## Amazon Music

# The Careers Behind the Beats

### Key Student Learnings

### Phenomena Question

*How does a song go from being recorded to streaming on Amazon Music?*

*How do people collaborate to build or update software like the Amazon Music app?*

### Overarching Content Question

*What computer science is behind a song being recorded in the studio and streaming on apps like Amazon Music?*

career tours

amazon

# Vocabulary

## Stop 1: Producer

**Hardware**
The physical parts of a computer or device

**Input**
Information entered into or received by a computer

**Sound Energy**
The movement of vibrations through matter in the form of waves

**Software**
The code or instructions that tell the computer how to work and what to do

## Stop 2: Mastering Engineer

**Output**
Information given to users like sound, light, or information

**Wavelength**
The distance between peaks or valleys in a wave; determines a sound's pitch and frequency

**Amplitude**
The height of a sound wave; determines a sound's energy and volume

**Export**
To save information in a format that can be used by another application (app)

## Stop 3: Lawyer

**Copyright**
A law that stops people from using other people's work without permission

**Licensing**
Getting legal permission to use another person's work

## Stop 4A: Amazon Music

**Streaming**
Using a computer app to access a large library of media on demand

## Stop 4B: Host

**Front end**
The elements of an app the user can see and interact with

# Vocabulary

## Stop 4B: UX Designer

**Back End**
The code within an app that works behind the scenes to ensure the app functions

**User Experience (UX)**
The way a customer feels and thinks when using a game, website, or app

## Stop 4B: UX SDE

**Requirements**
A detailed document that sets out exactly what a product or a process should include

## Stop 4C: SDE

**Ingestion**
The process of obtaining or importing data for storage in a database or server

**Data**
Information that can be read or stored by a computer

**Machine learning**
The science of getting computers to perform actions or make predictions based on learnings or past experiences

# Intro

## Behind the Beat

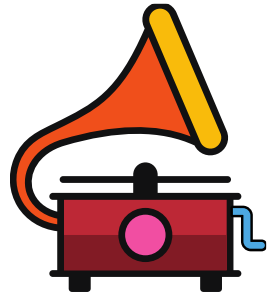
**Watch this Tour Stop in:** Video 1

### What are we learning about on this tour?

The history of music is also one of technological innovation. Before the early 1900s, if you wanted to listen to music, you had to go hear it performed live or play it yourself! This all changed in 1877, when Thomas Edison invented the first phonograph that could record the audio vibrations of sound waves. Fast forward a few decades to the early 1900s, when the electronics company RCA Victor launched the first record player that could be purchased by everyday consumers, allowing people to bring recorded music into their homes.

Over the years, how people have consumed music has changed, from needing to own physical copies of the music they liked (vinyl records, cassette tapes, CDs) to the widespread use of digital media (mp3 files) and having a whole library of music at their fingertips on streaming apps like Amazon Music.

# Standards



### CS Standards

**1B-IC-18** Discuss computing technologies that have changed the world, and express how those technologies influence, and are influenced by, cultural practices.

# Intro

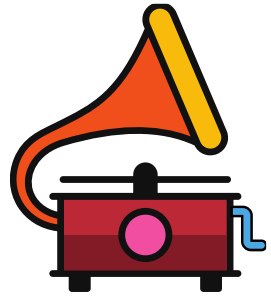
## Behind the Beat

**Watch this Tour Stop in:** Video 1

But how does a song even get recorded? How do streaming apps, like Amazon Music, make it easy for people to search and listen to the music they want, when they want to hear it?

On today's tour, we're going to take you on a song's journey from the recording studio to streaming on Amazon Music; along the way, you'll discover the computer science and careers behind your favorite beats.

# Standards



### Other Education Standards

**HS-ETS1-3** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts

# Stop 1

## Capturing Inputs

**Watch this Tour Stop in:** Video 2, Video 3

### Pre-Stop Trivia Poll

In 1877, the first machine that could record and playback sound was invented. What was on the very first audio recording?

