific moods.

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computer-derived comparison

representation of the song

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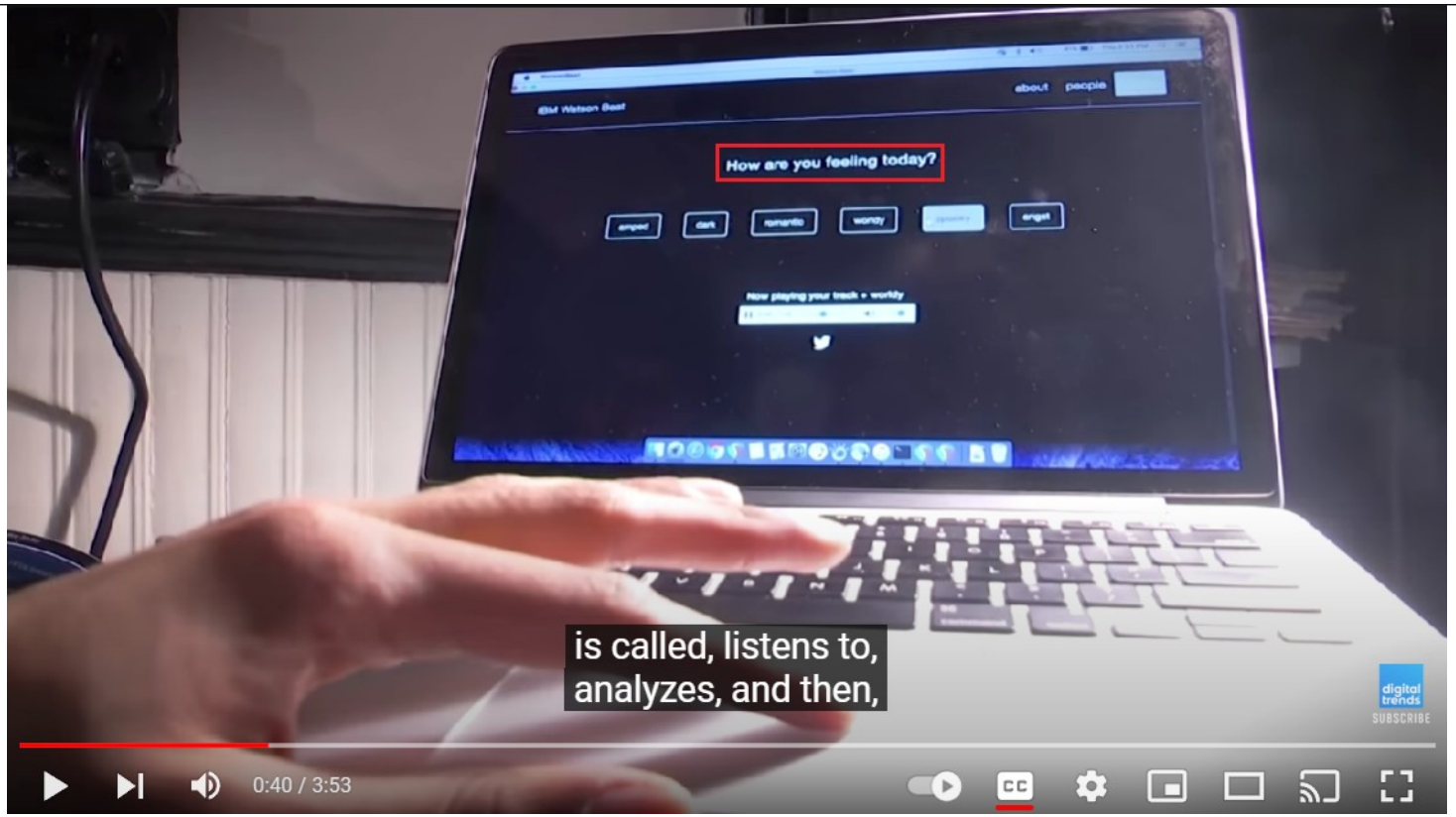
Rhythm

The rhythm section of The Watson Beat is responsible for the drum beat, bass line, and chord progressions of the composition. There are many parameters that you can pass into The Watson Beat, including time signature, tempo, and mood [2]. Using these parameters, and an understanding of music theory, The Watson Beat selects the next note to be used in the progression (the action). It utilizes Reinforcement Learning (RL), a type of machine learning diagramed below. If the note chosen for the next line in the progression is a standard concept (like a 1–4–5 in G), then the system is rewarded, and if the next note is odd (in a music theory sense), then system is penalized. This method steers the RL Agent to imitate, with a

https://medium.com/@anna_seg/the-watson-beat-d7497406a202



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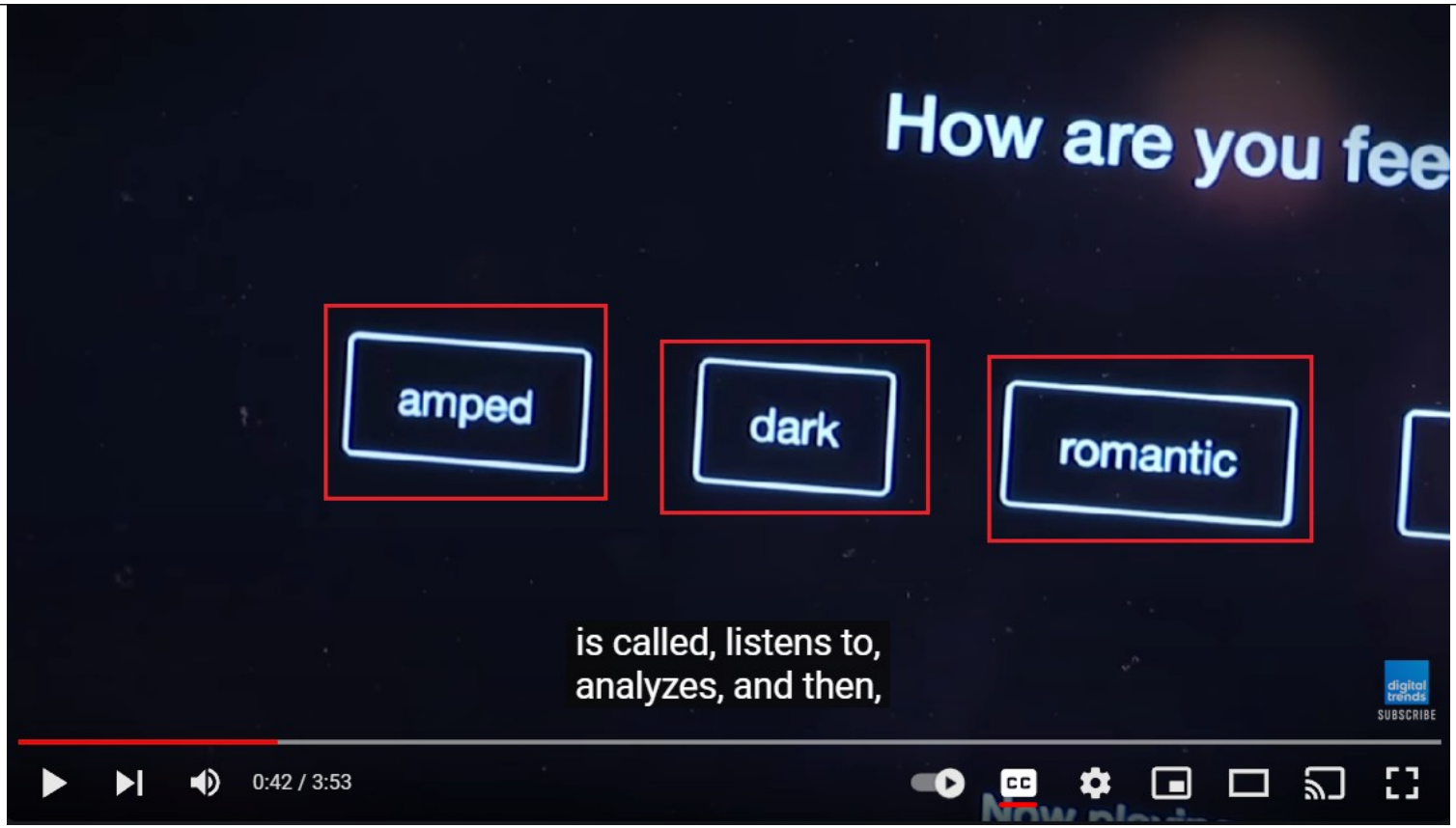

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Frequencies and Their Potential Emotional Effects

While research is ongoing, the following musical elements are often associated with these effects:

- **High Frequencies:** These can create a sense of alertness, focus, and even mild agitation.
- **Low Frequencies:** These promote relaxation, calmness, and sometimes even introspection or melancholy.
- **Minor Keys:** Often evoke feelings of sadness, longing, or introspection.
- **Major Keys:** Typically associated with happiness, optimism, and energy.

