

# AP<sup>®</sup> Computer Science A

## Course Overview

The AP<sup>®</sup> Computer Science Curriculum includes an eighteen week class covering the topics in units 1 through 10. Students wishing to continue with the AP<sup>®</sup> curriculum take a thirty-six week class that includes all topics from the AP Computer Science A Curriculum and the majority of the topics from the AP Computer Science B Curriculum. These topics are covered in units 11 through 21.

The purpose of this course is to introduce the students to the object-oriented paradigm using the java programming language. This course teaches students to use the standard Java Library classes from the AP Java subset listed in Appendices A and B of the AP Computer Science Course Description.

The students will demonstrate their understanding of the material by completing programming assignments in the lab as well as answering written questions. Students are expected to participate in daily classroom discussions which include the social and ethical responsibilities of computer users.

### **Texts**

Lambert, Ken, and Martin Osborne. *Fundamentals of Java, Comprehensive Course*. 2<sup>nd</sup> ed. Boston: Course Technology, 2002.

College Board. *AP GridWorld Case Study*.

## Units of Study

Unit 1: Background Information	Unit Goal: The students will be able to describe the evolution of computer languages, computer architecture, the software development cycle, and the fundamental concepts of object-oriented programming	[c2] [c8] [c9]	C2 -The course includes all of the topics listed in the “Computer Science A” column of the Topic Outline in the <i>AP Computer Science Course Description</i> .
	1. Computer Architecture a. Hardware b. Software c. Binary data representation		C3 - The course teaches students to design and implement computer-based solutions to problems in a variety of application areas.
	2. Programming Languages and Software a. The evolution of programming languages b. The software development cycle c. The social and ethical use of computers		C4 -The course teaches students to use and implement commonly used algorithms and data structures.
	3. Fundamental Concepts of Object-Oriented Programming a. Classes b. Methods c. Encapsulation d. Information hiding		C5 -The course teaches students to develop and select appropriate algorithms and data structures to solve problems.
Unit 2: Simple Java Programs	Unit Goal: The students will be able to write, edit, compile, and run a simple Java program.	[c3] [c4] [c5] [c6]	C6 - The course teaches students to code fluently in an object-oriented paradigm using the programming language Java. The course teaches students to use standard Java library classes from the AP Java subset delineated in Appendices A and B of the <i>AP Computer Science Course Description</i> . (Note: Students who study a language other than Java in AP Computer Science must also be taught to use Java, as specified in the AP Java subset.)
	1. Writing a Program in Java a. Creating a project b. Writing code c. Compiling a program d. Running a program		
	2. Understanding Errors a. Syntax errors b. Compile-time errors		
	3. Turtle Graphics a. Importing packages b. Writing a simple Turtle Graphics program		

C9 - The course teaches students to recognize the ethical and social implications of computer use.

C8 - The course teaches students to identify the major hardware and software components of a computer system, their relationship to one another, and the roles of these components within the system.

<b>Unit 3: Data Types and Mathematical Expressions</b>	Unit Goal: The students will be able to name and use variables and constants.	[c3] [c4] [c5]	C3 - The course teaches students to design and implement computer-based solutions to problems in a variety of application areas.
	1. Data Types <ul style="list-style-type: none"> <li>a. Numeric</li> <li>b. String</li> </ul>		
	2. Expressions <ul style="list-style-type: none"> <li>a. String literals</li> <li>b. Variables</li> <li>c. Constants</li> </ul>		
	3. Math Operators		
	4. Input and Output		
	5. More Errors <ul style="list-style-type: none"> <li>a. Syntax</li> <li>b. Run-time</li> <li>c. Logic</li> </ul>		C4 -The course teaches students to use and implement commonly used algorithms and data structures.
<b>Unit 4: Math Methods and Control Statements</b>	Unit Goal: The students will be able to use the standard math methods and control statements in writing classes and Java programs.	[c3] [c4] [c5]	C5 -The course teaches students to develop and select appropriate algorithms and data structures to solve problems.
	1. Math Methods <ul style="list-style-type: none"> <li>a. sqrt</li> <li>b. round</li> <li>c. pow</li> <li>d. abs</li> <li>e. Math.PI constant</li> <li>f. Random numbers</li> </ul>		
	2. Control Statements <ul style="list-style-type: none"> <li>a. If and If-else</li> <li>b. while-loop statements</li> <li>c. for loop statements</li> <li>d. break statement</li> </ul>		