**A. Mary Had a Little Lamb**
B. Baby Shark
C. Beethoven's 5th Symphony
D. A speech delivered by the President

The phonograph, the first machine to record and playback music, was invented by Thomas Edison in 1877. To show others what his machine could n do, he recorded himself saying the popular nursery rhyme.

**Note:** Note: Websites like Britannica credit Edison as the first to record and playback sound, but there was recorded sound a little before that, which was like a seismograph recording earthquakes:
**Source:** https://time.com/5084599/first-recorded-sound/

# Stop 1

## Capturing Inputs

**Watch this Tour Stop in:** Video 2, Video 3

### How are music inputs captured in a recording studio so they can be shared?

In live music performances, musicians use equipment that is durable, portable, and can amplify sound to fill up the entire room (microphones, instruments, amplifiers). But that equipment isn't the best for recording. For example, microphones may sound muffled or the recording may pick up unwanted background sounds.

When an artist wants to record their music, they head to a recording studio. At the studio, an artist will work with a **producer** to create the best recording of their song possible.

CAREER FOCUS:

**Music Producer**

# Stop 1

## Capturing Inputs

**Watch this Tour Stop in:** Video 2, Video 3

**So, how do they do this?** Using science and computer science!

For studio recording, musicians and producers use high quality **hardware** (physical parts of a computer or device) and **software** (code or instructions that tell a computer how to work and what to do).

**How does recording work?** Recording music requires collecting and storing audio (sound) **inputs** (information entered into or received by a computer) onto a computer. One input into the recording system may be singing or playing an instrument into a microphone. To collect these inputs, artists and producers head to a recording studio and use special **hardware** (devices you can touch) to capture their sounds. Hardware can include microphones, instruments, studio mixers, and other computing equipment.

CAREER FOCUS:
**Music Producer**

# Stop 1

## Capturing Inputs

**Watch this Tour Stop in:** Video 2, Video 3

**How do computers capture sound inputs?** All sound is energy that travels through the air in the form of vibrations (**sound energy**). Microphones have a special component called a diaphragm that moves when sound waves pass through it. These sound waves can come from a person's voice or an instrument. When the diaphragm moves, it creates tiny electrical signals, which are sent through wires to hardware that processes and converts the signals into code that a computer's software can understand.

### Mid-Stop Review Question: Vocabulary Review

A musician singing into a microphone or playing a keyboard plugged directly into a computer are examples of audio _____?

A. output **B. inputs** C. software D. algorithms

CAREER FOCUS:

**Music Producer**

# Stop 1

## Capturing Inputs

**Watch this Tour Stop in:** Video 2, Video 3

**What software do producers use to capture sound inputs?** Back in the day, music used to be recorded onto giant reels or tapes. If an artist made a mistake or a producer wanted a part to sound differently, artists would have to re-record the whole song or physically cut and tape parts of the tape. Today, producers use special **software** called a Digital Audio Workstation, or DAW for short. This software allows producers and musicians to easily manipulate music to add effects, re-record certain parts of a song, reorder parts of a song, add layers to the music, and much more. Producers then store the audio on the computer hardware or in the cloud and can share the song with others.

The job of a producer is a big one – controlling all inputs and outputs in a studio to record songs that sound great to listeners. And thanks to modern hardware and software, this is much easier to do than back in the day!

When the song is recorded and everyone agrees on the mix – how it sounds, how it feels – the producer passes the song on to a mastering engineer.

CAREER FOCUS:
**Music Producer**

# Stop 1

## Capturing Inputs

**Watch this Tour Stop in:** Video 2, Video 3

### Review Questions Vocabulary Review

A producer hits record on a Digital Audio Workstation (DAW). A DAW is an example of _____ used to capture audio inputs.

A. sound energy
**B. software**
C. inputs
D. An instrument

Hardware inside of a microphone can convert _____ into electric signals when recording songs.

A. software
B. other hardware
**C. sound energy**
D. light energy

CAREER FOCUS:
**Music Producer**

# Stop 1 Standards

## CS Standards

**1B-CS-02** Hardware and software work together as a system to accomplish tasks.

**1B-IC-18** Discuss computing tech that have changed the world, and how those techs influence, and are influenced by, cultural practices.