one or more moods of the song

https://englishpluspodcast.com/can-music-frequencies-change-your-mood/

Expression of emotion — one or more moods of the song — frequency characteristics

Different pitches evoke different emotions. Higher pitches are often associated with brightness and excitement, while lower pitches may convey depth and introspection. Composers and musicians use pitch variations to express a wide range of emotions in their music.

https://thedemostop.com/blogs/music-education/music-industry/what-is-pitch-in-music/

One of the most significant aspects of pitch in music is its ability to convey meaning and emotion. **Different pitches can evoke different moods and feelings, from the uplifting and joyful to the sombre and melancholic.** For example, a **higher pitch can often convey a sense of excitement or elation,** while a **lower pitch can suggest sadness or seriousness.**

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wherein the known similarities in representations of other songs is based at least in part on a human-trained machine using the representations of the other songs,	The accused instrumentality discloses that the known similarities in representations (e.g., frequency characteristics of the songs, etc.) of other songs (e.g., other songs in the database) is based at least in part on a human-trained machine (e.g., AI and machine learning algorithms) using the representations (e.g., frequency characteristics of the songs, etc.) of the other songs (e.g., other songs in the database). As shown below, the accused instrumentality is a cognitive cloud-based music program developed using AI and machine learning that uses musical notes to analyze the moods and reproduce music based on the identified mood. Each song is analysed to create a representation which includes frequency characteristics of the song such as pitch, tone, etc. to infer the mood of the song. When a user searches a song specific to moods, the accused instrumentality compares the representation of the desired song to the known similarities in representations of other songs in the database. These known similarities are informed by the machine learning model, which is trained to understand how different frequency characteristics correlate with specific moods. The accused instrumentality determines which songs have similar moods. For example, if the user plays a score with a “happy" mood, the system will search for frequency characteristics of other scores in the database associated with happiness. Thus, it generates a new musical composition based on how closely its mood matches the moods of other songs classified by the human-trained machine-learning model.

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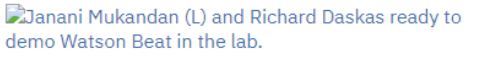
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	IBM's music arm of Watson: Watson BEAT, is changing the game. IBM's Watson Beat is a cognitive cloud-based music program developed using AI and machine learning. The machine's music generation algorithms analyse individual tracks and collect data on pitch, time and key signatures, and note sequences. Using this collected data, it works out what a listener might want, or what an artist may be inspired by. Of course, this does not immediately equal a smash hit that everyone will love, but it certainly has the potential to aid producers and song-writers know their audience and get inspired. https://telefonicatech.com/en/blog/big-data-ai-changing-music-game-ib

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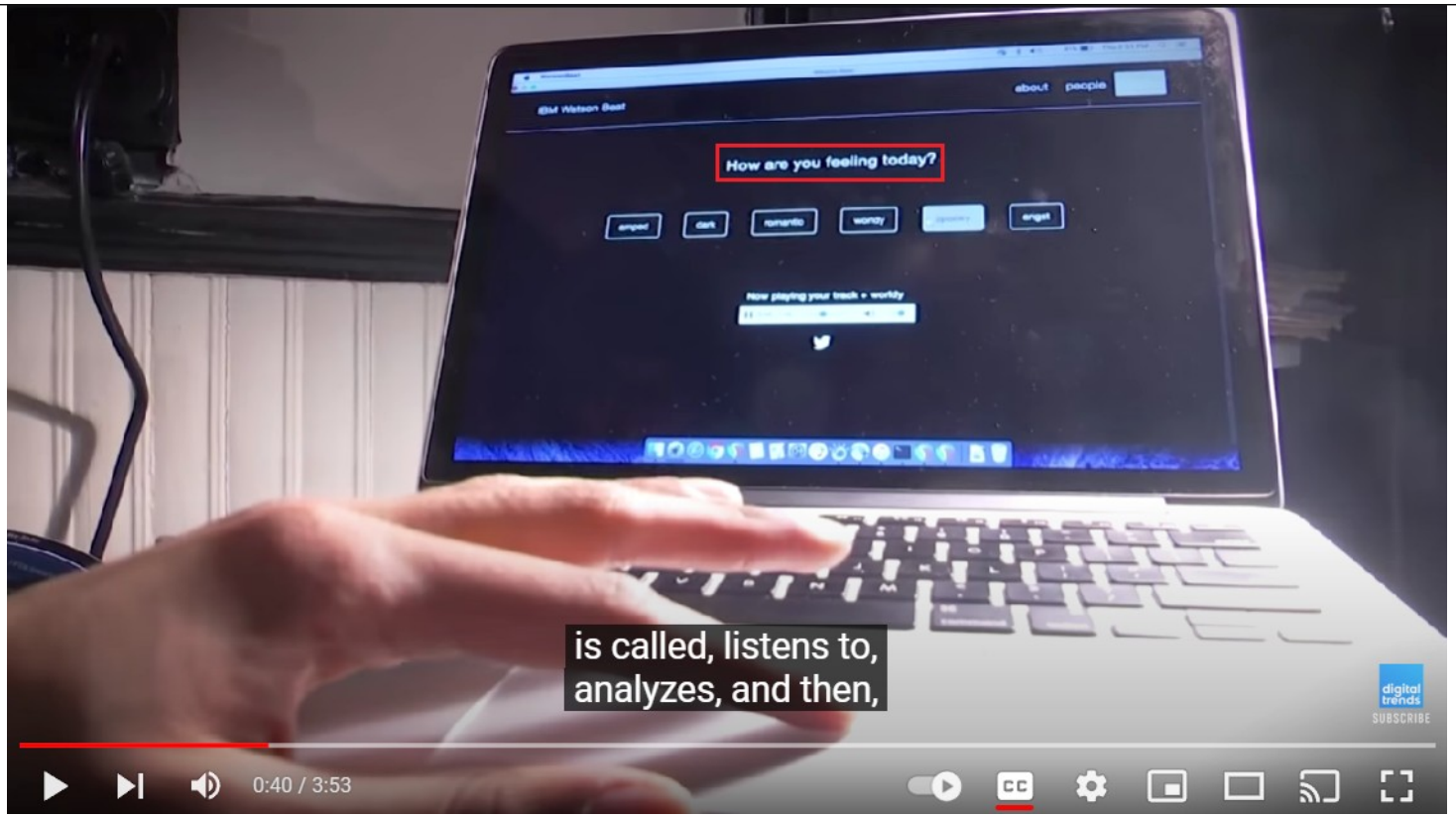
	https://www.ibm.com/blogs/think/2016/10/watson-music/ For this partnership, Watson analyzed the last five years of culture and music data to uncover new emotional insights to augment Alex's creative process. To identify the most pervasive themes, the team used the Watson Alchemy Language API to read and understand Nobel Peace Prize speeches, New York Times articles, Billboard song lyrics, movie synopses and more. The Watson Tone Analyzer API then ingested more than 2 million lines of related social content to understand the emotional sentiment surrounding these themes. Combined, these APIs helped us to build the "emotional fingerprint" of each of the last five years. human-trained machine Alex then tapped into Watson BEAT to examine and better understand popular musical trends. And Watson BEAT is more than your average music-suggestion engine. Today, music-recommending apps use genre terms and ratings to suggest similar songs we might like. For example – if you like Wiz Khalifa's 2015 hit "See You Again", you might also like Maroon 5's 2012, "Payphone" (featuring Wiz Khalifa). They recommend based on other songs, not how a person feels in the moment. https://www.ibm.com/blogs/think/2016/10/watson-music/



