

PROGRAMMING MERIT BADGE 2018

Let's see just how far the rabbit hole
goes!

Instructor Info

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Chris' Career

- Master in Computer Science from WSU
- Started career as Research Scientist @ BBN Technologies
- Became a backend/server developer
 - Worked at TriGeo Network Security for 9 years
 - Solarwinds for 3 years
- Research-QA Engineer at Tenable Network Security
- Software Engineer at Tenable Network Security

Chris' First Computer



Programming Resources

- Boys Life
 - <http://boyslife.org/programming/>
- Our programming resources
- Codecademy
 - <http://www.codecademy.com>
- Invent With Python
 - <http://inventwithpython.com/>
- The Mag Pi Magazine
 - Even if you are not using the Raspberry Pi, the articles are still very relevant.

Embedded Processors and Electronics Resources

- Suppliers
 - Adafruit.com
 - SparkFun.com
 - EvilMadScientist.com
- Learning
 - <http://arduino.cc/en/Tutorial/HomePage>
 - <http://tronixstuff.com/tutorials/>
- Project Ideas
 - <http://www.instructables.com>
 - Arduino and Raspberry Pi channels

What are the parts of a programmable device?

- Central processing unit
- Peripherals
 - Screen
 - Mouse
 - Touch screen
 - Compass
 - Printer
 - Hard Drive

CPU

How does a processor work?

- Numbers, lots and lots of numbers!
 - Binary numbers
 - Two States – a 1 or a 0
 - What is a 1?
 - What is a 0?
 - Whatever we want them to be!
 - TTL logic – 5v or Ground
 - Modem – 1200Hz or 2000Hz
 - RS-485 protocol – which wire has a higher voltage

How does a processor work?

Continued...

- Two types of numbers
 - Instructions
 - Data
- Computer reads in an instruction and does what it is programmed to do when it sees that instruction
 - \$A9 – Load the Accumulator
 - \$80 – Store the Accumulator to memory
- Otherwise it's just a number

In the end

That's just the hardware, if we want it to do something useful we need...

[https://www.ted.com/talks/steven_johnson_how
_play_leads_to_great_inventions](https://www.ted.com/talks/steven_johnson_how_play_leads_to_great_inventions)

What is programming?

- Getting something to do what you want!
 - Animals (including humans)
 - Computers
- Computers
 - The process of developing and implementing various sets of instructions to enable a computer to do a certain task.





[illegible]

History of Programming

- The history of programming is the history of computers

One of the first home computers



Programming in the Dark Ages

- Switches and blinking lights
 - Entered the instructions and data into memory one byte at a time
- Paper tape
- Punch Cards
- Instructions go from the cards into the computers memory
 - Still what happens today, just faster and more convenient

First big Milestone

- Assemblers
 - Allowed programmers to work with a more human readable format
 - Managed memory to some extent
- Linkers
 - Allowed programmers to build reusable bits of code
 - Programmers could share code

Human Readable 2 Binary

```
section .data    ;section declaration
```

```
msg db "Hello, world!",0x00    ;our dear string
len equ $ - msg                ;length of our dear string
```

1111000101010111010101010101010111000011010101010101101010101010101010000000111111010101011110011100010101
011100011010101010101010101011100010101011010101010101011100001101010101010110101010101010101000000011
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Second milestone

Compilers and Interpreters

- Led to the development of languages like C, Fortran and Pascal
- Very human readable
 - `Printf("Hello World!");`
- Allows a more expressive way of working

Object oriented programming

- Paradigm shift
 - Not how to do some thing
 - Describes a machine of parts and how those parts act
 - Each object has responsibilities and behaviors
 - Easier to maintain
 - Easier to modify
- Examples

Software!

And that takes programming!

Programming

- Is the glue that gets everything to work together
- Provides the flexibility to make the device do multiple tasks
 - Smartphones
 - Who makes calls anymore?
 - Hubble Telescope
 - Mars Rover
- “Most good programmers do programming not because they expect to get paid or get adulation by the public, but because it is fun to program.”
 - Linus Torvalds

C

- Compiled language
- Basis for a number of different languages
 - C++
 - C#
 - Java
- Can get as low level as assembly
- Used in embedded programming and systems programming

Javascript

- ❑ Designed to run within a web browser
- ❑ “Loosely typed” language
- ❑ With a number of new libraries, it is a great language for building thin clients within the browser

Python

- ❑ Interpreted Language – no compile step!
- ❑ Batteries Included
 - If you want to do something, there is probably a library to do it
- ❑ Dynamic language
 - Object properties and method can be created at runtime
- ❑ Available on almost any computing platform you can think of

Scratch

- Visual Programming environment
- Developed at MIT to teach programming
- Great for developing games and animations
- Perfect for beginners
- Can interface with electronics through special boards
 - Makey Makey
 - Raspberry Pi
- <http://scratch.mit.edu/>

Alice

- Visual programming language
- Developed at CMU to teach programming
- 3D game creation
- <http://www.alice.org/index.php>

Arduino

- ❑ Microcontroller, not a computer
- ❑ Programmed in C from a computer
- ❑ Designed for interfacing with electronics
- ❑ Comes in lots of different variations
 - Uno
 - Micro
 - Explora
- ❑ Lots of libraries and examples online!
- ❑ Available at Radio Shack

Raspberry Pi

- A full on Linux computer
- Hooks up to a television
- Has some pins for interfacing with electronics
 - Not as many as the Arduino
- Can run any of the programming languages we have discussed

Kano Computer

- Computer kit with a Raspberry Pi center
 - Includes case, keyboard, WiFi dongle, cables, Linux OS on memory card – no monitor.
- All setup to learn Python and Javascript
 - Pong and Minecraft Mods projects
- <http://www.kano.me/>

Questions?

Lets talk about code!

- Data
- Conditions
- Loops
- Code reuse / organization

Steps to writing Application

- Analysis
- Design
- Code
- Test

Where is Software used?

Other Links

- SpoCode
 - <http://www.spocode.org/>
- Startup Weekend Spokane #6
 - <http://www.up.co/communities/usa/spokane/startup-weekend/4440>

Tools of the Trade

- Source version control
 - Software system to manage code base and updates
 - CVS, SVN, Git
 - <https://github.com> / <https://bitbucket.org> / <https://gitlab.com>
- Editor / Integrated Development Environment (IDE)
 - Eclipse for Java, etc., Visual Studio for C/C++/C#/etc.
- Tracking systems
 - Jira, Redmine, Bugzilla,
- Collaboration tools
 - Wikis (MediaWiki, Confluence, Forums, etc.)

- “Always code as if the guy who ends up maintaining your code will be a violent psychopath who knows where you live.”
- – Martin Golding

It takes a Family

- Communication – written and oral
 - Exchanges
- Cooperation
 - Inclusion
- Delegation
- Humility
- Consistency
- Inclusion

Questions?