**2-CS-02** Design projects that combine hardware and software components to collect and exchange data. Collecting and exchanging data involves input, output, storage, and processing.

## Other Education Standards

**4-PS4-1 Waves and Their Applications in Tech for Information Transfer** Develop a model of waves to describe patterns in terms of amplitude and wavelength, and showcase that waves can cause objects to move.

**HS-PS4-5** Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

# Stop 2

## Improving & Finalizing Outputs

**Watch this Tour Stop in:** Video 4, Video 5

### How does computer science help improve and finalize music outputs so they sound good on all types of devices and in different environments?

In the early days of recording, bands would play together in a single room around a single microphone. This caused some instruments to sound louder than others.  Bass heavy recordings could even make the needle jump out of the groove when playing a record!

Today, each instrument/sound input can be recorded and tracked separately, allowing producers and engineers to balance the sounds later. This is important because people listen to music in different ways and on different devices. Engineers must improve and finalize the **output** (what comes out of a computer or device) so no matter how the person is listening (earbuds, portable speaker, in the car), the music sounds the same.

**So how do engineers use computer science to improve the output of an audio recording?**
Through mastering. Mastering is ensuring the final mix of a song is prepared and ready for distribution, whether on physical media (vinyl, cds) or digitally (computer files, streaming). Mastering is done by a special engineer called a mastering engineer, who uses computer science to enhance the overall audio quality of a recording to make it sound best for listeners.

CAREER FOCUS:
**Mastering Engineer**

# Stop 2

## Improving & Finalizing Outputs

**Watch this Tour Stop in:** Video 4, Video 5

In order to understand mastering, we must understand the components of a sound wave. The amplitude, or height of a wave, determines its energy and its volume. Louder sounds, like drum hits, have higher amplitudes, and softer sounds, like guitar strums, have lower amplitudes. When recording, some instruments or voices may sound louder or softer at different points in the song. You wouldn't want a jump scare in the middle of listening to your favorite song because of a sudden spike in volume or have to strain your ears to hear softer sounds. Algorithms in digital audio workstation software can bring the louder and softer parts closer in volume to make all the elements of a song sound more cohesive.

Sound wavelengths (distance between the peaks, or crests in a wave) control the frequency and pitch of a sound. Higher pitched sounds (birds chirping, flutes, cymbals) have short wavelengths Lower pitched sounds (bass guitar, kick drum) have long wavelengths. Equalization in music mastering uses software (and sometimes artificial intelligence) to adjust the volume of short, medium, and long wavelengths of sound inputs to get the desired tone and balance the sounds so it's best for listeners.

CAREER FOCUS:

**Mastering Engineer**

# Stop 2

## Improving & Finalizing Outputs

**Watch this Tour Stop in:** Video 4, Video 5

### Mid-Stop Trivia Poll

What do you think it means to export a song?

**A. To save a file so it can be used by other software**
B. To send the file to another country in the mail
C. To open a file in special software

After a song is mastered, it is ready to be passed to the music label or back to the artist for distribution. The mastering engineer must **export** the output (save a copy of the song file in a format that can be understood by another app or computer). The file could be exported onto media hardware (vinyl, cds) or it could be saved as a file to be shared digitally. Saving a file in formats like mp3 or wav makes it easy to share with other devices.

When a file is exported, it's tagged with data about the song like the title, author, year, genre, song length, performers, and language. Once a song is exported and tagged, it's almost ready for release – but first, it must be legally protected!

CAREER FOCUS:
**Mastering Engineer**

# Stop 2

## Improving & Finalizing Outputs

**Watch this Tour Stop in:** Video 4, Video 5

### Review Question: Vocabulary Review

Mastering engineers adjust the _____ of sound waves, which determines the sound's volume (how loud or soft the sound is).

A. pitch

B. wavelength

C. export

**D. amplitude**

CAREER FOCUS:

**Mastering Engineer**

# Stop 2 Standards

## CS Standards

**1B-CS-02** Hardware and software work together as a system to accomplish tasks.

**1B-AP-08** Compare and refine multiple algorithms for the same task and determine which is the most appropriate.

## Other Education Standards

**4-PS4-1 Waves and Their Applications in Tech for Information Transfer** Develop a model of waves to describe patterns in terms of amplitude and wavelength, and showcase that waves can cause objects to move.

