1. Technical Support Fundamentals
    a. Introduction to IT
        i. What is IT?
            1. Information Technology - The use of digital technology, like computers and the internet, to store and process data into useful information
            2. The IT industry refers to the entire scope of all the jobs and resources that are related to computing technologies within society.
            3. Job examples:
                a. Network Engineers - who ensure computers can communicate with each other
                b. Hardware Technicians - who can replace and repair components
                c. Desktop Support - who make sure that end users can use their software properly
            4. IT isn't just about building computers and the internet, it's really about people. That's the heart and soul of IT support work.
            5. What good is technology or information if people can't use technology or make sense of the information?
            6. IT helps people solve meaningful problems by using technology which is why you'll see its influences in:
                a. Education
                b. Medicine
                c. Journalism
                d. Construction
                e. Transportation
                f. Entertainment
                g. Any industry
            7. IT is about changing the world through the ways we collaborate, share, and create together.
            8. Digital Divide
                a. Growing skills gap between those with digital literacy and those with limited or none. People without digital literacy skills are falling behind
                b. There are many social and economic reasons why some people have digital literacy skills and other people do not
                c. Maybe you're from a community where there wasn't any internet or you couldn't afford a super-fast computer and had to use one at your school or library instead
                d. People like us are the real solution to bridging that digital divide
                e. Overcoming the digital divide not only involves confronting and understanding the combination of socio-economic

factors that shape our experience, but also helping others confront and understand those experiences
        f. By getting into IT you'll help serve those in your communities, and organizations, and maybe even inspire a new generation of IT pioneers.
        g. "When I think about solving the digital divide, I can't help but think of all the opportunities and breakthroughs that folks from diverse backgrounds and perspectives in the industry can bring." - Kevin Limehouse
ii. What does an IT Support Specialist do?
    1. So what does the day-to-day work of someone in IT Support look like? Well, it varies a ton based on whether you're doing in-person or remote support at a small business or a large enterprise company, and there's really no such thing as day-to-day work since the puzzles and challenges are always new and interesting
    2. In general an IT Support Specialist makes sure than an organizations' technological equipment is running smoothly. This includes the following for office and computing equipment:
        a. Managing
        b. Installing
        c. Maintaining
        d. Troubleshooting
        e. Configuring
    3. Using failure as feedback is an important skill both in IT and in life
iii. From Abacus to Analytical Engine
    1. Computer - a device that stores and processes data by performing calculations
    2. Before we had actual computer devices, the term computer was used to refer to someone who actually did the calculation
    3. Punch Cards - Cards that had holes in them that were historically used to store data or perform actions
    4. Punch cards were the first binary system used for machines.
    5. Algorithm - A series of steps that solve specific problems
iv. The Path to Modern Computers
    1. Cryptography - the art of writing and solving codes
    2. Apple
    3. IBM
    4. Microsoft
    5. Linux
    6. PDAs - Personal Digital Assistants
    7. Nokia
v. Your History of Computing
    1. How have you seen technology transform in your own life? What was the oldest computer or device you remember using? How

does this compare to the machines you use today? What was your favorite piece of tech that is no longer popular or in common use? What are some modern benefits you're grateful for? Share your own "history of computing" with your fellow learners!

a. My family had a computer in the late 90s. I remember we got internet access pretty early on too. I saw and owned the old cell phones that had cloth covers because the cases were hard enough. I also saw the rise of PDAs, Blackberry, Sidekick, and flip phones like Razr. I too, like Kevin Limehouse (the instructor of this module) talked my family into gifting me one of the old computers they were going to get rid of. This ended up happening several times and I began what I called "Frankenstein-ing" the computer hardware pieces together. There were a few times I received computers from friends and other family members that had better CPUs or RAM than the main machine I was using. I would adjust and move swappable hardware to the best and most applicable machine.
b. I learned some psuedocode in a game called RPG Maker and messed with hexadecimal values using tools like Game Genie, Gameshark, and Action Replay for major title consoles and computer games. Through the help of message forums and gaming communities, I learned how to edit the program and save files directly to make the sprite and/or stat and inventory changes I wanted to see. Following that I also began building front-end web pages and sites for myself based on my favorite video games, animes, and interests.
c. I also explored the growing field of Music Technology and Audio Engineering. Software and tools that were once used only by industry experts and world-renowned producers/audio engineers became accessible to the average musician. Some stuff that I thought was possible wasn't around until more recently (Guitar to MIDI for example), but my hunch and intuition with technology has always felt spot on.

vi. Computer Language

1. Binary System - The communication that a computer uses, also known as a base-2 numeral system. This means it only talks in 1s and 0s.
2. Technically a bit is a binary digit
3. A group of 8 bits is a byte
4. A byte of zeros and ones could look like 10011011. Each byte can store one character, and we can have 256 possible values thanks

that a base-2 system, two to the eighth. In computer talk, this byte can mean something like the letter c. This is how a computer language is born. Let's make a quick table to translate something a computer might see into something we'd be able to recognize. What does the following translate to? Did you get hello? Pretty cool. By using binary, we can have unlimited communication with our computer. Everything you see on your computer right now, whether it's a video, an image, texts or anything else, is nothing more than a one or a zero. It is important that you understand how binary works. It is the basis for everything else we'll do in this course. Make sure you understand the concept before moving on.

vii. Binary
    1. Imagine a lightbulb with a switch
        a. Switched on - the state is 1
        b. Switched off - the state is 0
        c. A series of 8 on and off lightbulbs represents 8 bits with a state of zero or one
    2. The above example is similar to how the Loom machine would thread punch cards:
        a. If there was a hole, the hole would be threaded
        b. If there was no hole, the needle wouldn’t go through
        c. The Loom machine’s concept was evolved for computers to recognize these punch card holes or lack thereof as 0s and 1s. Computers could take these bits and bytes to calculate any possible amount of numbers
    3. Binary Today
        a. Binary in today’s computer isn’t done by reading the holes. It uses electricity via transistors allowing electrical signals to pass through. If there is an electric voltage we would denote it as one. If there isn’t, we would denote it by zero.
        b. Just having transistors isn’t enough for our computer to be able to do complex tasks.
        c. Logic gates - Allow our transistors to do more complex tasks, like deciding where to send electrical signals depending on logical conditions

viii. Logic Gates
    1. Knowing how logic gates work is important to understanding how a computer works. Computers work by performing binary calculations. Logic gates are electrical components that tell a computer how to perform binary calculations. They specify rules for how to produce an electrical output based on one or more electrical inputs. Computers use these electrical signals to represent two binary states: either an “on” state or an “off” state. A

logic gate takes in one or more of these binary states and determines whether to pass along an “on” or “off” signal.

2. Six common logic gates
    a. NOT gate
    b. AND gate
    c. OR gate
    d. XOR Gate (AKA exclusive OR gate)
    e. NAND gate (AKA not-AND gate)
    f. XNOR gate (AKA not-XOR gate)
3. Combining gates (building circuits)
    a. Logic gates are physical electronic components—a person can buy them and plug them into a circuit board. Logic gates can be linked together to create complex electrical systems (circuits) that perform complicated binary calculations. You link gates together by letting the output from one gate serve as an input for another gate or by using the same inputs for multiple gates. Computers are this kind of complex electrical system.
4. Schematic Diagrams - represent the gates in this context

ix. Abstraction
1. Abstraction - To take a relatively complex system and simplify it for our use
2. We use abstraction in our everyday life - to drive a car you don’t need to know how an engine or transmission works directly. If you buy a car from a different manufacturer, even though under the hood might be different, the way you operate the vehicle will mostly be the same
3. Abstraction hides complexity by providing a common interface
4. Error messages are an abstraction

x. Computer Architecture Overview
1. Hardware layer - Made up of the physical components of a computer
2. Operating System - Allows hardware to communicate with the system
3. Software layer - How we as humans interact with our computer
4. User - Interacts with the computer; one of the most important layers we’ll learn about

xi. Module 1 Glossary

2. Week 2
    a. Hardware
        i. The Modern Computer
        ii. Introduction to Computer Hardware
            1. Computers ultimately just calculate, process, and store data.

2. Ports - Connection points that we can connect devices to that extend the functionality of our computer
3. CPU (Central Processing Unit) - The brain of our computer, it does all the calculations and data processing
    a. Communicates pretty heavily with RAM
4. RAM (Random Access Memory) - Our computer's short-term memory
5. Hard Drive - Holds all of our data, which includes all of our music, pictures, applications
6. Motherboard - It is the body or circulatory system that connects all the pieces together
    a. holds everything in place and allows the components to communicate with each other. It's the foundation of our computer.
7. Power Supply - converts the electricity from our wall outlet into a format that our computer can use

b. Programs, the CPU, and Memory
    i. Programs - Instructions that tell the computer what to do
    ii. External Data Bus (EDB) - A row of wires that interconnect the parts of our computer
    iii. Memory Controller Chip (MCC) - a bridge between the CPU and the RAM
    iv. Address Bus - Connects the CPU to the MCC and sends over the location of the data but not the data itself, then the MCC takes the address and looks for the data and then data is then sent over the EDB.
    v. Cache - smaller than RAM but it lets us store data that we use often and let's us quickly reference it
        1. A cache is a hardware or software component that stores data temporarily to improve data retrieval and processing speeds. It serves as a high-speed data storage layer that stores frequently accessed or recently used data, allowing for quicker access and reducing the need to fetch the data from slower, primary storage locations.
        2. Caches are commonly used in computer systems, including CPUs (Central Processing Units), web browsers, operating systems, and various software applications, to optimize data access. The primary purpose of a cache is to reduce latency and enhance system performance by providing faster access to data that is likely to be needed again in the near future.
        3. Different types of cache:
            a. CPU Cache: Processors have multiple levels of cache (L1, L2, L3) to store frequently accessed instructions and data, reducing the time it takes to fetch them from main memory.

b. Web Browser Cache: Web browsers store website elements like images, scripts, and stylesheets in a cache to speed up subsequent visits to the same website.
c. Disk Cache: Operating systems and hard drives use disk caches to temporarily store frequently accessed data from storage devices like hard drives or SSDs, reducing read/write latency.
d. Content Delivery Network (CDN) Cache: CDNs use caches distributed across various locations to store and serve web content (e.g., images, videos) closer to end-users for faster access.
e. Memory Cache: Some software applications and databases use memory caches to store frequently accessed data in RAM, speeding up data retrieval compared to fetching it from disk storage.

4. There are 3 different cache levels in a CPU:
    a. L1 - **Level 1 cache:** L1 cache is the fastest and smallest of the three CPU cache levels. L1 holds the data currently in use by the CPU. Each CPU core usually has its own L1 cache.
    b. L2 - **Level 2 cache:** L2 cache holds less data than L3 cache, but it has faster access speeds. L2 holds a copy of the most recently accessed data that is not currently in use by the CPU. Each CPU core normally has its own L2 cache.
    c. L3 - **Level 3 cache:** L3 cache is the largest and slowest of CPU cache. However, it is often twice as fast as RAM. L3 is the first CPU cache location to store data after it is transferred from RAM. L3 cache is often shared by all of the cores in a single CPU.
5. Caches operate on the principle of locality, which means that data that has been accessed recently or is located near other accessed data is more likely to be accessed again in the near future. Caches are managed by algorithms and policies to determine which data to retain and which to replace when space is needed for new data.
6. In summary, caches are an essential part of modern computing systems, playing a crucial role in improving overall system performance by reducing the time it takes to access frequently used data.

vi. Clock Speed - the maximum number of clock cycles it can handle
1. CPUs have an internal clock that keeps its operations in sync. It connects to a special wire called a clock wire. When you send or

receive data, it sends a voltage to that clock wire to let the CPU know it can start doing calculations.
2. Think of clock wires as the ticking of a clock, for every tick the CPU does one cycle of operations. When yu send a voltage to the clock wire as referred to as a clock cycle, if you have lots of data you need to process in the command you need to run lots of clock cycles
3. Have you ever seen a CPU in the store and has something labeled 3.4Ghz? This number refers to the clock speed of the CPU, which is the maximum number of clock cycles it can handle in a certain time period.
4. in a certain time period.
5. 3.40 Ghz is 3.4 billion cycles per second, that's super fast. But just because it can run at this speed doesn't mean it does, it just means that it can't exceed this number. Still, that number doesn't stop some people from trying.
6. There's a way you can exceed the number of clock cycles on your CPU on almost any device, it's referred to as overclocking and it increases the rate of your CPU clock cycles in order to perform more tasks. This is commonly used to increase the performance in low-end CPUs. Let's say you're a gamer and you want to have better graphics and less lag while playing, you might want to over clock your CPU when you play the game. But there are cons to doing this like potentially overheating your CPU.

