

# AP Computer Science A

Curriculum/Content Area: Computer Science	Course Length: 2 Terms
Course Title: AP Computer Science A	Date last reviewed: August 2016
Prerequisites: Algebra II or consent of Instructor	Board approval date: November 15, 2016

## Desired Results

### Course description and purpose:

In this course, students will learn to write computer programs in the JAVA programming language. The course will provide students with a conceptual background in computing and computer science. Major emphasis will be placed on sequential processing, algorithm design, various testing methods, logical reasoning and problem solving techniques. The course follows the syllabus recommended by the College Board to qualify a student for the Advanced Placement Computer Science A examination.

<p><b>Enduring Understandings (EUs):</b></p> <ol style="list-style-type: none"> <li>1. Algorithms are precise sequences of instructions for processes that can be executed by a computer and are implemented using programming languages.</li> <li>2. A variable is an identifier for a memory location whose content can change.</li> <li>3. A variable is a single memory location where an object contains both state and behavior.</li> <li>4. The scope of a variable is the part of the program where a variable can be referenced.</li> <li>5. A boolean expression is any expression that evaluates to true or false.</li> </ol>	<p><b>Essential Questions (EQs):</b></p> <ol style="list-style-type: none"> <li>1. What is an algorithm?</li> <li>2. What is a variable?</li> <li>3. What is the difference between a variable and an object?</li> <li>4. What is the scope of a variable?</li> <li>5. What is a boolean expression?</li> <li>6. What is a decision structure?</li> <li>7. What is the difference between a pretest loop and a posttest loop?</li> <li>8. What is an infinite loop?</li> <li>9. What is "null"?</li> <li>10. What are two basic data structures?</li> </ol>
--	---

6. A decision structure performs action based on the outcome of one or more boolean expression(s).
7. A pretest loop checks the value of a boolean expression before iterating and a posttest loop checks the value of a boolean expression after the loop has iterated.
8. An infinite loop iterates infinitely.
9. The "null" identifier is a Java reserved word which represents an object reference that does not reference a valid object.
10. Arrays and ArrayLists are two basic data structures.

## Assessment Evidence

<b>Performance assessments:</b>  Performance assessments including class design, method creation, and the writing of programs will be used to evaluate a student's comprehensive knowledge of course content.	<b>Other assessments:</b>  Formative and summative assessments including programming opportunities and sample AP exam questions will be used to evaluate a student's level of mastery on individual topics.
---	---

<b>Unit Title: Local Variables/Constants and Input</b>
A. Primitive Data Types B. Declaring Local Variables/Constants C. Assignment of Values D. Input E. Calling public methods F. Order of Operation G. Casting and Promotion
<b>Standards:</b>
<b>Computer Science Teachers Association Standards:</b> <b>CT.L2-01:</b> Use the basic steps in algorithmic problem-solving to design solutions (e.g., problem statement and exploration, examination of sample instances, design, implementing a solution, testing, evaluation). <b>CT.L2-03:</b> Define an algorithm as a sequence of instructions that can be processed by a computer. <b>CT.L2-04:</b> Evaluate ways that different algorithms may be used to solve the same problem. <b>CT.L2-06:</b> Describe and analyze a sequence of instructions being followed (e.g., describe a character's behavior in a videogame as driven by rules and algorithms). <b>CT.L2-08:</b> Use visual representations of problem states, structures, and data (e.g., graphs, charts, network diagrams, flowcharts). <b>CT.L3A-07:</b> Describe how various types of data are stored in a computer system. <b>CL.L3B-03:</b> Evaluate programs written by others for readability and usability. <b>CPP.L2-04:</b> Demonstrate an understanding of algorithms and their practical application. <b>CPP.L2-09:</b> Collect and analyze data that is output from multiple runs of a computer program. <b>CPP.L3A-03:</b> Use various debugging and testing methods to ensure program correctness (e.g., test cases, unit testing, white box, black box, integration testing).