**HS-PS4-5** Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

# Stop 3

## Protecting Your Creativity

**Watch this Tour Stop in:** Video 6

### Pre-Stop Trivia Poll

True or False: When you pay to listen to music, you can do whatever you want with the song recording.
A. True **B. False**

When you buy a song file or pay for a music service, what can you do with the recordings?
A. Send it to all of your friends and family
B. Use it in a movie or TV show
**C. Listen to it**
D. Use it to advertise products

### How do streaming services get the rights to distribute songs?

Imagine you own a bicycle and your friend wants to borrow it. You agree to let them borrow it but for a fee. You also set out conditions, such as telling them they can't do tricks on the bike, and they must lock it up wherever they go. This agreement is like the agreement Amazon Music makes with record labels, who own their artists' song recordings.

CAREER FOCUS:
**Lawyer**

# Stop 3

## Protecting Your Creativity

**Watch this Tour Stop in:** Video 6

Record labels – companies that help manage producing and distributing music for artists – don't want others using their artists' songs without permission. In order to make sure others don't steal or use their artists' sound recordings, labels apply for a legal protection called a **copyright** (a law that stops people from using other people's work without permission). Record labels usually own the copyright to the artists' tracks. Copyrights give the label the exclusive right to reproduce and distribute sound recordings.

You hear music in TV shows and movies or you may hear an artist cover (or reproduce) another artist's song and there's millions of songs on streaming apps. So how do others get access to a song if they don't own it? Through **licensing** – getting legal permission to use another person's work.

At Amazon Music, lawyers **license** sound recordings from record labels. Lawyers from music services negotiate contracts, or make a deal, to get permission to include songs in a collection of music. It's like a permission slip, but for being able to use a song. If the label agrees to license their artists' music, they work out a deal that may include details such as how much the label will get paid and how their artists' tracks are marketed or advertised.

CAREER FOCUS:

**Lawyer**

# Stop 3

## Protecting Your Creativity

**Watch this Tour Stop in:** Video 6

Once Amazon Music has the license, or rights, to a song, they can offer the song to their users. When the license contract runs out, Amazon's lawyers must make a new deal with labels and artists or risk the music being removed from the streaming service's catalog.

### Review Question: Vocabulary Review

Music services must _____ songs from record labels to offer tracks for users to listen to.

**A. license** B. copyright
C. record D. export

CAREER FOCUS:
**Lawyer**

# Standards

### CS Standards

**1B-IC-21** Use public domain or creative commons media, and refrain from copying or using material created by others without permission.

# Stop 4A

## Streaming

**Watch this Tour Stop in:** Video 7

### Pre-Stop Trivia Poll

How long do you think it would take to listen to all the music currently available on Amazon Music, if you listened without stopping.

A. About 1 year
B. About 10 years
C. About 50 years
D. About 100 years
E. About 250 years
**F. Over 500 years**

**Source:** AMU has 100 million songs. Average length of a song is 3 minutes.
300 million minutes / 60 minutes / 24 hours / 365 days = 571 years

### How did our access to music change over time?

Once recorded music was invented, people could access music via the radio or by purchasing physical media/hardware (vinyl records, then 8-track tapes, cassette tapes, compact discs). But this media had limitations like sound quality and limited storage capacity.

# Stop 4A

## Streaming

**Watch this Tour Stop in:** Video 7

The late 1990s and early 2000s saw the rise of digital media files. People could ‘rip’ (copy) their physical media onto computers and create digital files, only limited by the hard drive space on computers. Cloud computing (the delivery of computing resources, including storage and processing, through the Internet) allowed technology companies to store large libraries of music at data centers around the world and instantly share them to customers over the Internet. People could purchase individual songs or full albums and access them immediately. But digital files came with their own problems, and it became easy for people to use the Internet to steal and share music they ripped or purchased.