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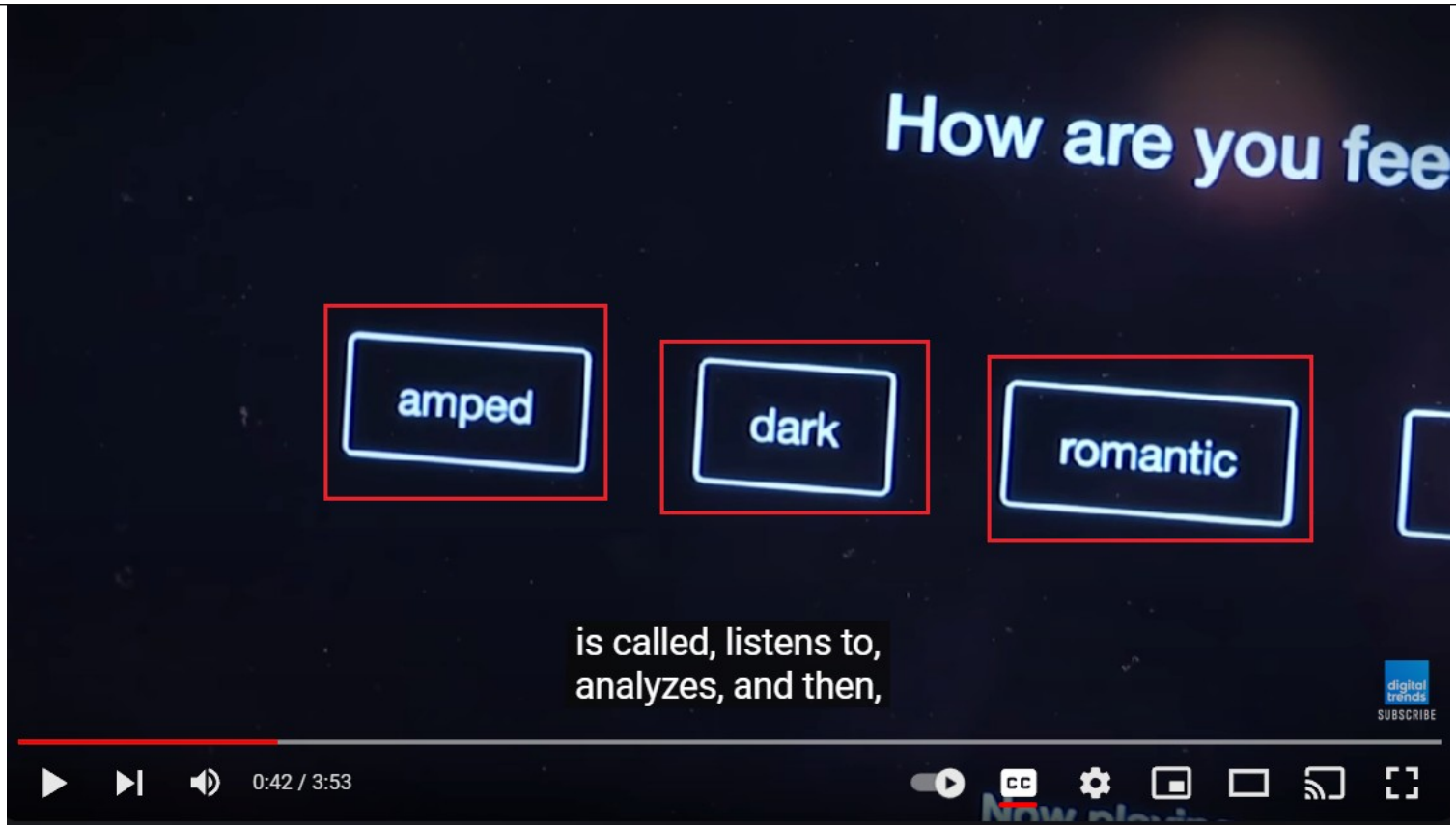

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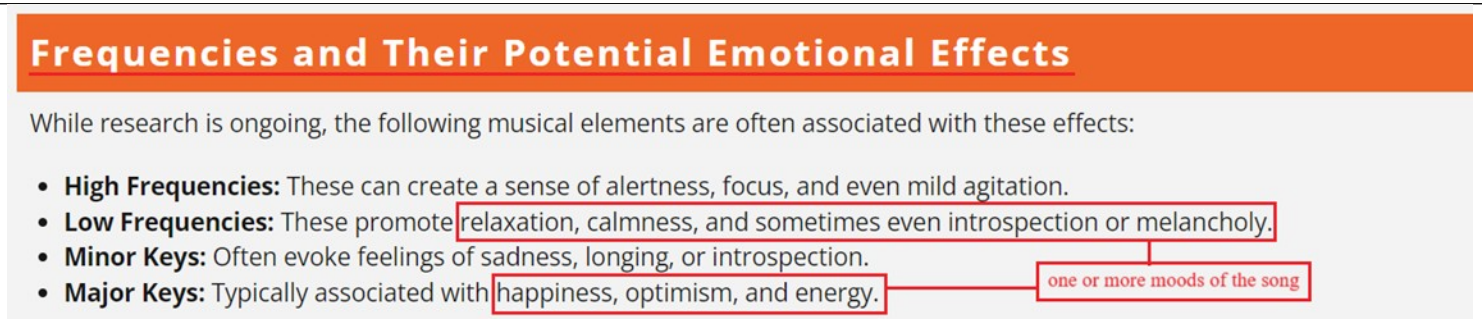

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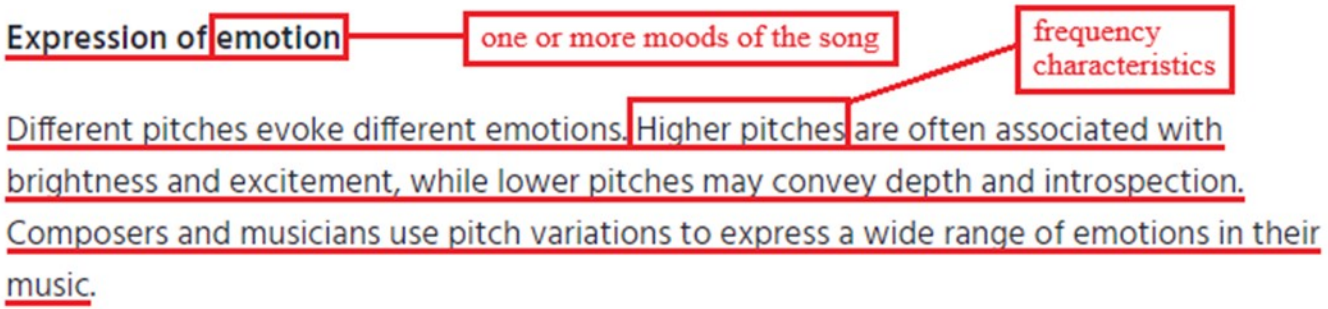

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	https://www.aulart.com/blog/understanding-the-importance-of-pitch-in-music/# Hey there, music enthusiasts! Let's dive into the world of music and explore a term that gets thrown around a lot: tone. When we talk about tone in music, we're talking about the quality of sound, specifically the pitch of a musical note. It's what makes each instrument or voice unique and helps us tell them apart, even when they're playing the same note. Think of it like hearing a guitar and a piano playing the same note—you can instantly tell the difference in tone. Pretty cool, right? Well, in this blog, we're gonna explore what tone is all about and how you can use it to take your songwriting game to the next level. So, how can you use tone in music? Well, it's all about creating a certain mood or emotion. By choosing the right notes and instruments, you can convey different feelings in your songs. For example, playing a minor chord progression on a piano can bring out that melancholic, sad vibe, while strumming some major chords on a guitar can fill your music with happiness and joy. https://melodystudio.net/2023/08/07/tone-in-music-what-it-is-and-how-to-use-it/
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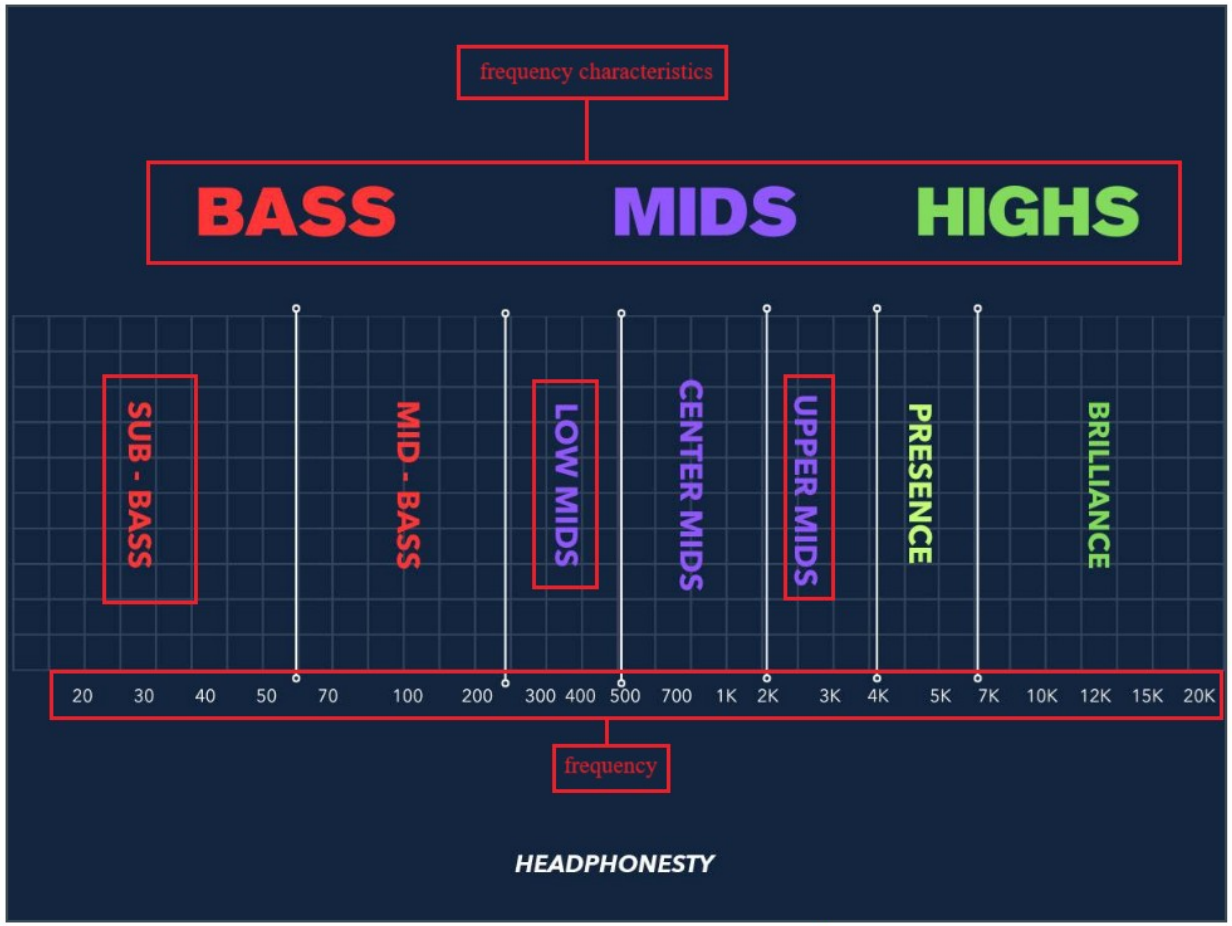