**CPP.L3A-05:** Use Application Program Interfaces (APIs) and libraries to facilitate programming solutions.

**CD.L2-01:** Recognize that computers are devices that execute programs.

**CD.L2-02:** Identify a variety of electronic devices that contain computational processors.

**CD.L2-03:** Demonstrate an understanding of the relationship between hardware and software.

**CD.L2-04:** Use developmentally appropriate, accurate terminology when communicating about technology.

**CD.L3A-03:** Describe the principal components of computer organization (e.g., input, output, processing, and storage).

**CD.L3A-04:** Compare various forms of input and output.

**WI Standards for Literacy in All Subjects:**

**CCSS.ELA-LITERACY.RST.11-12.4:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

**CCSS.ELA-LITERACY.RST.11-12.7:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

**CCSS.ELA-LITERACY.RST.11-12.9:** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

**Learning Targets:**

I can:

- list the primitive data types used in the APCS A subset
- pick an appropriate primitive data type to store real world data
- declare and assign values to local variable/constants
- use Classes and Methods to input primitive data types from the keyboard
- develop mathematical equations using the math operators
- define and give examples of promotion/casting

**Unit Title: Object Oriented Programming**

A. Write a Class Definition

- i. State
- ii. Behavior

B. Designing and Implementing Constructors and Methods

- i. Default and Alternate Constructors

- ii. Pass values to a method
- iii. Return a value from a method
- C. Data Integrity Testing
- D. toString, equals, and clone methods

**Standards:**

**Computer Science Teachers Association Standards:**

**CT.L2-01:** Use the basic steps in algorithmic problem-solving to design solutions (e.g., problem statement and exploration, examination of sample instances, design, implementing a solution, testing, evaluation).

**CT.L2-04:** Evaluate ways that different algorithms may be used to solve the same problem.

**CT.L2-06:** Describe and analyze a sequence of instructions being followed (e.g., describe a character's behavior in a video game as driven by rules and algorithms).

**CT.L3B-10:** Decompose a problem by defining new functions and classes.

**CL.L3B-03:** Evaluate programs written by others for readability and usability.

**CPP.L2-04:** Demonstrate an understanding of algorithms and their practical application.

**CPP.L2-09:** Collect and analyze data that is output from multiple runs of a computer program.

**CPP.L3A-03:** Use various debugging and testing methods to ensure program correctness (e.g., test cases, unit testing, white box, black box, integration testing)

**CPP.L3A-05:** Use Application Program Interfaces (APIs) and libraries to facilitate programming solutions.

**CPP.L3B-02:** Use tools of abstraction to decompose a large-scale computational problem (e.g., procedural abstraction, object-oriented design, functional design).

**WI Standards for Literacy in All Subjects:**

**CCSS.ELA-LITERACY.RST.11-12.4:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

**CCSS.ELA-LITERACY.RST.11-12.7:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

**CCSS.ELA-LITERACY.RST.11-12.9:** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

**Learning Targets:**

I can:

- write a Class definition
- construct multiple objects from a Class definition
- call methods of an object
- determine the integrity of data
- define and code the toString, equals, and clone methods

**Unit Title: Decision Structures**

- A. Relational Operators
- B. Boolean Expressions
- C. Lazy Evaluation
- D. single alternative decision structures
- E. double alternative decision structures
- F. nested decision decision structures

**Standards:**

**Computer Science Teachers Association Standards:**

**CT.L2-01:** Use the basic steps in algorithmic problem-solving to design solutions (e.g., problem statement and exploration, examination of sample instances, design, implementing a solution, testing, evaluation).

**CT.L2-04:** Evaluate ways that different algorithms may be used to solve the same problem.

**CT.L2-06:** Describe and analyze a sequence of instructions being followed (e.g., describe a character's behavior in a video game as driven by rules and algorithms).

**CL.L3B-03:** Evaluate programs written by others for readability and usability.

**CPP.L2-04:** Demonstrate an understanding of algorithms and their practical application.

**CPP.L2-09:** Collect and analyze data that is output from multiple runs of a computer program.

**CPP.L3A-05:** Use Application Program Interfaces (APIs) and libraries to facilitate programming solutions.

**WI Standards for Literacy in All Subjects:**

**CCSS.ELA-LITERACY.RST.11-12.4:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*.

**CCSS.ELA-LITERACY.RST.11-12.7:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

**CCSS.ELA-LITERACY.RST.11-12.9:** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process,

phenomenon, or concept, resolving conflicting information when possible.

