

Syllabus

2018/2019



Holberton

Table of Contents

1) Why Holberton?

2) Our approach

3) Syllabus

a) Year 1

b) Year 2

WHY HOLBERTON?

**“There's going to be
1.4m Tech Jobs
in the next decade&only
400k trained
people to fill them.”**

Courtesy: The New York Times

Become a Software Engineer in 2 years.
The best want to hire the best.

Holberton

Holberton is not your typical School.

You won't see **any teachers here**, it's true. Here, **we learn best by collaborating**. Here, every student becomes a mentor, because the surest way to cross the finish line is **by supporting one another**.

We encourage our students to always ask why and challenge the standards of the status quo. By challenging ourselves and each other, **we're building a new kind of community**. Because **diversity brings resilience**, we welcome many different points of view. The only thing we won't tolerate here is intolerance.

At Holberton, we aren't just learning how to code. We're learning how to learn, together.

We're going to rewrite the rules, for the better.

What Sets Holberton Students Apart



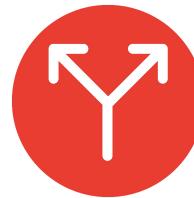
Full Stack Engineers

Our curriculum covers low-level programming , algorithm, high-level programming and system engineering. Our students have solid software engineering foundation - not just knowing one programming language.



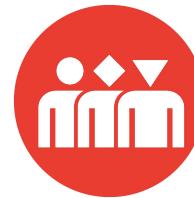
Master of Soft Skills

Students will not only learn technical skills but build up their soft skills through presentations, technical writing, and group projects - making them a valuable asset to any team.



Adaptable

Our students learn how to learn, therefore they are able to pick up new skills and tools very quickly within any type of environment.



Diverse

Our students come from a variety of backgrounds and experiences - bringing a unique perspectives to any work environment.

Companies that hire our students

Our students have landed software engineering jobs and internships across all industries and company sizes.

Here are some of the employers who have hired our students:



change.org

Google

credit karma

Genentech

IBM

CISCO

Our Schools



Admission

*** Our selection process is based only on talent and motivation, and not on the basis of educational degree, or programming experience.**

The selection process is the beginning of the curriculum as you will start learning through it. You do not need to know anything about programming to apply. It consists of four different levels:

LEVEL 00



Fill out a short online form about yourself (about 2 minutes)

LEVEL 01



Small online projects and tests that you can do at your own pace (about 2 hours)

LEVEL 02



A step by step challenge during which you will create your first website (2 weeks)

LEVEL 03



Onsite or Remote interview and tech challenge

WELCOME!

OUR APPROACH

No Pre-course

Holberton does not expect students to come in with previous software engineering experience (although if you do have experience, that's awesome too).

There is **no pre-course work** (that's why you are attending a school after all), but we do recommend that you read through *The C Programming Language* book by Kernighan and Ritchie or *Programming in C* by Stephen Kochan.

The goal of reading through the book is not to deeply understand all the concepts, but just to familiarize yourself with key terminology and content.

Coursework

Expect the first 9 months to be intense and challenging (we are training you to be full-stack software engineers in two years). You will start with low-level programming in C, and work your way through some higher level programming languages - getting some hands on experience with OOP programming and front-end development. You will also work with system administration and DevOps.

There are no formal teachers, or formal lectures. Students are learning by creating and we rely on peer-learning, collaboration and industry-relevant curriculum to guide the way. There is no competition here at Holberton, rather students are helping each other towards their goals. Of course, there is also technical staff available to answer questions and extend support, as well as mentors who share their expertise along the way.

Soft Skills

In today's tech world, it's not enough to be good at technical skills, you need to be a clear communicator as well.

We push our students to work on their public speaking skills, to publish blog posts to online tech communities and publications, and to speak at conferences and meetups.

This not only prepares students to be team players and clear communicators, but creates amazing networking opportunities.



Holberton

Professional Development

We know that the skills to get the job are different from the skills to be good at a job. From week zero, we immerse students in professional growth and development via workshops, projects, meetups, and work simulations.