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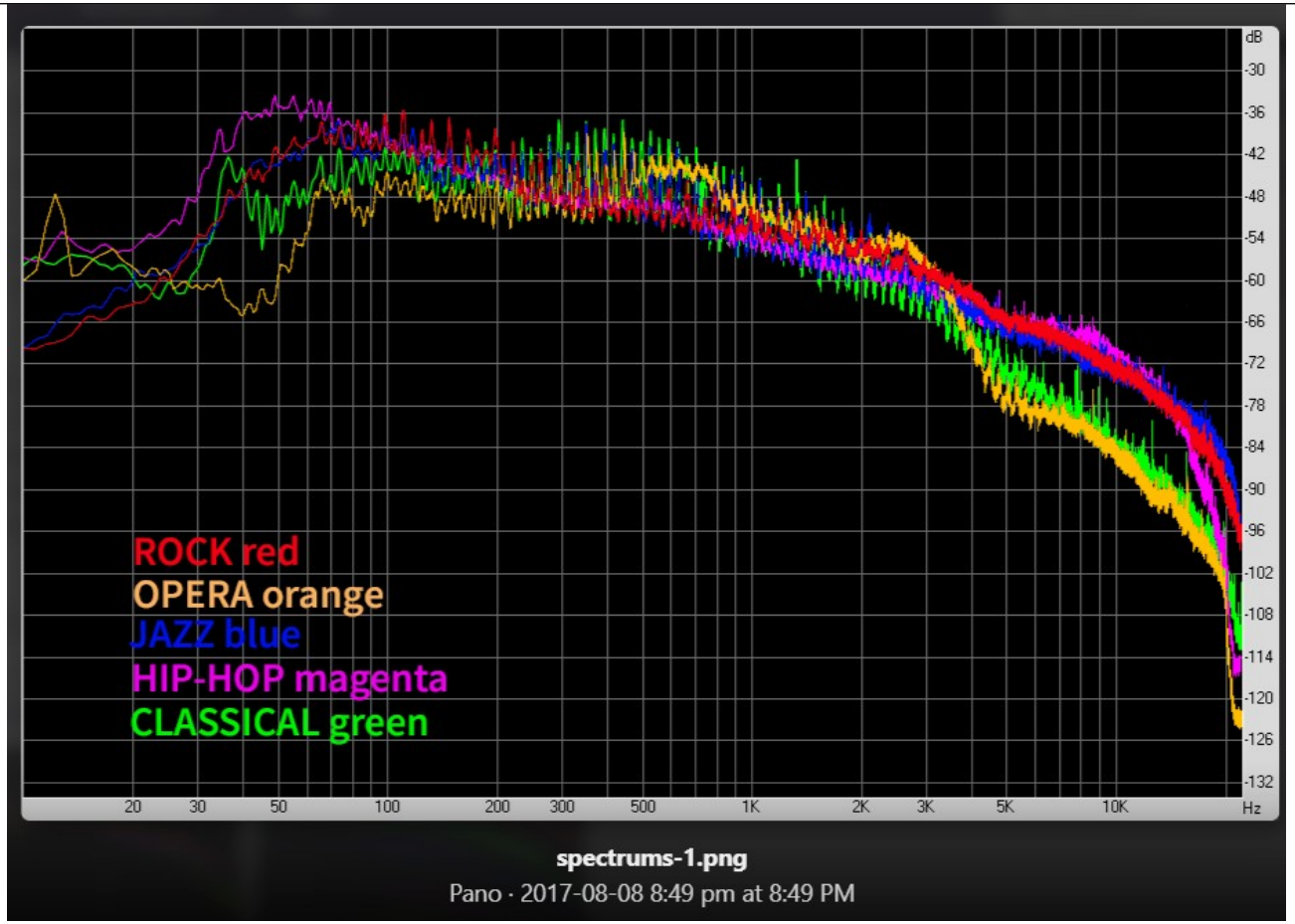

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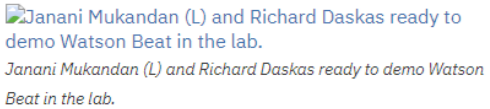
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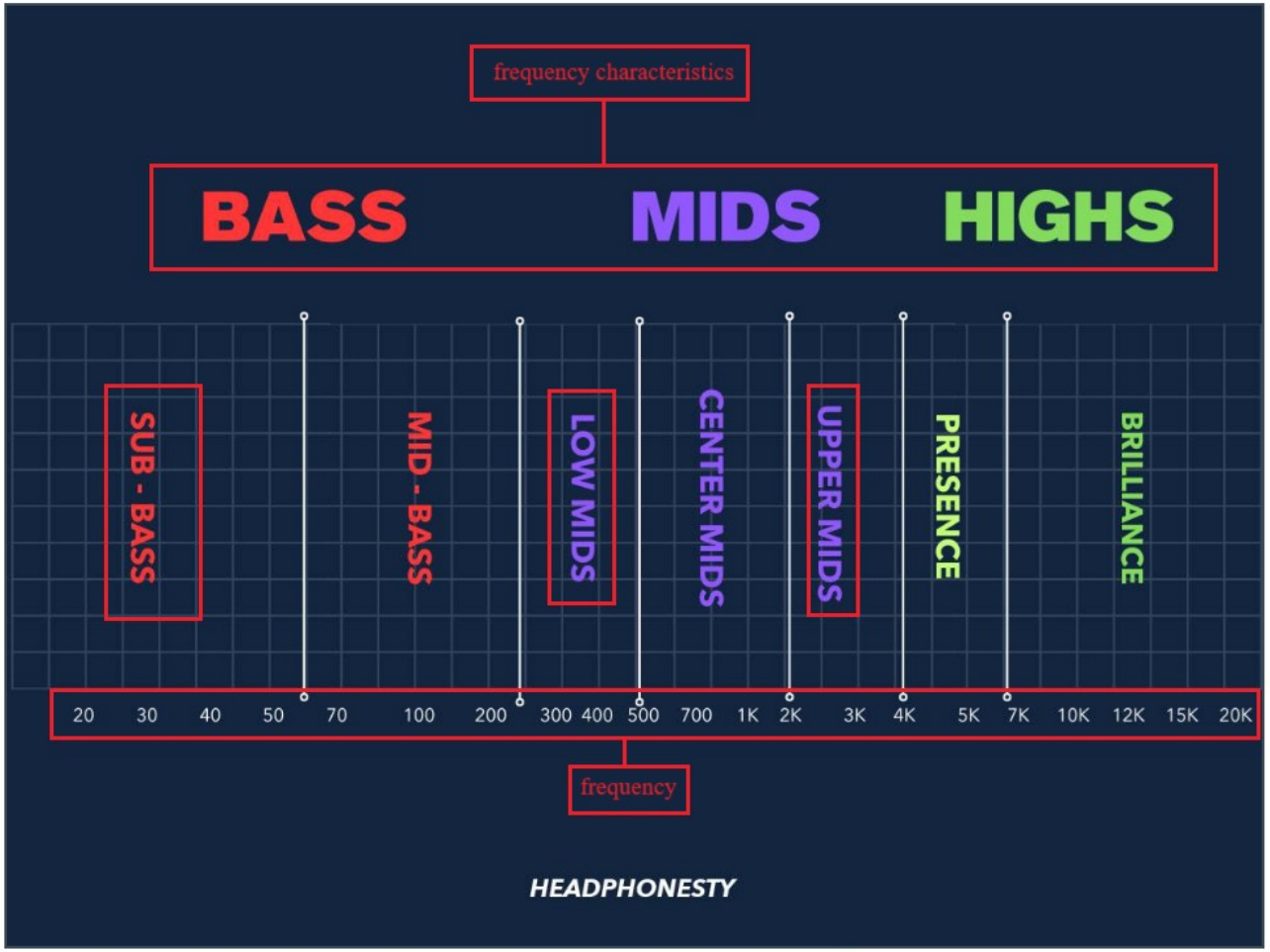