**Learning Targets Addressed:**

I can:

- Use relational operators to create a boolean expression
- Define lazy evaluation
- Define and code a single alternative decision structures
- Define and code a double alternative decision structure
- Define and code nested decision structure

**Unit Title: Iterations**

- A. While Loops
- B. Do While Loops
- C. For Loops
- D. Nested Loops
- E. Infinite Loops

**Standards:**

**Computer Science Teachers Association Standards:**

**CT.L2-01:** Use the basic steps in algorithmic problem-solving to design solutions (e.g., problem statement and exploration, examination of sample instances, design, implementing a solution, testing, evaluation).

**CT.L2-04:** Evaluate ways that different algorithms may be used to solve the same problem.

**CT.L3A-01:** Use predefined functions and parameters, classes and methods to divide a complex problem into simpler parts.

**CL.L3B-03:** Evaluate programs written by others for readability and usability.

**CPP.L2-04:** Demonstrate an understanding of algorithms and their practical application.

**CPP.L2-05:** Implement problem solutions using a programming language, including: looping behavior, conditional statements, logic, expressions, variables, and functions.

**CPP.L2-09:** Collect and analyze data that is output from multiple runs of a computer program.

**CPP.L3A-05:** Use Application Program Interfaces (APIs) and libraries to facilitate programming solutions.

**WI Standards for Literacy in All Subjects:**

**CCSS.ELA-LITERACY.RST.11-12.4:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

**CCSS.ELA-LITERACY.RST.11-12.7:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

**CCSS.ELA-LITERACY.RST.11-12.9:** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

**Learning Targets:**

I can:

- Define and code a while loops
- Define and code a do while loop
- Define and code a for loop
- Define and code nested loops
- Identify infinite loops



**Unit Title: Arrays and ArrayLists**

- A. Array class methods and fields
- B. One dimensional Arrays
- C. Multi-dimensional arrays
- D. ArrayLists
- E. Wrapper classes

**Standards:****Computer Science Teachers Association Standards:**

**CT.L2-01:** Use the basic steps in algorithmic problem-solving to design solutions (e.g., problem statement and exploration, examination of sample instances, design, implementing a solution, testing, evaluation).

**CT.L2-04:** Evaluate ways that different algorithms may be used to solve the same problem.

**CT.L3A-01:** Use predefined functions and parameters, classes and methods to divide a complex problem into simpler parts.

**CT.L3B-06:** Compare and contrast simple data structures and their uses (e.g., arrays and lists).

**CL.L3B-03:** Evaluate programs written by others for readability and usability.

**CPP.L2-04:** Demonstrate an understanding of algorithms and their practical application.

**CPP.L2-05:** Implement problem solutions using a programming language, including: looping behavior, conditional statements, logic, expressions, variables, and functions.

**CPP.L2-09:** Collect and analyze data that is output from multiple runs of a computer program.

**CPP.L3A-05:** Use Application Program Interfaces (APIs) and libraries to facilitate programming solutions.

**WI Standards for Literacy in All Subjects:**

**CCSS.ELA-LITERACY.RST.11-12.4:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

**CCSS.ELA-LITERACY.RST.11-12.7:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

**CCSS.ELA-LITERACY.RST.11-12.9:** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

**Learning Targets:**

I can:

- declare, initialize, manipulate, and display the values of the elements stored in a one dimensional Array object
- declare, initialize, manipulate, and display the values of the elements stored in a multi-dimensional Array object
- declare, initialize, manipulate, and display the values of the elements stored in an ArrayList object
- define and document the use of a Wrapper class

### Unit Title: Interfaces, Ploymorphism, and Inheritance

- A. Interfaces
  - i. state and behavior
  - ii. object vs interface types
- B. Polymorphism
- C. Inheritance
  - i. super class
  - ii. sub class
  - iii. scope
  - iv. type conversion
  - v. state and behavior

### Standards:

#### Computer Science Teachers Association Standards:

**CT.L2-01:** Use the basic steps in algorithmic problem-solving to design solutions (e.g., problem statement and exploration, examination of sample instances, design, implementing a solution, testing, evaluation).