Whiteboarding, mock interviews, professional networking, and more begin as soon as students start the program so that they're confident and competent when the time comes to prove they're ready for the job.



Holberton

Job Search

Utilizing our networks, and creating networks of your own will provide you with the best opportunities to find a job as a Software Engineer - to know someone on the inside who can get your resume in front of the right people and give you a personal recommendation.

We are not just concerned about you finding your first career in tech, though; we want to equip you with the knowledge and resources to drive your job search so that you are independently successful in the years to come - regardless of how your interests or the industry evolves.

You'll learn how to build your narrative, demonstrate your technical skills, negotiate, and navigate the industry with confidence.



Holberton

Mentors

Our mentors are the backbone of Holberton.

They provide feedback about our curriculum, are resources for our students, and are an endless source of knowledge about the most current technologies and frameworks.

They help keep the school in check to make sure we are delivering the most relevant content to each new cohort of students. They provide mentorship, deliver workshops and collaborate on projects given to students.

This partnership with mentors across all spectrums of the tech industry creates paramount and unprecedented exposure for our students.



Holberton

SYLLABUS

Syllabus: Year 1 & Year 2

Our program walks through the major arms of computer science and software engineering - data structures, algorithms, low-level and high-level programming, Linux and UNIX system programming, web front-end and back-end, databases, security, system administration, and devops. Additionally, you develop professional skills such as public speaking, networking, project management, and effective communication. You will get experience in each of these areas, and have the opportunity to specialize your technical skills and potential through customized Year 2 options.

This syllabus is an overview of the topics, languages, and frameworks you will learn during your 24 months at Holberton. It is not a definitive outline, and is subject to change to fit the needs of the ever changing tech industry.

A project-based school for the next generation of software engineers

Holberton Curriculum Team

How our program works

9 months on site

LOW LEVEL

You will understand how programming languages and Unix system work or "what is going on under the hood".

- C programming language
- Graphic programming
- Unix programming
- Data structure and algorithms
- Reverse engineering and security

+HIGH LEVEL

You will create a complete web service from databases, back-end and an amazing front-end website with the latest technologies.

- Python
- Front-End
- Object-Oriented-Programming
- Databases

+DEVOPS

You will build web infrastructure similar to the ones powering Tech powerhouse like LinkedIn, Facebook and Google.

- Linux / Command Line
- Soft skills
- Infrastructure design & management

6 months

INTERNSHIP

Once you have built up the foundations and fundamentals of software engineering, it's time to put what you have learned into practice.

We give students all the tools and support to go out and find a job as a Software Engineer.

9 months

SPECIALIZATION

It's time to specialize. Study in one of 4 tracks: Linux, Web-stack, VR/AR or independent studies

- C Low level and Algorithms
- Web Stack Development
- AR/VR
- Machine Learning

YEAR 1



Holberton teaches full-stack software engineering with a project based approach, we have a mission to cultivate community and encourage innovation.

LOW LEVEL

You will understand how programming languages and Unix system work AKA “what is going on under the hood”. This will allow you to optimize and debug anything later in your career. You will be working with algorithms and data structures which are essential foundations for any great Software Engineer - the type that the best companies want to hire.

Low Level

C programming language

- Compilation
- Commenting code and following a coding style standard
- Variables, types, operators, expressions Loops, nested loops
- Conditional statements
- Functions
- Pre processor, macros, header files
- Pointers, pointers to pointers, pointers to functions, pointer arithmetic
- Arrays, multidimensional arrays
- Structures
- Static and dynamic libraries
- Program arguments
- Dynamic allocation
- Virtual Memory, Heap and stack
- Binary operations
- Makefiles

Graphic programming

- SDL2
- Isometric projection Raycasting

Unix programming

- Unix / Linux overview
- File I/O, Memory allocation Process creation and termination System calls

Data structure and algorithms

- Time and space complexity
- Arrays, structures
- Linked lists, doubly linked lists, circular linked lists (you are gonna love linked lists)
- Stacks and queues
- Hash tables
- Recursion
- Search & Sorting algorithms
- Binary trees, BST, AVL