<b>Unit 5: Classes</b>	Unit Goal: The students will be able to design and implement a simple class and define objects.	[c3] [c4] [c5] [c6]	<p><b>C3</b> - The course teaches students to design and implement computer-based solutions to problems in a variety of application areas.</p> <p><b>C4</b> -The course teaches students to use and implement commonly used algorithms and data structures.</p> <p><b>C5</b> -The course teaches students to develop and select appropriate algorithms and data structures to solve problems.</p>
	1. Class Structure <ul style="list-style-type: none"> <li>a. Super and sub classes</li> <li>b. Constructors</li> <li>c. Private instance variables</li> <li>d. Private and public methods</li> <li>e. Parameters</li> </ul>		
	2. Modifying Code of a Pre-written Class <ul style="list-style-type: none"> <li>a. Scope of variables</li> <li>b. Lifetime of variables</li> </ul>		
	3. Creating a Class <ul style="list-style-type: none"> <li>a. Private information</li> <li>b. Public methods</li> </ul>		
<b>Unit 6: Complex Conditional Statements and More Complex Classes</b>	Unit Goal: The students will be able to construct complex Boolean expressions and nested if statements and write more complex classes.	[c3] [c4] [c5]	<p><b>C6</b> - The course teaches students to code fluently in an object-oriented paradigm using the programming language Java. The course teaches students to use standard Java library classes from the AP Java subset delineated in Appendices A and B of the <i>AP Computer Science Course Description</i>. (Note: Students who study a language other than Java in AP Computer Science must also be taught to use Java, as specified in the AP Java subset.)</p>
	1. Logical Operators <ul style="list-style-type: none"> <li>a. &amp;&amp;</li> <li>b.   </li> <li>c. !</li> </ul>		
	2. Nested if Statements		
	3. Nested Loops		
	4. More Complex Classes <ul style="list-style-type: none"> <li>a. The fraction class with all its methods</li> <li>b. Error Trapping</li> </ul>		

<b>Unit 7: Arrays</b>	Unit Goal: The students will be able to declare, instantiate, and manipulate arrays.	[c3] [c4] [c5] [c6]	<b>C3</b> - The course teaches students to design and implement computer-based solutions to problems in a variety of application areas.  <b>C4</b> -The course teaches students to use and implement commonly used algorithms and data structures.  <b>C5</b> -The course teaches students to develop and select appropriate algorithms and data structures to solve problems.
	1. One Dimensional Arrays <ul style="list-style-type: none"> <li>a. Declaring</li> <li>b. Instantiating</li> <li>c. Manipulating</li> </ul>		
	2. Two Dimensional Arrays <ul style="list-style-type: none"> <li>a. Declaring</li> <li>b. Instantiating</li> <li>c. Manipulating</li> </ul>		
	3. Arrays and Methods <ul style="list-style-type: none"> <li>a. Passing arrays to methods</li> <li>b. Arrays of objects</li> </ul>		
<b>Unit 8: Types of Classes and Interfaces</b>	Unit Goal: The students will be able to use interfaces, super classes, and abstract classes to create new classes.	[c3] [c4] [c5] [c6]	<b>C6</b> - The course teaches students to code fluently in an object-oriented paradigm using the programming language Java. The course teaches students to use standard Java library classes from the AP Java subset delineated in Appendices A and B of the <i>AP Computer Science Course Description</i> . (Note: Students who study a language other than Java in AP Computer Science must also be taught to use Java, as specified in the AP Java subset.)
	1. Static vs. Non-Static <ul style="list-style-type: none"> <li>a. Variables</li> <li>b. Methods</li> </ul>		
	2. Interfaces <ul style="list-style-type: none"> <li>a. Implements statement</li> </ul>		
	3. Super Classes <ul style="list-style-type: none"> <li>a. Inheritance</li> </ul>		
	4. Abstract Classes <ul style="list-style-type: none"> <li>a. Inheritance</li> </ul>		
	5. Equality of Objects <ul style="list-style-type: none"> <li>a. ==</li> <li>b. .equals</li> </ul>		
	6. Try and Catch Statements		