vii. Overclocking a CPU's frequency involves three variables:
1. The base CPU clock frequency, often measured in GHz.
2. The core frequency, which is calculated by multiplying the base frequency by the CPU core multipliers.
3. The core voltage, which needs to be increased in small increments to meet the increasing power demand of the CPU during the overclocking process.

viii. Warnings on overclocking
1. Overclocking the CPU can damage the computer if not configured properly. Operating a CPU at a higher speed can overheat the CPU and surrounding hardware, which can cause the computer system to fail. Additionally, overclocking the CPU can shorten the overall lifespan of the computer and void the computer's warranty. It is better to avoid overclocking the CPU and instead purchase the appropriate CPU speed necessary to meet computing demands.

c. Components
i. CPU
1. Instruction Set - a list of instructions that our CPU is able to run

    a. Instruction sets are hard-coded into our CPU so different CPU manufacturers may use different instruction sets, but they generally perform the same instructions
    b. Every single program on your computer, while extremely complex, is broken down into very small and simple instructions found in our instruction set.
2. As an IT Support Specialist, you may be:
    a. Replacing failed hardware disks
    b. Upgrading RAM modules
    c. Installing Video Cards
3. Popular CPU manufacturers or chipsets:
    a. Intel
    b. AMD
    c. Qualcomm
4. These CPU manufacturers use different product names to differentiate their processes:
    a. Intel Core i7
    b. AMD Athlon
    c. Snapdragon 810
    d. Apple A8
    e. And more!
5. When you select your CPU, you'll need to make sure it's compatible with your motherboard - the circuit board that connects all your components together
6. CPU Sockets
    a. LGA - Land Grid Array
        i. An LGA socket gas pins coming out of the motherboard
        ii. The socket size may vary
    b. PGA - Pin Grid Array
        i. A PGA Socket has pins coming out of the processor itself
7. CPUs get hot and need a Heat Sink to keep them cool
    a. Heat Sinks take the heat from our CPU and dissipate it through a fan or another medium
8. CPU Architecture - how much data they can efficiently handle
    a. 32 bit
    b. 64 bit
9. Supplemental reading
    a. https://support.microsoft.com/en-us/office/choose-between-the-64-bit-or-32-bit-version-of-office-2dee7807-8f95-4d0c-b5fe-6c6f49b8d261?ui=en-us&rs=en-us&ad=us
    b. https://en.wikipedia.org/wiki/64-bit_computing#32-bit_vs_64-bit%E2%80%A6

ii. RAM - Random Access Memory
    1. We use RAM to store data that we want to access quickly
    2. This data changes all the time so it isn't permanent
    3. Almost all RAM is volatile, which means that once we power off our machines, the data stored in RAM is cleared
    4. To run a program, we need to make a copy of it in RAM so our CPU can process it
    5. If you have say 16gb of ram, that means your machine can run up to 16 gigabytes of programs, meaning you can run a lot of programs at the same time
    6. When you're typing in a document, you're using RAM
    7. There are lots of types of RAM, and the one that's commonly found in computers is DRAM, or Dynamic Random Access Memory
    8. DRAM - Dynamic Random Access Memory
        a. When 1 or 0 is sent to DRAM, it stores each bit in a microscopic capacitor, this is either charged or discharged, represented by 1 or a 0. These semiconductors are put into chips that are on the RAM and store our data.
        b. They're also different types of memory sticks that DRAM chips can be put on. The more modern DIMM sticks which usually stands for Dual Inline Memory Module have different sizes of pins on them.
        c. I should call out, we don't really buy RAM based on the number of DRAM chips they have, they're labeled by the capacity of RAM on a stick, like an eight-gig stick of RAM. After DRAM was created, RAM manufacturers built something called SD RAM which stands for synchronous dram. This type of RAM is synchronized to our system's clock speed, allowing quicker processing of data.
        d. In today's system, we use another type of RAM called double data rate SDRAM or DDR SDRAM for short. Most people refer to this RAM as DDR, even shorter. There are lots of iterations of DDR, from DDR1, DDR2, DDR3, and now, DDR4. DDR is faster, takes up less power, and has a large capacity than earlier SD RAM versions. The latest version DDR4 is the fastest type of short-term memory currently available for your computer, and faster RAM means that programs can be run faster and that more programs can run at the same time. Keep in mind that any RAM sticks you use need a compatible motherboard with a different number of pins aligned with the motherboard RAM slots.

iii. The Motherboard

1. The motherboard, the foundation that holds our computer together. It lets us expand our computers functionality by adding expansion cards. It routes power from the power supply, and it allows the different parts of the computer to communicate with each other. In short, it's a total boss. Every motherboard has a few key characteristics.
    a. Chipset - decides how components talk to each other on our machine
        i. Made up of two parts:
            1. Northbridge - interconnects stuff like RAM and video cards
            2. Southbridge - maintains our IO or input-output controllers, like hard drives and USB devices, that input and output data.
        ii. In some modern CPUs, the Northbridge has been directly integrated into the CPU so there isn't a separate Northbridge chipset.
        iii. The chipset is a key component of our motherboard that allows us to manage data between our CPU, RAM, and peripherals
        iv. Peripherals - External devices we connect to our computer, like a mouse, keyboard, and monitor
    b. Expansion Slots - Give us the ability to increase the functionality of our computer
        i. If you wanted to upgrade your graphics card, you could purchase one and just install it on your motherboard through the expansion slot.
        ii. The standard for an expansion bus today is the PCI Express or Peripheral Component Interconnect express. A PCIe bus looks like a slot on the motherboard and a PCIe base expansion card looks like a smallest circuit board.
    c. Form Factor - Determines the amount we can put in and the amount of space we'll have
        i. The most common form factor for motherboards is ATX, which stands for Advanced Technology Extended. ATX actually comes in different sizes too. In desktops, you'll commonly see full-sized ATXs. If you don't want to use an ATX form factor, you could use an IT or information technology extended form factor. These are much smaller than ATX boards. For example, the Intel NUC uses a variation of the ATX board, which comes in three board sizes; mini ITX, nano ITX, and pico ITX.
        ii. When building your computer, you will need to keep in mind what type of form factor you want. Do you want

to build something small that can't handle as much workload, or do you want a powerhouse workstation that you can add lots of functionality to? The form factor will also play a role into what expansion slots you might want to use. Understanding motherboards and their characteristics can be a big plus one fixing hardware issues since things like the type of RAM module or processes socket are dependent on the kind of motherboard they need to fit into. Let's say you're responding to a ticket for a user who's having video problems, you don't want to make it all the way to their desk only to realize the graphics card you bought as a replacement doesn't fit the motherboard their computer uses.

iv. Physical Storage: Hard Drives
    1. Storage Units
        a. Bit - smallest unit of data storage. A bit can store one binary digit, so it can store a one or a zero.
        b. Byte - comprised of eight bits. A single byte can hold a letter, number or symbol.
        c. Kilobyte (KB) - made up of 1,024 bytes
        d. Megabyte (MB) - made up of 1,024 kilobytes
        e. Gigabyte (GB) - made up of 1,024 megabytes
        f. Terabyte (TB) - made up of 1,024 gigabytes
    2. Storage Devices
        a. Hard Disk Drive (HDD) - uses a spinning platter and a mechanical arm to read and write information.
            i. Revolutions Per Minute (RPM) - the speed that the platter rotate allows you to read and write data
            ii. More prone to damage because of moving parts
        b. Solid Dtate Drive (SSD) - information is stored on microchips
            i. No moving parts and data travels a lot faster than HDDs. Slimmer form factor than HDDs
            ii. Also more expensive than HDDs
        c. Hybrid SSD and HDD Drives - offer SSD performance where you need it for things like system performance, such as putting your computer along with hard disk drives, but less important stuff like basic file storage.
    3. Connection Interfaces
        a. ATA interfaces are the most common ones. The most popular ATA drive is a Serial ATA or SATA, which uses one cable for data transfers. SATA drives are hot swappable, great term, don't you think? It means you don't have to turn off your machine to plug in a SATA drive. SATA drives move data faster and use a more efficient cable like this one than its predecessors. SATA has been the de facto interface for HDDs

today. But people quickly found that using the SATA cable wasn't good enough for some of the blazing fast SSDs that were coming on the market.

b. The interface couldn't keep up with the speeds of the newest SSDs. So another interface standard was created called NVM express, or NVMe. Instead of using a cable to connect your drive to your machine, the drive was added as an expansion slot, which allows for greater throughput of data and increased efficiency.

v. Power Supply
    1. DC - Direct Current
        a. Flows in one direction
    2. AC - Alternating Current
        a. Changes directions constantly
    3. Power supply converts the AC we get from the wall into low voltage DC power that we can use and transmit throughout our computer
    4. Voltage - the power/pressure of electricity
    5. Examples
        a. Electricity kind of works like a water system and a faucet. The higher the water pressure, the more that comes out. Too much pressure could make too much water come out or cause problems
        b. On vacation, the instructor plugged a 120 V device into a 220 V outlet. The device burst into flames from being overloaded by electricity. If it were the other way around, it would have worked but charged slowly due to having less voltage than the device can accept
            i. Outlet - Device - Result
                1. 220V -> 120V - Explosion/Fried
                2. 120V -> 220V - Fine but slow
    6. In some cases, less voltage can deteriorate the performance of the device and cause damage in the long-term
        a. As a general rule, be sure to use the proper voltage for your electronics
    7. The amount of electricity coming out as current or amperage and its measured in amps.
    8. We can think of amps as pulling electricity as opposed to voltage, which pushes electricity
    9. Wattage - the amount of volts and amps that a device needs
    10. Power Supplies just give you the amount your system needs. It’s best to err on the side of large power supplies, you can power most basic desktops with a 500-watt power supply
    11. But if you're doing something more demanding on your computer like playing a high resolution video game or doing a lot of video production and rendering, you will likely need a bigger power supply for your computer. On the other hand, if all you're doing is just

browsing the web, the power supply that comes with your computer should be fine.

12. VAC - volts of alternating current
    a. **Voltages in the Americas**
        i. North, Central, and parts of South America use the 110-127 VAC standard for common wall sockets. Computers and power supplies sold in these regions are designed to use this level of power.
    b. **Voltages for most of the world**
        i. Most countries use the 220-240 VAC standard for common wall sockets. Computers and power supplies sold in these areas are designed to use this higher voltage.
13. The computer's power supply plugs into an adapter on the computer's motherboard. The wiring for this connection uses color coded wires. Each wire color carries a different voltage of electricity to the motherboard or serves as a grounding wire. A standard ATX motherboard power adaptor has either 20-pins or 24-pins to connect these wires. The 20-pin design is an older technology. The 24-pin connector was developed to provide more power to support additional expansion cards, powerful CPUs, and more. The 24-pin connector has become the standard for today's personal computer power supplies and motherboards.
14. The power supply will have multiple connectors that plug into the motherboard, hard drives, and graphic cards. Each cable has a specific purpose and delivers the appropriate amount of electricity to the following parts:
15. Connections from a PC power supply (ATX 2)
    a. Floppy disk drive (obsolete)
    b. "Molex" universal (e.g. IDE hard drives, optical drives)
    c. SATA drives
    d. Graphics cards 8-pin, separable for 6-pin
    e. Graphics cards 6-pin
    f. Motherboard 8-pin
    g. Motherboard P4 connector, can be combined to 8-pin mainboard connector 12V
    h. ATX2 24-pin, divisible 20+4, and can therefore also be used for old 20-pin connections

vi. Mobile Devices

1. Mobile devices are computers too. They have:
    a. CPUs
    b. RAM
    c. Storage
    d. Power Sytems
    e. Peripherals
2. Mobile devices are usually very integrated; meaning you can't take them apart because the components were built a way that you can't take them apart
    a. The smaller the device, the more integrated the components usually are.
    b. The CPU, RAM, and storage might be soldered directly to the device's motherboard
3. Very small mobile devices use a System on a Chip or SoC
4. System on a Chip (SoC) - Packs the CPU, RAM, and sometimes even the storage onto a single chip
    a. Not only are they small, they use less battery power than if those components were separated
5. Mobile devices can have peripherals such as bluetooth headphones or a smart watch. Mobile devices can also be peripherals to other devices. A smart watch for example can be a peripheral to a smartphone, and the heart monitor within the smart watch can be that device's respective peripheral
6. Batteries and charging systems
    a. Rechargeable batteries have a limited lifespan, which is measured in charge cycles
    b. Charge Cycle - One full charge and discharge of a battery
    c. When a battery is reaching the end of its lifespan, it may take longer to charge and might not hold as much charge as when it was new.
    d. Rechargeable batteries can be damaged by very cold or very hot environments. Don't charge or discharge rechargeable batteries unless they're within their safe operating temperature range. Its not just that a damaged rechargeable battery might not perform well, it can also be very dangerous. Batteries can swell, rupture, and sometimes even catch fire. Before working with a damaged battery, you should know how to safely handle it.
    e. Some devices will slow themselves down when a battery is getting old to make the battery last longer. If your device is

running much slower than usual or shutting down unexpectedly, one thing to check is the battery life.