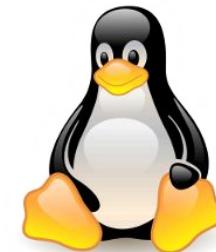
Reverse engineering and security

- Introduction to assembly basics
- Disassembling
- Buffer-overflow
- Executable code injection
- Tools - strings, ltrace, objdump, radare2, radiff2, ldd

Optional

Examples of Low Level Projects

- Create your own printf function
- Code from scratch a mini-shell
- Your own Maze (mini game)



Linux

HIGH LEVEL

You will create a complete web service with databases, back-end and an amazing front-end website with the latest technologies. This project will give you all the skills to work in the best companies in Silicon Valley such as Facebook or Dropbox. You will gain the skills to quickly learn and adapt to new frameworks for building product or to iterate on an existing codebase.

High Level

Python

- Interpretation
- Commenting code
- Following a coding style standard
- Variables, types, operators, expressions Loops, nested loops, iterators
- Conditional statements (if, else, while)
- Functions
- Libraries
- Data structures
- Exception management
- Class, Metaclass, decorator
- Network requests
- Application Programming Interface Scripting

Front-End

- HTML/CSS
- Accessibility
- Javascript
- JQuery

Object-Oriented-Programming

- Object notion - what's an object?
- Public - internal interfaces
- Inheritance
- Data formatting (JSON/XML/...)
- Serialization and deserialization

Databases

- SQL language
- Relational database
- Data definition language
- Data manipulation language
- Data control language
- MySQL - SQLite
- Object-relational mapping

Examples of Projects

- Create your own AirBnB website complete with database, front-end, back-end, console, and testing
- Hack a website security by scripting requests



SYSADMIN / DEVOPS

You will build web infrastructure similar to those powering Tech powerhouses like LinkedIn, Facebook and Google. You will architect scalable, reliable and secure systems using web servers, load balancers, databases, firewalls and more. You will learn to automate your job, so that you can easily manage anything from one server or hundreds of them.

SYSADMIN / DEVOPS

Linux / Command Line

- How the Shell works
- Navigating the file system
- Manipulating files
- I/O redirections, standard input, standard output, pipes, filters
- Permissions
- Job control
- Shell scripts

Soft skills

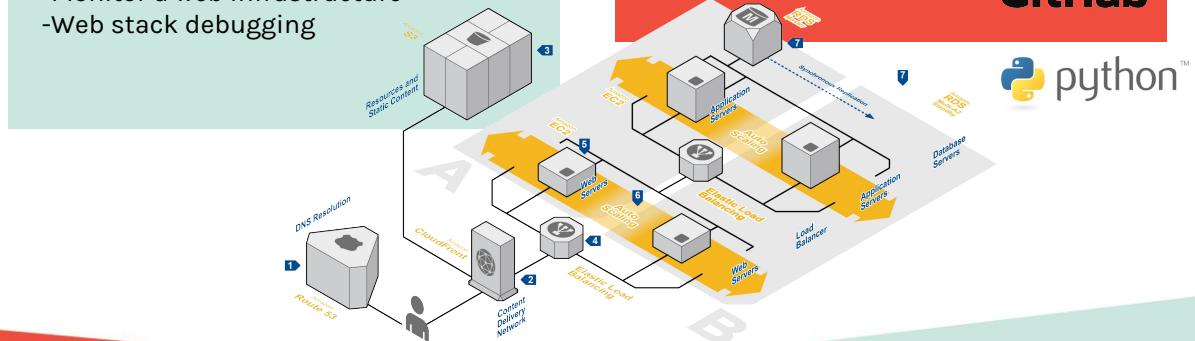
- Organizing meetups
- Fireside chat sessions
- Attend meetups and conferences
- Technical articles
- Public speaking
- Mastering social media
- Networking
- Project management
- Conflict Resolution

Infrastructure design & management

- Parsing
- Advanced Log parsing
- Advanced SSH
- Setup a domain name
- Understanding DNS
- Setup SSL certificate
- Manage Web servers
- Manage Load balancers
- MySQL Primary/Replica setup
- Firewall management
- Web infrastructure design
- Monitor a web infrastructure
- Web stack debugging

Examples of Projects

- Build a web infrastructure like the ones powering Facebook, LinkedIn, Twitter...
- Learn to work at scale
- Develop tools for Cloud environments



YEAR 2



In Year 2, you will be able to choose from 4 specializations.

