FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT

AP Computer Science A

Date: November 2018
Proposed Grade Level(s): 10-12
Grading: A-F
Course Length: 2 Semesters
Subject Area: Career Technical Education
Credits: 5.0 per semester

CTE Sector / Pathway: Information and Communication Technologies / Systems Programming (174A)
Prerequisite(s): AP Computer Science Principles or Computer Science & Programming (both with a C or better) or teacher approval
Intent to Pursue 'A-G' College Prep Status: Yes A-G
Course Identifier: G: College Preparatory

COURSE DESCRIPTION:

AP® Computer Science A is both a course for potential computer science majors and a foundation course for students planning to study in other technical fields such as engineering, physics, chemistry, and geology. The course emphasizes programming methodology, procedural abstraction, and in-depth study of algorithms, data structures, and data abstractions, as well as a structured lab component comprised of a minimum of 20 hours of hands-on lab experiences integrated throughout the course. Instruction includes preparation for the AP Computer Science A Exam. This course follows the AP College Board approved sample syllabus # 1172779v1.

GENERALS GOALS:

Students will acquire and demonstrate the following skills:

Curricular Requirements as defined by AP College Board:

Curricular Requirement	Description	Unit(s)
CR1	The course teaches students to design and implement computer-based solutions to problems.	All
CR2a	The course teaches students to use and implement commonly used algorithms	10, 14
CR2b	The course teaches students to use commonly used data structures	7, 8
CR3	The course teaches students to select appropriate algorithms and data structures to solve problems.	8, 10, 11, 14
CR4	The course teaches students to code fluently in an object-oriented paradigm using the programming language Java.	11, 12, 13
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.	5, 6, 7
CR6	The course includes a structured lab component comprised of a	Cumulative

	minimum of 20 hours of hands-on lab experiences.	
CR7	The course teaches students to recognize the ethical and social implications of computer use.	2

UNITS OF INSTRUCTION:

Unit 1 - Karel J. Robot (Introduces objects and inheritance)
In unit one, students are introduced to object oriented programming and inheritance using the Karel J. Robot simulation environment. Students learn the basics of object oriented programming in a controlled environment that provides immediate feedback. Students develop a basic understanding of classes and objects. Students are introduced to basics of looping and conditional statements and apply them in the Karel J Robot environment to solve specific problems. Example activities may include using loops to clear a field of beepers or using loops and conditionals to redistribute beepers in a specific pattern in a field. **[CR1]**

Unit 2 - Java Basics
Unit two introduces students to many of the terms used in computer science to describe computer hardware and computer systems. Students discuss computer use policies and the ethics associated with various forms of intellectual property in the computer science profession. Students will develop understanding of how all the different parts of a computer system work and be able to label the parts of a computer. Students demonstrate how to write, compile and run basic programs. Students recognize various compile time, runtime and logic errors and debug them. Students begin to use basic input (BufferedReader) and output (System.out.println) commands to enhance their program's functionality. Labs tasks include area and perimeter calculations for basic geometric figures, simulating inputs and outputs of a registrar program or similar activities using objects, inputs and outputs. **[CR1] [CR7]**

Unit 3 - Defining Variables, Arithmetic Expressions
In unit three, students master the used of fields and variables in the AP Java subset. Students correctly use the assignment operations and begin to use casting. Students demonstrate industry approved coding styles including the use of comments to document their programs. Students begin to use arithmetic expressions in their programs including the use of precedence. Computer scientists and engineers use a variety of numbering systems. Students convert numbers between various numbering systems (decimal, binary, octal, hexadecimal) and understand why they are used. Labs include a paycheck program to enter employee information and calculate standard and overtime pay or something similar. **[CR1]**

Unit 4 - Introduction to Classes and OOP
In unit four, students begin to write their own classes and apply the fundamentals of object-oriented programming. Students discuss the different approaches taken by computer scientists to develop code and the pros and cons of each. Students create their own classes and include constructors. Students write code for accessor and mutator methods to apply the concept of encapsulation. Students understand the differences between public and private access types and use them appropriately. Students include the appropriate use of parameters, fields and instance

variables in their code. Students design methods and use preconditions, post conditions and assertions appropriately. **[CR1]**

Unit 5 - Conditionals and Looping
In unit five, students code more complex programs, taking advantage of conditionals and looping behaviors. Students use the following in their programs: control statements, counter, infinite loop, iteration, nested loops, logical operators to construct syntactically correct loops and conditional statements. Students apply debugging techniques such as hand-tracing and extra print statements to diagnose and fix errors that may occur with loops. Students evaluate looping and conditional code quality by calculating statement execution counts. Students make programs more robust using logical operators and applying DeMorgan's theorem as needed. Students write programs to apply these concepts. Problems may include: approximate PI using Leibniz's method, base conversion from base ten to 2, guess my number game, calculation of rectangle perimeter and range now using all combinations of a certain range. **[CR1] [CR5]**