vii. Peripherals and Ports
    1. Peripherals - Anything that you connect to your computer externally that adds functionality
        a. USB - Universal Serial Bus Devices
            i. The most popular connections for our gadgets
            ii. USB 2.0, 3.0, and 3.1
                1. 2.0 - transfer speeds of 480 Mb/s
                2. 3.0 - transfer speeds of 5 Gb/s
                3. 3.1 - transfer speeds of 10 Gb/s
            iii. MB is megabyte or unit of data storage, while Mb/s is a megabit per second, which is a unit of data transfer rate
                1. Remember that 1 byte is 8 bits, so to transfer a 1MB file in a second, you need an 8 Mb/s connection speed
            iv. If you connect a USB 2.0 device into a USB 3.0 port, you won't get 3.0 transfer speed but you can still use the port since it's backward compatible, meaning older hardware will work with newer hardware.
            v. The ports are easy to differentiate, let me show you. In general, USB 2.0 are black and USB 3.0 are blue and 3.1 ports are teal. This may change depending on manufacturers.
            vi. The most recent one is a Type C connector, which is meant to replace many peripheral connections. It's quickly becoming a universal standard for display and data transfer.
        b. Display
            i. Most computer monitors will have one or more of these connections, but you might encounter some older standards too
            ii. DVI cables are generally just output video, if you need to hook up a monitor or projector for a slide presentation, and you want audio too, you may be out of luck, instead, you want to look at one of the following cables, HDMI.
            iii. HDMI - This has become a standard in lots of televisions and computers nowadays, and outputs both video and audio
            iv. Another standard that's become popular among manufacturers is a display port, which also outputs audio and video.
            v. USB Type C can also do data transfer and power

c. Supplemental Reading on Connector Types
    i. Connector Types
        1. A computer has many physical ports or connectors. You can use these connectors to connect devices that add functionality to your computing, such as a keyboard, mouse, or monitor. These external devices are called peripherals. IT often works with and troubleshoots these peripherals, so it is helpful to understand the types of connectors. This reading will cover different types of connectors and their uses.
    ii. USB Connectors
        1. USB 2.0: Black port on the computer, 480 Mbps transfer speed
        2. USB 3.0: Blue port on computer, 5 Gbps transfer speed
        3. USB 3.1: Teal port on the computer, 10 Gbps transfer speed
        4. USB ports are backwards compatible, meaning a USB port can connect any of the three generations of USB type A connectors. The connected cable will determine the speed of data transfer. Connecting a USB 3 to a USB 2 port will result in 480 megabits (Mbps) per second of speed.
    iii. Micro USB, USB-C & Lightning Port
        1. Micro USB is a small USB port found on many non-Apple cellphones, tablets, and other portable devices.
        2. USB-C is the newest reversible connector with either end having the same build. USB-C cables replace traditional USB connectors since they can carry significantly more power and transfer data at 20 Gbps.

3. USB4 uses Thunderbolt 3 protocol and USB-C cables to transfer data at speeds of 40 Gbps and provide power as well.
4. Lightning Port is a connector exclusive to Apple that is similar to USB-C. It is used for charging and connecting devices to computers, external monitors, cameras and other peripherals.

iv. Communication Connectors
1. Plain Old Telephone Service (POTS) refers to cables transmitting voice through twisted copper pair wires. Landline telephones, dial-up internet, and alarm systems use POTS. The RJ-11 (Register Jack 11) connector is used for POTS.
2. Digital Subscriber Line (DSL) provides access to high-speed networks or the internet through telephone lines and a modem. The RJ-45 connects a computer to network elements and is mostly used with ethernet cables.
3. Cable Internet uses a cable TV infrastructure and a modem to provide high-speed internet access to users. An F type connector is commonly used with cable modems..
4. Fiber-optic cables contain strands of glass fibers inside an insulated casing that send data long-distance and allow for higher-bandwidth communication. The major internet providers use fiber-optic cables for high-speed internet service.

v. Device Connectors - IT professionals will encounter legacy devices that still use older connectors such as DB89 and Molex.
1. DB89 connectors are used for older peripherals like keyboards, mice, and joysticks. An IT professional may still

encounter a DB89 connector for external tools a computer uses and should recognize the cable to connect to the appropriate port.
2. Molex connectors provide power to drives or devices inside the computer. Molex connectors are used for connecting a hard drive, disc drive (CD-ROM, DVD, Blu-ray), or a video card.

vi. Punch Down Blocks
1. A punch down block is a terminal strip used to connect telephone or data lines. Punch down blocks are a quick and easy way to connect wiring. IT professionals use punch down blocks to change a wire or make a new connection for a telephone system or Local Area Network (LAN).

vii. Key Takeaways
1. IT professionals need to be familiar with cables and connectors used to attach peripheral devices to computers.
2. USB connectors are the most common connector type and they transfer data and power to devices connected to a computer.
3. Communication connectors, such as RJ-45 and fiber optic cables, connect devices to the internet and one another.
4. IT professionals may encounter legacy devices that use older connectors such as DB89 and Molex.
5. Punch down blocks are terminal strips used to connect telephone or data lines.

d. Supplemental Reading for Projectors

i. Projectors
1. Projectors are display devices for when you need to share information with people in the same location! Most

projectors can be used just like any other display on a computer, and with a few differences, can be troubleshot just like any other display device. For example, projectors can have **dead** or **stuck pixels**, and can acquire **image burn-in**, just like other types of displays.

ii. Connectors and Cables
    1. You will connect a computer to a projector using a display cable like
        a. VGA,
        b. DVI
        c. HDMI
        d. DisplayPort
    2. When you do this, the computer's operating system will detect that a new display has been added. Depending on what your computer's video adapter supports, this new display can be extended or mirrored just like if you had added a second monitor!
    3. lot of times, display issues with projectors come down to the connectors and the cables that you are using. Because people frequently connect and disconnect from projectors, the cables and connectors can become worn out or damaged. Always consider this early in your troubleshooting if the projection display flickers or disappears.

iii. Device Drivers
    1. Just like other display devices, if your computer does not correctly recognize the display resolution of the projector it may default to a very low-resolution **VGA mode** like 640x480 or 1024x768. If this happens, your computer may need a device driver for your projector. Take a look at the support website for your projector's manufacturer!

iv. Lighting
    1. Projectors often rely on expensive, hot, very bright incandescent bulbs, or lamps. If a projector gets too hot for the lamp to safely operate, the projector will shut down. If the lamp burns out, the projector will either not work or will shut itself down. It is increasingly common for projectors to rely on LED lights, rather than incandescent lamps. These LED lights have far fewer issues with overheating, and have much longer lifespans than incandescent lamps.
v. Calibration
    1. Sometimes, like when a projector is first installed, reset, or moved, you will need to calibrate the projector image to account for the distance and angle that the projector is installed at. If the image is skewed or keystoned, you might need to recalibrate the projector geometry. Calibrating the image involves focusing the image, and making adjustments to the image to make it square and aligned with the projection surface. Every projector is a little different, so refer to the vendor documentation to complete this task!

e. Taking Tech Apart

viii. Starting it Up
1. BIOS
    a. Drivers/Services - contain the instructions our CPU needs to understand external devices like keyboards, webcams, printers, etc.
    b. Our CPU doesn't know that there is a device that it can talk to. It has to connect to something called the BIOS or basic input output services.
    c. The BIOS is software that helps initialize the hardware in our computer and gets our operating system up and running. Unlike the programs, you're

probably used to running a web browser or operating system. The bios isn't stored on a hard drive. Our motherboard stores the bios in a special type of memory called the read only memory chip or ROM chip. Unlike RAM, ROM is non-volatile, meaning it won't erase the data if the computer is turned off. Once the operating system loads, we're able to load drivers from non-essential devices directly from the hard drive.

d. In today's system there's another player for bios called UEFI, which stands for Unified Extensible Firmware Interface. UEFI performs the same function of starting your computer as a traditional BIOS, but it's more modern and has better compatibility and support for new hardware. Most hardware out there today comes with UEFI built in. Eventually, UEFI will become the predominant BIOS.
e. Our computers run a test to make sure all the hardware is working correctly. This is called a power-on self-test or POST. The bios runs it when you boot up your computer. The POST figures out what hardware is on the computer. It happens before the BIOS initializes any hardware or loads up essential drivers. If there's an issue with anything at that point, there's no way to display it on the screen since things like the video driver haven't been loaded. Instead, the computer can usually produce a series of beeps, almost like Morse code, which will help identify the problem. Different manufacturers have different beep codes. If you computer successfully boots up, you may hear a single beep. If you hear two beeps, it could mean a POST error. It's best to refer to your motherboard manual to find out what each code means.
f. Also, you should know that not all machines have built-in speakers. Don't worry if your computer boots without a beep. If it does have a built-in speaker, being able to distinguish what the beep codes mean is an extremely helpful tool when troubleshooting boot issues. One last thing, we will discuss our BIOS

settings. There's a special chip on our motherboard called the CMOS chip. It stores basic data about booting your computer, like the date, time, and how you want it to start up. You can change these settings by booting into CMOS or BIOS settings menu. It varies on different computers, but usually when you boot the computer, there will be a quick screen that tells you what button to push to get into the settings. From there, you can change the basic BIOS settings of your machine.

g. In an IT support role, you might interact with the BIOS more often than you think. BIOS settings control which devices to boot to. In an IT role, you might need to change the settings more often than not. A frequently performed IT task is the reimaging of a computer. The term refers to a disk image, which is a copy of an operating system. The process of reimaging involves wiping and installing an operating system. This procedure is typically performed using a program that stored on some external device, like a USB memory stick or a CD ROM, or even a server accessible through the network. To access these programs and perform the re-image, you will need to use the bios to tell the computer to boot up from that external device.

2. Ben: Skills of IT Professionals
    a. Ben - VP & CIO of Google
    b. The one great constant in the technology industry is it's history of change and the speed of that change so no education is going to give anyone the skills they need for an entire career. You've got to have curiosity, you've got to have a lifetime of curiosity and a dedication to a lifetime of learning because the tools and technology that we use in this industry are always going to be changing. Great tech skills are really important but the important thing about technology is that it serves people and it serves the interests of people. You have to like people you have to like helping them, you have to have empathy and sympathy for their problems. That is the most

important thing. There's no corner of our lines are of industry of government or society that IT and technology don't play a role in, and these are skills that don't just help you in your job, but they can help you with every facet of your life. They're going to be relevant to everything that we do in our lives for as far into the future as anyone can predict, try this program out. If you can learn this material, if you liked this material, then you can have a great career and technology and don't worry about the other stuff.

3. Putting it All Together: Installing The Processor
    a. Before you work on the physical components of your machine, you should ground yourself to prevent electrostatic discharge.
    b. Even the slightest bit of electricity can cause damage to delicate computer components, so you should always make sure to ground yourself.
    c. Molex - A molex is a component connector
4. Putting it All Together: Adding the RAM And The Drive
    a. Make sure to connect the SATA power plug to the SSD
    b. Remember, the SATA cables can only go in one way

ix. Mobile Device Repair
1. Factory Reset - Remvoes all data, apps, and customizations from the device
2. Some repairs may not be able to be done by yourself without voiding the manufacturer’s warranty.
3. Best Practices:
    a. Protect against static discharge
    b. Use the right tools
    c. Keep parts organized and labeled. Taking pictures along the way can help a lot too.
    d. Follow vendor documentation
    e. Test the device to make sure it works

x. Mobile Display Types
1. Liquid Crystal Displays (LCD)
    a. In-Plane Switching (IPS)
    b. Twisted Nematic (TN)
    c. VA-Vertical Alignment
2. Light Emitting Diodes (LED)