Specializations for 2019

C Low level and Algorithms

Learning the Linux Kernel capabilities by reproducing C standard library functions and command-line tools.
Fundamentals of network communication, parallel programming, and advanced data structures and algorithms.
Building a simple cryptocurrency in C by building the entire Blockchain logic and using cryptography with OpenSSL as well.

Web Stack Development

Demystifying front-end and back-end development with emphasis on cache, authentication, NoSQL, React, Angular, responsive design, and accessibility.

AR/VR

C#, Unity3D, and concepts like UI design, interaction design, as well as working with 3D assets, animation, and audio to develop interactive mixed reality experiences.

Machine Learning

Fundamentals of neural networks, deep learning, unsupervised learning, and large scale data collection/handling applied to computer vision, natural language processing, and time series analyses using Python3's Numpy, Tensorflow and Keras.

AR/VR

Specialization

AR/VR

Holberton's **Augmented Reality / Virtual Reality (AR/VR)** curriculum teaches the fundamentals of **programming in C#** and developing **interactive mixed reality projects in Unity3D**, the world's leading real-time game engine.

Throughout the nine months here at Holberton, students will learn Unity3D concepts such as **scripting, animation, UI design, creating shaders, game testing**, as well as learning **UX concepts specific to AR and VR**, including **immersive storytelling, spatial audio, and user comfort**.

Mixed reality is a young, evolving industry and becoming involved now, **means shaping and influencing the future of the field**.



The C# section of the AR/VR curriculum covers the fundamentals of programming, data structures, algorithms, and best practices, as well as test-driven development and introductory linear algebra.

C# Curriculum

Some concepts covered include:

- If/else statements, loops, functions
- Data structures
- Exceptions
- Structs, classes, namespaces
- Test-driven development
- Linear algebra
- Interfaces
- Generics
- Delegates, events
- Algorithmic problem solving



The Unity section of the AR/VR curriculum teaches the Unity software, its concepts and workflow, as well as design principles and UI/UX considerations for mixed reality. First, students will focus on developing a complete 3D game, then use their Unity skills to design a variety of experiences for both AR and VR.

Unity Curriculum

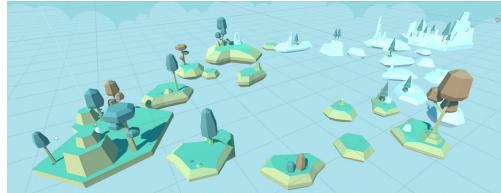
Some concepts covered include:

- Unity workflow and best practices
- Unity scripting
- HUD/UI design
- Animation
- Audio
- Lighting/rendering
- Shader programming
- Game testing
- UX for mixed reality
- Accessibility

Here are some of the projects that students will be working on

VR

- 360 Video
- On-Rails Experience
- Seated/Standing Experience
- Room Scale Experience



AR

- Marker-based Recognition
- Projection-based Application
- Location-based Application
- Face Tracking

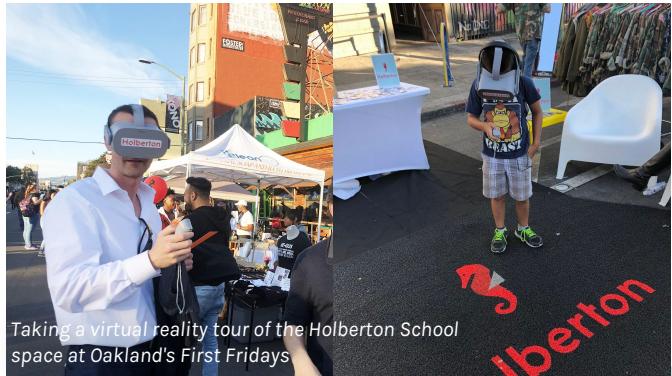


Development of the 3D game project

At the end of the year 2, students will develop an interactive mixed reality project of their choosing that they will pitch, build, and present.