Unit 6 - The String Class
In unit six, students gain in-depth knowledge of the string class. Students instantiate string objects and use all the methods in the AP Java subset in their programs. Students understand that strings are immutable. Students will complete the Magpie Chatbot lab from AP College Board. **[CR1] [CR5]**

Unit 7 - Array List
In unit seven, students investigate the features of the ArrayList class. Students understand the pros and cons of using an ArrayList. Students create array lists to solve problems which may include the WordList problem from the 2004 AP CSA exam (Free- Response Question 1, AP Central®). **[CR2b][CR5]**

Unit 8 - Arrays
In unit eight, students investigate the features and functions of the array structure in Java. Students declare and initialize arrays and manipulate them with loops and conditionals. Students define array terminology including element, index, logical size, physical size and parallel arrays. Students declare arrays with and without initializer lists. Students manipulate arrays using loops and array indices. Students define boundary cases to guarantee they do not go beyond the bounds of their array. Students work with arrays of primitives and arrays of objects. Students appropriately choose when to use and array and when to use an ArrayList. For example, students may create a one-dimensional array, read in numbers and place each one in an even, odd, and/or negative list.
[CR1] CR2b] [CR3]

Unit 9 - Two-dimensional Arrays
In unit nine, students expand their skills with arrays by creating and manipulating 2-D arrays. In the process, students are introduced to the object-oriented concepts of inheritance and Java interfaces. Students represent their program's configurations using class diagrams to highlight inheritance. Students understand the meaning of row-major order and demonstrate traversing all and portions of a two-dimensional array. Students write code with nested loops to manipulate

objects in a 2-D array. Students apply these concepts to the Picture Lab from AP College Board or similar activities. **[CR1]**

Unit 10 - Searching and Sorting Arrays
In unit ten, students compare and contrast various sorting mechanisms including selection and insertion sorts. Students compare and contrast various searching methods including sequential and binary searches. Students understand the algorithms behind these sorting and searching techniques. Students trace sorting and searching algorithms and understand time constraints of each. Students understand the time efficiency of each sort and search and when it is desirable to use each one. Students write a method for searching an array and inserting or deleting information from given positions in an array. Given different scenarios, students should be able to choose the most appropriate sort or search. Students identify reusable components from existing code using classes and class libraries. Students apply these techniques by making their own "utility" class that includes all of these sorts and searches or solving some other searching and sorting problems. **[CR1] [CR2a] [CR3]**

Unit 11 - Elevens Lab
In unit eleven, students complete the Elevens Lab as defined by AP College board (or some similar project) to experience basic game design and development, experimenting with a large program. In this lab, students use and modify classes and apply the concept of inheritance by extending the abstract Board class. Students analyze and discuss the efficiency of shuffling algorithms. Students understand how the classes are related to one another and the reasons for preferring one algorithm over another. **[CR1][CR3] [CR4]**

Unit 12 - More on Classes, Inheritance, Interfaces
In unit twelve, students continue to refine and improve their coding skills by extending a class to demonstrate inheritance using an abstract and non-abstract class as the parent class. Students diagram inheritance relationships. Students know how to apply polymorphism and know when it is appropriate to override methods in a super class. Students implement an interface in their code. Students create and extend a class given class specifications with the relationships among the classes described. Problems solved by the students may be creating and extending an abstract Shape class, completing the Pet Parade problem (2004 AP Computer Science A Exam: Free-Response Question 2, on AP Central). **[CR1] [CR4]**

Unit 13 - Inheritance
In unit thirteen, students demonstrate applications of inheritance. They may do this with their own project or use teacher driven projects like a zoo or company situation. **[CR1] [CR4]**

Unit 14 - Recursion (and Merge Sort)
In unit fourteen, students discuss the concept of recursion and analyze examples of recursive code. Students create a recursive method to solve a problem. Students compare and contrast recursive and iterative solutions to problem and determine when it is best to use each one. Students understand and use a merge sort and calculate the informal runtime of merge sort and compare its running time to the other sorts already learned. One application of recursion that may be used is a factorial program. Students may also rewrite loop programs to use recursion instead. **[CR1] [CR2a] [CR3]**

Unit 15 – Review for AP exam
In unit fifteen, students review for the AP exam in a variety of ways including taking practice exams and discussing the AP Java subset specifics. Student familiarize themselves with the resources that will be available to them during the exam.

TEXTBOOKS AND RESOURCE MATERIALS:

Textbooks
Horstmann, Cay. *Big Java*. Hoboken, N.J.: Wiley, 2012.