**CT.L2-04:** Evaluate ways that different algorithms may be used to solve the same problem.

**CT.L2-12:** Use abstraction to decompose a problem into sub problems.

**CT.L3A-01:** Use predefined functions and parameters, classes and methods to divide a complex problem into simpler parts.

**CL.L2-03:** Collaborate with peers, experts, and others using collaborative practices such as pair programming, working in project teams, and participating in group active learning activities.

**CL.L3B-03:** Evaluate programs written by others for readability and usability.

**CPP.L2-04:** Demonstrate an understanding of algorithms and their practical application.

**CPP.L2-05:** Implement problem solutions using a programming language, including: looping behavior, conditional statements, logic, expressions, variables, and functions.

**CPP.L2-09:**Collect and analyze data that is output from multiple runs of a computer program.

**CPP.L3A-05:**Use Application Program Interfaces (APIs) and libraries to facilitate programming solutions.

**WI Standards for Literacy in All Subjects:**

**CCSS.ELA-LITERACY.RST.11-12.4:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

**CCSS.ELA-LITERACY.RST.11-12.7:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

**CCSS.ELA-LITERACY.RST.11-12.9:** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

**Learning Targets:**

I can:

- List the characteristics and code an Interface
- Detail the advantages of Interfaces and Inheritance pertaining to code re-use
- Write multiple class definitions using inheritance
- Document the scope of a field and method in an inheritance model
- convert a reference between sub class, super class, and the object class

**Unit Title: Recursion, Sorting, and Searching**

- A. Recursion
- B. Sorting
  - i. bubble
  - ii. selection
  - iii. insertion
  - iv. merge
- C. Searching
  - i. linear
  - ii. binary
- D. Number Conversion

**Standards:**

**Computer Science Teachers Association Standards:**

**CT.L2-01:** Use the basic steps in algorithmic problem-solving to design solutions (e.g., problem statement and exploration, examination of sample instances, design, implementing a solution, testing, evaluation).

**CT.L2-04:** Evaluate ways that different algorithms may be used to solve the same problem.

**CT.L2-05 :** Act out searching and sorting algorithms.

**CT.L2-12:** Use abstraction to decompose a problem into sub problems.

**CT.L2-14:** Examine connections between elements of mathematics and computer science including binary numbers, logic, sets and functions

**CT.L3A-01:** Use predefined functions and parameters, classes and methods to divide a complex problem into simpler parts.

**CT.L3A-03:** Explain how sequence, selection, iteration, and recursion are building blocks of algorithms.

**CT.L3A-05:** Describe the relationship between binary and hexadecimal representations.

**CT.L3B-03:** Critically examine classical algorithms and implement an original algorithm.

**CL.L2-03:** Collaborate with peers, experts, and others using collaborative practices such as pair programming, working in project teams, and participating in group active learning activities.

**CL.L3B-03:** Evaluate programs written by others for readability and usability.

**CPP.L2-04:** Demonstrate an understanding of algorithms and their practical application.

**CPP.L2-05:** Implement problem solutions using a programming language, including: looping behavior, conditional statements, logic, expressions, variables, and functions.

**CPP.L2-09:** Collect and analyze data that is output from multiple runs of a computer program.

**CPP.L3A-05:** Use Application Program Interfaces (APIs) and libraries to facilitate programming solutions.

**WI Standards for Literacy in All Subjects:**

**CCSS.ELA-LITERACY.RST.11-12.4:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

**CCSS.ELA-LITERACY.RST.11-12.7:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

**CCSS.ELA-LITERACY.RST.11-12.9:** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

**Learning Targets:**

I can:

- Define recursion and cite reasons why recursion is used
- Trace a recursive algorithm to determine its outcome
- Document the process, requirements, similarities, and differences between a bubble, selection, insertion, and merge sort
- Determine the appropriate search algorithm for a data set
- Convert a number between the binary, decimal, octal, and hexadecimal number systems