Then **streaming** (using a computer to access data files **on demand**) was developed. With streaming, rather than listeners having to purchase digital files, companies like Amazon could provide a full library of music to users to listen to at any time over the Internet. People could listen to any song in a large catalog of music and play the file directly from the data center without having to store the file on their own device.

# Stop 4A

## Streaming

**Watch this Tour Stop in:** Video 7

To ensure labels get paid for their artists' music, music listeners can pay for a subscription to access music or music may be available for free with advertising. People can access virtually any song they want without having to purchase each individual file or album, drastically reducing the amount of illegal sharing. Streaming services have evolved to also include various levels of streaming quality, exclusive content, and custom playlist curation, helping listeners discover new music instantly.

Streaming music requires the development and maintenance of specific apps to access files from data centers and let people listen whenever, wherever. These apps are the result of countless hours of collaboration among thousands of people.

### Review Question: Vocabulary Review

_____ allows people to access music files on demand over the Internet, instead of lugging around heavy records.

A. copyright  B. amplitude  **C. streaming**  D. sound energy

# Stop 4A Standards

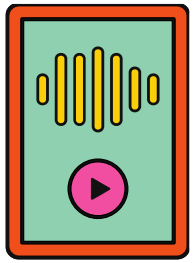
## CS Standards

**1B-IC-18** Discuss computing technologies that have changed the world, and express how those technologies influence, and are influenced by, cultural practices.

## Other Education Standards

**HS-ETS1-3** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

# Stop 4B



## The Front End

**Watch this Tour Stop in:** Video 8, Video 9

### How are apps designed and built so they're easy to use?

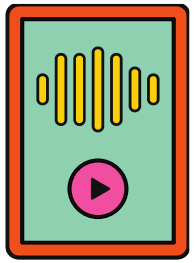
Every single app that exists in the world has two main components: the **front end** (the elements of an app that a user can see and interact with) and the **back end** (the code within an app that works behind the scenes to ensure the app functions). The creation of streaming apps requires the expertise of engineers and designers who work collaboratively to ensure the front end of an app is easy and enjoyable to use and the back end is coded correctly so the app works as intended.

The front end of an app is designed by a UX designer, who focuses heavily on the **UX**, or **user experience** (the experience a customer has when using a game, website, or app). Imagine you open up an app and can't figure out how to use it. The buttons are too small, you have no idea how to search for music, the directions are complex, and ads and pop-ups take over your screen. You'd probably get frustrated and delete that app from your phone! It's the job of a UX designer to make sure using an app is fun, easy, and accessible for all types of users.

CAREER FOCUS:

**UX Designer**

# Stop 4B



## The Front End

**Watch this Tour Stop in:** Video 8, Video 9

UX designers begin with research. They ask questions like, “What is the target audience and what are their needs?” Sometimes UX designers research and brainstorm from scratch, and sometimes they seek inspiration from other popular digital experiences to identify what features users love! With an app like Amazon Music, users need an easy and enjoyable way to search for their favorite songs, discover new music, and play and pause music.

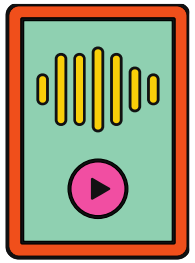
From there, a UX designer organizes content and steps through the logical journey a user would take  to go from opening the app to achieving their desired result. They think through everything! How big should the buttons be? Where should the buttons be placed? What colors should we use that won’t strain people’s eyes? How should we order the words in the menu?

UX designers use special software to design the front end of an app. This software allows them to show what the visual experience will look like and how it might change when users interact with it. After many rounds of feedback, revisions, and testing, the UX designer passes the design to a software development engineer for coding.

CAREER FOCUS:

**UX Designer**

# Stop 4B



## The Front End

**Watch this Tour Stop in:** Video 8, Video 9

### Mid-Stop Trivia Poll

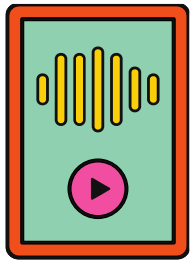
When crafting buttons and app flow, designers focus on the _____, the way a customer thinks or feels when interacting with an app

**A. User Experience (UX)** B. back end
C. streaming D. licensing

A UX designer creates the visuals for what the design should look and feel like, but the design still needs to be coded. Front end engineers review the **design specifications** (a detailed document that sets out exactly what a product or a process should be). They first must make sure every part of the design is possible to code. If it's not, they may pass the design back to the UX designer to make changes.