3. Organic Light Emitting Diodes (OLED)
    a. Active Matrix Organic Light Emitting Diode (AMOLED)
    b. Inorganic mini-LEDs (mLEDs)
    c. Inorganic micro-LEDs (μLEDs)

xi. Operating Systems - the whole package that manages our computer's resources and lets us interact with it
1. 2 main parts of an OS
    a. User Space
        i. Applications
    b. Kernel Space
        i. Process Manager
        ii. Memory Manager
        iii. File Manager
        iv. I/O Manager
2. Hundreds of OS exist
3. Focus in this course is on the major ones used in IT
    a. Windows
    b. Mac
    c. Linux
4. Common Linux Distributions
    a. Ubuntu
    b. Debian
    c. Red Hat
5. Some other OS
    a. Kali Linux (adding this in myself)
    b. Chrome OS
6. Chrome OS and Android OS both run Linux kernel underneath the hood
7. Our kernel optimizes memory usage and makes sure our applications have enough memory to run
8. I/O Management - Anything that can give us input, or that we can use for output of data

xii. Files and File Systems
1. File Handling
    a. Data
    b. Meta Data
    c. File System
2. Major file systems
    a. NTFS - used by Windows
        i. Encryption

        ii. Faster access speeds
        iii. Security
    b. ReFS - new file system being worked on by Microsoft but not ready for consumer use just yet
    c. EX T4 - a standard for Linux (different distributions of Linux may use different file system types
    d. In general, different file system types don't play nicely with each other
        i. Might not be able to easily move files across different systems
    e. Best to use the file system your OS recommends
    f. We write to our hard drive in the form of data blocks
    g. When we save something to our hard disks, it doesn't always sit in one piece
    h. Block storage - improves faster handling of data because the data isn't stored as one long piece and can be accessed quicker
    i. Metadata
        i. File owner
        ii. Permissions
        iii. File size
        iv. Date modified
        v. Date created
        vi. File type
    j. File extension - the appended part of a filename that tells us what type of file it is in certain operating systems

xiii. Process Management
    1. Process - a program that's executing, like our web browser or text editor
    2. Program - an application we can run, like Chrome
    3. Time Slice - a very short interval of time that gets allocated to a process for CPU execution
    4. CPU executes processes one at a time
    5. CPU executes a process fast, in milliseconds
    6. If your computer is running slowly, and your CPU resources are being maxed out, there can be many factors at play.
        a. It's possible that one process is taking up more time slices than it should. This means the next process can't be executed.

        b. Another possibility is that there are too many processes that want CPU time and the CPU can't keep up with them.
        c. Even though the Kernel does its best to manage processes for us, we may need to step in manually from time-to-time.
    7. Kernel - Creates processes, efficiently schedules them, and manages how processes are terminated

xiv. Memory Management and Virtual Memory
    1. Remember that when a process runs, it needs CPU time, but it also needs memory. When processes are run, they have to take up space in memory, so that the computer can read and load them quickly.
    2. However, compared to our hard disk drives, memory comes in smaller quantities. So to give us more memory than we physically have, we use something called virtual memory.
    3. Virtual Memory - the combination of hard drive space and RAM that acts like memory that our processes can use

xv. I/O Management
    1. I/O Devices - devices that perform input and output
        a. These include our monitors, keyboards, mice, hard disk drives, speakers, Bluetooth headsets, webcams, and network adapters.
        b. These I/O devices are all managed by our kernel, the kernel needs to be able to load up drivers that are used so that we can recognize and speak to these different types of hardware. When the kernel is able to start the drivers to communicate with hardware, it also manages the transfer of data in and out of the devices.
        c. I/O doesn't just mean the transfer of data between us and our devices. The devices also need to be able to talk to each other. Our kernel handles all the inter communication between devices. It also figures out what the most efficient method of transfer is and it tries its best to make sure our data doesn't have errors during process.
        d. When you're troubleshooting or solving a problem with a slow machine it's usually some sort of hardware resource deficiency.

        i. If you don't have enough RAM you can't load up as many processes. If you don't have enough CPU you can't execute programs fast enough. If you have too much input coming into the device or too much output going somewhere you'll also block other data from being sent or received.
    e. It's slow is one of the most common problems you'll solve in an IT support role. Knowing the potential sources of that slowness is a big help when you're trying to narrow down the cause of the latency. Troubleshooting is such an important part of any IT support role. Beyond desktop support, identifying the source of a resource bottleneck and a server or large IT system like a Web application can unlock performance gains and new heights of responsiveness for your users.

xvi. Interacting with the OS: User Space
1. There are two ways we can interact with our OS
    a. Shell
        i. A program that interprets text commands and sends them to the OS to execute
    b. Graphical User Interface (GUI)
        i. A visual way to interact with the computer
    c. Power Users - above average computer users
        i. Shell is still commonly used by power users.

xvii. Logs
1. Logs are files that record system events on our computer, just like a system’s diary

xviii. The Boot Process
1. Power On > BIOS/UEFI > POST > Boot Device > Bootloader > OS > Kernel > System processes and User Space launched
    a. BIOS/UEFI - a low-level software that initializes our computer’s hardware to make sure everything is good to go
    b. POST - Power On Self Test
    c. depending on the bios or UEFI configuration of boot device will be selected. Devices that are attached to

our system, like hard drives, USB drives, CD drives, etc, are configured in a certain boot order.

d. Bootloader - a small program that loads the operating system

xix. Boot Methods

1. While the most common way to boot a computer is to simply push the power button and allow the normal process to run, there are many other boot options. This reading covers the various methods you can use to boot a computer.
2. Internal Method
    a. You can create partitions on the computer's drive so that only one part of the drive runs the boot process. A common reason to partition your drive is to have two separate operating systems on your computer, such as both Windows and Linux. When you have two operating systems on your drive, you must choose which one will run the boot process. Having two possible systems to boot into is called dual booting.
    b. While having two operating systems can be helpful for various reasons, it is especially helpful when one system is failing or unable to boot. If this happens, you can still boot the computer using the other system and troubleshoot from there.
3. External Tools
    a. External tools can be used to boot the computer. You can load the needed resources on an external tool to boot a system before any problems happen.
    b. External bootable devices include:
        i. USB drive: You use a USB drive loaded with resources needed to boot the computer. This drive is inserted into a USB port and chosen at startup.
        ii. Optical Media: You use a disk loaded with booting resources. This disk can be a DVD, CD, or Blu-ray disk and is loaded through the computer's optical drive.
        iii. Solid State Boot Drive: You use a solid state drive to boot. Solid state drives do not use spinning discs or moving parts. This solid state

drive can be installed in your computer or can be a smaller device such as a flash drive.

iv. External hot-swappable drive: You boot from an external hard drive that can be moved between computers without turning it off.

v. Network boot: You boot the operating system directly from a local area network (LAN) without using a storage device. Your computer must be connected to a LAN for this option.

vi. Internet-based boot: You boot the computer from an internet source, as long as it is a secure source. Your computer must be connected to the internet for this option.

4. Window OS or Linux OS
    a. In order to boot either Windows OS or Linux OS with an external tool, you'll need to enter BIOS at startup by pressing F2/F12/Del keys. From there you can change the boot order so that the first option is the external tool you want to use.
5. macOS
    a. If booting macOS, press and hold the Option key at startup. This will open up the Startup Manager, which will scan your computer and identify bootable devices. Then you can choose the bootable device you want to use.

xx. Boot Methods Best Practices

xxi. Mobile Operating Systems

xxii. Cindy: Drive and career path

1. Technology is a real equalizer
    a. For people who don't have the current educational background, there are tons of websites and resources you can learn from for free

xxiii. Choosing an Operating System

1. The operating systems in use by an organization have a lot to do with the applications and systems that they need to run.
    a. Are you working with an organization or service that requires the use of a specific operating system?
    b. What hardware will be used?

        i. Modern operating systems do a pretty good job of supporting common hardware.
    c. CPU Architectures
        i. 32-bit
        ii. 64-bit
    d. Make sure the CPU and OS are compatible
2. As an IT Support Specialist, you'll install an operating system many times, so using one single disk won't be time-efficient or scalable.

xxiv. Virtual Machines

1. Virtual Machine (VM) - Just a copy of a real machine
2. Virtual Machines use physical resources like:
    a. Memory
    b. CPU
    c. Storage

xxv. Installing Windows 10

xxvi. Windows 10 & 11 Feature Matrix

xxvii. Installing Linux

1. I've already loaded Ubuntu on a plain USB drive pro tip. Since the Ubuntu is open source, you can download the free operating system installed image directly from their website and install it using whatever media you like. I've included a link to it in the next supplemental reading. I should also call out that you can't just copy the install file to a USB drive and expect it to work. It has to be copied in a way that makes a USB device bootable from our bios. To load the image onto your USB device and make it bootable, you can use a tool like etcher.io.

xxviii. Supplemental Reading for Ubuntu

xxix. What is Chrome OS?

1. Unlike other operating systems, Chrome OS has one main purpose: to be a secure and simple way for the user to interact with the web.
2. Today, you can do so much just through your web browser:
    a. Communicate through email
    b. Create and share documents
    c. Edit photos
    d. Connect remotely to another computer

3. That said, ChromeOS is more than just a web browsing operating system. It can also run Android and Linux applications inside containers.
    a. The user interface in ChromeOS is customized, so you can only see the Chrome interface. Process management, memory and input and output are still happening behind the scenes but you don't need to deal with any of that.
4. Chrome OS machines are interchangeable because most data is stored in the cloud, not locally.
5. The user doesn’t need to worry about problems or hacks in the system because it’s designed to stay up and running

xxx. MacOS
1. Finder is the file manager for all Macs

xxxi. Tri Ngo: How to overcome obstacles and become successful in IT
1. The IT world is not that scary. So let me give a little example of where I'm from. So I'm from an underprivileged family who immigrated here to the US. So I had a language barrier. Access to technology was also a barrier. I mean back in the day I didn't have access to it and I worked hard to deal with all these obstacles. And right now I think people are quite lucky because there are economic opportunities. There is technological resources out there that are available on the internet. A lot of them are in formats that people are more than willing to share their opinion and share their solutions and share their knowledge. So I think everyone is fortunate to have these resources available to them now. And I think that opens up opportunities to all of you. I think that it's okay to make mistakes. We're all human, it's okay to fail and then learn from those failures and not to give up. For example, when I launched a web page for my first job there were a lot of errors that were showing up in the JavaScript that I had written and everybody was able to see that. I fixed them very quickly and in the end I was able to produce something good. And I was able to learn about troubleshooting and how to fix bugs on the web page and it was really quite beneficial.

xxxii. Introduction to Qwiklabs
1. Quiklabs - an online learning environment that takes you through live, real-world scenarios you may encounter as an IT Support Specialist

xxxiii. Untitled document

xxxiv. Qwiklabs tips and troubleshooting steps

d. What is Networking?

i. Basics of Networking

1. The Internet is just an interconnection of computers around the world, like a giant spider web that brings all of us together.
2. We call the interconnection of computers a network. Computers in a network can talk to each other and send data to one another.
3. You can create a simple network with just two computers. In fact, you might already have your own network at home connecting all of your home devices.
4. Don’t make the mistake of thinking the internet is the World Wide Web
5. The Internet - the physical connection of computers and wires around the world
6. The Web - the information on the internet
7. The World Wide Web isn't the only way we can access the Internet. Your email, chat, and file-sharing programs are also ways you can access the Internet.
8. In the IT field, managing, building, and designing networks is known as networking. Networking is a super important and large field in IT. There are specialized jobs, college degree programs, and tons of literature dedicated entirely to networking. If you work in the IT field, it's super critical that you understand the fundamentals of networking.
9. The Internet is composed of a massive network of satellites, cellular networks, and physical cables buried underneath the ground. We don't actually connect to the Internet directly. Instead, computers called servers connect directly to the Internet.
10. Servers store the websites that we use, like Wikipedia, Google, Reddit, and BBC. These websites serve content.
11. The machines that we use, like our mobile phones, laptops, video game consoles, and more are called clients. Clients request the content like pictures, websites from the servers. Clients don't connect directly to the Internet. Instead, they connect to a network run by an Internet service provider or

ISP, like CenturyLink, Level 3, Comcast, Telefonica and things like that.

