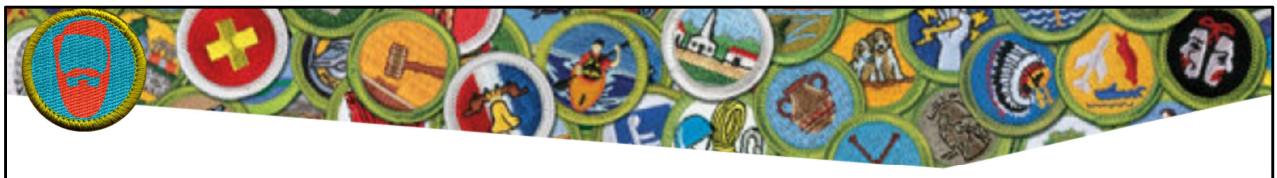
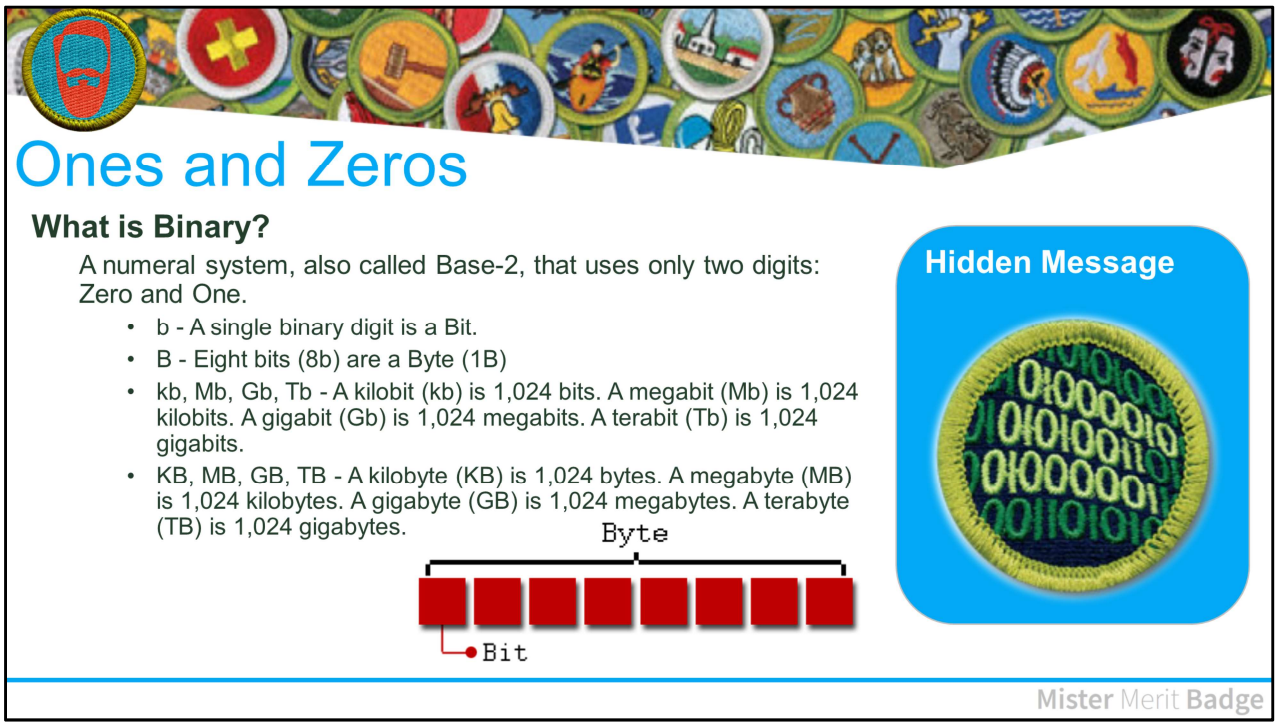


Merit Badge Class

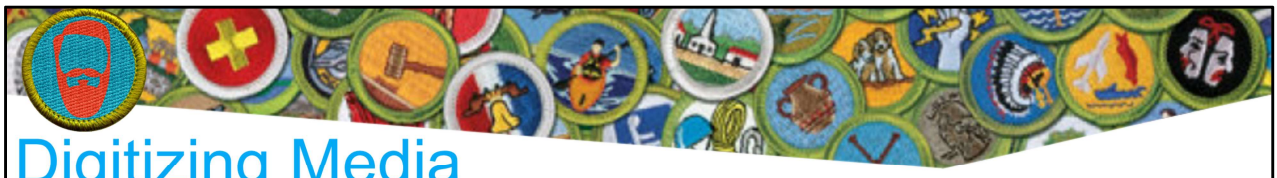
Programming and Digital Technology

Mister Merit Badge


THERE ARE ONLY
10
TYPES OF PEOPLE
THOSE WHO UNDERSTAND
BINARY
AND THOSE WHO DON T



There are 256 different combinations for a single byte. The American Standard Code for Information Interchange (ASCII) is a method for mapping bytes to characters. The binary on the Programming Merit Badge reads 42 53 41. In ASCII 42 = B, 53 = S and 41 = A. The Hidden Message is BSA.



Digitizing Media

Text
The characters from a text message are stored using Unicode, each character is a single byte. Unicode is a method for mapping bytes to characters, based on ASCII but with millions more possible characters. This allows the support of multiple languages, and emojis.

Audio
With a digital audio recording, the device captures the analog signal using a microphone, or another audio input, and it processes through a analog-to-digital converter chip. When you replay the file it goes through a digital-to-analog chip that turns it back to a sound wave.

Pictures
A digital picture is stored in a series of small dots called pixels.

- Monitors are rated by their resolution. so example a monitor that is 1024x768 has 1,024 pixels in the horizontal row and 768 in the vertical row.
- Cameras are rated by mega-pixels, so a 13 mega-pixel camera will have 13 million pixels in every picture taken

Video
A digital video is stored the same way pictures are, but a video is a series of pictures. The pictures, or frames, are shown very quickly typically 30-60 frames per seconds. The sound is synced with the video.

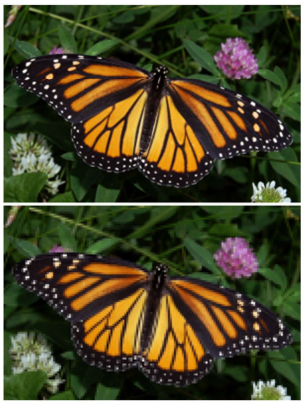
Digitally Shrunken

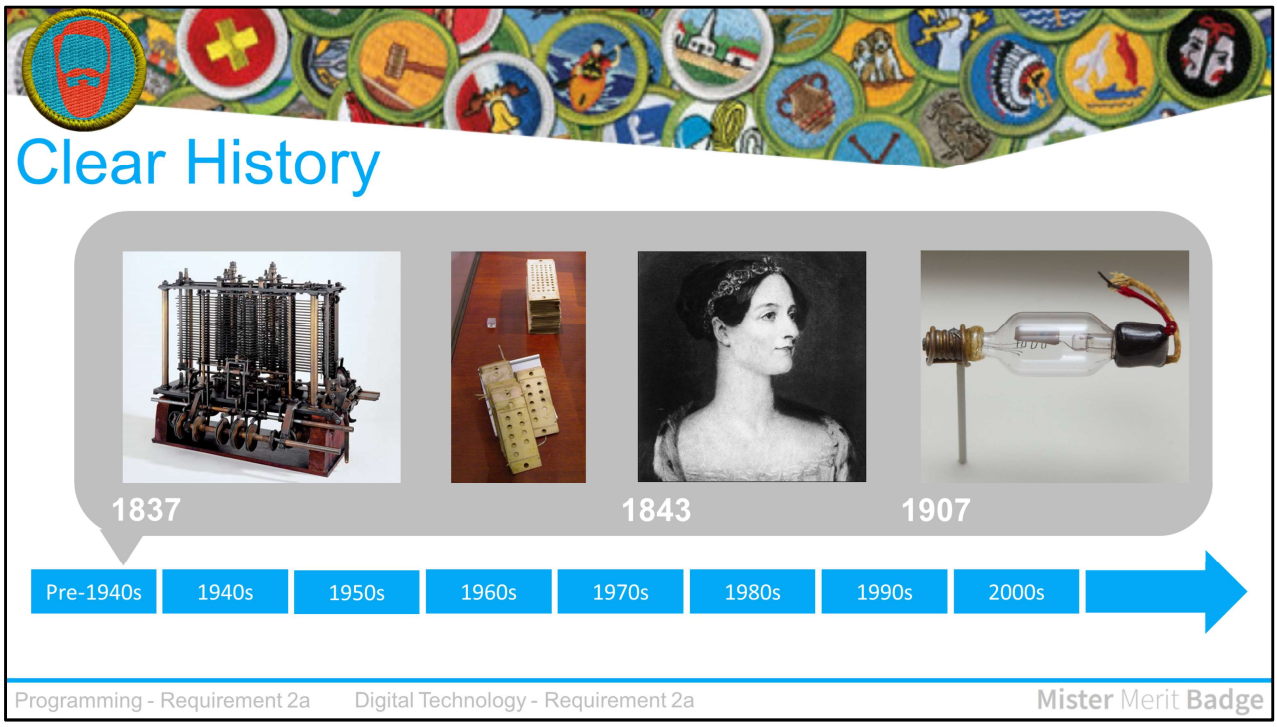
We use compression to make files smaller, allowing them to download faster and take up less storage space. What is removed in compression? Redundancy of data, patterns are recognized and shortened using key tables, any unnecessary data, audio tones beyond human hearing. There are two types of compression.

Lossy
Compression of a file where some data is lost. Shrinking a picture for email, web, or text

Lossless
Compression where all information is retained. Text files, Databases, and retain original picture size.

