

## Course Syllabus: Advanced Placement Computer Science A

This course is designed for students who are serious about programming. JAVA requires a good mathematical background and strong problem solving skills. The course is designed to prepare a student for the Advanced Placement® Computer Science exam, level A. Topics include: simple, user defined and structured data types, algorithm development, decisions and loops, arrays, recursion, searches and sorts, data abstraction, and classes.

Edhesive's AP CS is approved by the College Board as an authorized AP Computer Science course.

### Prerequisites

Learning Java requires a good mathematical background and good problem solving skills. Students should have a strong foundation in mathematics (at least Algebra I) and be comfortable with functions and the concepts found in the uses of functional notation. Previous computer programming experience is not required.

### Teaching Strategies

This course focuses on the details of writing computer software using the Java programming language. Our goal is to stress an object-oriented perspective throughout the material. The course emphasizes basic ideas of software engineering and our goal of developing high-quality software. We will also look at and discuss social and ethical issues around computing in class discussion boards throughout the year.

The course will be taught in the format of a massive open online course (MOOC). The course will consist of video lectures, daily programming exercises, longer coding assignments, regular quizzes and exams. Students will also participate in online discussion forums. By the end of the course, students will be well prepared to take the AP® Computer Science exam.

Each lesson listed below includes practice exercises including shorter coding problems. Well over 20 hours of instructional time is spent in hands on coding. Students participate regularly in a moderated discussion forum that provides support for lesson material and also introduces discussions of the ethical implications of programming including copyright law, software piracy, intellectual property, privacy, and network reliability.

### Textbook

This course will reference a free, online textbook.

Eck, David J. "Introduction to Programming Using Java." Hobart and Williams Smith Colleges, 17 May 2013. Web. 09 July 2013.

## Curricular Requirements

Curricular Requirements		Page(s)
CR1	The course teaches students to design and implement computer-based solutions to problems.	3 - 11
CR2a	The course teaches students to use and implement commonly used algorithms.	5, 6, 9, 10
CR2b	The course teaches students to use commonly used data structures.	5 - 10
CR3	The course teaches students to select appropriate algorithms and data structures to solve problems.	5, 6, 9, 10
CR4	The course teaches students to code fluently in an object-oriented paradigm using the programming language Java.	3 – 11
CR5	The course teaches students to use elements of the standard Java library from the AP Java subset in Appendix A of the AP Computer Science A Course Description.	3 – 11
CR6	The course includes a structured lab component comprised of a minimum of 20 hours of hands-on lab experiences.	3 - 11
CR7	The course teaches students to recognize the ethical and social implications of computer use.	1

## Course Outline

### Unit 1: Introduction to Java

This unit introduces students to the basics of programming in Java. Emphasis is on correct programming style and formatting.

#### Duration:

- 4 Weeks

#### Objectives and Topics:

- Basic Input and Output
- Variables
- Number Operations including +, -, \*, /, % and the AMth.java functions: static int abs(int x), static double abs(double x), static double pow(double base, double exponent), static double sqrt(double x), static double random() // returns a double in the range [0.0, 1.0)
- Data Types
- Comments and Program Design
- Error Correction

#### Lessons

- Lesson 1: Output in Java
- Lesson 2: Escape Characters
- Lesson 3: User Input and Variables
- Lesson 4: Data Types
- Lesson 5: Number Calculations
- Lesson 6: Numeric Casts
- Lesson 7: Modular Division
- Lesson 8: String and Number Output
- Lesson 9: Math Functions
- Lesson 10: Round-off Error

#### Assessments and Programming Labs:

- Assignment 1 - Weighted Average
- Assignment 2 - Change Machine
- Quiz 1 and Exam 1

## Unit 2 Conditionals and Loops

This unit introduces some of the basic constructs of programming including conditionals and loops. In addition, students are introduced to debugging techniques and tracing code.

### Duration:

- 3 Weeks

### Objectives and Topics:

- If Statements
- Boolean Operations
- DeMorgan's Law
- Short Circuit Evaluation
- While Loops
- Java constants Integer.MIN\_VALUE and Integer.MAX\_VALUE

### Lessons

- Lesson 11: Simple if's
- Lesson 12: If's - Making Decisions
- Lesson 13: Else
- Lesson 14: Booleans and Truth Tables
- Lesson 15: Short Circuit Evaluation
- Lesson 16: DeMorgan's Law
- Lesson 17: While Loops
- Lesson 18: Tracing Code and Counting Iterations
- Lesson 19: More Loops
- Lesson 20: Flag Variables

### Assessments and Programming Labs:

- Assignment 3 – Horoscope
- Quiz 2 and Exam 2

## Unit 3: Strings and One Dimensional Arrays

In this unit students shift from acquiring programming techniques to working with classes and algorithms. String and arrays are used as examples of object data types. Some of the standard algorithms on data structures are introduced, such as finding a max and min, and transversals, insertion and deletion with arrays.