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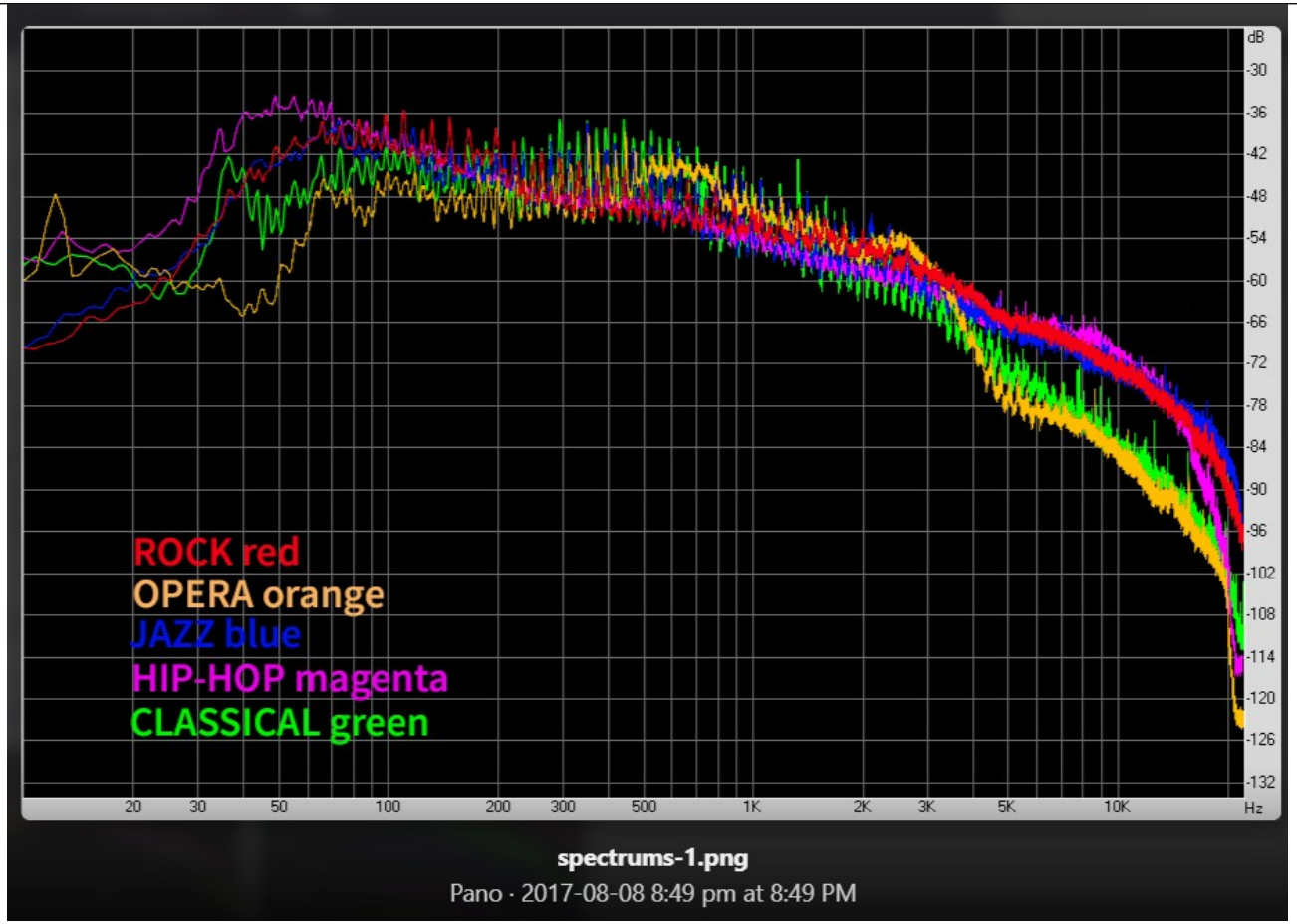

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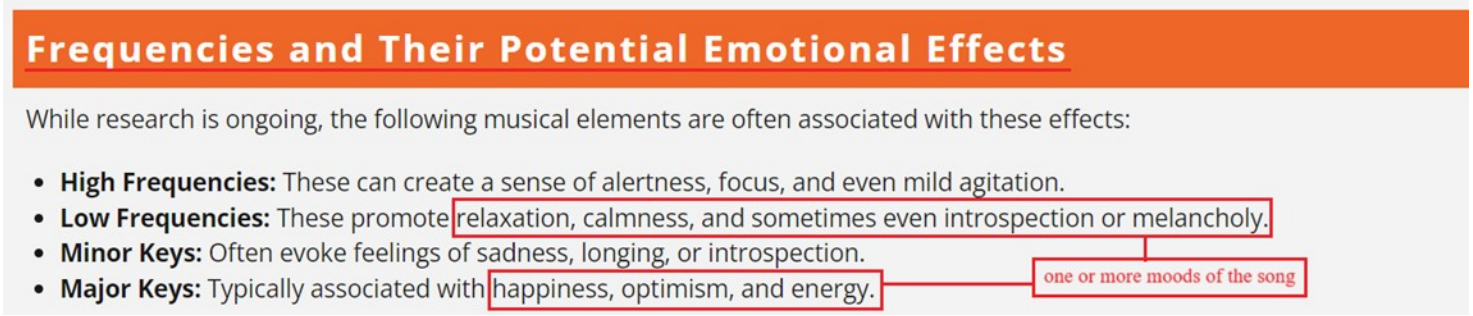

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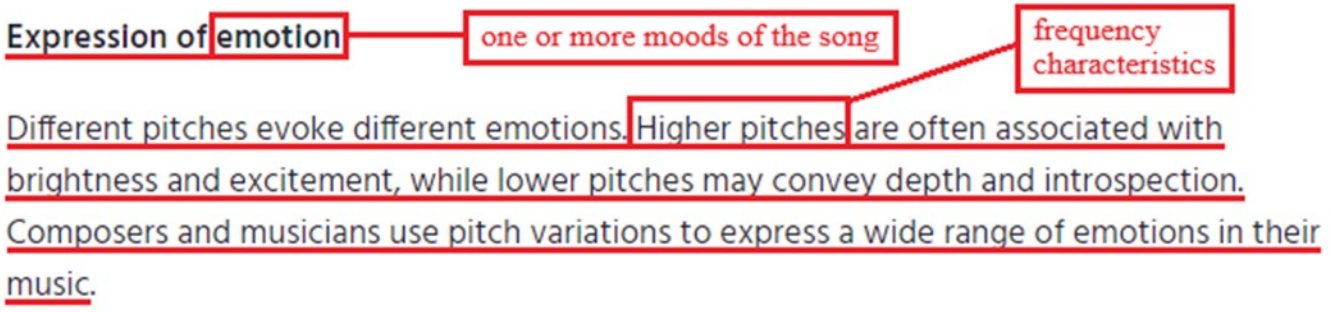