Media	Example Lossy Format	Example Lossless Format
Images	JPEG	PNG
Audio	MP3	FLAC



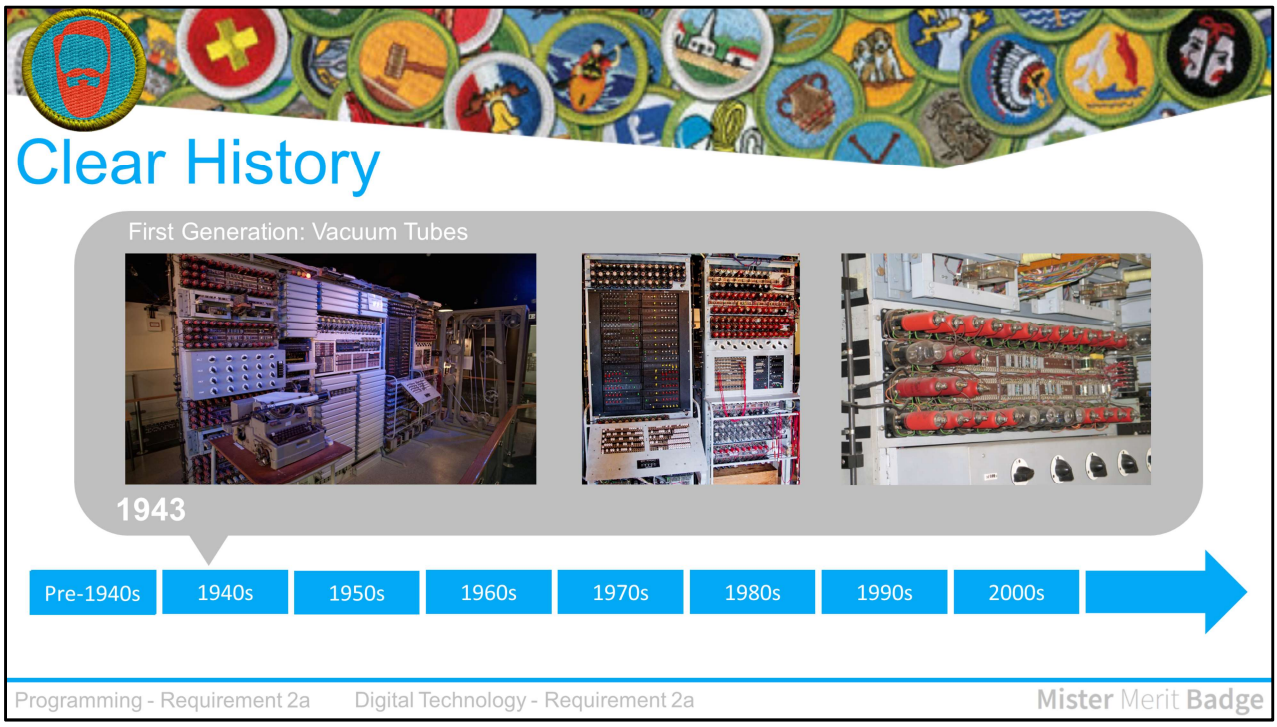


1837 – The Analytical Engine was a mechanical computer proposed by Charles Babbage. The concept of the design is considered to be the the first design for a general-purpose computer ever created, becasuse it incorporated an arithmetic logic unit, control flow in the form of conditional branching and loops, and integrated memory.

Punch Cards – A Punch Card is a piece of stiff paper that can be used to contain digital information represented by the presence or absence of holes in predefined positions. Punch Cards were originally invented in 1725 for the defining weaving patterns for looms, but later used to give various machines instructions. Punch Cards were used by the Analytical Engine and were still used in computers well into the 20th century.

1843 – Mathematician Ada Lovelace translated an article on the Analytical Engine from French to English, in addition to the translation she included detailed notes on how to instruct the Analytical Engine to calculate Bernoulli numbers. Her notes are considered the first program ever written.

1907 – Triode Vacuum Tube was invented. While not the first type of vacuum tube, the triode was the first to amplify signal, allowing more powerful electronics using less electricity.



1943 – The Colossus Mark 1 was a prototype computer developed by British codebreakers during WWII to help decode the Lorenz cipher; 10 versions of the Colossus computers were made between 1943 and 1945. The Colossus Mark 1 was the world's first programmable, electronic, digital computer. It was also the first computer to use switches and cables for programming.

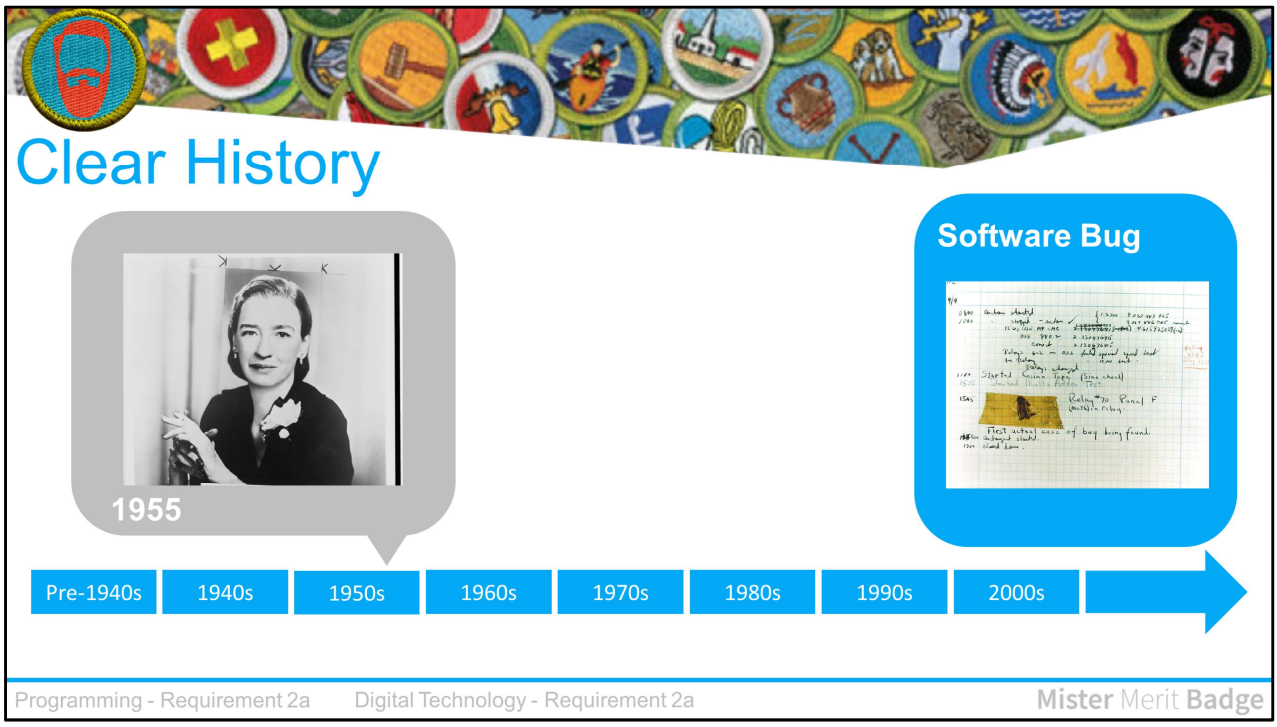
1945 – John Von Neumann wrote the first published description of the logical design of a computer using the stored-program concept. A Stored-Program Computer is a computer where a program can be electronically stored in memory instructions could be modified and run by the computer.

1947 – The transistor was invented. A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. Transistors are the key active component in practically all modern electronics and are considered it to be one of the greatest inventions of the 20th century.

1949 – John Von Neumann's design for a self-reproducing computer program is considered the world's first computer virus.

Machine Code – During this time, if a computer could electronically store programs, programmers had manually write their programs as machine code. Each instruction in Machine Code performs a very specific task in a CPU register or memory.

Second Generation Computers – Second Generation computers used transistors instead of vacuum tubes.
1953 – Manchester Transistor Computer was the first computer to use the transistor instead of vacuum tubes.
Assembly Language – Assembly is a low-level programming language for a programmable device. Code is written by the programmer in assembly and then compiled, or translated, in Machince Code. Each assembly language is specific to a particular computer architecture.