Many tech companies, large and small, are **expanding into the AR and VR space**, including **Amazon, Google, Apple, Facebook, Microsoft, and Sony**. While they are most popularly known for gaming and entertainment, AR and VR have been adopted outside the tech sector as well, including the medical, auto, and construction industries.

Jobs in the AR and VR space include application development, mobile development, product design, interaction design, game development, and more. Entry-level AR and VR positions can start as high as **\$80-90k / year**.



LOW LEVEL

Specialization

Low Level

Holberton's **low-level programming specialization** allows students to **dive into the complexity of the C programming language and the Linux operating system**. Students will also be challenged with advanced data structures and algorithms, and they will uncover all the **mechanisms behind the Blockchain technology** by building their own basic cryptocurrency from scratch, entirely in C.

This **9 month specialization** builds a great foundation if you aim to become a fast-growing Software Engineer as it will **widely develop your understanding of “how things work under the hood”**.

Linux and C programming



Linux

This first part of the low-level curriculum is an extension to Holberton's first year program. Students will extend their knowledge of the C programming language and the Linux system throughout more complex projects.

Those advanced concepts include but are not limited to:

Linux and C programming

- File streams
- The Linux programming interface: system calls
- Memory management
- Process tracing
- IPC:Inter-Process Communication
- The ELF file format
- Assembly with Intel x86
- The Linux filesystem

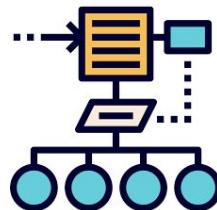
Data Structures and Algorithms

This next part of the low-level curriculum is designed to introduce to students complex, yet widely used data structures and algorithms. Data structures and algorithms are a means of manipulating and transforming data. They help developers solve problems in a reliable and maintainable way.

Those advanced data structures and algorithms include:

Data Structures and Algorithms

- File streams
- The Linux programming
- interface: system calls
- Memory management
- Process tracing
- IPC:Inter-Process Communication
- The ELF file format
- Assembly with Intel x86
- The Linux filesystem



Blockchain

This last part of the low-level specialization teaches students how to build their own Blockchain, and extend it to a basic cryptocurrency. The whole project will be built from scratch and entirely in C.

Blockchain is a very big trend, and it not only applies to the software industry, but to many others, such as banking, health, telecommunication, and more. By the end of this big project, students will have a strong understanding of what makes the Blockchain technologies so reliable and secure.

Here is a non-exhaustive break down of what this project covers:

Blockchain

- Cryptography in the blockchain
- The Blockchain data structures implementations in C
- Block mining
- From Blockchain to cryptocurrency



Going further...

After **9 months of low-level specialization**, students will possess a **very strong and precious knowledge of the C programming language**. The majority of the softwares used in the industry are built on top of the C language, and knowing the root of a technology becomes a really valuable skill when it comes to **troubleshooting issues, or designing projects**. Students will also be able to rely on their **deep understanding of the Linux system and its interface**, giving them the best assets to build reliable applications in the future, and to **stay professionally versatile**.

Possible careers/jobs

- **SRE** → Strong knowledge of the Linux system = perfect for application maintenance and reliability
- **Junior Blockchain engineer** → Strong understanding of the blockchain mechanisms
- **Embedded SWE** → Strong knowledge of C, which is widely used in embedded systems, deep understanding of system architectures
- **IoT Engineer** → Same reasons as Embedded engineer, as lots of IoT devices require embedded technologies
- **Game engine developer** → Game engines are built using low-level technologies such as C/C++ and Assembly, to give developers flexibility, as they need to work closely with the hardware in order to create the most optimized engines.