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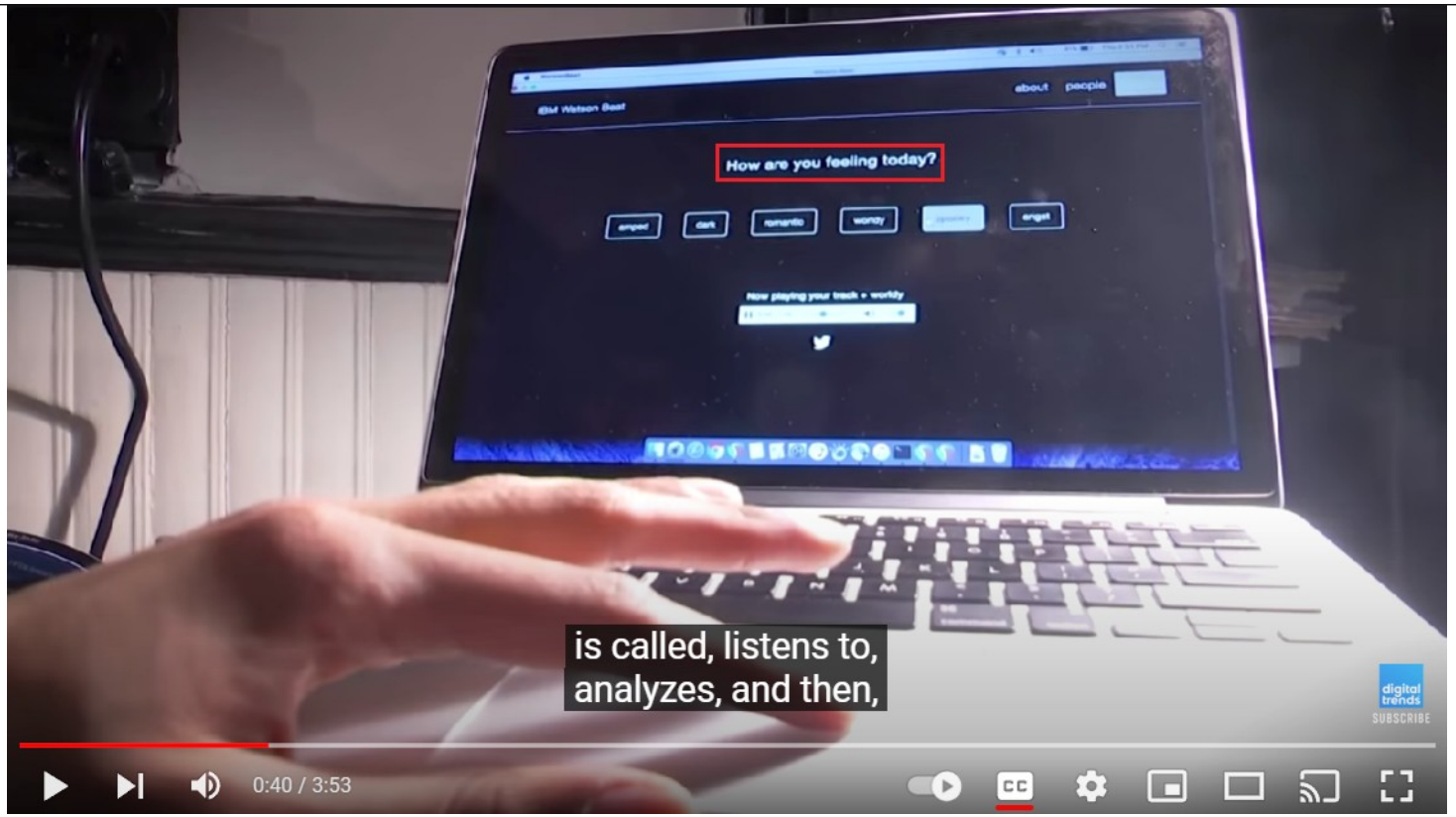

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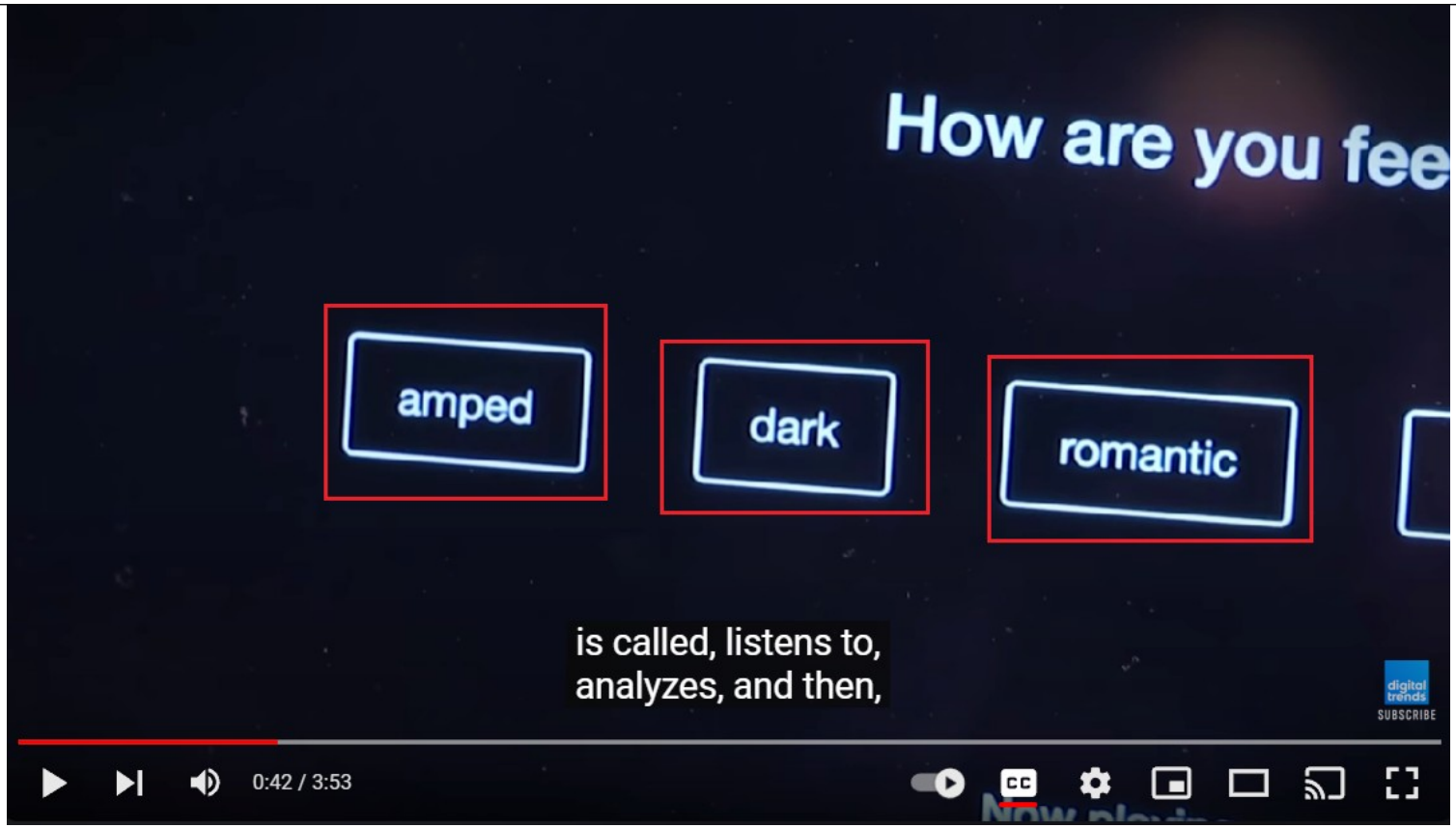

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Classification via Tags: Music mood classification often involves tagging songs with emotional descriptors such as "happy," "sad," "energetic," and "relaxing." Machine learning models can then be trained on these tags to automatically classify songs based on their emotional content.

Mood	Intensity	Timbre	Pitch	Rhythm
Happy	Medium	Medium	Very High	Very High
Exuberant	High	Medium	High	High
Energetic	Very High	Medium	Medium	High
Frantic	High	Very High	Low	Very High
Anxious/Sad	Medium	Very Low	Very Low	Low
Depression	Low	Low	Low	Low
Calm	Very Low	Very Low	Medium	Very Low
Contentment	Low	Low	High	Low

https://kratichoudhary258.medium.com/music-mood-classification-relativity-to-music-therapy-7c44250c45dc

and wherein	The accused instrumentality discloses that the selection is based on the similarity between the

the selection is based on the similarity between the one or more moods of the song and the one or more moods of the plurality of the other songs.	one or more moods (e.g., categorizing songs into moods such as happy, sad, etc.) of the song (e.g., a particular song with a desired mood) and the one or more moods (e.g., categorizing songs into moods such as happy, sad, etc.) of the plurality of the other songs (e.g., other songs in the database, etc.). As shown below, the accused instrumentality is a cognitive cloud-based music program developed using AI and machine learning that uses musical notes to analyze the moods and reproduce music based on the identified mood. Each song is analysed to create a representation which includes frequency characteristics of the song such as pitch, tone, etc. to infer the mood of the song. When a user searches a song specific to moods, the accused instrumentality compares the representation of the desired song to the known similarities in representations of other songs in the database. These known similarities are informed by the machine learning model, which is trained to understand how different frequency characteristics correlate with specific moods. The accused instrumentality determines which songs have similar moods. For example, if the user plays a score with a “happy" mood, the system will search for frequency characteristics of other scores in the database associated with happiness. Thus, it generates a new musical composition based on how closely its mood matches the moods of other songs classified by the human-trained machine-learning model.

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June 7, 2016 | Written by: Chris Nay

Categorized: IBM Research | IBM Watson

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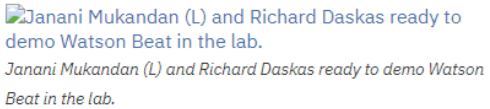
Watson already helps chefs and home cooks alike come up with never-before-eaten recipes. It also assists artists and helped one color coordinate a mural, and another make a cognitive dress for the Met Gala in New York. Now researchers are working to make the system capable of collaborating with musicians to produce original songs and scores.

Watson Beat is a cognitive cloud-based app being developed by machine learning and artificial intelligence expert Janani Mukundan, a Dire Straits fan with no musical training but a PhD in computer engineering, and Richard Daskas, a composer and professional musician.