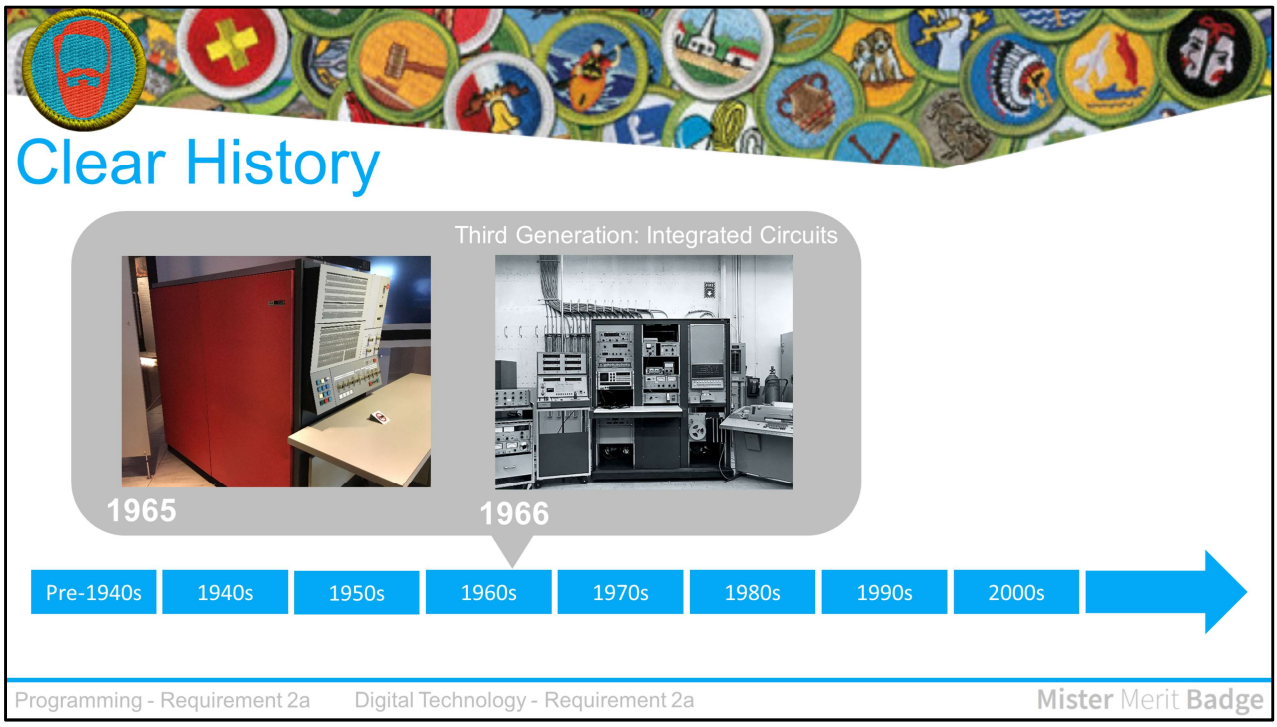


1955 – Grace Hopper designs FLOW-MATIC. FLOW-MATIC was the first programming language to express operations using English-like statements.
Bug – In 1947, while investigating performance issues with a computer Grace Hopper discovered a moth that was stuck in machine, causing the issue.

1958 – The Integrated Circuit is invented. The integrated circuit is a set of electronic circuits on one small flat piece (or "chip") of semiconductor material, normally silicon. The integration of large numbers of tiny transistors into a small chip results in circuits that were siginificantly smaller, cheaper, and faster than those constructed of individual electronic components.

1959 – Influenced by the design FLOW-MATIC, and the belief that programming languages should be machine-independent, Grace Hopper helped create COBOL.

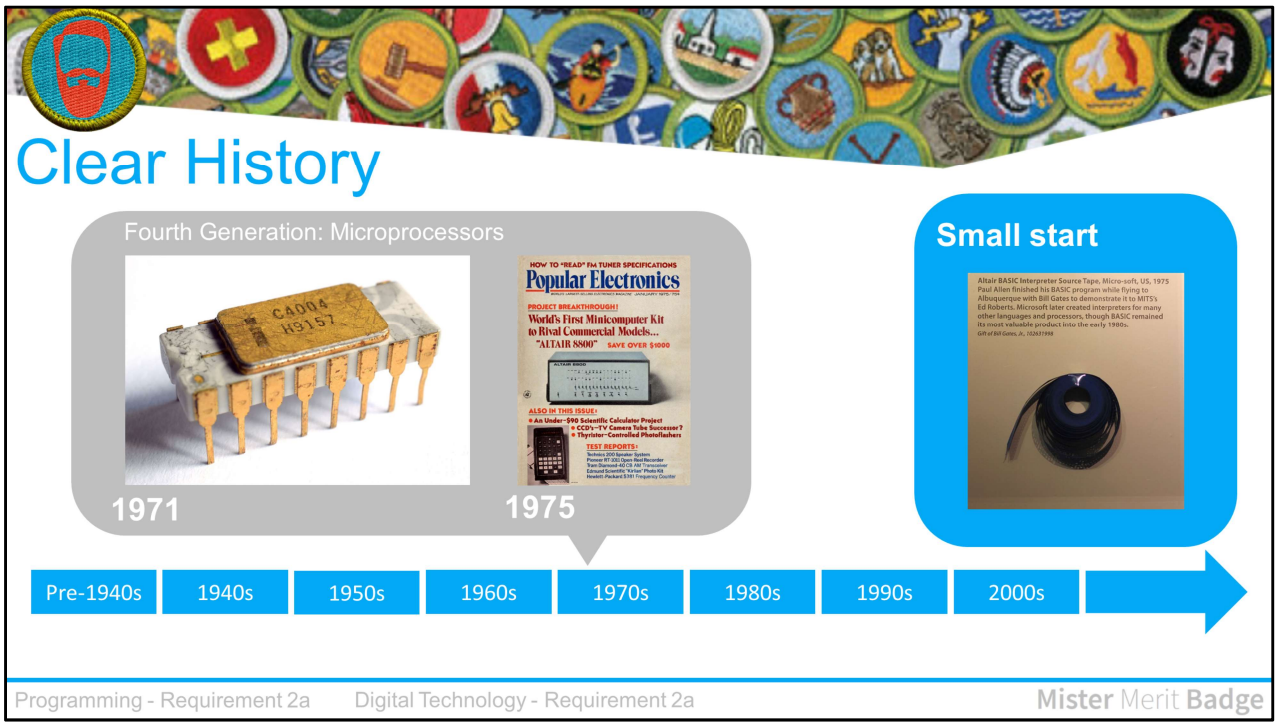
COBOL code sample



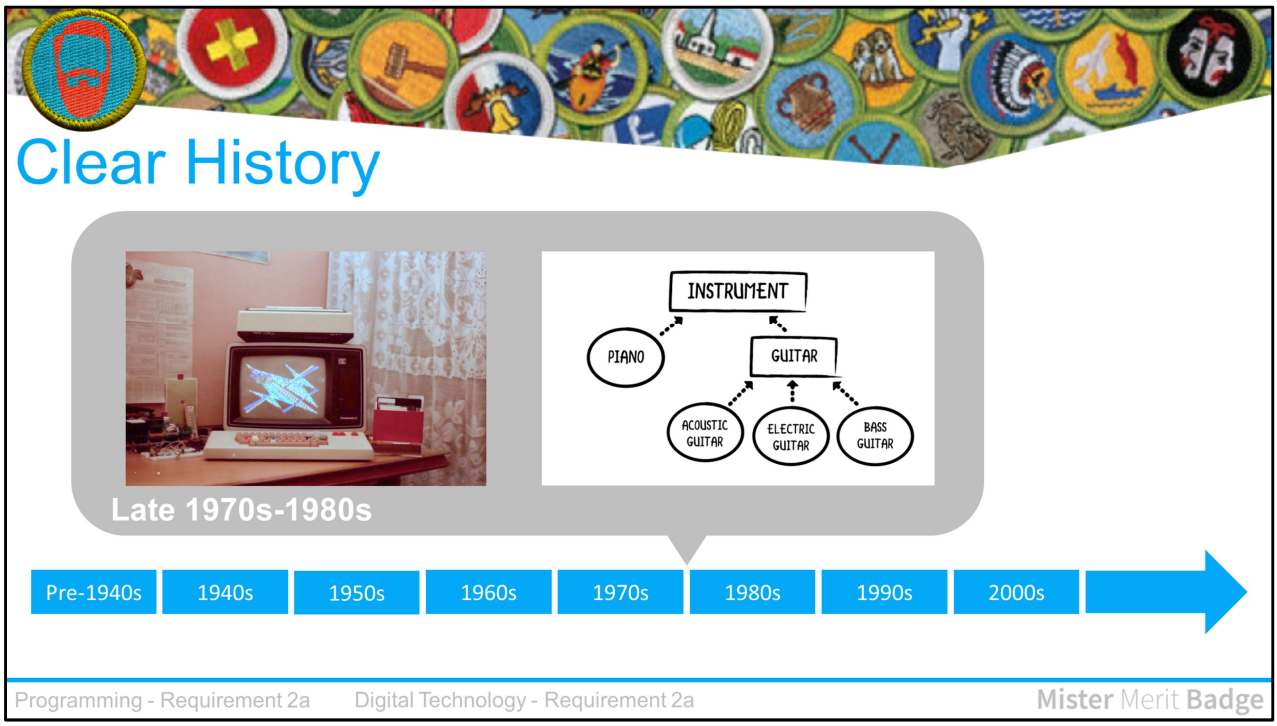
1965 – IBM released the System/360 series of computer. The System/360 family of computers could all run the same software, but with different performances, and at different prices. The computers could be upgraded as the users' needs grew, meaning they could move up to larger computers, and still keep all of their investment in programs, data and storage media.

Third Generation Computers – Third Generation computers feature integrated circuits.

1966 – Hewlett-Packard begins selling their first computer, the HP 2116A which features integrated circuits.