<b>Unit 9: Strings</b>	Unit Goal: The students will be able to use the methods of the String classes.	[c3] [c4] [c5] [c6]	<b>C3</b> - The course teaches students to design and implement computer-based solutions to problems in a variety of application areas.  <b>C4</b> -The course teaches students to use and implement commonly used algorithms and data structures.  <b>C5</b> -The course teaches students to develop and select appropriate algorithms and data structures to solve problems.  <b>C6</b> - The course teaches students to code fluently in an object-oriented paradigm using the programming language Java. The course teaches students to use standard Java library classes from the AP Java subset delineated in Appendices A and B of the <i>AP Computer Science Course Description</i> . (Note: Students who study a language other than Java in AP Computer Science must also be taught to use Java, as specified in the AP Java subset.)
	1. String Methods <ul style="list-style-type: none"> <li>a. charAt</li> <li>b. compareTo</li> <li>c. equals</li> <li>d. indexOf</li> <li>e. length</li> <li>f. replace</li> <li>g. substring</li> <li>h. toLower</li> <li>i. toUpper</li> <li>j. trim</li> </ul>		
<b>Unit 10: Java GUI's</b>	Unit Goal: The students will be able to create an interactive Java GUI.	[c3] [c4] [c5] [c6]	
	1. GUI Components <ul style="list-style-type: none"> <li>a. Layouts</li> <li>b. Color schemes</li> <li>c. Buttons</li> <li>d. Text fields</li> <li>e. Focus listeners</li> </ul>		
<b>Unit 11: Searching and Sorting</b>	Unit Goal: The students will be able to write and recognize various sorts.	[c3] [c4] [c5] [c6]	
	1. Searching <ul style="list-style-type: none"> <li>a. Linear search</li> <li>b. Binary search</li> </ul>		
	2. Sorting <ul style="list-style-type: none"> <li>a. Bubble sort</li> <li>b. Selection sort</li> <li>c. Insertion sort</li> <li>d. Merge Sort</li> </ul>		
	3. The compareTo Interface <ul style="list-style-type: none"> <li>a. Implementation for classes</li> </ul>		

<b>Unit 12: ArrayLists</b>	Unit Goal: The Students will be able to write programs using ArrayLists and there methods.	[c3] [c4] [c5] [c6]
	1. ArrayLists <ul style="list-style-type: none"> <li>a. Instantiation</li> <li>b. Methods</li> <li>c. Wrapper classes</li> <li>d. Sorting</li> </ul>	
<b>Unit 13: Recursion</b>	Unit Goal: The students will be able to write recursive methods.	[c3] [c4] [c5] [c6]
	1. Recursion <ul style="list-style-type: none"> <li>a. Definition</li> <li>b. Examples</li> <li>c. QuickSort</li> <li>d. Timing various sorts</li> </ul>	
<b>Unit 14: Collections</b>	Unit Goal: The students will be able to write code using various types of collections.	[c3] [c4] [c5] [c6]
	1. Lists <ul style="list-style-type: none"> <li>a. Methods</li> <li>b. Iterators</li> <li>c. ListIterators</li> </ul>	
	2. Stacks <ul style="list-style-type: none"> <li>a. Applications               <ul style="list-style-type: none"> <li>i. Evaluating mathematical expressions                   <ul style="list-style-type: none"> <li>1. the StringTokenizer class</li> <li>2. infix form</li> <li>3. postfix form</li> </ul> </li> </ul> </li> </ul>	
	3. Queues <ul style="list-style-type: none"> <li>a. Application and implementation</li> <li>b. Priority queues</li> </ul>	
	4. Sets <ul style="list-style-type: none"> <li>a. Sorted sets</li> <li>b. Tree sets</li> </ul>	
	5. Maps <ul style="list-style-type: none"> <li>a. Sorted maps</li> </ul>	

**C3** - The course teaches students to design and implement computer-based solutions to problems in a variety of application areas.

**C4** -The course teaches students to use and implement commonly used algorithms and data structures.

**C5** -The course teaches students to develop and select appropriate algorithms and data structures to solve problems.

**C6** - The course teaches students to code fluently in an object-oriented paradigm using the programming language Java. The course teaches students to use standard Java library classes from the AP Java subset delineated in Appendices A and B of the *AP Computer Science Course Description*. (Note: Students who study a language other than Java in AP Computer Science must also be taught to use Java, as specified in the AP Java subset.)