Lambert, Ken, and Martin Osborne. *Fundamentals of Java: AP Computer Science Essentials*. Boston: Course Technology, 2011.

Resource Materials
Teacher Copy Only: Bergin, Joseph et al. *Karel J Robot: A Gentle Introduction to the Art of Object-Oriented Programming in Java*. Redwood City, Calif.: Dreamsongs Press, 2005.

Class set for lab activities:
Barnes, David J and Kolling, Michael, 6th Edition, *Objects First with Java 6e A Practical Introduction Using BlueJ*, Pearson, 2016.

COMMON CORE STATE ANCHOR STANDARDS FOR READING (K-12):

Key Ideas and Details
1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
3. Analyze how and why individuals, events, or ideas develop and interact over the course of a text.

Craft and Structure
4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
5. Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text (e.g., a section, chapter, scene, or stanza) relate to each other and the whole.
6. Assess how point of view or purpose shapes the content and style of a text.

Integration of Knowledge and Ideas
7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.

Reading Range / Text Complexity

10. Read and comprehend complex literary and informational texts independently and proficiently.

COMMON CORE STATE ANCHOR STANDARDS FOR WRITING (K-12):

Text Types and Purposes

1. Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.
2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
3. Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details and well-structured event sequences.

Production and Distribution of Writing

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.
6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

Research to Build Knowledge

7. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.
8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
9. Draw evidence from literary or informational texts to support analysis, reflection, and research.

Range of Writing

10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

COMMON CORE STATE ANCHOR STANDARDS FOR SPEAKING AND LISTENING (K-12):

Comprehension and Collaboration

1. Prepare for and participate effectively in a range of conversations and collaborations with

diverse partners, building on others' ideas and expressing their own clearly and persuasively.
2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.

Presentation of Knowledge and Ideas

4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and ensure that the organization, development, and style are appropriate to task, purpose, and audience.
5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
6. Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

CTE STANDARDS FOR CAREER READY PRACTICE:

1. Apply appropriate technical skills and academic knowledge.
   Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make connections between abstract concepts with real-world applications and recognize the value of academic preparation for solving problems, communicating with others, calculating measures, and other work-related practices.
2. Communicate clearly, effectively, and with reason.
   Career-ready individuals communicate thoughts, ideas, and action plans with clarity, using written, verbal, electronic, and/or visual methods. They are skilled at interacting with others, are active listeners who speak clearly and with purpose, and are comfortable with the terminology common to the workplace environment. Career-ready individuals consider the audience for their communication and prepare accordingly to ensure the desired outcome.
3. Develop an education and career plan aligned with personal goals.
   Career-ready individuals take personal ownership of their own educational and career goals and manage their individual plan to attain these goals. They recognize the value of each step in the educational and experiential process and understand that nearly all career paths require ongoing education and experience to adapt to practices, procedures, and expectations of an ever-changing work environment. They seek counselors, mentors, and other experts to assist in the planning and execution of education and career plans.
4. Apply technology to enhance productivity.
   Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring and using new technology. They understand the inherent risks—personal and organizational—of technology applications and they take actions to prevent or mitigate these risks.

5. Utilize critical thinking to make sense of problems and persevere in solving them.
   Career-ready individuals recognize problems in the workplace, understand the nature of the problems, and devise effective plans to solve the problems. They thoughtfully investigate the root cause of a problem prior to introducing solutions. They carefully consider options to solve the problem and, once agreed upon, follow through to ensure the problem is resolved.

6. Practice personal health and understand financial literacy.
   Career-ready individuals understand the relationship between personal health and workplace performance. They contribute to their personal well-being through a healthy diet, regular exercise, and mental health activities. Career-ready individuals also understand that financial literacy leads to a secure future that enables career success.
7. Act as a responsible citizen in the workplace and the community.
   Career-ready individuals understand the obligations and responsibilities of being a member of a community and demonstrate this understanding every day through their interactions with others. They are aware of the impacts of their decisions on others and the environment around them and think about the short-term and long-term consequences of their actions. They are reliable and consistent in going beyond minimum expectations and in participating in activities that serve the greater good.
8. Model integrity, ethical leadership, and effective management.
   Career-ready individuals consistently act in ways that align with personal and community-held ideals and principles. They employ ethical behaviors and actions that positively influence others. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the direction and actions of a team or organization, and they recognize the short-term and long-term effects that management's actions and attitudes can have on productivity, morale, and organizational culture.
9. Work productively in teams while integrating cultural and global competence.
   Career-ready individuals positively contribute to every team as both team leaders and team members. They apply an awareness of cultural differences to avoid barriers to productive and positive interaction. They interact effectively and sensitively with all members of the team and find ways to increase the engagement and contribution of other members.
10. Demonstrate creativity and innovation.
    Career-ready individuals recommend ideas that solve problems in new and different ways and contribute to the improvement of the organization. They consider unconventional ideas and suggestions by others as solutions to issues, tasks, or problems. They discern which ideas and suggestions may have the greatest value. They seek new methods, practices, and ideas from a variety of sources and apply those ideas to their own workplace practices.
11. Employ valid and reliable research strategies.
    Career-ready individuals employ research practices to plan and carry out investigations, create solutions, and keep abreast of the most current findings related to workplace environments and practices. They use a reliable research process to search for new information and confirm the validity of sources when considering the use and adoption of external information or practices.
12. Understand the environmental, social, and economic impacts of decisions.
    Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact other people, organizations, the workplace, and the environment. They are aware of and utilize new technologies, understandings, procedures, and materials and adhere to regulations affecting the nature of their work. They are cognizant of impacts on the social condition, environment, workplace, and profitability of the organization.