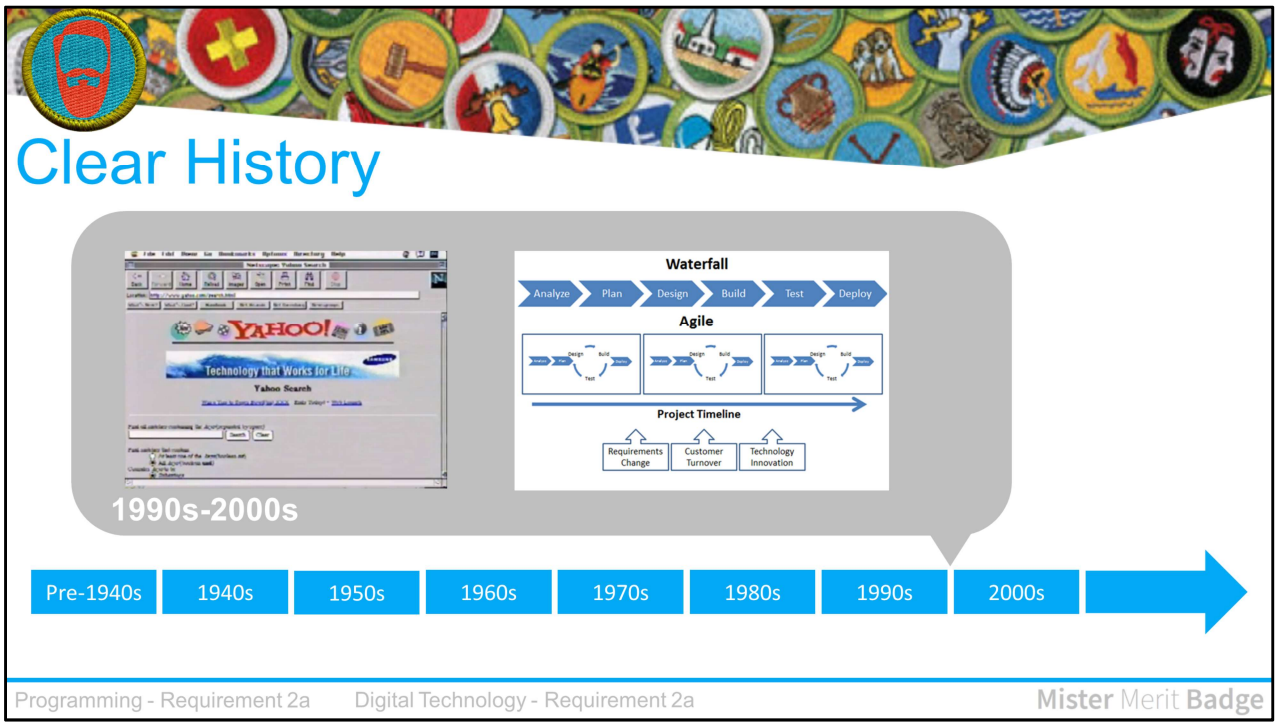


1971 – Intel releases it's first commercially available microprocessor by Intel. A microprocessor is a computer processor which incorporates the functions of a computer's central processing unit (CPU) on a single integrated circuit.
Fourth Generation Computers – Fourth Generation computers include microprocessors.
1975 – MITS' Altair 8800 is released. First sold as a build it yourself kit, then later as a fully assembled computer, the Altair 8800 was the first commercially successful personal computer.
Altair BASIC – The first programming language designed for the Altair 8800, Altair BASIC, was the first product by a new company called Microsoft.



Late 70s-1980s – Computers become more common place, in both businesses and homes.

Object-oriented programming – Object-oriented programming is a programming paradigm based on the concept of classes, which are made up of attributes; and small portion of code known as methods. The overall perpose of this is reusable code, for example, a class can inherit attributes from another class.



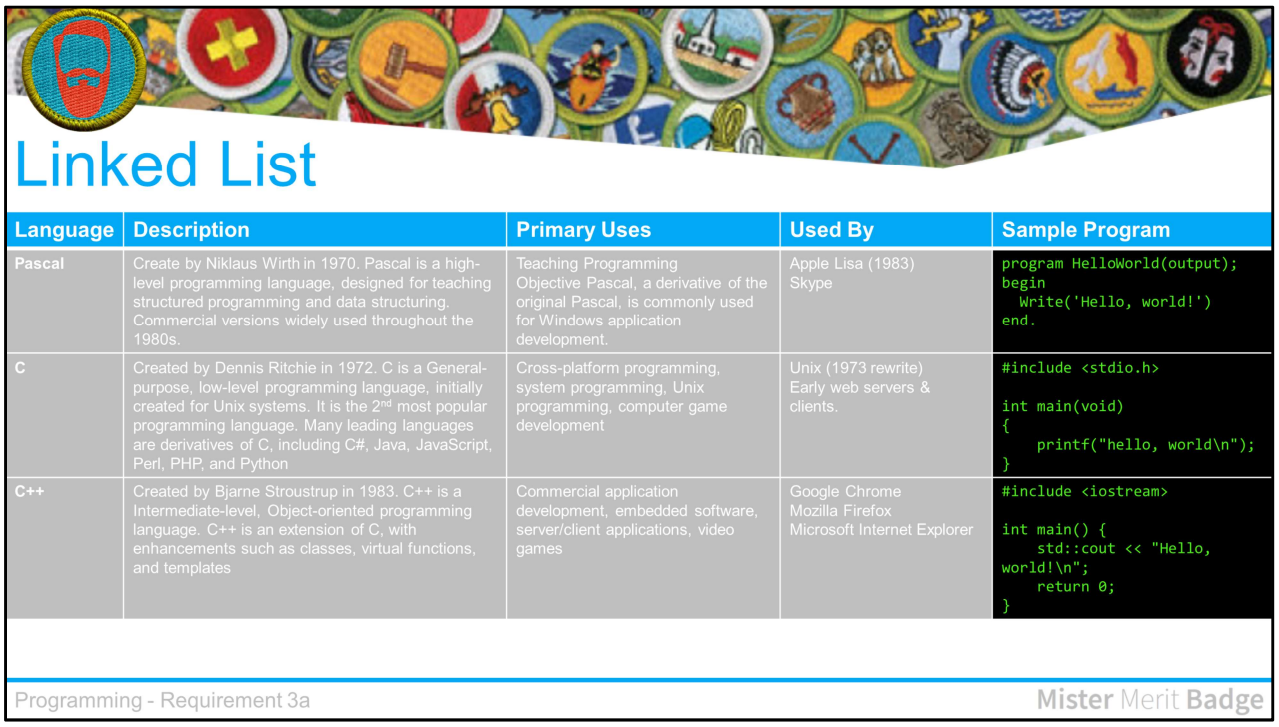
1990-2000s – The internet is introduced further expanding the need and uses of computers. Web based programming languages are also introduced.
Software Development Methodologies – While programming languages continue to evolve, the principles of software development do too. Different software development methods, like Agile, begin gaining in popularity, rather than the traditional Waterfall method.

Clear History

- History review.
- How does digital technology in your lifetime compare to older generations?
- What kinds of computers or devices do you imagine will be available when you are an adult?
- In what ways have programming and programming languages evolved?

Pre-1940s | 1940s | 1950s | 1960s | 1970s | 1980s | 1990s | 2000s

Discussion



Linked List

Language	Description	Primary Uses	Used By	Sample Program

Pascal	Create by Niklaus Wirth in 1970. Pascal is a high-level programming language, designed for teaching structured programming and data structuring. Commercial versions widely used throughout the 1980s.	Teaching Programming
		Objective Pascal, a derivative of the original Pascal, is commonly used for Windows application development.
			Apple Lisa (1983)
			Skype
				`program HelloWorld(output);`
				`begin`
				`  Write('Hello, world!')`
				`end.`

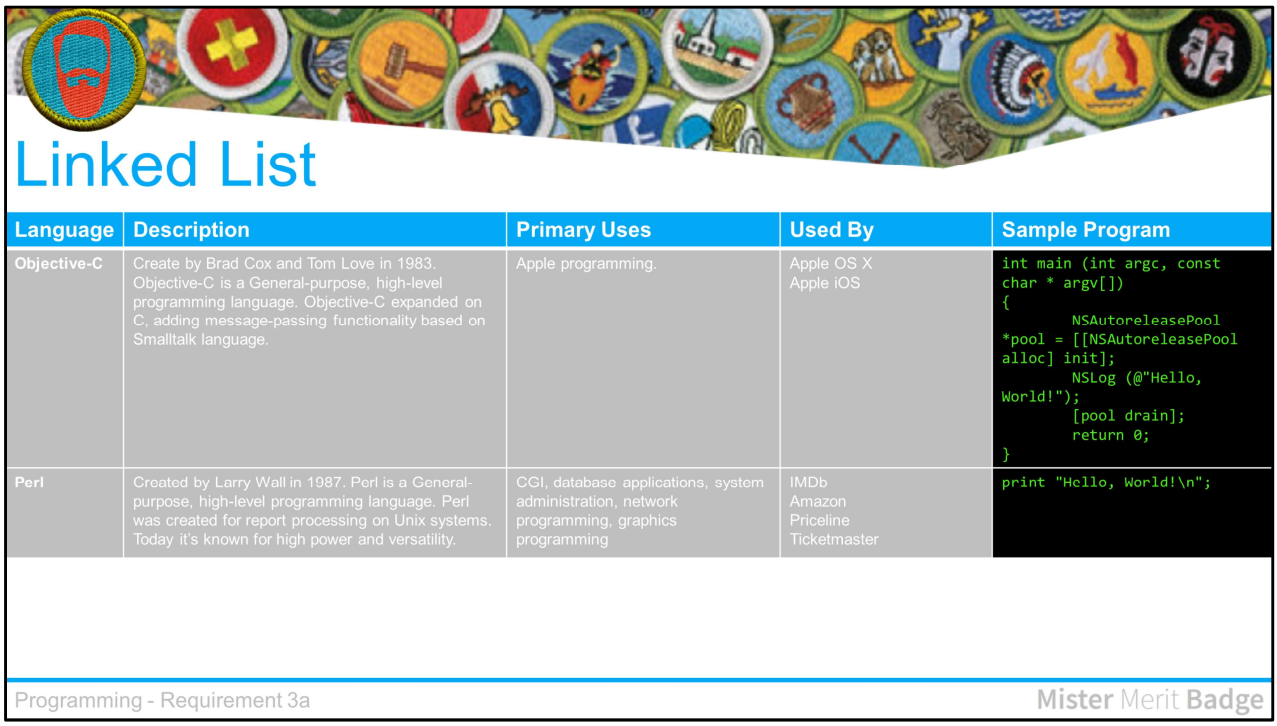
C	Created by Dennis Ritchie in 1972. C is a General-purpose, low-level programming language, initially created for Unix systems. It is the 2nd most popular programming language. Many leading languages are derivatives of C, including C#, Java, JavaScript, Perl, PHP, and Python	Cross-platform programming, system programming, Unix programming, computer game development	Unix (1973 rewrite)
			Early web servers & clients.
				`#include <stdio.h>`
				