<b>Unit 15: Trees</b>	Unit Goal: The Students will be able to use tree terminology and write algorithms for Binary Trees.	[c3] [c4] [c5] [c6]	C3 - The course teaches students to design and implement computer-based solutions to problems in a variety of application areas.
	1. Binary Trees <ul style="list-style-type: none"> <li>a. Traversals</li> <li>b. Binary Search Trees</li> </ul>		
<b>Unit 16: Indexed Lists and Linked Lists</b>	Unit Goal: The students will be able to write classes that use indexed, linked, and doubly linked list structures.	[c3] [c4] [c5] [c6]	C4 -The course teaches students to use and implement commonly used algorithms and data structures.
	2. The IndexedList interface <ul style="list-style-type: none"> <li>a. Fixed size</li> <li>b. Single linked implementation <ul style="list-style-type: none"> <li>i. Nodes</li> </ul> </li> </ul>		
	3. Positional Lists <ul style="list-style-type: none"> <li>a. Fixed size</li> <li>b. Doubly linked</li> </ul>		C5 -The course teaches students to develop and select appropriate algorithms and data structures to solve problems.
<b>Unit 17: Files</b>	Unit Goal: The students will be able to use input and output files.	[c3] [c4] [c5] [c6]	C4 -The course teaches students to use and implement commonly used algorithms and data structures.
	1. Files Classes <ul style="list-style-type: none"> <li>a. Input stream</li> <li>b. Output stream</li> </ul>		
	2. File Input <ul style="list-style-type: none"> <li>b. Exception handling</li> <li>c. Reading from a data text file</li> </ul>		
	3. File Output <ul style="list-style-type: none"> <li>a. Fileoutputstream <ul style="list-style-type: none"> <li>1. opening</li> <li>2. closing</li> </ul> </li> <li>b. writing to a data file</li> </ul>		



<b>Unit 18: Advanced Graphical User Interfaces</b>	Unit Goal: The students will be able to create advanced graphical user interfaces for applications.	[c3] [c4] [c5] [c6]	<p><b>C3</b> - The course teaches students to design and implement computer-based solutions to problems in a variety of application areas.</p> <p><b>C4</b> -The course teaches students to use and implement commonly used algorithms and data structures.</p> <p><b>C5</b> -The course teaches students to develop and select appropriate algorithms and data structures to solve problems.</p> <p><b>C6</b> - The course teaches students to code fluently in an object-oriented paradigm using the programming language Java. The course teaches students to use standard Java library classes from the AP Java subset delineated in Appendices A and B of the <i>AP Computer Science Course Description</i>. (Note: Students who study a language other than Java in AP Computer Science must also be taught to use Java, as specified in the AP Java subset.)</p>
	1. Swing Classes		
	2. AWT Classes		
	3. Components <ul style="list-style-type: none"> <li>a. Containers</li> <li>b. Frames</li> <li>c. Panels</li> <li>d. Fields</li> <li>e. Labels</li> <li>f. Buttons</li> <li>g. Layouts</li> <li>h. Listeners               <ul style="list-style-type: none"> <li>i. Window and Button</li> </ul> </li> <li>i. Fonts</li> <li>j. Size</li> <li>k. SetEnabled</li> <li>l. Menus</li> <li>m. Events</li> </ul>		
<b>Unit 19: The Case Study</b>	Unit Goal: The students will be able to run, modify, and write new methods for the AP Computer Science Case Study.	[c7]	
	1. GridWorld Case Study. The College Board, 2006		
<b>Unit 20: Review for the AP Exam</b>	Unit Goal: The students will be able to answer sample multiple choice and free response questions similar to those on the AP exam.	[c6] [c7]	
	1. Practice Questions (to include questions pertaining to the current Case Study) <ul style="list-style-type: none"> <li>a. Multiple choice</li> <li>b. Free response</li> </ul>		
<b>Unit 21: Applets and More GUI's</b>	Unit Goal: The students will be able to create applets from scratch and from existing programs.	[c3] [c4] [c5] [c6]	
	1. Applets <ul style="list-style-type: none"> <li>a. Definition</li> <li>b. From existing applications</li> <li>c. From scratch</li> </ul>		