Together, they have taught Watson about the specifics of rhythm, pitch, and instrumentation, as well as the differences in genres. All of it combines in algorithms running through Watson's neural network to help artists create a original compositions.


Janani Mukandan (L) and Richard Daskas ready to demo Watson Beat in the lab.

Janani Mukandan (L) and Richard Daskas ready to demo Watson Beat in the lab.

"Watson Beat knows what sounds good to us. And based on input, it knows, for example that if a user wants a 'dark' or 'gloomy' song, that it should use a minor key," Janani said.

https://www.ibm.com/blogs/think/2016/06/training-watson-to-be-your-musical-muse/

Listen and learn

Watson Beat then keeps learning from its users. In as few as eight bars or 15 seconds of input, it can churn out a multi-instrument, minutes-long track that can be adjusted according to the mood and genre any budding Beethoven chooses. Here is a sample of an original piece by Richard:

Richard only wrote it for, and played it on the piano. But he decided to amp it up – give it an up-tempo sound with a bass line, drum kit, and a Middle Eastern beat. With just the sample above, here is what Watson Beat banged out:

"Watson Beat can understand MIDI (file) inputs of entire songs – even multiple songs – or individual instruments. Or, like the sample above, it can comprehend live play. I plugged a keyboard into my laptop and ran the app as I played," Richard said.

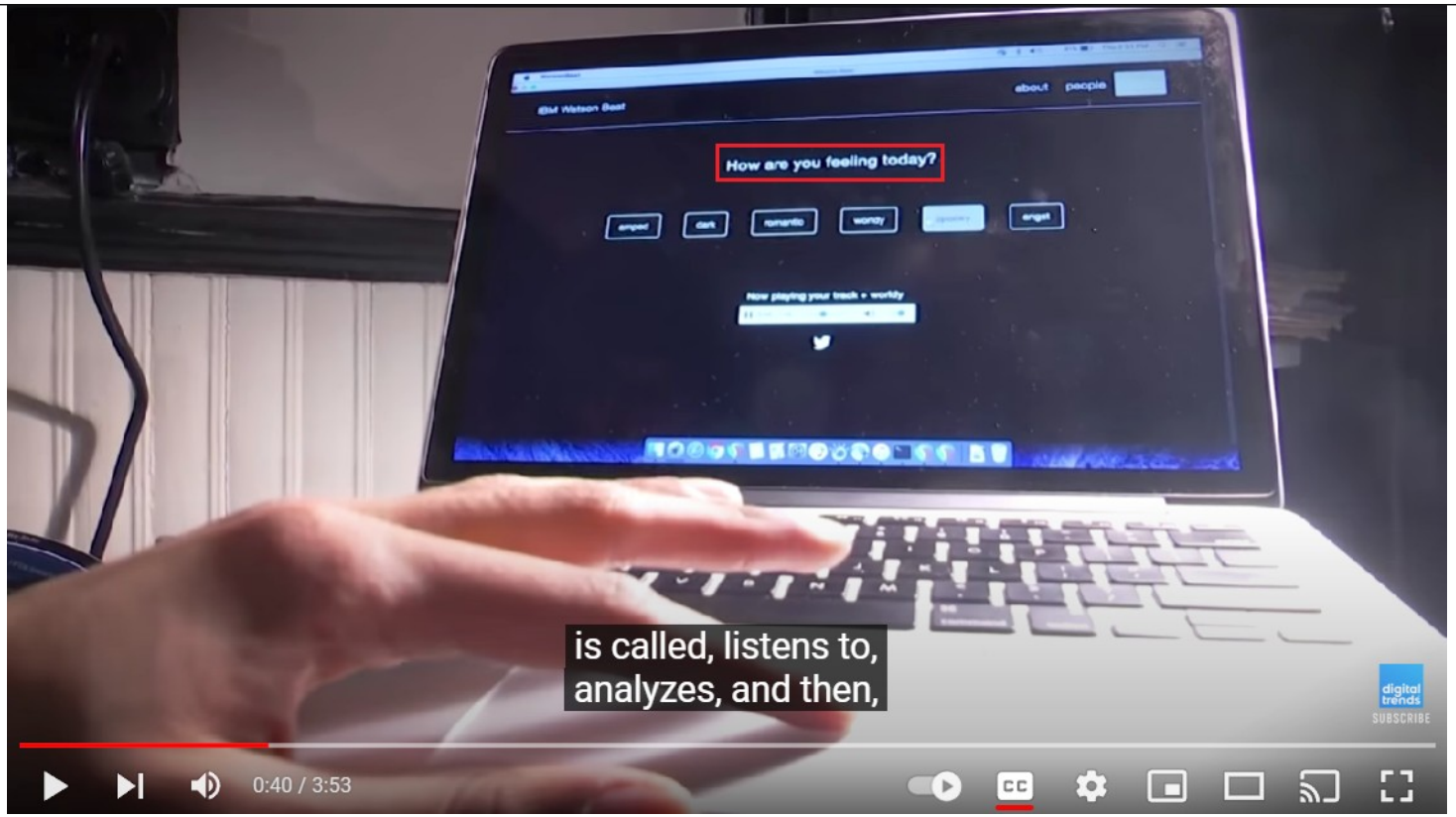
Richard determined the upbeat style of the song, as well as the variation of the additional instruments, by introducing perturbations into Watson Beat's neural network. These adjustments, done via an app, tell the system how similar or different the collaborative composition should be, compared to the original. This sliding scale of cognitive computing influence can come in especially handy for those whose last piano lesson stopped with Mary Had a Little Lamb!

https://www.ibm.com/blogs/think/2016/06/training-watson-to-be-your-musical-muse/

	Using machine learning algorithms, Watson BEAT is capable of learning from songs by deconstructing a song's pitch, time and key signatures, note sequence, and note velocity (how hard a note was struck). frequency characteristics of the song Combined with theories about emotional responses to music, Watson BEAT can generate completely new musical scores based on a variety of preferred moods (joyful, devastated, anxious etc.) or feelings (spooky, mysterious, cheerful, etc.). correspond to one or more moods of the song Using this technology, Alex could create new songs – even snippets of songs, like a bass line – until he found a sound that inspired him. And while "Not Easy" is an original work, Watson BEAT gave Alex many new ways to experience musical themes and human emotions. To dive even deeper into the insights, the IBM team used the Cognitive Color Design Tool to create an interactive visualization of the data based on the images, album artwork and colors that inspire Alex. The tool blends together understanding of psychological effects of colors, the interrelationships between emotions, and image aesthetics to create a custom color palette, tailored to the individual. https://www.ibm.com/blogs/think/2016/10/watson-music/

	Rhythm The rhythm section of The Watson Beat is responsible for the drum beat, bass line, and chord progressions of the composition. There are many parameters that you can pass into The Watson Beat, including time signature, tempo, and mood [2]. Using these parameters, and an understanding of music theory, The Watson Beat selects the next note to be used in the progression (the action). It utilizes Reinforcement Learning (RL), a type of machine learning diagramed below. If the note chosen for the next line in the progression is a standard concept (like a 1–4–5 in G), then the system is rewarded, and if the next note is odd (in a music theory sense), then system is penalized. This method steers the RL Agent to imitate, with a sense of randomness, a rhythm and progression for the composition. https://medium.com/@anna_seg/the-watson-beat-d7497406a202

	IBM's music arm of Watson: Watson BEAT, is changing the game. IBM's Watson Beat is a cognitive cloud-based music program developed using AI and machine learning. The machine's music generation algorithms analyse individual tracks and collect data on pitch time and key signatures, and note sequences. Using this collected data, it works out what a listener might want, or what an artist may be inspired by. Of course, this does not immediately equal a smash hit that everyone will love, but it certainly has the potential to aid producers and song-writers know their audience and get inspired. https://telefonicatech.com/en/blog/big-data-ai-changing-music-game-ib