12. ISPs have already built networks and run all the unnecessary physical cabling that connects millions of computers together in one network. They also connect to other networks and other ISPs. These other networks connect to the networks of Google, Reddit, universities, basically all the other networks in the world. Together, they form one giant network of computers called the Internet.
13. Computers on a network have an identifier called an IP address. An IP address is composed of digits and numbers like 100.1.4.3. When we want to access a website, we're actually going to their IP address, like 172.217.6.46.
14. Devices that can connect to a network have another unique identifier called a MAC address. MAC addresses are generally permanent and hard-coded onto a device.
15. When you send or receive data through a network, you need to have both an IP and a MAC address. You might be wondering why we need to have two different numbers to identify something. That's a good question. Think again of the letter analogy we use before. An IP address is your house address, while the MAC address is the name of this recipient of the letter. You want to make sure your letter gets to the right location and to the right person.

ii. Networking Hardware
    1. Ethernet Cable
    2. Network port
    3. Wifi
    4. Fiber Optic Cables
        a. This method is the most expensive as it is faster than all the other options
        b. Gets its name from the glass fibers that move data through light instead of electricity. This means that we send ones and zeros through a beam of light instead of an electrical current through a copper wire.
    5. Router - connects lots of different devices together and helps route network traffic
    6. Network Stack - a set of hardware or software that provides the infrastructure for a computer

        a. You might need to investigate the network stack in your job. You'd start with making sure the end user computers are working properly. Then you turn your attention to other possible points of failure, like the cabling, switches and routers that work together to access the Internet.

iii. TCP/IP
    1. Think of network protocols like a set of rules for how we transfer data in a network
    2. There are rules to make sure that our packers are:
        a. Routed efficiently
        b. Aren't corrupted
        c. Secure
        d. Go to the right machine
        e. Named appropriately
    3. Transmission Control Protocol - Delivers information from one network to another
    4. Internet Protocol - Delivers packets to the right computers

iv. The Web
    1. All websites can be accessed through the web
    2. URL - Uniform Resource Locator
        a. WWW - World Wide Web
        b. Domain Name - google, reddit, etc
        c. Domain Name Endings - .com, .net, etc
            i. Different domain name endings are standards for what type of website it might be
                1. .edu is mainly used for educational institutions
    3. ICANN - Internet Corporation for Assigned Names and Numbers
    4. DNS - Domain Name System
        a. Acts like our internet's directory and lets us use human-readable words to map to an IP address
        b. The computer doesn't know what google.com is, it only knows how to get to an IP address. With DNS it's able to map google's IP address with google.com
        c. Every time you go on a website, your computer is performing a DNS look up to find the IP address of the website name you typed in.

        i. This trick can be a good first step in diagnosing certain kinds of DNS issues.
        ii. So if you're able to access a website by its IP address but not its human readable domain name, then there's a good bet that there's probably a problem somewhere in the DNS configuration your network is using.
v. Victor: First job experiences
    1. My first IT job I was essentially a glorified spam filter. They hired me part time to go through the spam folder and then find anything that got mislabeled the spam and forward it to people's inboxes. So I did that for about a week and then I was like this is insane, there is no way that huge companies are paying people to sit in the back of the room and do this. So I started installing at the time, I was like spam assassin is like open source mail filter. Yeah, and then I basically like automated that away and I told my boss about it and I was like hey this is like we don't need this anymore, I don't need to do that anymore. So then I started doing other things and I'm like I would create new accounts that would delete all accounts. And I kind of just did that. I grew into eventually becoming like the full time sys admin for for the company there. When I graduated I started looking at other large companies that I might be excited to work for. So Google was one of them and I threw my resume together and I sent it over for one of the IT jobs that they had here and I didn't really think I was going to get it. I was literally in the means of moving to Seattle when they told me like can you start in four weeks? So I had to figure it out. I had four weeks to change my plans entirely and I started here and I learned like what IT really looked like in a huge environment.
vi. History of the Internet
    1. About the instructor
        a. My name is Gian Picasa and I'm a Program Manager in Android Security. I help protect Android's two billion plus users by managing new security features for each of Android's deserts or versions of Android. I've always loved technology and I worked in IT since I was 16 and throughout university, I would fill my past time reading about new tech and building servers

from old computer parts in my basement. My earliest memory of working on tech is waiting for my parents to go to sleep so I could quietly dial up the Internet while the phone was free and just browse websites all night long and read about random tech things. My first jobs were as a one-person IT crew at three non-profit organizations. It was both stressful and really exciting to be responsible for everything, from configuring and administrating backup servers to just showing new employees how to access email and use their computers. I'm really excited to be here with you. I was never a really great test taker and my grades reflected that. But I knew with hard work and perseverance, I could build a great career in IT and so can you.

2. 1950s - where it all started
    a. Computers were huge and bulky
    b. If you were a programmer, you would need to interact directly with these massive computers. That would get real old real fast. Especially if you had several people who wanted to use the only computing resource available.
3. Late 1960s - the US government spun up a project called DARPA
    a. It went on to create the earliest version of the internet that we've seen today with ARPANET
    b. Eventually, computer programmers were able to share a single computing resource by being able to remotely access the computer.
    c. There was still a big problem, Networks couldn't talk to each other.
4. 1970s - critical breakthrough in computer networking
    a. It wasn't until the 1970s that we had a critical breakthrough in computer networking that fix this problem. It was thanks to computer scientists, Vinton Cerf and Bob Kahn who created the method we call the Transmission Control Protocol and the Internet Protocol, or TCP/IP. First, only a handful of computers in universities, governments and businesses adopt TCP/IP, then hundreds. Then in the span of 50 years,

billions of computers. TCP/IP is the protocol that we use on the Internet today. Finally, people around the world could send data to one another.

5. 1990s
    a. But there were still a problem. The information they sent was just text, it wasn't centralized and it was pretty bland. Then in the 1990s, a computer scientist by the name of Tim Berners-Lee invented the worldwide web. It utilized different protocols for displaying information in webpages and became the predominant way of communication and accessing the Internet. Anyone who had an Internet connection at that time was able to access the information source of the World Wide Web.
    b. It's been 30 years since the creation of the World Wide Web. We've gone from sending simple email messages in the viewing basic web pages to having video chats and instant news updates, order food, buy books, and even cars in a matter of seconds, taking the online course like this wasn't even possible until recently. The creation of the Internet that we know today was the culmination of knowledge and engineering from many brilliant scientists and organizations.

vii. Limitations of the Internet

1. There are different versions of IP Addresses
    a. The current protocol, Internet Protocol version four or IPV4, is an address that consists of 32 bits separated into four groups.
        i. IPV4 addresses can be something like 73.55.242.3
    b. Even though it might seem like a lot of possible IPV4 addresses, there are less than 4.3 billion IPV4 addresses. There are way more than 4.3 billion websites out on the web today. Some IPV4 addresses are even reserved for special purposes. The number of usable IP addresses is even less. A device that wants to connect to the Internet needs to have an IP address. But devices around the world have already

exceeded those numbers. Where have we been getting IP addresses?

c. IP addresses have been able to keep up with the amount of devices in the world thanks to IPV6 or Internet Protocol version 6 addresses, IPV6 addresses consists of 128 bits, four times the amount that IPV4 uses, which means way more devices can have IP addresses. The adoption of IPV6 addresses has been slow but steady. Eventually, you'll start seeing more and more IPV6 addresses in the wild. An example of IPV4 address can be something like 172.14.24.1. But an IPV6 address can be something like what you see here (379f:3e7d:4860:0000:0000:66ee:1336:2213). Quite a bit of a difference, don't you think?
d. Here's an analogy for how big this difference is between IPV4 and IPV6. With IPV6, there are two to the 128th power possible IP addresses. Two to the 128th power is an insanely huge number, so huge that scientists had trouble describing with words just how big this number is. Here's an analogy. Think of a grain of sand. If you scoop up a handful, do you know how many grains you have in your hand? Probably a lot, but that's not even close to the number we're talking about. Now, take all the grains of sand in the entire world. Assuming there are roughly seven and a half times ten to the 18th power grains of sand in the world that still wouldn't be enough IPV6 addresses. Now, let's take all the sand from multiple Earths. Now you're close to what that number would be. It's a crazy large number.
e. Just know that we won't be running out of IPV6 addresses anytime soon. Another mitigation tool that we've been able to use is NAT or Network Address Translation. This lets organizations use one public IP address and many private IP addresses within the network. Think of that like a receptionist that a company. You what number to dial to get to the company. Once you reach the receptionist, he can transfer your call to one of the private numbers inside

the company. Now, instead of companies using hundreds of public IP addresses, they can just use one IP address. Remember the routers we talked about earlier? One task you might need to perform when you're an IT support specialist is to configure NAT on a router to facilitate communication between your company's network and the outside world.

viii. Changing careers
    1. A lot of the skills from my previous jobs, such as at the call center that I can apply now, is my attention to detail. Having the soft skills of being creative, thinking outside of the box, those have all helped me in my new position. >> All the jobs that I've had prior to IT, their main fundamental was customer service. It's that same customer service fundamental that has transferred to my current IT position. >> I definitely think that working, especially for the police department, did get me prepared for this. Because when you're working in a 911 center, you really never know what's going to happen. >> I was already in a really high position as a restaurant manager, and that's when I felt like I plateaued. I couldn't do that for the rest of my life. And here I am as an IT consultant entry level. I have health insurance. I have plenty of time off.

ix. Impact of the Internet
    1. Ads that used to only reach local folks can now reach folks all over the world
    2. Products can be sold and bought all over the world
    3. Globalization - the movement that lets governments, businesses, and organizations communicate and integrate together on an international scale.
        a. Thanks to the internet:
            i. Countries can communicate with each other faster.
            ii. Global and financial trade has increased dramatically.
            iii. Globalization has transformed almost every aspect of human society as we know it.
            iv. Media and social movements have become globalized too.
    4. TV can now be streamed, don’t have to catch the broadcast

5. Online courses and classic education

x. Internet of Things
    1. You may have heard of the phrase Internet of Things or IoT. This concept is pretty new, but already has a major impact on the future of computing. The concept is fairly simple. Basically, more and more devices are being connected to the Internet in a smarter fashion. Did you know that there are now smart thermostats. Instead of manually programming them when you'll be out of the house, they'll just know when you leave and turn off the air conditioning for you. It's not just your thermostat. Many companies out there are making smarter household devices. There are fridges that can keep track of what foods you have in there, toasters that can be controlled by your smartphone, lights that can change depending on your mood and cars that drive you instead of you driving them. The world is moving towards connecting manual devices to the internet and making them smarter. These decisions have many societal implications though, especially when it comes to cybersecurity, or personal privacy. But there's also a huge potential for IoT to completely transform the world in ways we have yet to see. In the future, people may be shocked to learn that we had to do manual things like make your own coffee, or drive to the grocery store. While you may not experience working with an Internet of Things device, you should be aware that it will become a large part of the future of computing.

xi. Gian: What he does in Android Security
    1. My name is Gian Bokassa, and I'm a Program Manager with the Android Security Team. The Android Security Team is responsible for protecting over two billion Android devices are on the world. But specifically, what I do with the team is I work with anywhere from the end-users to our partners, all the way up to the engineering teams within Google on each Android dessert release, which is what we call versions of Android. Depending on what needs to be done for that release and that cycle, I'm the person. We have lots of discussions with external partners and phone manufacturers on helping them adopt new security features that run on Android for their next phone release. Internally, we're always trying to think one step ahead and try and think of what the

next vulnerability or next area that we can improve the platform exists in. Security is important to everyone in the chain because as more and more of our data becomes digitized, it's even more important to keep it all protected. From a programming perspective, you can say build a secure system. But if there's one flaw somewhere in that software and that flaw could be one byte. The whole system could be open insecure and anyone can just take it down.

xii. Privacy and Security
    1. COPPA - Children’s Online Privacy Protection Act
    2. The added convenience made possible by the Internet also makes it harder and harder for us to maintain anonymity. When you purchase something online, you're buying habits can be logged, and you may be targeted with marketing, even when you want to do something simple, like book a dinner reservation, your name, phone number, email, and maybe even a credit card number are required. Now think about the information you post publicly; name, pictures, family, friends, and even your location may be available to anyone online. Be aware of what you're sharing by reviewing the privacy policy of the service before you use it. It's up to you to decide if the trade-offs of a service are worth sharing your personal information. In most cases, companies are trying to build great products that make our lives easier. They may offer their products for free because you provide them with free data. Just make sure your information won't fall into the wrong hands. Privacy doesn't just affect us on a personal scale. It's also become a concern for governments. In Europe, data regulation and privacy are strictly protected to help EU citizens gain more control over their personal information. COPPA, or the Children's Online Privacy Protection Act, also regulates the information we show to children under the age of 13. There are many more examples of government regulation of privacy. It's no longer something we can think of on an individual scale. Another concern that's grown with the rise of the Internet is the issue of copyright. Imagine you create a beautiful graphic and upload it on the web for your friends to see, then some random stranger takes your graphic, claims that as their own, and sells it for profit. Thankfully, several companies

have been founded and designed specifically to help solve this issue of copyright and intellectual property theft. There are also efforts in place that you've learned about, like open source projects that benefit from being on the Internet. In these cases, open collaboration allows a project to thrive. On top of privacy and copyright considerations, computer security is another issue that you may face in both your personal and professional life. More and more companies are being targeted in cybersecurity attacks. For example, the WannaCry attack that started in Europe, infected hundreds of thousands of computers across the world. The financial loss of that attack has been estimated at over a billion dollars. Hospital computers were even infected. In a critical life threatening moment, every second matters. Not being able to perform basic medical duties, like pulling medical records took time away from doctors and nurses, and more importantly, the lives of their patients. Before the WannaCry attack, there were lots of other worldwide attacks. In 2011, the Sony PlayStation network was attacked and around 77 million user accounts had personal information exposed. Everything from entire governments to businesses that handle the data of millions of people have been compromised. Computer security is no longer the job of specialized security engineers. It's everyone's responsibility. As an IT support specialist, you'll need to have a fundamental understanding of computer security. I spend every day working in security. I love working in the field because I get to help protect people and their devices from all over the globe.