MACHINE LEARNING

Specialization

Machine Learning

Holberton's **machine learning specialization** teaches the theories behind modern-day breakthroughs in the fields of computer vision, natural language processing, recommender systems, autonomous driving, and more. Students will also learn how to apply these concepts using technologies such as **Pandas**, **Numpy**, **Tensorflow**, and **Keras**. Throughout their **nine months of study**, students will dive deep into **supervised**, **unsupervised** and **reinforcement learning**, as well as the related **mathematical principles**. Recent advances in this field have **sparked a fourth industrial revolution**, accelerating the rate of automation and scientific discoveries. Entering such a field now will inevitably **help shape society's progress for decades to come**.

Mathematics

- Scalars, Vectors, Matrices, and Tensors
- The Dot Product and Matrix Multiplication
- Matrix Identities, Inverses, and Determinants
- Normalization
- Scatter and Contour Plots
- Line and Bar Graphs
- Summation and Product Notation
- Derivatives and Partial Derivatives
- The Chain and Product Rules
- Eigenvalues and Eigenvectors
- Single Value Decomposition
- Marginal and Conditional Probabilities
- Expectation, Standard Deviation, Variance, and Covariance
- Probability Distributions
- Bayesian Probability
- Mixture Models

Supervised Learning

- Multi-Layered Networks
- Forward and Back propagation
- Stochastic Gradient Descent
- Weight and Bias Initialization
- Bias and Variance Tradeoff
- Regularization
- Hyperparameter Optimization
- Convolutional Neural Networks
- ResNets
- Deep Convolutional Architectures
- Recurrent Neural Networks
- Deep Recurrent Architectures

Unsupervised and Reinforcement Learning

- Principal Component Analysis
- Clustering
- Embeddings
- Autoencoders
- Bayesian Optimization
- Viterbi Algorithm
- Hidden Markov Models
- Monte Carlo Method
- Environment, States, Agents, and Actions
- Value and Policy Functions

Data Management

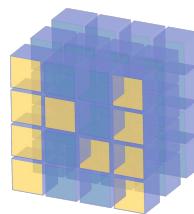
- Web Scraping
- Data Labeling
- Avoiding Human Bias
- SQL Databases
- Query Optimization
- Map Reduce



Project Examples

- Object Detection ('What is in this photo?')
- Facial Verification
- Voice Recognition ('Alexa', 'Hey - Siri', 'Cortana', 'Hey Google')
- Sentiment Analysis ('What does this person want?', 'What is happening in this photo?')
- Speech to Text
- Stock Predictions
- Recommender Systems (Netflix 'Recommended for you')
- Game Agents (AlphaGo)

At the end of the year, students will develop a machine learning project of their choosing that they will pitch, build, and present.



NumPy



TensorFlow



Pandas

matplotlib

K Keras

WEB STACK



Specialization

Web Stack

Holberton's **web stack** specialization advances the **web development principles and skill** introduced in Year 1. Students will learn advanced skills in **front-end and back-end development** - mastering **frameworks** that are in high demand throughout the industry. Whether you want to do front-end, back-end, or full stack engineering, this curriculum will prepare you to **create, maintain, and improve web applications** and websites - some of which you use every single day. By following this specialization, you will be well-versed in **React JS, responsive design, NoSQL, MySQL, Redis, Elasticsearch, RESTful APIs, authentication, and much more.**

Webstack fundamentals

- HTML/CSS
- Python
- Javascript
- Web JQuery
- MySQL

Front-end advanced

- Sass & Scss sprite
- Accessibility
- Responsive design
- CSS sprite
- React JS (State, Redux, Router, Request)

Back-end advanced

- Caching
- No-SQL databases
- MySQL advanced
- Redis
- Elasticsearch
- RESTful API
- authentication: Basic, Session and OAuth

Frameworks discovery

- Node JS: build a file uploader
- Vue JS: build a CSS Sprite generator
- Ruby On Rails: build a books store
- Angular JS: build a Github stats
- Go: build a files distribution system



Join us!
Start your application now
by following the links below:

USA
COLOMBIA