CodeHS

AP Computer Science A Course Syllabus (Mocha)

Introduction

AP Computer Science A introduces students to computer science through programming. Fundamental topics in this course include the design of solutions to problems, the use of data structures to organize large sets of data, the development and implementation of algorithms to process data and discover new information, the analysis of potential solutions, and the ethical and social implications of computing systems. The course emphasizes object-oriented programming and design using the Java programming language.

The CodeHS AP Computer Science A course is a year-long course designed to help students master the basics of Java and equip them to successfully pass the College Board AP Computer Science A Exam at the end of the school year. All learning materials and resources teachers and students need for a successful year-long AP Computer Science A course can be found on the CodeHS website.

Course Overview and Goals

Prerequisites

It is recommended that a student in the AP Computer Science A course has successfully completed a first-year high school algebra course with a strong foundation of basic linear functions, composition of functions, and problem-solving strategies that require multiple approaches and collaborative efforts. In addition, students should be able to use a Cartesian (x, y) coordinate system to represent points on a plane. It is important that students and their advisers understand that any significant computer science course builds upon a foundation of mathematical reasoning that should be acquired before attempting such a course.

This course is meant to be a first time introduction to computer science, and does not require students to come in with any computer programming experience. However, we recommend that students take our Introduction to Computer Science prior to our AP courses (more info at codehs.com/library). Students who have completed our Intro to CS course will be able to apply knowledge of concepts covered in the Intro course to the more advanced setting of the AP courses.

Learning Environment
The course utilizes a blended classroom approach. The content is fully web-based, with students writing and running code in the browser. Teachers utilize tools and resources provided by CodeHS to leverage time in the classroom and give focused 1-on-1 attention to students. Each unit of the course is broken down into lessons. Lessons consist of video tutorials, short quizzes, example programs to explore, and written programming exercises, adding up to over 100 hours of hands-on programming practice in total. Several units have free response questions that have students consider the applications of programming and incorporate examples from their own lives.

Programming Environment
Students write and run Java programs in the browser using the CodeHS editor.

College Board Personal Progress Checks
College Board has launched the [AP Classroom](#), a new resource for teachers with summative and formative assessments. At the end of each unit, we recommend that teachers give students the corresponding Personal Progress Check to understand student strengths and weaknesses.

More information: Browse the content of this course at https://codehs.com/course/53

Course Breakdown

Unit 1: Introduction to Programming in Java with Karel the Dog (3 weeks: 12-15 hours)
In this module, students learn the basics of java commands, control structures, and problem-solving by solving puzzles with Karel. Students will get a high-level introduction to many of the major computer science concepts but will revisit these with more detail later on in the course. Browse the full content of this unit at https://codehs.com/library/course/53/module/126

Topics Covered	- Karel Commands - Defining vs. Calling Methods - Designing methods - Program entry points - Control flow - Looping - Conditionals - Classes - Commenting code - Preconditions and Postconditions - Top Down Design

Unit 2: Basic Java (9 weeks: 40-25 hours)
In this module, students learn the basics of the Java programming language. This module covers printing, variables, types, as well as how to use the basic control structures in the Java language. The module concludes with a few more advanced concepts such as De Morgan's law and Short Circuit conditionals. Browse the full content of this unit at
https://codehs.com/library/course/53/module/127

Topics Covered	- Printing - Variables - Types - Arithmetic Expressions - Casting `ints` and `doubles` - Input/Output - Errors - Loops - Conditionals - De Morgan's Laws - Short Circuit Evaluation - Debugging - Nested Control Structures - Working with the Java `String` class - Understand computer ethics such as acceptable use policies, copyright, intellectual property, and privacy

Unit 3: Methods (3 weeks: 12-15 hours)
In this module, students are introduced to methods. They will learn how to define methods in their programs using parameters and return statements, as well as correctly commenting programs with methods. Students will also use autograders to test if their methods are working correctly. Browse the full content of this unit at https://codehs.com/library/course/53/module/128

Topics Covered	- Methods - Parameters - Return values - Javadocs - Understand how to iterate over a String and process each character - Java Exceptions - Compile-Time vs Run-Time Exceptions - Java `String` class and methods - Java `Character` class and methods - Quick overview of static methods, more detail in next Unit
Associated Lab: - Magpie - Consumer Review Lab	

Unit 4: Classes and Object Oriented Programming (6 weeks: 25-30 hours)