xiii. Heather Adkins: keeping hackers out

1. My name is Heather Adkins. I'm director of information security and privacy here at Google. And our job is to keep the hackers out. Every day at Google for me is a new day. It's like a new job every day. Hackers are very interesting and very diverse in the way that they do things. They're either hacking for fun and fame because they're intellectually curious and they want to understand how things work. Or they're hacking for money because they want to steal money from people or they're hacking because they want to steal information. And so for us we try to understand how the

hackers work so that we can understand what kinds of things we have to do to prevent them from doing it. You have to understand how the internals work, you have to understand how the programmer built it, and this is really thrilling. You get to ride alongside the programmer and understand what they were thinking when they were designing the software and anticipate what mistakes they might have made. We prepare for being hacked by understanding how hacking works. And this is often the most exciting part of our work because we get to break the systems and I think a lot of us who get into the field think what would it be like to rob a bank, what would it be like to hack into a system? And here we get to play the other side of that. So we have hackers of our own who hack our systems and tell us how they did it. And we also study how the actual attackers in the world are hacking other people. I think that the field of security is so exciting for us, those of us who do it as a profession, because it's changing all the time. That presents us with new challenges every single day. And it also appeals to us, I think because it means that we're protecting users. Google has a service offered to billions of people on the planet, and we do it because we want to protect them.

xiv. Learner Story: Melinda
    1. The world changes. Things change. I was cleaning up the other day, and I was throwing away old disks from our first computer, those little floppy disks. Nobody use that anymore. But I thought floppy disks were cool back then. So if I weren't a lifelong learner, I'd still be stuck like that floppy disk. I believe it's never too late to go in a new direction, and I think IT is my thing. I think that's going to be my thing.

e. Introduction to Software
    i. Module Introduction
        1. Software - how we, as users directly interact with our computer
            a. The OS is software
            b. Music programs, word processors, and more all are software
            c. If hardware is the physical stuff that you can pick up and hold, software is the intangible instructions that tell the hardware what to do

ii. How software is built: Coding, scripting, and programming
    1. Coding - translating one language to another
    2. Scripting - coding in a scripting language
        a. Scripts - mainly used to perform a single or limited range task
    3. Programming - coding in a programming language
        a. Programming languages - special languages that software developers use to write instructions for computers to execute

f. Common Scripting Solutions

g. Types of Software
    i. Copyright is used when creating original work
    ii. Important to review the licenses needed to use the software
    iii. Commercial Software - usually requires a license to use and/or be shared
    iv. Open Source Software - open and shared with developers who can modify and contribute to the project. Developers can also distribute their own versions
        1. Software that can be free to use, modified, and shared is known as open-source software.
    v. Two types of software categorized by function
        1. Application software - any software created to fulfill a specific need, like a text editor, web browser, or graphic editor
        2. System software - software used to keep our core system running, like operating system tools and utilities
            a. Firmware - software that's permanently stored on a computer component
                i. BIOS is a type of Firmware

h. Revisiting Abstraction
    i. Earlier in this course, we talked about how programs are instructions that are given to a CPU. We can send binary code or bits to our CPU, then they'll use an instruction set to run those commands. But these CPUS might be from different manufacturers and may have different instructions. There might even be all kinds of different hardware components like video cards and hard drives that also have their own special interfaces. So how do we write a program that the hardware can understand? Well, one way would be to write a program for each possible combination of CPU and hardware using the native languages and interfaces of these components, but there are potentially millions of possible

configurations of hardware. So how do we get anything to work with all this complex and diverse hardware? Well, thanks to the efforts of computer scientists and the principle of abstraction, we can now use programming languages to write instructions that can be run on any hardware.

i. Recipe for Computing
    i. Assembly language - allowed computer scientists to use human readable instructions, assembled into code, that the machines could understand
    ii. Compiled programming languages - uses human readable instructions, then sends them through a compiler
        1. Admiral Grace Hopper invented this in 1952 to help make programming easier.
    iii. Interpreted languages aren’t compiled ahead of time.
    iv. The script is run by an interpreter, which interprets the code into CPU instructions just in time to run them.
    v. Computer scientists have developed hundreds of programming languages in the past couple of decades to try and abstract the different CPU instructions into simpler commands. Along the way, another type of language emerged that was interpreted rather than compiled, interpreted languages aren't compiled ahead-of-time. A file that has code written in one of these languages is usually called a script. The script is run by an interpreter which interprets the code into CPU instructions just in time to run them.
j. Phelan: Learning IT in the Navy
    i. In high school, I wasn't really sure what I wanted to do yet, but when I joined the US Navy, one of the options for job was an information systems technician. Information technology and the Navy can be pretty exciting. You get to be very resourceful if you're out on a deployment in the desert. Perhaps, you have to use the tools that you have at hand to get the job done. So I remember being in a server room in a tent with the sand blowing in and we'd occasionally have to take out the servers and then reverse the vacuum and blow the dust and sand out of the server to make sure that they kept working. So obviously I can't go into too much specifics and details but in the Navy, one of my favorite technology moments was when the command came down that we needed to do this thing and I had to write a program to actually do it. And I've never written a program before. And I was like, okay, I mean, I'll try. And so I did the research, I did the learning, I figured it out, I wrote

the program it ran, and it did the thing that I wanted it to do. And I was so satisfied. That was an amazing experience. I made this thing from nothing and it actually performed the action that I wanted it to, which was pretty cool.

k. Managing Software
    i. There are certain types of software that perform specific functions like drivers, which allow us to interact with our hardware. There are applications that we use for our day-to-day job functions. And there are utilities that we use like a calculator, settings, and other tools.
    ii. Software bug - an error in software that causes unexpected results
l. Installing, Updating, and Removing Software on Windows
    i. Git - a version control system that helps keep track of changes made to files and directories
    ii.
m. Installing, Updating, and Removing Software on Linux
    i. Using the command line
n. Software Automation
    i. Automation - makes processes work automatically
    ii.
o. Module 6 Introduction
    i. You've already learned about the hardware, operating systems, and software layers of the computer architecture model. Now it's time to learn about the most important layer, the user layer. Troubleshooting problems and solid communication with users, may be one of the most challenging parts of your job as an IT support specialist. But by the end of this module, you'll know the best way to handle them. Fixing problems and creating positive interactions with people, are two fundamental skills that can be applied to almost any situation in the IT world and beyond. Knowing how to analyze an issue, identifying the causes and effects, and use the information to find potential solutions, are skills that everyone from IT support specialist to doctors can use. Hi, I'm Marti Clark, and I'm a manager with Google's internal IT Support Program. Even though I grew up around technology and worked at my university's help desk, going into tech wasn't something that was encouraged by my teachers, or my family. Now as a manager, I try to encourage all techs I work with to follow their passion. It's this passion to help others grow and my love for technology that led me here. Helping people with technology is both rewarding, and challenging endeavor. I encourage my team to take advantage of

their work with users to spin up ideas, solutions, and opportunities for improvement. The technical aspects of problem solving are super useful. But don't forget the real reason most technology exists is to improve people's lives. Whether it's the routing algorithm that form the backbone of the internet, or the software tools that let people create amazing art. The ways that people interact with technology are central to IT. As an IT support specialist, you're uniquely positioned to combine technology and people know-how to make those interactions better, and make a difference in people's day-to-day lives.

ii. Ask Questions!
    1. How would you respond if I asked you, do you know how long it'll take me to get to the bank? You'd probably ask, where are you, where's the bank? Are you walking, driving, biking? But if you just guessed the details of my situation to direct me to the bank, your response would be a day late and $1 short. It seems such a natural thing to ask questions and gather information to solve a problem. But it's usually one of those most overlooked steps and troubleshooting.
    2. Troubleshooting - the ability to diagnose and resolve a problem
    3. IT Support is about working in the service of others.
    4. Always try to create a positive experience for the user
        a. Important not to make the user feel dumb when assisting them

iii. Isolating the Problem
    1. Example, guess a number - x < 100; 5 questions/guesses
        a. Straight guesses, not good success rate
            i. 5? No
            ii. 7? No
            iii. 12? No
            iv. 72? No
            v. 3? No
        b. Limit the Scope - much more effective
            i. > 25? Yes!
            ii. > 38? Yes!
            iii. < 45? Yes!
            iv. Is it 42? Yes!
    2. The power of isolating a problem can quickly and effectively help you figure out where the issue lies. The

isolate-the-problem method is meant to shrink the scope of your problem so that you know you're looking in the right area.

3. Root cause - the main factor that’s causing a range of issues
4. “Now that we have the ask-questions approach nailed down let's cover another effective troubleshooting method , isolating the problem. The goal of this method is to shrink the scope of the potential issue. Let's start with a simple game. I have a number I'm thinking of that's less than 100. Can you figure out what it is? You have five questions you can ask me. As you might have guessed, just guessing a number isn't the way to go. Is it 5? No. Is it 7? No. Your odds of figuring it out this way are super low. Instead, you should be shrinking the scope of where the number could be. You could ask, is it greater than 50? No. We know the number is 50 or less. We've just isolated our problem and cut down half of the answers we started with. To narrow the scope further you could ask, is it greater than 25? Yes. Is it greater than 38? Yes. Is it lower than 45? Yes. Is the number 42? Yes, the number is 42. Nice work. The power of isolating a problem can quickly and effectively help you figure out where the issue lies. The isolate-the-problem method is meant to shrink the scope of your problem so that you know you're looking in the right area. After you continually isolate the problem you'll eventually end up at the root cause. Root cause is the main factor that's causing a range of issues. Finding the root cause is a critical concept in IT support because it means that you're able to prevent an issue from happening again and again to multiple users. Sometimes the root cause can be difficult to find and extremely obscure. Don't give up if it isn't immediately obvious. Discovering root cause may be tedious but it's well worth the effort.”

iv. Follow the Cookie Crumbs
    1. Another effect of troubleshooting method is called Follow the cookie crumbs. This method requires you to go back when the problem first started, and work forward from there.
        a. When did this problem start? - gives a lot of information oftentimes

v. Start with the Quickest Step First

1. We want to get to a root cause effectively. But sometimes there are multiple options we can use to isolate something. How do we know which option to try first? It's pretty simple. Try whatever is fastest first.
    a. In the example of the application not working, a restart and an reinstall could both be potential solutions to the issue.
    b. A restart was faster than a re-install in this case so it made sense to try that first. The app now works and we have our resolution

vi. Troubleshooting Pitfalls to Avoid
1. Pitfall # 1 - Going into autopilot
    a. Moving through issues out of habit without careful thought more often than not, they're small variables that change the problem you're seeing entirely. Ask questions and gather data so you can fully understand an issue. This takes less time than having to redo some sloppy work you did in autopilot mode.
2. Pitfall # 2 - Not finding the root cause
    a. It's very easy to get distracted by small problems that pop up but it's super important to remember there's probably a very big problem causing all these small problems. Spend a little extra time investigating the issue instead of trying to fix all the small holes. If you're trying to do a quick fix, it's tempting to wipe the system and start from scratch. This approach is like using a hammer when a surgical scalpel might be more appropriate tool. Let's say user isn't able to access a particular website, re-inventing the system isn't a great solve. It doesn't get to the root cause and it doesn't help further your knowledge investigating the problem but testing out possible issues and solutions incrementally and identifying the root cause can end up saving a lot of time and effort in the end and it feels really empowering as an IT support specialist. With that, you'll be able to go out in the real world and use your new skills to methodically troubleshoot an issue.

vii. Amir: Attributes in an IT support space

1. So there are three key attributes that we review when taking a look at potential people for the IT support space. First and foremost passion the IT space is always changing and in order to stay on top of it and continue learning, you're going to need to be passionate about the space. The next is going to be problem solving. You will not have all the answers to all the questions that people ask you and that's okay. What you need to have is a strategy and the tools and resources to find that answer to help support some of these new challenges that come up as technology develops. The third is communication. You're working with a wide range of individuals and those soft skills when communicating with people and supporting them and making sure you understand what their needs are is very, very important to be successful in this role and make sure that you are providing them with a positive experience.

viii. Intro to Soft Skills

1. In IT Support, you work with users to fix technology and improve how people use it
    a. To accomplish this, you need to develop a trust between you and the user.
2. Lots of employers believe that good customer service also builds brand loyalty, which is a key to success.
3. Great Customer Service requires:
    a. Exhibiting empathy
    b. Being conscious of your tone
    c. Acknowledging the person you’re talking to
    d. Developing trust with the user
4. The action you take by looking at it from their perspective is what empathy is all about
5. Whenever possible, acknowledge the user. This reduces the tension that might build and helps you understand how you're working toward a solution.
6. Empathy and acknowledgement are a big part of building trust
    a. Without these, you’ll find it difficult to connect with the user
7. Be honest with the user, even if you think they won’t be happy about it
8. Never be afraid to admit when you’re wrong