CAREER FOCUS:
**Front End Engineer**

# Stop 4B



## The Front End

**Watch this Tour Stop in:** Video 8, Video 9

If the design is able to be coded, a front end engineer will program each individual component of the front end. This front end development ensures buttons can be pressed, each app component is in the right place, the correct images appear, menus can open and close, and all parts of a UX designer's design are implemented into the app.

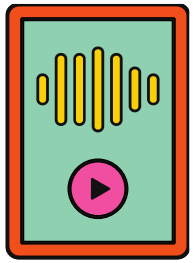
### Review Question: Vocabulary Review

Some engineers write the code for the buttons, menus, and other design elements of an app's _____ – the parts that you see and interact with

A. back end **B. front end** C. hardware D. export

CAREER FOCUS:
**Front End Engineer**

# Stop 4B Standards

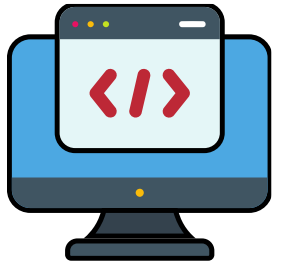


## CS Standards

**1B-IC-19** Brainstorm ways to improve the accessibility and usability of technology products for the diverse needs and wants of users.

**2-AP-15** Seek and incorporate feedback from team members and users to refine a solution that meets user needs.

# Stop 4C



## The Back End

**Watch this Tour Stop in:** Video 10, Video 11

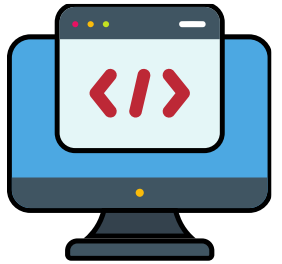
### How do algorithms and machine learning help users search for artists they may like and want to listen to?

A UX Designer and front end engineer could create the coolest front end of all time, but it means nothing if the app doesn't do what it's intended to do! Users would get frustrated if they pressed a button and music didn't play, or if they searched for a song by Taylor Swift and were given "Twinkle Twinkle Little Star".

The creation of the **back end** (the code within an app that works behind the scenes to ensure the app functions) is as critical as the front end. At Amazon Music, getting music into the music library (or catalog), ensuring users get the right song when searching, and helping users discover new music are critical components of the back end of the music app.

CAREER FOCUS:
**Principle Engineer**

# Stop 4C



## The Back End

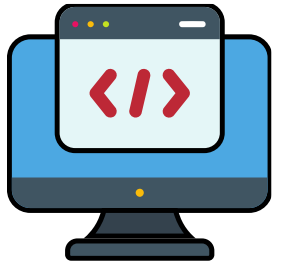
**Watch this Tour Stop in:** Video 10, Video 11

**How are songs added to Amazon Music?** After a song is recorded, tagged, exported, and licensed, it must get **ingested** (uploaded for storage in a database or server) to Amazon Music's system. A record label or other music distribution service will upload a package of information to Amazon Music's **servers** (computers whose function is to store, process, send, or receive data). That package includes a high quality recording of the song, all of the song's tags (title, artist, genre, year), the cover art, and any other relevant information. **Engineers** at Amazon Music check the file package and Amazon's publishing software takes over. The software converts the music file into a format that can be used by the Amazon Music app and it is published to the front end in the app so people can find it and start listening!

Each month, Amazon Music ingests millions of songs, using software to quickly check for quality and add the music to its vast library. But how do people find the song they're looking for or discover new music they may like? It all comes down to the music search component of the back end.

CAREER FOCUS:
**Principle Engineer**

# Stop 4C



## The Back End

**Watch this Tour Stop in:** Video 10, Video 11

### Mid-Stop Trivia Poll: Vocabulary Review

What is one responsibility of a **backend** engineer in a music app?