In this module, students learn the basics of Object Oriented Programming in Java, which is a powerful programming paradigm. Students learn how objects store data and interact with each other in Java programs. Students design and implement classes and extend classes using inheritance. Browse the full content of this unit at
https://codehs.com/library/course/53/module/277

Topics Covered	
	● Using classes as a client
	● Classes vs Objects
	● Class methods
	● Instance variables
	● Constructors
	● Visibility
	● Information hiding
	● `this`
	● `static`
	● `super`
	● The Java `Math` class and methods (`abs, pow, sqrt, sin, cos`)
	● Creating random values with the CodeHS `Randomizer` class
	● Designing classes
	● Creating classes
	● Getter and setter methods
	● Inheritance
	● Method overloading
	● Local variables and scope
	● Comparing objects vs primitive types
	● Abstract classes
	● packages
	● Polymorphism
	● Interfaces
	● Modifying classes to implement interfaces
	● `Object` is the superclass of all classes

Unit 5: Data Structures (6 weeks: 25-30 hours)

In this module, students learn basic data structures in Java including arrays, ArrayLists, 2-dimensional arrays, and HashMaps. They also explore the concepts of using interfaces. Data structures will be used to design larger applications. Browse the full content of this unit at
https://codehs.com/library/course/53/module/278

Topics Covered	
	● Declaring and initializing arrays
	● Constructing `ArrayLists`
	● Indexing into arrays/`ArrayLists`
	● Iterating over arrays/`ArrayLists`
	● Getting the length of an array/`ArrayLists`
	● `ArrayIndexOutOfBoundsException`
	● `IndexOutOfBoundsException`
	● Understand array variables are references to objects

	● Arrays/`ArrayLists` as parameters and return values
	● Inserting and deleting array/`ArrayList` elements
	● Wrapper classes - `Double`, `Integer`
	● Storing objects/primitives in arrays vs. `ArrayLists`
	● Numerical representations of integers
	    ○ Representations of non-negative integers in different bases
	    ○ Implications of finite integer bounds
	● The `List` interface
	● Declaring and initializing 2-D rectangular arrays
	● Using nested loops to iterate through 2-D arrays
	● row-major order
	● Students reminded about indices starting at 0
	● Constructing, adding to, and iterating through `HashMaps`
	● Deciding which data structures to use when designing a class

Associated Lab: ● Pokemon Simulator ● Mad Libs ● Quiz Creation ● Elevens ● Picture Lab ● Consumer Review Lab ● Celebrity Lab	

Unit 6: Algorithms and Recursion (3 weeks: 12-15 hours)

In this module, students are introduced to fundamental searching and sorting algorithms including sequential search, binary search, insertion sort, selection sort, and mergesort. They will also be introduced to the important concept of recursion where they will analyze existing recursive functions as well as write their own.. Browse the full content of this unit at https://codehs.com/library/course/53/module/279

Topics Covered	● What is an algorithm? ● Algorithms in real life ● Implementing and using Sequential Search ● Implementing and using Binary Search ● Comparing relative run times of Sequential and Binary Search ● Brief introduction to Big-Oh ● Counting comparisons in searches and sorts ● Insertion Sort ● Selection Sort ● Merge Sort ● Pros and cons of each sorting algorithm ● Divide and Conquer ● Recursion ● `java.util.Arrays` ● Sorting and searching with both arrays and `ArrayLists`

Unit 7: AP Test Practice (3 weeks: 12-15 hours)

In this module, students get a practice exam in the same format as the AP Computer Science in Java test. Browse the full content of this unit at https://codehs.com/library/course/53/module/280

Topics Covered	- Students know what to expect on the AP Exam - Practice solving AP Exam type multiple choice questions - Practice solving AP Exam type free response questions

Unit 8: Final Project (3 weeks)

In this module, students take the skills they've learned throughout the course to create a final project. Browse the full content of this unit at https://codehs.com/library/course/53/module/639

Topics Covered	- Allow students to think creatively about the applications of the concepts covered in the course - Scoping a project - Designing an application from scratch - Incremental development - Testing - Debugging

Optional Supplemental Materials

These supplemental materials should be used following the Prerequisite Units mentioned:

Supplementary Units	Prerequisite/Recommended Unit(s)	# of activities
Java Outside of CodeHS	AP Review / After Unit 9. This material is not on the AP test and can offer a good extension after the test.	11
Computer Ethics	No Prerequisite / After Unit 1	3