9. If the customer is making comments like “I already answered that”
    a. Let's say you're chatting back and forth with the user. You're asking a lot of questions to better troubleshoot the issue. The user is answering them, but also makes comments like geez, I already answered this in my last email. Or I just want to know what's causing my problem. You choose to ignore this and continue on with your troubleshooting. You think you're close to solving the problem and these side comments are just a distraction. But then the user stops fully engaging with you and only gives you half answers to your questions. Now you're not able to solve the issue at all. The user's unhappy, you're unhappy, and the company's unhappy. It's a bad situation. Instead of ignoring the user in that situation, you could have said, I'm sorry for asking these questions. Sometimes repeating them will help new information and pop up. Or you could have said sorry for the repeat questions, I don't want to give you a superficial cause when we could fix the root issue and you won't have to chat with us again. This helps them to understand your method and become part of the solution.
10. Following Through and Setting Expectations
    a. It's important to acknowledge your own actions if you think they might otherwise confuse the user, let's say user contacts you to fix something. After collecting some information, you go radio silent. What's user to do? Would they ask if you're still there? Will they wait awkwardly until you came back on the line, how long would they wait before ending the call or saying something? How would they feel about their interaction with you? Pretty awkward. But what if he said, I need to do some research on this issue. Would you mind waiting about five minutes or less while I do that? They'd probably say sure, and keep themselves occupied while they wait. They'd also feel more confident in your ability to resolve the issue. This leads to the most important thing to remember when working with people and that's developing trust. This

is easy to do if you have repeat users, they see you every workday. One bad day isn't going to stop them from trusting that you know what you're doing. But in a transactional user base for the user only contacts the company once or twice. How you interact with each user, each time, is going to break or build that trust. Why is trust so important? Without it, the user could be difficult to work with and could even ignore your advice completely. Empathy and acknowledgment are big part of building trust. Without these, you'll find it difficult to connect with user. By seeing things from the user's perspective, you're more likely to find the solution that will help them specifically. This lets them know that you care and they'll be more likely to be engaged in the interaction. It's also important to follow through on your commitments and promises. If you tell someone you're going to follow up in one hour, then be sure to make it happen. If you don't, acknowledge the oversight and apologize, be sure that any claims you make can be backed up. Don't make something up to a user because you think it will help in the moment. Be honest with the user, even if you think they won't be happy about it and never be afraid to admit when you're wrong.

11. Anatomy of an Interaction
    a. Just be a professional, acknowledge the user, and show them some respect.
    b. If they start asking you a bunch of questions while you're still troubleshooting, you can do two things. First option, you can ignore them because they're just talking out loud. Second option, you can pause and say something like, "I'd be happy to answer all of your questions, but I want to look up this one first. I've written them all down though, so I won't forget them." If you say that make sure to write the questions down.
    c. To really build a rapport, try to remember a personal fact they've mentioned and bring it up later. Maybe they mentioned they love cats, later while you're waiting for something to load, ask them if they have

any cats or what their cat's name is. This shouldn't be forced. If you're not the type to engage in small talk, skip it.

d. Make sure you clarify the person’s issue before you start to troubleshoot
e. If you’re supporting a user remoely and need them to run some commands, don’t forget to tell them why you need them to execute the commands
f. The last five minutes of the interaction will set the tone for how the user feels walking away from the interaction
    i. Make sure to end on a positive note!
        1. Reiterate the resolution
        2. State the next steps
        3. Ask the user if they have any questions

12. How to Deal with Difficult Situations Part I
    a. If you've ever worked in customer service, then you've dealt with difficult situations. The way you handle them in the food industry and tech roles are pretty similar. But before we dive into that, we're going to take a step back and talk about the science behind what's happening in these situations.
        i. Let's say someone's yelling at you, rather it's about a overcook steak or broken computer, your reaction to either will probably be similar. Your palms might be sweating, your hands might shake, or your mouth goes dry, tunnel vision might kick in. These are all normal physiological reactions that happen in response to a perceived threat. This is part of our biological makeup dating back to the time when people hunted for their food. When you're being chased by a cougar you needed your senses to be at high alert in order to keep yourself alive. Even though someone yelling at you isn't the same as the cougar attacking you, it can feel similar in the moment.
        ii. Your brain is releasing a mix of chemicals and hormones to heighten your senses and keep you alert. Unfortunately, a side effect is that

you may have trouble focusing on specific tasks. Not ideal. It's in times like these that you might go on autopilot where your body has a physical reaction and it's hard to focus. It's super important to recognize these moments and put a plan in place to reboot yourself out of the situation.

1. Sometimes I feel this way when I'm teaching a class and someone is ignoring me. They just don't pay attention. I used to call them out on it, the fight response, but this never ended well. Sometimes they had a good reason for being on their phone and calling them out never made them listen more. Now when I feel myself in that situation, I noticed that my pulse increases. When I realize it's happening, I make sure to look around and focus on people who are more engaged in the lesson and make eye contact with them. Soon I feel my pulse slow down.
2. Some of your experiences in IT support might trigger similar reactions. Once you've identified this reboot action, write it down. Remember, your brain isn't always working well in the heat of the moment, so it helps to have something to remind you what to do. It could be anything from squeezing a stress ball to looking away to taking a deep breath. The first couple of times, it may not work, so give it time.

iii. When you have a difficult situation, take a moment to think about what went wrong. How are you feeling? What was your reaction? Why did you raise your voice? After a while, it becomes second nature to catch yourself in de-escalate situation. To really hold yourself accountable, tell a co worker what you're trying

to do. Give them a recap of the interaction and ask them for their feedback on the interaction. You might get some great tips.

1. But here's the bad news. Things aren't over once you get yourself back on track. That's when the hard work starts. Every situation is different and you'll learn the best strategies from experience and peer feedback. To get you started, I'll run through some tried and true techniques.
2. Keep in mind that it's fine if you don't get these right the first time. It takes practice, reflection, and feedback to really nail it, so don't give up.
3. The hardest and arguably the best technique is to identify where the interaction went wrong in the moment and redirect the conversation. This is really tough because it means remaining calm enough to objectively look at the interaction and understand what could have caused it to escalate. At first, try this once the interaction is over.

13. How to Deal with Difficult Situations Part II
    a. Another cause of frustration in user support interactions is when people talk over each other. This usually happens over the phone. Since there's sometimes delay, but it can happen in person to. Typically it leads to people talking louder and sometimes ends up feeling like you're yelling at each other. You've probably been in a situation like this with your friends or family. Everyone wants to talk and the person with the loudest voice wins.
    b. It's important to try and identify why this is happening. So you can course correct. In this case, you can simply stop talking to calm things down, then pause for about five or 10 seconds to make sure they're done talking and start again. This might take a few tries before the user realizes what they're doing and

gives you time to talk. Use that time to calm down and really listen to what the user is saying. Ask yourself, why are they talking over me? What am I missing then in those 5-10 seconds, collect yourself and think about what you want to say.

c. If the user is crossing the line and making you feel uncomfortable ignoring it can feel like the easiest solution. It isn't, remember that if you do the next person they interact with will be treated the same way and that's not okay. It's also easy to say that the person being attacked needs to stand up for themselves, but in situations like this one that's really hard, ideally by standards would call out this behavior in a calm way. It's also important that you escalate these issues to the appropriate channel. Whether that's your manager, the human resources department, whomever. Disclaimer, I love being in the IT support field and I don't want to dwell on the negative, but I do want to prepare you for what you might encounter.
d. So let me throw another tough scenario at you. You might find that a user skims over what you wrote or doesn't listen to the full instructions you present before taking action. When this happens, be patient. You've likely been on the other end of this before when you ignored instructions? Why were you overwhelmed with information? Were you in a hurry? Maybe you need reading glasses. Whatever the case might be, the best tactic is to break these steps down into smaller, more digestible pieces for the user. If you sent them an article that they didn't finish reading, ask where specifically in the documentation they're having issues. So that you don't have to bore them with the parts they already know. Sometimes you come across someone wanting to bend a policy or push back on an established process. Take this as a sign to look deeper into the situation. Is it really a company policy or just a common way of doing things? If it is a policy, is there documentation of it? You can reference that to the user. If not offer to follow up to get a definitive

answer. You might be surprised what you find. The takeaway here is that it's important to try to see things from other people's point of view. In that moment when you're feeling riled up and frustrated, take a minute to see the situation from the other person's perspective. If you were them, how would you be feeling? What would make you feel better? If you can train yourself to see things from another's perspective, you're on your way to turning things around.

ix. Documentation
    1. Ticketing Systems and Documenting Your Work
        a. Tickets - a common way of documenting an issue
        b. Bugs - issues with the system that weren't caused by an external source
        c. Example systems
            i. Bugzilla
            ii. JIRA
            iii. Redmine
        d. A great way to use the system for documentation is to update the ticket with what the issue is. The steps and procedures you're trying to resolve and the solution you arrived at. This is important for two reasons.
            i. The first is that it keeps the user in the loop.
            ii. The second is that it helps you audit your steps in case you need to go back and see what you did.
        e. You can also write down procedures and policies to create a documentation trail.
        f. Systems and processes are constantly changing, and so should your documentation
            i. It's important to update documentation, so that you aren't reading something that's old
        g. One last thing I want to call out about writing documentation is that you don't need to get creative with your writing. You aren't writing a short story, you're writing a technical document. You want to be as concise as possible so that when someone reads your document, they can easily figure out what they need to do.
    2. Process Documentation

    a. No documentation is the worst documentation. Imagine if it took you hours to figure out an issue to a problem and you didn't write it down. Your colleague encounters the same issue and takes hours to figure it out, then he also doesn't write it down. This can go on and on. It only takes a little bit of effort to create documentation and it can save you so much of your time, your company's time, and your users time.
    b. Documentation should be straight and clear cut. Your reader shouldn't have any questions when following the instructions you listed. Now, this is a good example of documentation.
    c. A good example of documentation: It starts off with a very specific and clear problem. It gives you background information on what the issue is. It even gives you the exact instructions on how to fix the issue, including which settings to navigate to and where. Remember, always write documentation that makes it easy for your reader to follow.
3. Documenting in Ticketing Systems
    a. Now that we've talked a little bit about documenting processes, let's talk about how you write documentation in ticketing or bug systems. You don't have to leave a full example of process documentation for every ticket you handle. If you encounter the same issue, just write the documentation once, then refer back to it. One of the more important aspects of writing documentation in a ticket or bug, is that you leave an audit trail to see what worked and what didn't.
    b. Good example - The tech described what the issue is, what caused the issue, and the specific steps they took to resolve it.
4. Your Opportunity for Success
    a. Hi, there. My name is Rob Clifton, and I'm a Program Manager at Google. My career in IT started about 17 years ago. At the time IT knowledge was mainly self-taught. I took certificate course as much like this one, and learned as much as I could along the way while I continued to go to college part-time to get an

associate's degree. Finding that first job wasn't easy. I had to convince someone to take a chance on me, even though I had no degree and no advanced education in IT. I applied for a lot of jobs, got a few interviews, received a lot of rejections, and eventually landed my first job fixing computers at a big box retailer. Over the next few years, I jumped around to different jobs, getting more experienced while I continued to go to school and finish my degree. I eventually landed at Google as a support tech in our Ann Arbor office. Twelve years later, I now lead the hiring efforts for our junior IT support roles. I've interviewed hundreds of candidates, and I help train our interviewers and how to find the best talent in the industry. Today, I'm excited to share what I've learned to help you prepare for your next interview. Going into an interview is a moment that lots of people dread. We're all afraid that we could say something wrong, that were not ready for that next step, or just that will be rejected. These are all normal feelings, but it helps to look at the interview as an opportunity. It's an opportunity for you to hone your interpersonal skills, learn more about the company, and make sure that the job is a good fit for you. It's an opportunity to advance your career and gain more work experience. Doing these lessons will give you some tips that will help you prepare for the interview. We want you to walk into your interviews feeling confident and excited. We'll show you what a technical interview on the subject at hand may look like.