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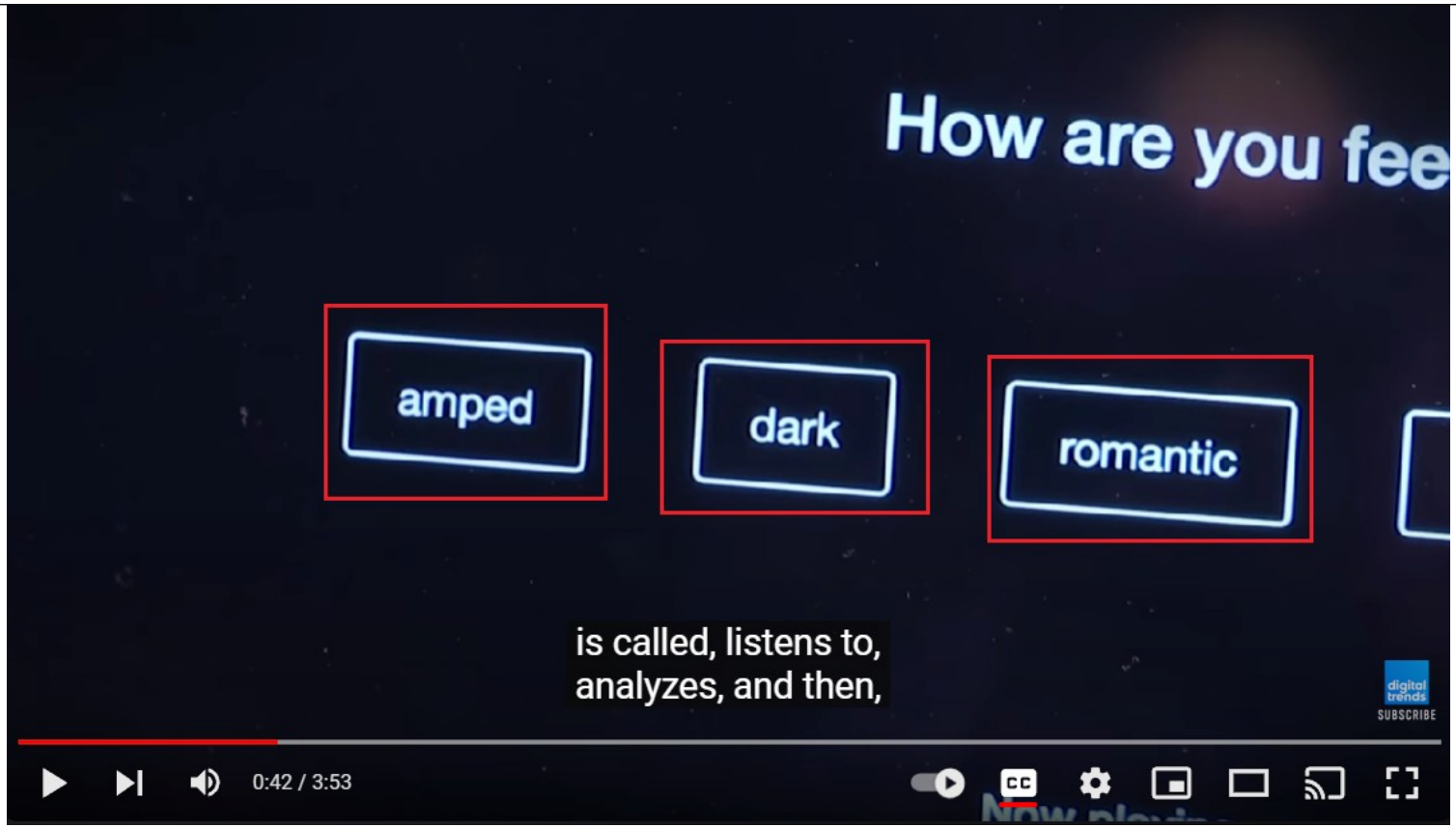

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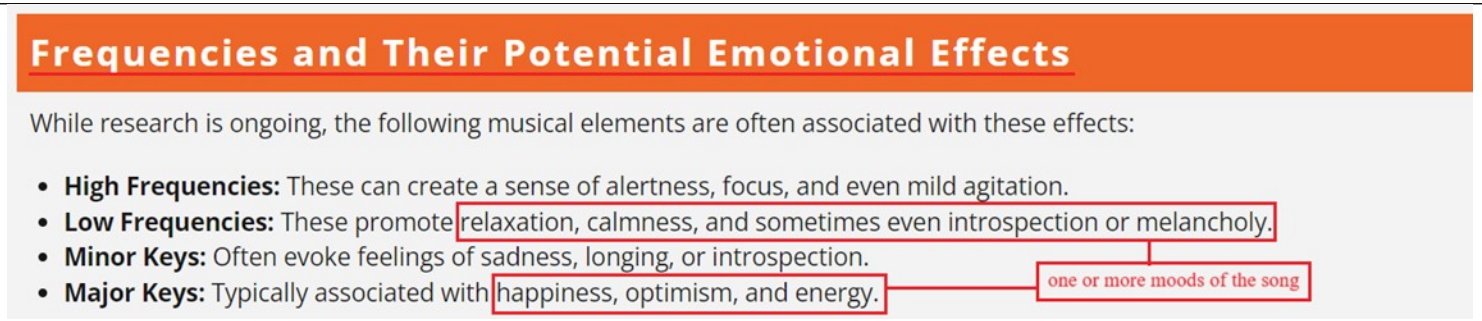

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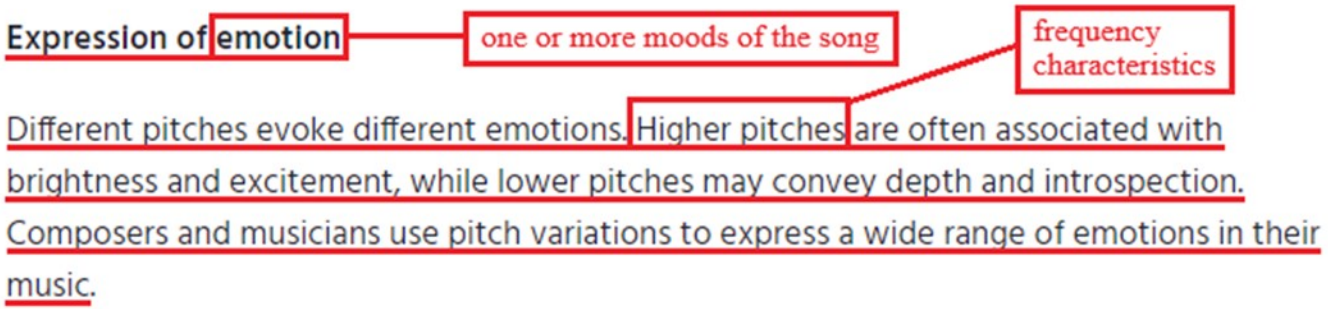

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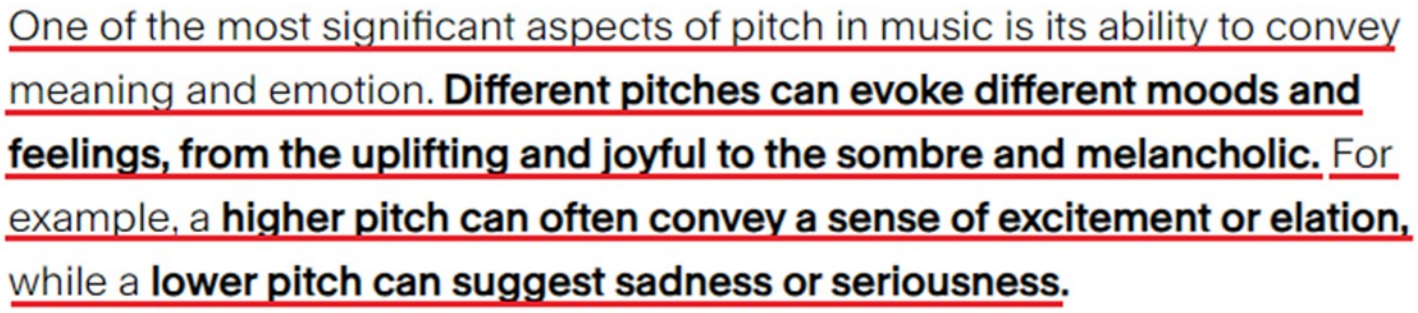

	https://www.aulart.com/blog/understanding-the-importance-of-pitch-in-music/# Hey there, music enthusiasts! Let's dive into the world of music and explore a term that gets thrown around a lot: tone. When we talk about tone in music, we're talking about the quality of sound, specifically the pitch of a musical note. It's what makes each instrument or voice unique and helps us tell them apart, even when they're playing the same note. Think of it like hearing a guitar and a piano playing the same note—you can instantly tell the difference in tone. Pretty cool, right? Well, in this blog, we're gonna explore what tone is all about and how you can use it to take your songwriting game to the next level. So, how can you use tone in music? Well, it's all about creating a certain mood or emotion. By choosing the right notes and instruments, you can convey different feelings in your songs. For example, playing a minor chord progression on a piano can bring out that melancholic, sad vibe, while strumming some major chords on a guitar can fill your music with happiness and joy. https://melodystudio.net/2023/08/07/tone-in-music-what-it-is-and-how-to-use-it/

Classification via Tags: Music mood classification often involves tagging songs with emotional descriptors such as "happy," "sad," "energetic," and "relaxing." Machine learning models can then be trained on these tags to automatically classify songs based on their emotional content.

Mood	Intensity	Timbre	Pitch	Rhythm
Happy	Medium	Medium	Very High	Very High
Exuberant	High	Medium	High	High
Energetic	Very High	Medium	Medium	High
Frantic	High	Very High	Low	Very High
Anxious/Sad	Medium	Very Low	Very Low	Low
Depression	Low	Low	Low	Low
Calm	Very Low	Very Low	Medium	Very Low
Contentment	Low	Low	High	Low

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