### Duration:

- 5 Weeks

### Objectives and Topics:

- Constructors
- Concatenation
- For Loops
- String methods: equals (), charAt ( ), toUpperCase(), substring ( )
- One Dimensional Arrays
- Transversals, Insertion and Deletion with Arrays
- Arrays of Objects

### Lessons:

- Lesson 21: Strings as Class Types
- Lesson 22: String functions
- Lesson 23: 1-D Arrays
- Lesson 24: The for loop
- Lesson 25: Algorithms
- Lesson 26: Algorithms on Arrays
- Lesson 27: Algorithms - Searching
- Lesson 28: Arrays of Strings
- Lesson 29: Arrays of Strings accessing Methods
- Lesson 30: Process Array of Strings
- Lesson 1011: Binary

### Assessments and Programming Labs:

- Assignment 4 - Tweet Tester
- Assignment 5 - Wild Card
- Assignment 6: Merge Arrays
- Quiz 3 and Exam 3

## Unit 4: Methods

In this unit students begin to write their own methods. An emphasis is placed on testing and program design. Recursion is introduced and direct comparisons between iteration and recursion are made.

### Duration:

- 4 Weeks

### Objectives and Topics:

- Void Methods
- Methods that Return a Single Value
- Overloading Methods
- Parameter Passing
- Primitive vs. Object Parameters
- Recursion

### Lessons:

- Lesson 31: Void Methods
- Lesson 32: Parameters
- Lesson 33: Parameters - Primitive vs Class
- Lesson 34: Return Methods
- Lesson 35: Overloaded Methods
- Lesson 36: Recursion - Part 1
- Lesson 37: Recursion - Part 2

### Assessments and Programming Labs:

- Assignment 7 - Binary Calculator
- Quiz 4 and Exam 4

## Unit 5: User-defined Classes

This unit begins the second term. Students transition from using classes and objects to designing and coding their own classes. This unit is also structured to serve as a review of the topics from Unit 1 as all of the programming techniques used in Term 1. In particular, basic arrays and ArrayLists are compared and contrasted. This unit also introduces the first of the AP Labs: Magpie.

For the coding exercises students transition to creating classes and data structures from scratch, a skill that is assessed in the lab assignments.

### Duration:

- 4 Weeks

### Objectives and Topics:

- ArrayList Class
- java.util.List interface
- Constructors
- Encapsulation via private variables and accessor and mutator methods
- Private/Public
- Writing equals() toString() methods
- Static Variables and Methods
- Wrapper Classes

### Lessons:

- Lesson 1: ArrayList
- Lesson 2: The for each Loop
- Lesson 3: Classes - The Basics and Encapsulation
- Lesson 4: Constructors
- Lesson 5: Static vs. Instance
- Lesson 7: Inheritance
- Lesson 6: AP Exam Review

### Assessments and Programming Labs:

- Assignment 1: Time
- Assignment 2: Light & Strand
- AP Lab Magpie
- Quiz 1 and Exam 1

## Unit 6: Advanced Classes

In this unit students continue to work with class design by covering the more advanced topics including polymorphism, inheritance, abstraction and interfaces. Students also continue working with the AP Labs by working through the Elevens student guide.

### Duration:

- 5 Weeks

### Objectives and Topics:

- Inheritance
- This vs. Super
- Abstract Classes
- Interfaces including the List and Comparable Interface

### Lessons:

- Lesson 7: Inheritance
- Lesson 8: Inheritance Overriding Methods
- Lesson 9: Abstract Classes
- Lesson 10: Is-A and Has-A Relationships
- Lesson 11: Interfaces
- Lesson 12: Wrapper Classes

### Assessments and Programming Labs:

- Assignment 3: School Classes
- Assignment 4: Time Comparable
- AP Lab: Elevens
- Quiz 2 and Exam 2



## Unit 7: Algorithms - Searching and Sorting

This unit is designed to thoroughly cover the standard algorithms required on the AP Exam along with reviewing some of the topics from Term 1 related to arrays. Searching algorithms are performed on both ordered and unordered lists.

### Duration:

- 3 Weeks

### Objectives and Topics:

- Sequential and Binary Searches
- Selection, Insertion and Merge sort

### Lessons:

- Lesson 13: Algorithms
- Lesson 14: Linear Search
- Lesson 15: Selection Sort
- Lesson 16: Insertion Sort
- Lesson 17: Binary Search
- Lesson 18: Merge Sort

### Assessments and Programming Labs:

- Assignment 5 - Shuffle
- Assignment 6 - Insert Names
- Quiz 3 and Exam 3

## Unit 8: Two Dimensional Arrays

This unit covers two dimensional arrays and covers the AP Lab Pictures.

### Duration:

- 2 Weeks

### Objectives and Topics:

- Two Dimensional Arrays
- Algorithms on Two Dimensional Arrays

### Lessons:

- Lesson 19: 2-D Arrays
- Lesson 20: 2-D Array Algorithms
- Lesson 21: Tracing Code

### Assessments and Programming Labs:

- Assignment 7: 2D Bitmap
- AP Lab: Picture
- Quiz 4 and Exam 4

## Unit 9: AP Exam Review

Students will be given a diagnostic exam and practice AP problems to prepare them to take the AP Computer Science exam. A series of review videos are provided covering the major topics on the AP Exam. The goal of the unit is to allow students to synthesize the material covered throughout the year and review any areas that could use strengthening.

### Duration:

- 3 Weeks

### Objectives and Topics:

- AP Exam Review

### Review Lessons:

- Programming Fundamentals
- Data Structures
- Logic
- Algorithms
- Object-Oriented Programming
- Recursion
- Software Engineering

### Assessments and Programming Labs:

- Diagnostic Exam
- Released AP Exam Free Response problems