CTE KNOWLEDGE AND PERFORMANCE ANCHOR STANDARDS:

1.0 Academics: Students will analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and

employment.

2.0 Communications: Students will acquire and accurately use Information and Communications Technology sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.

3.0 Career Planning and Management: Students will integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.

4.0 Technology: Students will use existing and emerging technology, to investigate, research, and produce products and services, including new information, as required in the Information and Communication Technologies sector workplace environment.

5.0 Problem Solving and Critical Thinking: Students will conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the Information and Communication Technologies sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem- solving techniques.

6.0 Health and Safety: Students demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Information and Communication Technologies sector workplace environment.

7.0 Responsibility and Flexibility: Students will initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Information and Communication Technologies sector workplace environment and community settings.

8.0 Ethics and Legal responsibilities: Students will practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms.

9.0 Leadership and Teamwork: Students will work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution as practiced in the SkillsUSA career technical student organizations.

10.0 Technical Knowledge and Skills: Students will apply essential technical knowledge and skills common to all pathways in the Information and Communication Technologies sector, following procedures when carrying out experiments or performing technical tasks.

11.0 Demonstration and Application: Students demonstrate and apply the knowledge and skills contained in the Information and Communication Technologies anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings.

CTE PATHWAY STANDARDS TO BE ADDRESSED:

C1.0 Identify and apply the systems development process.

- C1.1 Identify the phases of the systems development life cycle, including analysis, design, programming, testing, implementation, maintenance, and improvement.
- C1.3 Identify and describe how specifications and requirements are developed for new and existing software applications.

C1.4 Work as a member of, and within the scope and boundaries of, a development project team.

C1.5 Track development project milestones using the concept of versions.

C1.6 Diagram processes using flowcharts and the Unified Modeling Language.

C2.0 Define and analyze systems and software requirements.

C2.1 Describe the major purposes and benefits of development, including automation, improving productivity, modeling and analysis, and entertainment.

C2.2 Recognize and prevent unintended consequences of development work: programming errors, security issues, health and environmental risks, and privacy concerns.

C3.0 Create effective interfaces between humans and technology.

C3.1 Describe and apply the basic process of input, processing and output. C4.0 Develop software using programming languages.

C4.1 Identify and describe the abstraction level of programming languages from low-level, hardware-based languages to high-level, interpreted, Web-based languages.

C4.3 Identify and use different authoring tools and integrated development environments (IDEs).

C4.4 Identify and apply data types and encoding.

C4.5 Demonstrate awareness of various programming paradigms, including procedural, object oriented, event-driven, and multithreaded programing.

C4.6 Use proper programming language syntax.

C4.7 Use various data structures, arrays, objects, and files.

C4.8 Use object oriented programming concepts, properties, methods, and inheritance.

C4.9 Create programs using control structures, procedures, functions, parameters, variables, error recovery, and recursion.

C4.10 Create and know the comparative advantages of various queue, sorting, and searching algorithms.

C4.11 Document development work for various audiences, such as comments for other programmers, and manuals for users.

C5.0 Test, debug, and improve software development work.

C5.1 Identify the characteristics of reliable, effective, and efficient products.

C5.2 Describe the ways in which specification changes and technological advances can require the modification of programs.

C5.3 Use strategies to optimize code for improved performance. C5.4 Test software and projects.

C5.5 Evaluate results against initial requirements.

C5.6 Debug software as part of the quality assurance process.

C6.0 Integrate a variety of media into development projects.

C6.1 Identify the basic design elements necessary to produce effective print, video, audio, and interactive media.

C6.5 Analyze the use of media to determine the appropriate file format and level of compression.

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