				`int main(void)`
				`{`
				`  printf("hello, world\n");`
				`}`

C++	Created by Bjarne Stroustrup in 1983. C++ is a Intermediate-level, Object-oriented programming language. C++ is an extension of C, with enhancements such as classes, virtual functions, and templates	Commercial application development, embedded software, server/client applications, video games	Google Chrome
			Mozilla Firefox
			Microsoft Internet Explorer
				`#include <iostream>`
				
				`int main() {`
				`  std::cout << "Hello, world!\n";`
				`  return 0;`
				`}`

Programming - Requirement 3a

Mister Merit Badge

A list of popular programming languages



Linked List

Language	Description	Primary Uses	Used By	Sample Program

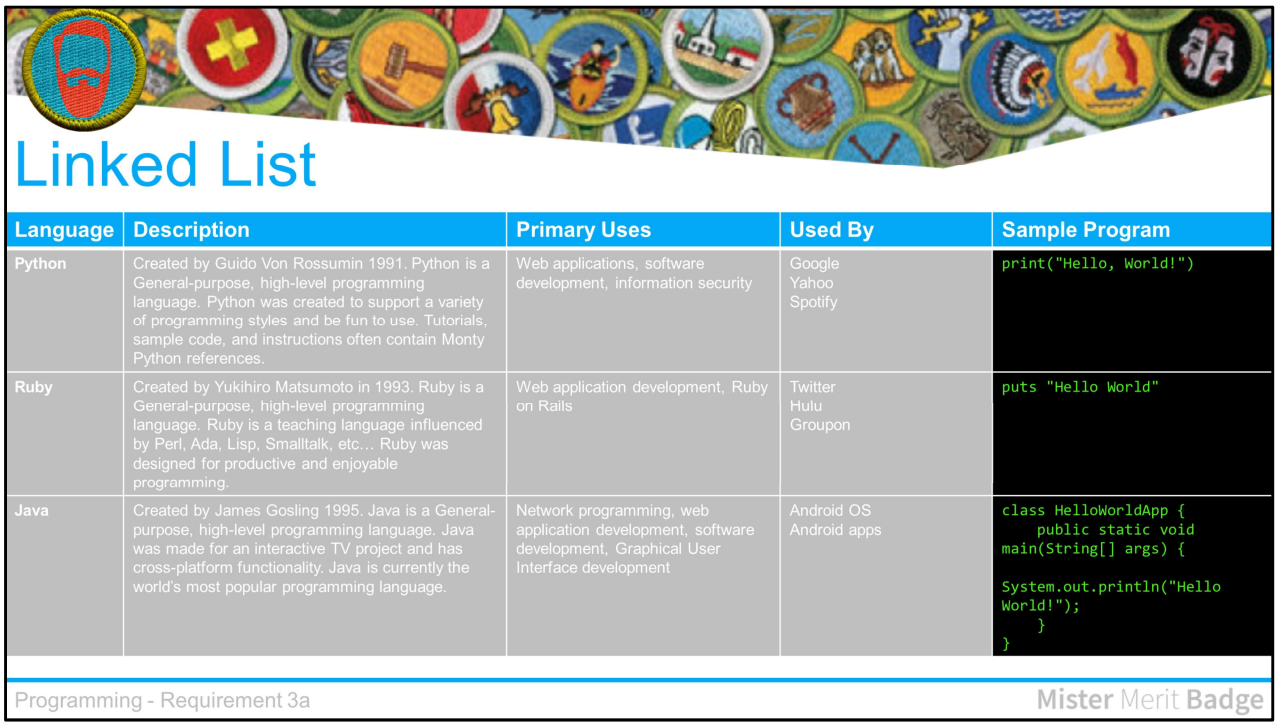
Objective-C	Create by Brad Cox and Tom Love in 1983. Objective-C is a General-purpose, high-level programming language. Objective-C expanded on C, adding message-passing functionality based on Smalltalk language.	Apple programming.	Apple OS X
			Apple iOS
				`int main (int argc, const char * argv[])`
				`{`
				`  NSAutoreleasePool *pool = [[NSAutoreleasePool alloc] init];`
				`  NSLog (@"Hello, World!");`
				`  [pool drain];`
				`  return 0;`
				`}`

Perl	Created by Larry Wall in 1987. Perl is a General-purpose, high-level programming language. Perl was created for report processing on Unix systems. Today it's known for high power and versatility.	CGI, database applications, system administration, network programming, graphics programming	IMDb Amazon Priceline Ticketmaster	`print "Hello, World!\n";`

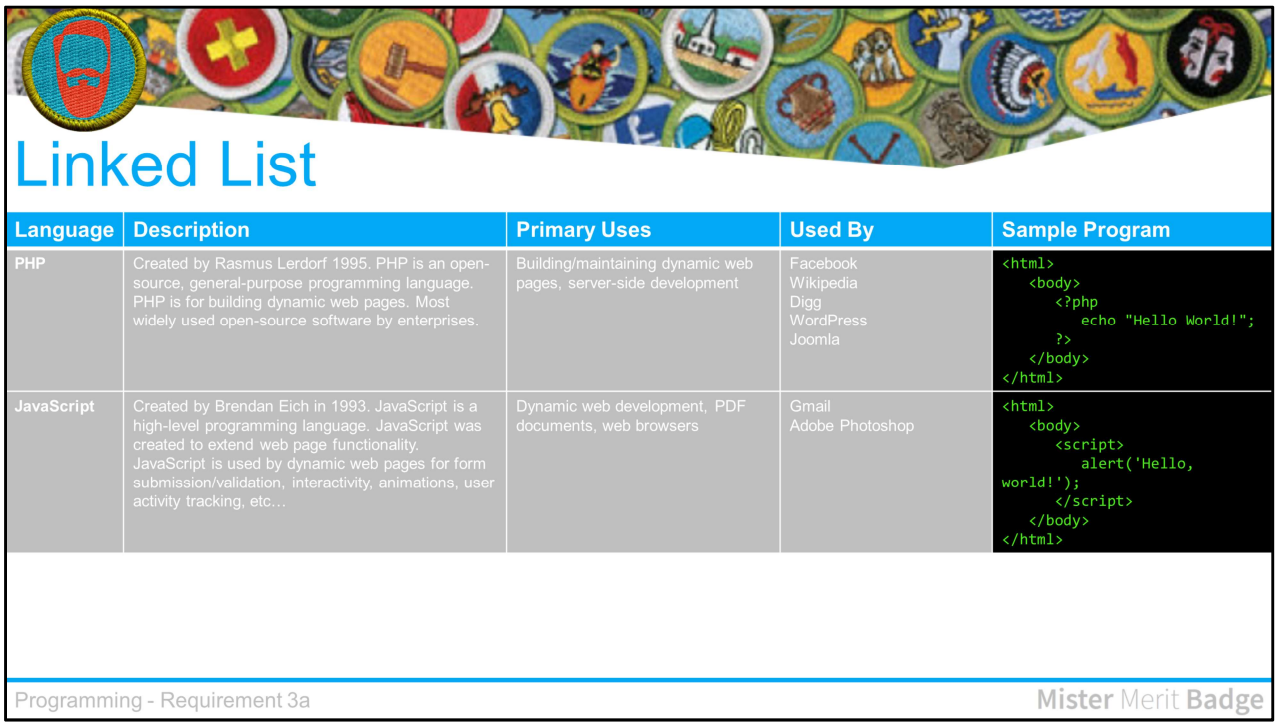
Programming - Requirement 3a

Mister Merit Badge

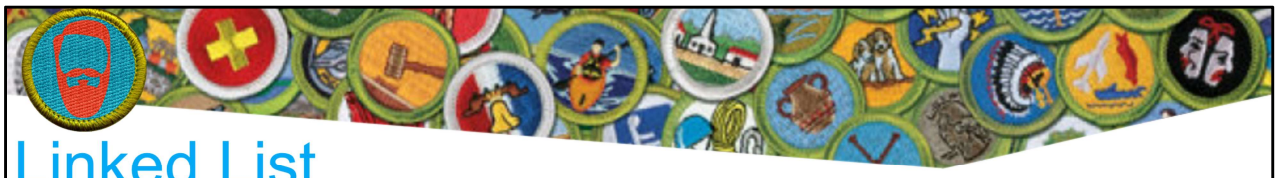
A list of popular programming languages



A list of popular programming languages



A list of popular programming languages



Linked List

- What a program or app is and how it is created?
- Name 4 programs or apps you or your family use and explain how each helps.
- Describe three different programmed devices you rely on every day
- Name 10 popular programming languages used today and how they are used.

Programming - Requirement 3b Digital Technology - Requirement 4a-b Mister Merit Badge