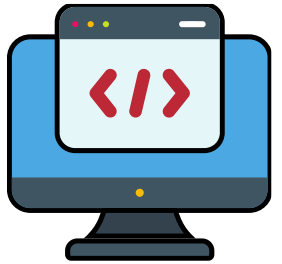
A. Write the code for the buttons and colors
B. Design the menus in an app
C. Conduct research with users
**D. Write the code that retrieves the correct song data**

When you go to a restaurant, you look at the menu and find the food that you'd like to order. But what if the menu had over 100 million items on it? You'd be reading the menu forever! You'd likely feel overwhelmed and unable to choose what you'd like to eat.

The Amazon Music catalog is like that menu. There are hundreds of millions of songs. So how do music listeners not get overwhelmed when searching for music on the app? Through machine learning.

CAREER FOCUS:
**Software Engineer**

# Stop 4C



## The Back End

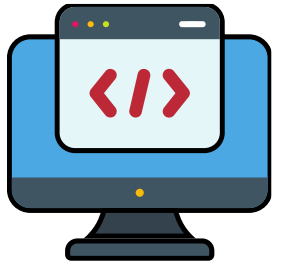
**Watch this Tour Stop in:** Video 10, Video 11

**Machine learning** is the science of getting computers to perform tasks or make predictions based on examples or past experiences. **Software development engineers** at Amazon Music write step-by-step procedures called algorithms to collect millions of **data points** or pieces of information, about what users are listening to. The algorithm may notice that a person who likes Beyoncé also listens to Khalid. A person who likes dance music may listen to DJ Marshmallow and David Guetta. An algorithm takes this information, combines it with the data that is tagged in the song, and learns which songs are similar to each other.

When a person searches for a song, machine learning uses what they've listened to in the past, what is relevant to their search (title, artist, type of music), and what songs are similar to each other to rank search results for the user. A user will see the search results in order from most relevant to least relevant on the front end of the app, ensuring you get the song you want to hear or discover new songs you may love!

CAREER FOCUS:
**Software Engineer**

# Stop 4C



## The Back End

**Watch this Tour Stop in:** Video 10, Video 11

When you use a streaming music app, remember there are a lot of people and a lot of programming involved in giving you the best listening experience. But how do all those engineers and designers work together? How do people know what they need to work on? Is there, like, a boss? Well yes! You'll find out at the next stop.

### Review Question: Vocabulary Review

Computers are trained using _____ to learn what people like to listen to and make new music recommendations.

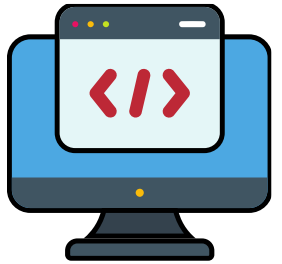
**A. machine learning** B. ingestion C. exporting D. hardware

Machine learning requires computer software to take in lots of _____, like the genre of a song or what other users are listening to.

A. sound energy B. amplitude C. licenses **D. data**

CAREER FOCUS:
**Software Engineer**

# Stop 4C Standards



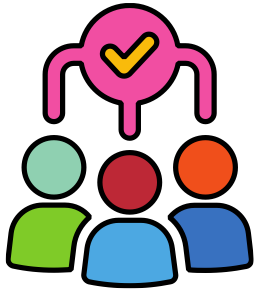
## CS Standards

**1B-AP-10** Create programs that include sequences, events, loops, and conditionals.

**1B-AP-12** Modify, remix, or incorporate portions of an existing program into one's own work, to develop something new or add more advanced features.

**2-AP-10** Use flowcharts and/or pseudocode to address complex problems as algorithms.

# Stop 4D



## Collaboration

**Watch this Tour Stop in:** Video 12

### How do hundreds of people collaborate to build and maintain a streaming app?

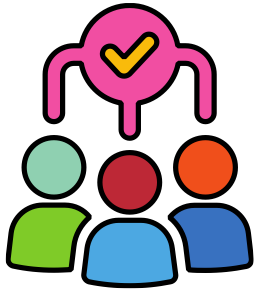
Imagine that a class is tasked with  painting a mural on a wall at school by the end of the school year. How will each student know what part of the mural to paint? How will they know what materials are needed? How will they ensure that the mural is completed in time? They'd probably look to their teacher to give out roles and keep the project on track.