5. Standing Out from the Crowd
    a. Your resume is your first introduction to a new company
    b. Make sure your resume is easy to read and clearly shows the recruiter or hiring manager that you're a strong fit for the job you're applying for. Avoid using lots of filler text in your resume.
    c. If you're new to the industry, you may not have a lot to put on your resume, but that's okay. You don't need to list out every piece of software you've used or

networking protocol you've ever learned about, stick to your relevant qualifications.

d. You should also make sure you have an up to date online presence. Your profile should look professional and have the most current resume, a photo and updated contact info.
e. Don't forget to do this, employers are using sites like LinkedIn more and more to reach out to candidates. Now, when you find a job that you want to apply for, you want to learn as much as you can about the role. First place to find this information is in the job description. The description will usually include the roles responsibilities and requirements and some information about the company. Take some time to understand those details and make sure it's a good fit for you. Feel free to ask your recruiter any additional questions you have about the role or the company.
f. Research the company
g. Learn where to go for the interview and make sure your attire is appropriate
h. Arriving a little early is always a good move, just in case it isn't an easy place to find

6. Crafting Your Resume
    a. Example Resume 1
    b. Example Resume 2
    c. Example Resume 3
7. Getting Ready for the Interview
    a. Mock Interviews - Pretending that you're in an interview, even if it's not real, will help you perform your best
    b. It's not just about knowing the answers; you also need to share your ideas clearly and concisely
        i. Break down complicated technical problems, processes, troubleshooting, and resolution into easy digestible bits of info or steps
        ii. Practice explaining complicated tech things like the above to non-technical friends and family members.
    c. While you're practicing answering questions you should also practice active listening habits, maintain

eye contact with the other person, not understanding when they speak, and ask relevant follow-up questions.
        i. If you can, it's great to practice with someone who also plans to interview for similar roles. This way you can take turns being the interviewer and the interviewee. This will allow you to put yourself in the interviewer's shoes and understand how best to answer each question.
    d. Elevator Pitch - A short summary of who you are and what kind of career you're looking for
    e. Now keep in mind, I don't recommend trying to script or memorize all of your answers. Instead, try explaining the same concepts in different ways. This allows for a more natural conversation and will help you adapt your answers in the actual interview where you won't know the questions.
    f. What you can write down and memorize is your elevator pitch. An elevator pitch is a short summary of who you are and what kind of career you're looking for. Make sure to include information like what you're passionate about, how you would like to grow, and what you're looking for in a new role. Practice delivering this pitch to different people and see how it sounds, even if you have it memorized, stay flexible, you never know in which context you may need it.
8. Creating Your Elevator Pitch
9. What to Expect During the Technical Interview
    a. When you're interviewing for a technical position, you'll likely have one or more interviews where you'll specifically need to demonstrate your technical skills and knowledge. These interviews may take the form of technical troubleshooting scenarios or explanations of technical concepts and subjects.
    b. Having a good probem-solving strategy is more important than knowing all the answers
    c. When you mention concepts or technologies, you should be ready to explain them and articulate why you may choose one thing over another

    d. It’s OK, and even expected, to ask the interviewer follow-up questions to ensure that the problem is correctly framed.
    e. Always use the data and evidence you have from the interviewer to inform your next steps.
    f. For example, if you need to solve a problem about a user being unable to connect to an internal system, you should ask follow up questions like:
        i. What operating system the user is using
        ii. How their computer is supposed to connect to the network
        iii. What error messages they are getting
        iv. Whether other users are affected?
        v. Your goal is to narrow the scope to find the root cause.
    g. If the question is very complex, it might become difficult to follow or explain the solution. In this case, it's useful to take notes and use diagrams to illustrate the problem. You can use this process when it makes sense. It doesn't mean you need to write everything down during an interview. Sometimes the answer is straight forward and you can just go ahead and explain it without writing anything down.
10. Showing Your Best Self During the Interview
    a. Being your best self for the interview starts the night before. Being fully rested will help you have more energy, be more focused, and minimize anxiety. So make sure that you get a good night sleep. Don't try to cram in any last-minute studying, this will only make you more anxious. Instead, try to relax and go to bed early. On the day of the interview eat a proper breakfast. It's never a good idea to be hungry during an interview. Aim to arrive earlier than the scheduled time and give yourself enough travel time for any mishaps along the way. Make sure you're comfortable before you begin the actual interview. Don't be afraid to ask for something if you need it. Use the restroom, grab a glass of water, and ask for a notepad and pen for notes or to illustrate answers when necessary. Be fully present for the duration of the interview. This

means turning off your phone to avoid interruptions and giving the interviewer your full attention. Use those active listening skills that you've practiced. Make eye contact, nod, indicate understanding, and ask follow-up questions. Don't forget to be yourself. You want the interviewer to remember you, so let your personality show. Make sure that you highlight what makes you unique. Remember that the interview is also an opportunity for you to ask questions about the things that you care about. You're interviewing them as much as they're interviewing you. Find out if this is a company that you want to work for and whether you'll be able to achieve your career goals there. Finally, remember to slow down. Most people start talking faster and faster when they're nervous, so be aware of your pace. If you notice that you're getting nervous, pause for a moment to take a few deep breaths, and then consciously slow down. Well, that's a lot of tips to remember. Feel free to re-watch these videos when your next interview is approaching to make sure that you have these ideas fresh in your mind.

11. Interview Role Play: Customer Service
    a. Downloaded the video for this
12. Sabrina: Technology can open doors
    a. Technology can open doors and allow you to achieve things that even you didn't expect. Growing up, I never pictured that I would be in technology, right? I didn't ever even expect to go to college. I don't think that it's about college. I do think that you need to be interested in learning. You need to be willing to push yourself, question assumptions and challenge other people. I've worked with a lot of people who have not gone to a four year college, and have been incredibly successful at google and at other large companies and small companies even that I've worked for here in Silicon Valley. Being willing to acknowledge what you don't know, but being interested in be like, okay, I don't know that, but I can figure it out or I want to see if I can figure it out. Testing your boundaries and

pushing yourself, really will drive your success beyond what you think you could achieve.

13. C1 Glossary

3. Course 2 - The Bits and Bytes of Computer Networking
    a. Course Introduction
        i. Protocol - a defined set of standards that computers must follow in order to communicate properly
        ii. Computer networking - the name we've given to the full scope of how computers communicate with each other
        iii. Networking involves ensuring that computers can hear each other, that they speak protocols other computers can understand, and that they repeat messages not fully delivered. Just like how humans communicate.
    b. The TCP/IP Five-Layer Network Model
        i. Application - 5
            1. Protocol - HTTP, SMTP, etc
            2. Protocol Data Unit - Messages
            3. Addressing - N/A
        ii. Transport - 4
            1. Protocol - TCP/UDP
            2. Protocol Data Unit - Segment
            3. Addressing - Port #s
        iii. Network - 3
            1. Protocol - IP
            2. Protocol Data Unit - Packet / Datagram
            3. Addressing - IP Address
        iv. Data Link - 2
            1. Protocol - Ethernet, Wi-Fi
            2. Protocol Data Unit - Frames
            3. Addressing - MAC Address
        v. Physical - 1
            1. Protocol - N/A
            2. Protocol Data Unit - Bits
            3. Addressing - N/A
        vi. Layer definitions
            1. Physical layer - represents the physical devices that interconnect computers
                a. The physical layer is a lot like what it sounds. It represents the physical devices that interconnect computers. This includes the specifications for the

networking cables and the connectors that join devices together along with specifications describing how signals are sent over these connections.

2. Data Link layer - Responsible for defining a common way of interpreting these signals so network devices can communicate
    a. Some sources will call this layer the network interface or the network access layer.
    b. Lots of protocols exist at the data link layer but the most common is known as ethernet. Although wireless technologies are becoming more and more popular. Beyond specifying physical layer attributes, the ethernet standards also define a protocol responsible for getting data to nodes on the same network or link.
3. Network layer - allows different networks to communicate with each other through devices known as routers
    a. Also sometimes called the internet layer
    b. Internetwork - a collection of networks connected together through routers, the most famous of these being the internet
    c. While the data link layer is responsible for getting data across a single link, the network layer is responsible for getting data delivered across a collection of networks. Think of one of the device on your home network connects with a server on the internet. It's the network layer that helps get the data between these two locations. The most common protocol used at this layer is known as IP or internet protocol.
    d. IP - is the heart of the Internet and most smaller networks around the world
    e. Network software is usually divided into client and server categories with the client application initiating a request for data and the server software answering the request across the network. A single node may be running multiple client or server applications. So you might run an email program and a web browser. Both client applications on your PC at the same time and your email and web server might both run on the same server. Even so, emails end up in your email

application and web pages end up in your web browser.

4. Transport layer - sorts out which client and server programs are supposed to get that data
    a. When you heard about our network layer protocol IP, you may have thought of TCP/IP, which is a pretty common phrase. That's because the protocol most commonly used in the fourth layer, the transport layer, is known as TCP or transmission control protocol. While often said together as the phrase TCP/IP, to fully understand and troubleshoot networking issues, it's important to know that they're entirely different protocols serving different purposes. Other transport protocols also use IP to get around including a protocol known as UDP or user data gram protocol. The big difference between the two is that TCP provides mechanisms to ensure that data is reliably delivered while UDP does not. Spoiler alert will cover differences between the TCP and UDP transport protocols in more detail later. For now, it's important to know that the network layer, in our case IP is responsible for getting data from one node to another. Also remember that the transport layer, mostly TCP and UDP is responsible for ensuring that data gets to the right applications running on those nodes.
5. Application layer - There are lots of different protocols at this layer and as you might have guessed from the name, they're application specific.
    a. Protocols used to allow you to browse the web or send and receive email are some common ones. The protocols that play in the application layer will be most familiar to you since there are ones you probably interacted with directly before even if you didn't realize it.
6. You can think of layers like different aspects of a package being delivered. The physical layer is the delivery truck and the roads. The data link layer is how the delivery trucks get from one intersection to the next over and over. The network layer identifies which roads need to be taken to get from address A to address B. The transport layer ensures that

delivery driver knows how to knock on your door to tell you your package has arrived. And the application layer is the contents of the package itself.

c. Supplementary Reading for The OSI Networking Model
    i. In addition to the five layer model we are working with, it's important to note that other models exist. The traditional TCP/IP Model only has four layers, as it doesn't differentiate between the physical layer and the data link layer, but is otherwise very similar to the one we'll be working with. The most well known other model is the OSI model. It's the model taught by many other networking certificate programs, like Net+ and Cisco's many networking certifications. The primary difference between our five layer model and the seven layer OSI model is that the OSI model abstracts the application layer into three layers total.
    ii. You can learn more about the OSI Networking Model by checking out these links:
        1. https://www.sans.org/reading-room/whitepapers/standards/osi-model-overview-543
        2. https://en.wikipedia.org/wiki/OSI_model
d. Alex: Why networking is important
    i. Every computing device that we interact with on a daily basis is a network device. Computers aren't stand-alone anymore in any way. From our phones, to a tablets, to a laptops, to a desktops, they're all networked in some way. They're all talking to other computers. To a lot of people networking is seen as some black magic and only certain people really understand what's going on. But in my experience, an IT support person who truly understands networking at a fundamental level, is just able to perform every aspect of their job so much more successfully. There are a lot of networking courses available. This is actually something that people have been teaching in this manner since the 90s. But I think this course is really different because it focuses on so many practical cases, as well as really focusing on the things that an IT support person needs to know and not necessarily a network engineer. We spend time on DNS. We spend a lot of time on different troubleshooting techniques and tools. We spend a lot of time just focusing on the things that on a day-to-day basis, someone in IT actually needs to know about.
e. The basis of Networking
f. Cables

i. Cables - connect different devices to each other, allowing data to be transmitted over them
ii. Most cables today can be split into two categories:
    1. Copper - most common form of networking cable
        a. The most common forms of copper twisted-pair cables used in networking are Cat5, Cat5e, and Cat6 cables.
    2. Fiber - contain individual optical fibers, which are tiny tubes made out of glass about the width of a human hair
iii. Crosstalk - when an electrical pulse on one wire is accidentally detected on another wire

g. Hubs and Switches
    i. Hub - a physical layer device that allows for connections from many computers at once
    ii. Collision domain - a network segment where only once device can communicate at a time
        1. If multiple systems try sending data at the same time, the electrical pulses sent across the cable can interfere with each other.
        2. This causes these systems to have to wait for a quiet period before they try sending their data again. It really slows down network communications and is the primary reason hubs are fairly rare.
    iii. Network Switch / Switching Hub - A switch is very similar to a hub, since you can connect many devices to it so they can communicate. The difference is that while a hub is a layer one or physical layer device, a switch is a layer two or data link device.
        1. This means that a switch can actually inspect the contents of the ethernet protocol data being sent around the network, determine which system the data is intended for and then only send that data to that one system. This reduces or even completely eliminates the size of collision domains on a network. If you guess that this will lead to fewer retransmissions and a higher overall throughput, you're right.

h. Routers
    i. Hubs and switches - the primary devices used to connect computers on a single network, usually referred to as a LAN or local area network
    ii. Router - a device that knows how to forward data between independent networks

1. While a hub is a layer one device and a switch is a layer two device. A router operates at layer three, a network layer. Just like a switch can inspect Ethernet data to determine where to send things, a router can inspect IP data to determine where to send things. Routers store internal tables containing information about how to route traffic between lots of different networks all over the world. The most common type of router you'll see is one for a home network or a small office.

iii.