Discussion

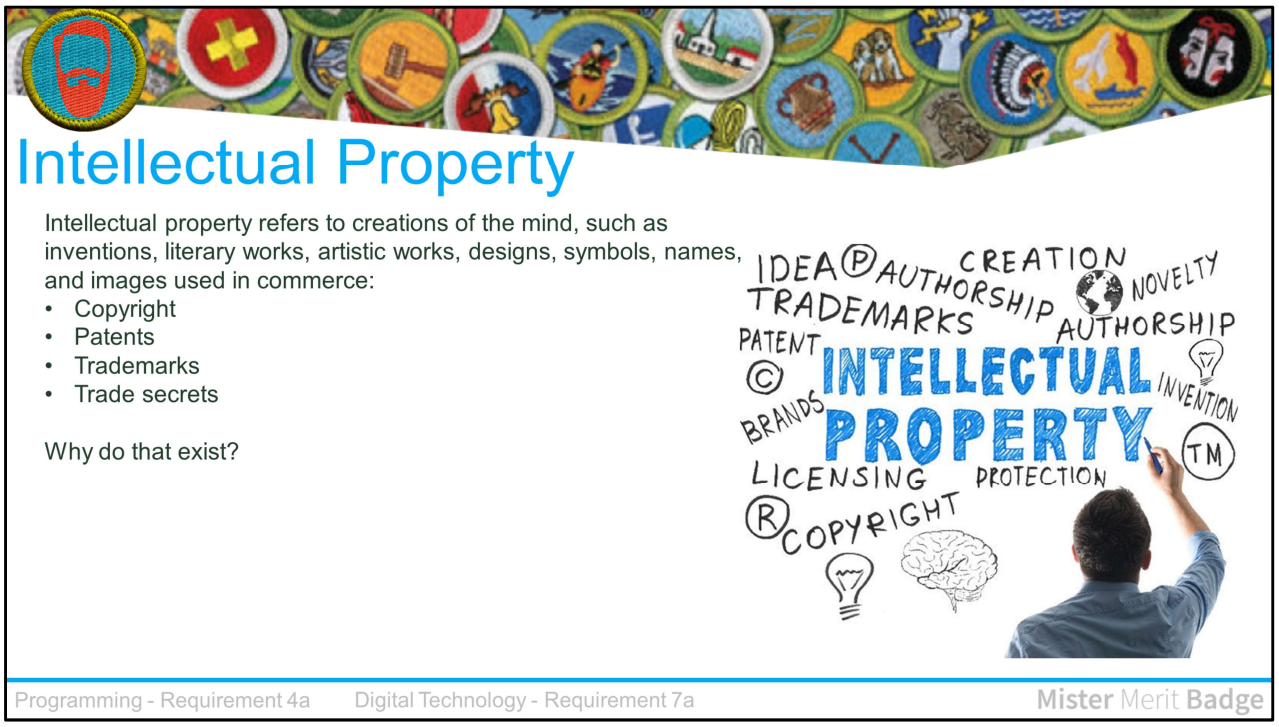
Bad Program!

Malicious software used to refer to a variety of forms of hostile or intrusive software. Types of malware include:

- Computer viruses
- Worms
- Trojan horses
- Ransomware
- Spyware
- Adware
- Scareware

How can you protect your devices and data from malware?

Discussion



Copyright – A copyright is geared toward literary and artistic works, such as books and videos.

Patent – A patent is a right, granted by the government, to exclude others from making, using, or selling your invention/idea.

Trademark – A trademark protects items that help define a company brand, such as its logo.

Trademark – A trademark protects items that help define a company brand, such as its logo.

Trade Secrets – A Trade Secret is something used by a business not generally known by others by which gives the business an economic advantage over competitors.

Intellectual Property

The drawing comes from 2 revisions of the same Apple iPhone Design patent application, the solid lines in the drawings are related to the patent, and the dotted lines are portions not claimed in this particular patent.

The drawings shows the bezel and front of the iPhone, the first revision didn't include the screen but the patent was updated to include the screen. We can compare the drawings from the patent to the actual Samsung Galaxy S 4G design.

Figure 3

This patent was specifically for the design of the front of the iPhone, not the technical specifics of the phone so it doesn't matter what type of the screen just the overall look/design. Apple sued Samsung over the Galaxy S 4G and two other phones for patent infringement for this particular patent along with some other patent, and a court found that Samsung did infringe on the design, with total damages of $163,018,625

Programs

When can you accept a free copy of a program from a friend?

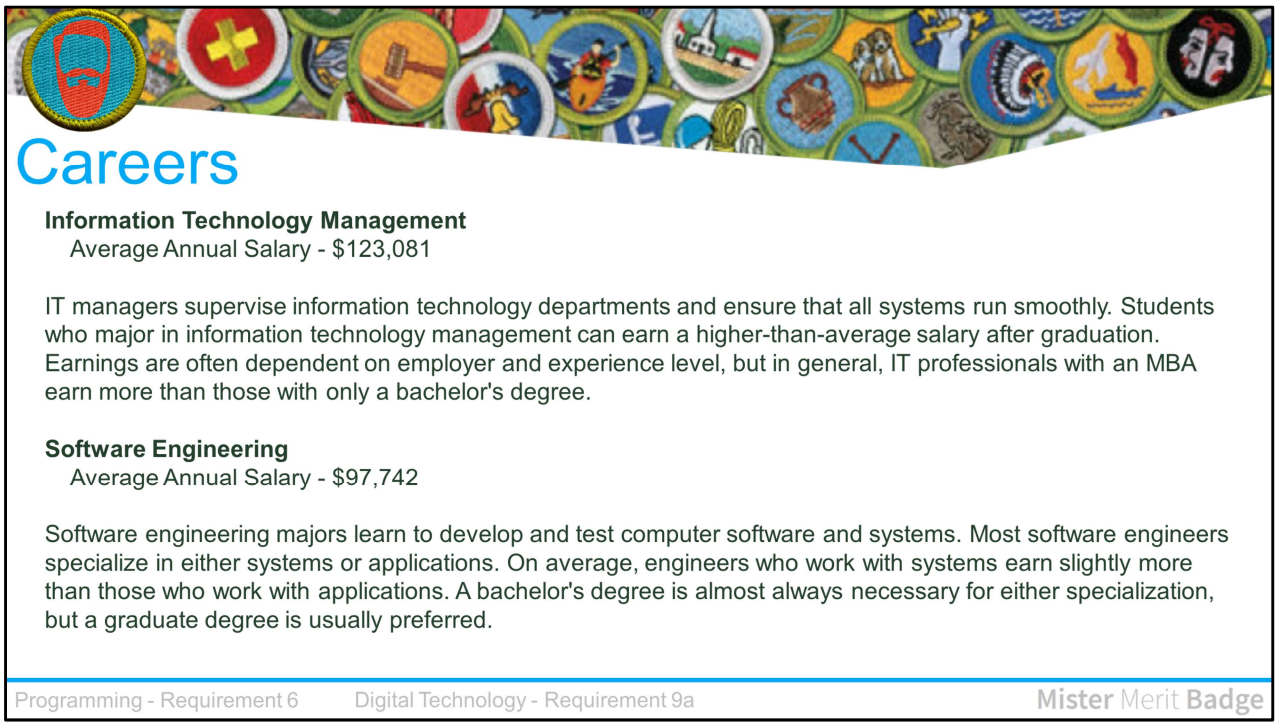
What is the difference between licensing and owning software?

What are the differences between freeware, open source, and commercial software? What is important to understand the differences?

Programming - Requirement 4b-c Digital Technology - Requirement 7b Mister Merit Badge

Discussion

Find out about three career opportunities. Pick one and find out the education, training, and experience required. Discuss this with your counselor and explain why this career might be of interest to you.



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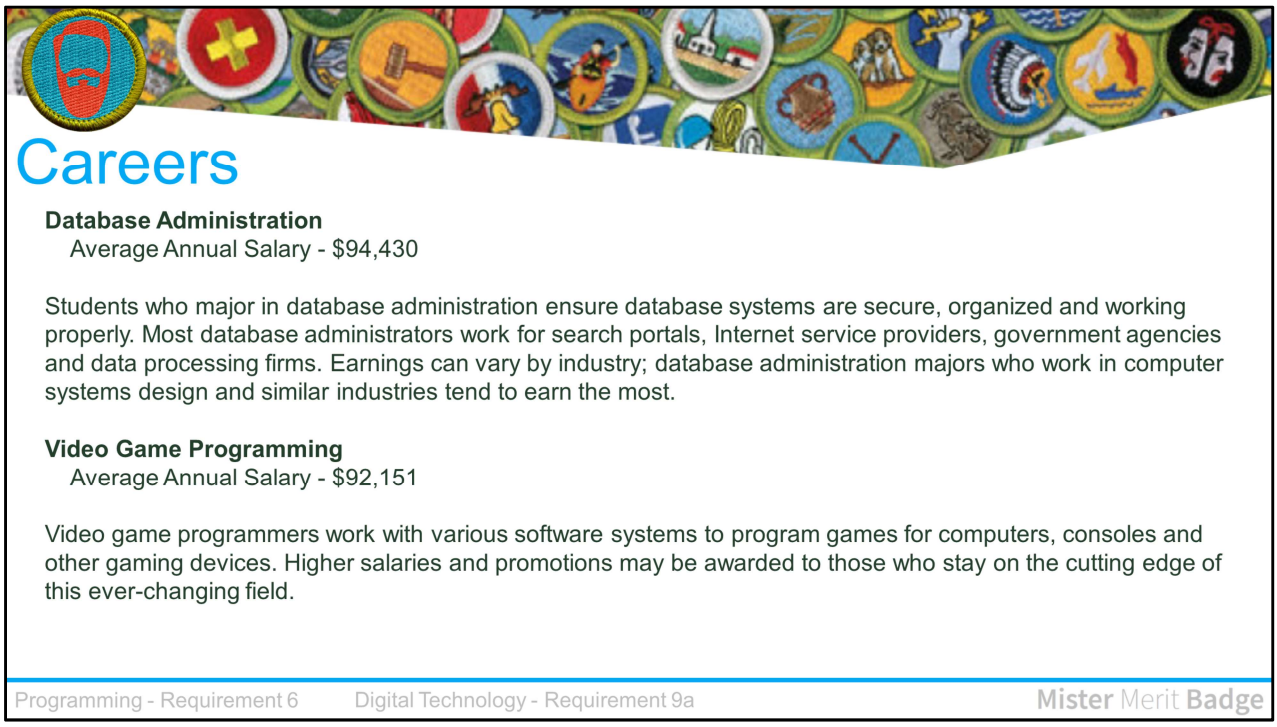