At tech companies, it's not a teacher keeping hundreds of engineers on track, but a product manager. A product manager is the person in charge of making sure everything runs smoothly – from the idea phase through to the finished product. Product managers may or may not know how to code, but they're essential in making sure that the best product gets delivered to customers.

CAREER FOCUS:

**Product Manager**

# Stop 4D



## Collaboration

**Watch this Tour Stop in:** Video 12

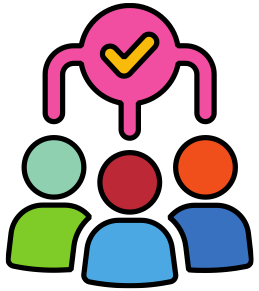
It's important for a product manager to keep their customers top of mind by thinking through what different people might want the product to do. In music, you might have customers who are constantly in search of new music to listen to. Or you may have customers that just want to listen to their favorite artist on repeat. Both listeners' desires need to be accounted for in the app.

Product managers create project timelines with specific milestones to make sure the product development work is completed on time. They know the strengths of each designer and engineer and delegate tasks to each team member accordingly. They may help engineers think through and solve problems along the way. Through organization, collaboration, and effective communication, product managers and teams of engineers and designers can build apps and new features that offer music fans seamless discovery and a great listening experience.

CAREER FOCUS:

**Product Manager**

# Stop 4D Standards



## CS Standards

**1B-AP-13** Use an iterative process to plan the development of a program by including others' perspectives and considering user preferences.

**1B-AP-16** Take on varying roles, with teacher guidance, when collaborating with peers during the design, implementation, and review stages of program development.

**2-AP-18** Distribute tasks and maintain a project timeline when collaboratively developing computational artifacts.

## Other Education Standards

**3-5-ETS1-1** Engineering Design. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

# Survey Polls

## Poll

Of the careers you saw today, which interests you most?

A. Producer
B. Mastering Engineer
C. Lawyer
D. Product Manager
E. UX Designer
F. SDE

How interested are you in pursuing careers in technology?

1 - Very uninterested
2 - Uninterested
3 - Neither interested nor uninterested
4 - Interested
5 - Very interested

How did this tour affect your interest in pursuing careers in technology?

1 - Decreased
2 – No change
3 - Increased

Overall, rate your tour experience on a scale of 1-5

1 - Extremely Unsatisfactory
2 - Unsatisfactory
3 - Neither Unsatisfactory or Satisfactory
4 - Satisfactory
5 - Extremely Satisfactory

Do you agree or disagree with the following statement: I feel like I belong in careers in technology.

1 - Strongly Disagree
2 - Disagree
3 - Neither Agree nor Disagree
4 - Agree
5 - Strongly Agree

# Stop 5

## Conclusion

**Watch this Tour Stop in:** Video 13

It takes a lot of computer science and people working together to bring you your favorite music. The song is recorded in the studio. It's licensed by a streaming service. And hundreds of people work together to build and constantly improve the streaming app so you can find and listen to your favorite songs effortlessly.

The next time you enjoy your favorite song on Amazon Music, reflect on the incredible teamwork of both the creative minds and computer science wizards who made this musical experience possible.

# Rapid Fire Review

## Review

Producers use _____, like microphones, instruments, and mixing boards, to capture sound inputs.

**A. hardware**
B. software
C. data
D. Amplitudes

The pitch – how high or low a sound is – is determined by a wave's _____ or, the distance between two of the same points in a wave.

A. amplitude
B. input
C. output
**D. wavelength**

Record labels own a _____ for their artists' songs, which gives them the right to choose who can use their property.

A. bicycle
B. license
**C. copyright**
D. software

# Rapid Fire Review

## Review

A UX designer passes over _____ to a front end engineer so they know exactly what to code.

A. software

B. Crayon drawings

**C. specifications**

D. hardware

Engineers _____ packages that contain songs, information, and artwork, then check the data before the track enters the music catalog.

A. export

**B. ingest**

C. stream

D. deliver