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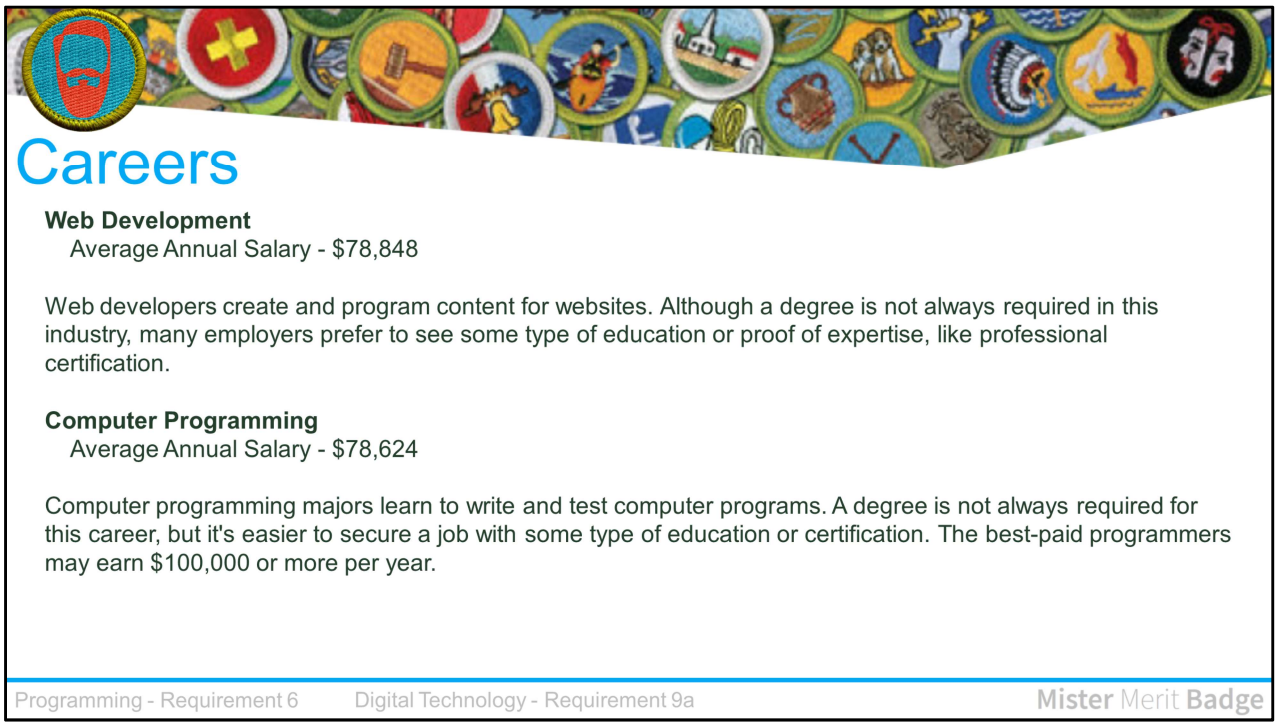

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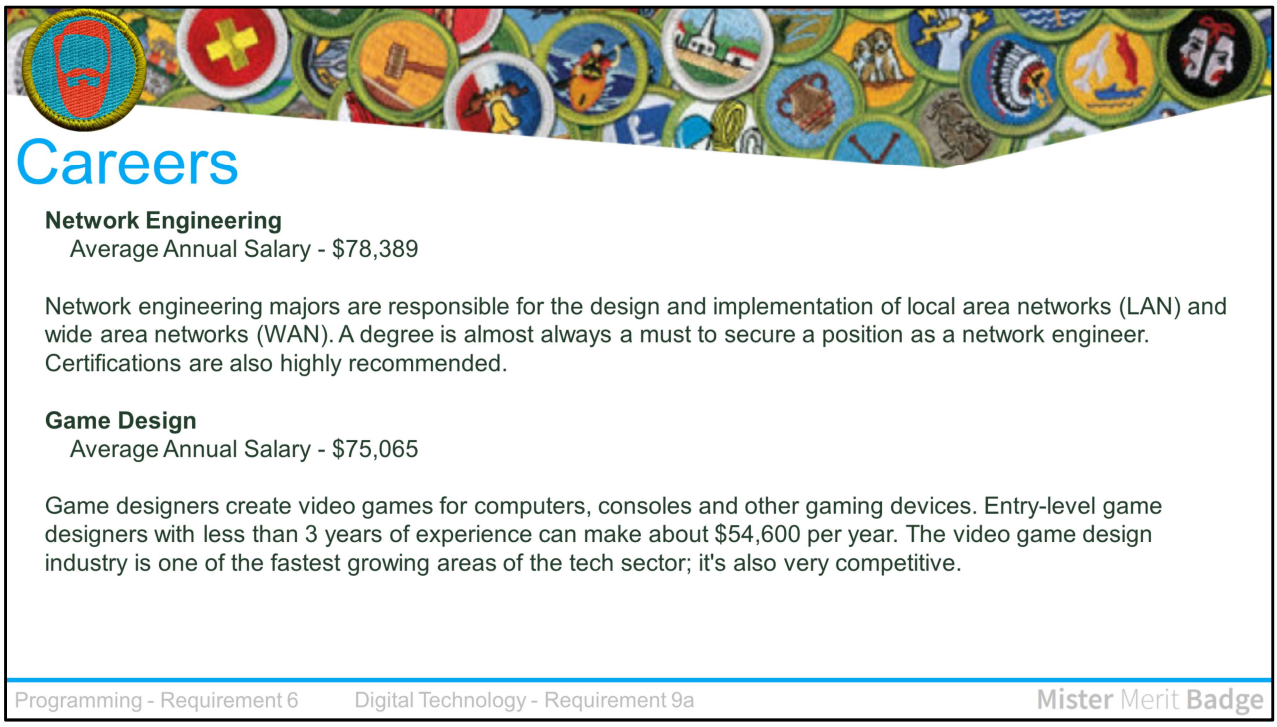

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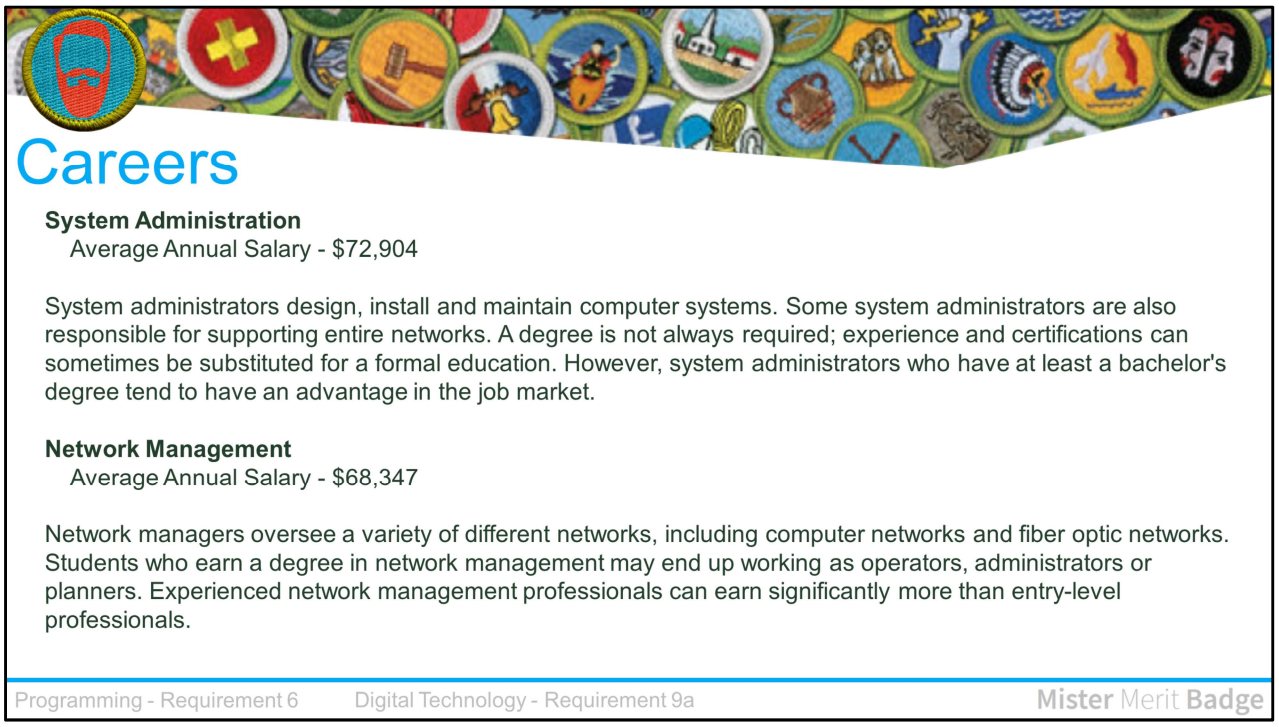


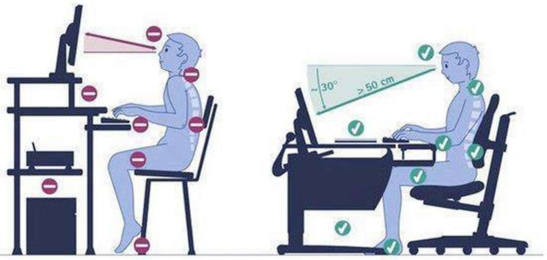
Find out about three career opportunities. Pick one and find out the education, training, and experience required. Discuss this with your counselor and explain why this career might be of interest to you.

#BattleScars

Programming Related Injuries

A Repetitive strain injury (RSI) is any damage to the tendons, nerves, muscles, and other soft tissues of the body caused by specific repeated movements which overstress the tissues.

- What type of injuries can occur during programming activities?
- How can these injuries be prevented and/or treated?



Programming - Requirement 1b

Mister Merit Badge

Example injuries: Posterior cervical dorsal syndrome (“computer back”), “Mouse shoulder”, Carpal tunnel syndrome, Tennis elbow, Lumbar sprains and strains, Disc injuries, eye strain.

Prevention and treatment: Proper posture, ergonomic equipment, desk and chair adjustments, stretching, exercise, taking break.

Compare

PLAYSTATION 4 PRO - SPECIFICATIONS

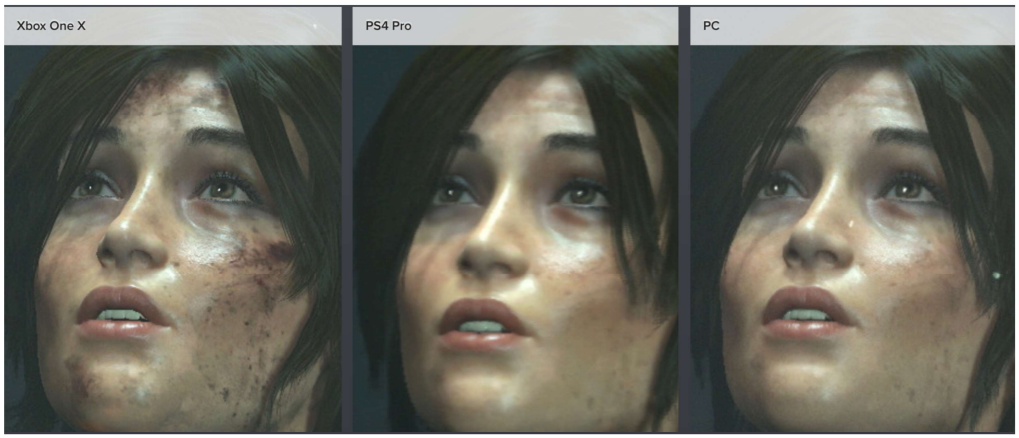
Main processor	Single-chip custom processor CPU: x86-64 AMD "Jaguar", 8 cores @2.1 GHz GPU: AMD RADEON clock speed @ 911MHZ
Memory	GDDR5 8GB
Storage size	1TB
BD/ DVD drive (read only)	BD × 6 CAV DVD × 8 CAV
Input/ Output	Super-Speed USB (USB 3.1 Gen1) × 3 AUX port × 1
Networking	Ethernet (10BASE-T, 100BASE-TX, 1000BASE-T)×1 IEEE 802.11 a/b/g/n/ac Bluetooth® 4.0 (LE)
AV output	HDMI™ out port (supports 4K/HDR) DIGITAL OUT (OPTICAL) port

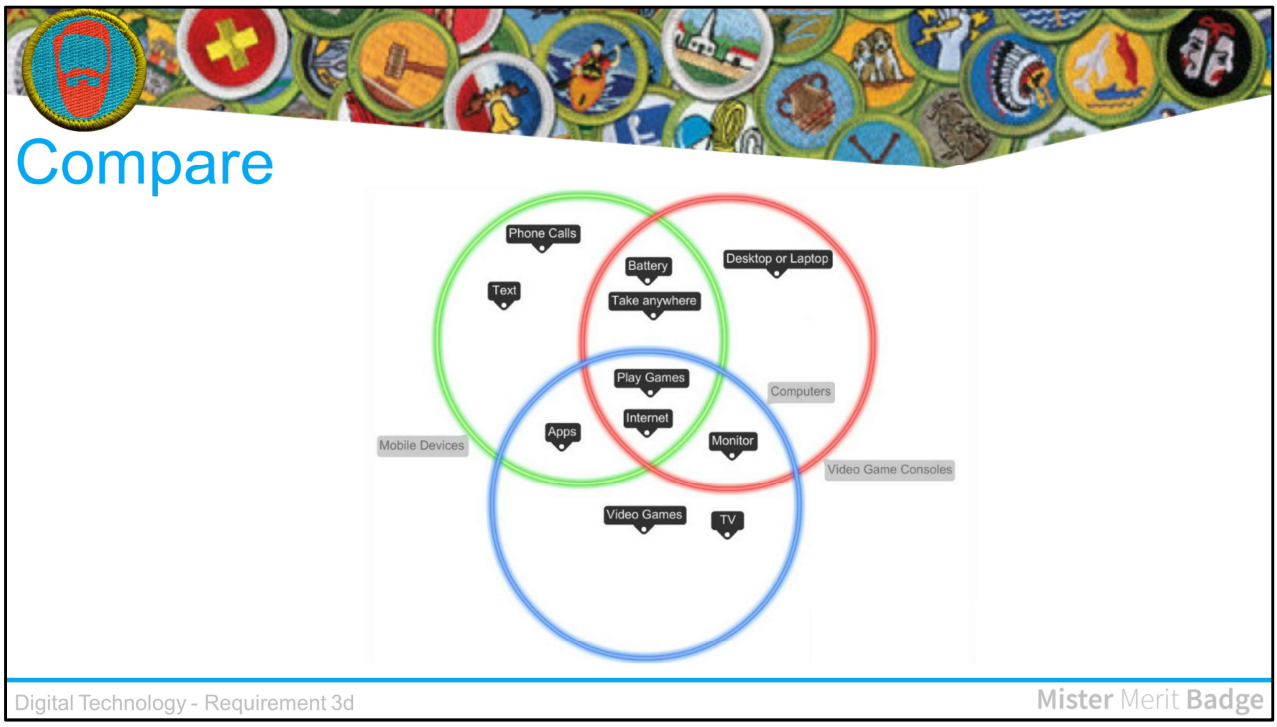
XBOX ONE X - SPECIFICATIONS

Main processor	Single-chip custom processor CPU: x86-64 (Jaguar Evolved) 8 core @ 2.3 GHz GPU: AMD RADEON clock speed @ 1172MHz
Memory	GDDR5 12GB
Storage size	1TB
BD/ DVD drive (read only)	BD × 6 CAV, Ultra HD Blu-ray DVD × 8 CAV
Input/ Output	Super-Speed USB (USB 3.1 Gen1) × 3
Networking	Ethernet (10BASE-T, 100BASE-TX, 1000BASE-T)×1 IEEE 802.11 a/b/g/n/ac Bluetooth® 4.0 (LE)
AV output	HDMI™ out port (supports 4K/HDR) DIGITAL OUT (OPTICAL) port 7.1 Dolby Atmos HDMI™ in port (supports 4K/HDR)

Describe two digital devices and how they are made more useful by their programming.

Compare





Discuss the similarities and differences between computers, mobile devices, and gaming consoles

Networking

A computer network exists where two or more devices are linked together to share data, hardware, software, and/or resources.

- What is the purpose of a computer network?
- How do digital devices connect to the Internet?

HTTP vs HTTPS

Anytime you visit a site using HTTP (HyperText Transfer Protocol), data sent between your computer and the web server is insecure, as opposed to HTTPS (HTTP Secure) which uses SSL certificates to create an encrypted connection between two points. That means sensitive info like login credentials or credit card numbers can be captured by hackers looking to steal your data.

Discussion

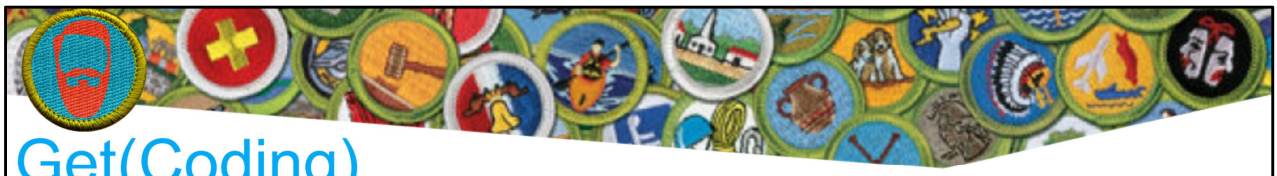
The Environment

Each year 125 million phones thrown away each year, creating 65,000 tons of waste.
Digital technology can have dangerous chemicals that leak into groundwater.

Manufacturers are changing processes minimizing hazardous chemicals by:
Reducing/eliminating lead solder
Mercury-free LCD's & arsenic-free glass
Bromine-free & chlorine-free circuit boards

- Why it is important to properly dispose of digital technology?
- What is required to become a certified recycler of digital technology hardware or devices?

Discussion



Get(Coding)

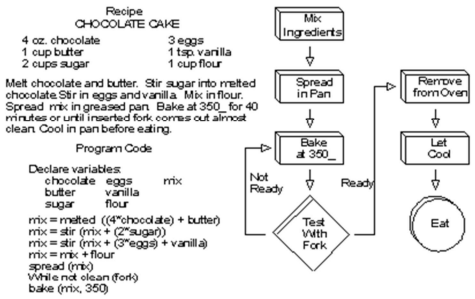
Programming Resources:

- Interactive Python tutorial
  http://www.learnpython.org
- Tutorials for JavaScript, PHP, and other aspects of web development
  http://www.W3schools.com
- Free tutorials and introductions to programming
  http://www.code.org
- Beginner information about programming for Visual Basic and PHP
  http://howtostartprogramming.com
- Free tutorials and other resources on how to program in C++
  http://learncpp.com
- Tutorials for Android app building
  http://developer.android.com/training/index.html

Write, Test and Run You Own Code:

Repl.it is an online compiler that supports multiple languages and can run on almost any device with a web browser.

https://repl.it/languages



A few suggestions to help you with your Programming projects.

Leftovers

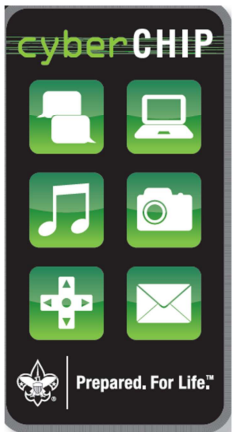
Requirements not covered in class:

Cyber Chip (if not presented today)
- Programming – Requirement 1a
- Digital Technology – Requirement 1

Programming Projects
- Programming – Requirement 5
  - Remember the 3 different programming languages should be pre-approved.
  - If sending SourceCode, the code should be commented and include your name to help the me review it

Internet search and HTTPs websites
- Digital Technology – Requirement 5b-c

Digital Technology Projects
- Digital Technology – Requirement 6
  - Google Docs, Sheets, and Slides are an easy way to create and share some of the projects listed



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