Rumson-Fair Haven Regional High School

Advanced Placement Computer Science

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Approved: **AUGUST 2014**

Section I: 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. In teaching this course, my reward comes when students can apply the programming tools they have learned to real-life examples on their own. Computer science is more than just programming. Students should leave my class with a clear understanding of Java and the ability to adapt to any new programming language that they are taught in college. I want them to have the confidence to tackle any problem-solving obstacles they encounter.

Section II: *2014New Jersey Core Curriculum Content Standards – Technology (October 2014)*

Standard 8 is composed of two sections, Educational Technology (8.1) and Technology Education (8.2). Following is a brief summary of the 2014 Standard 8 revisions:

- Grade bands were changed throughout Standard 8 to align with the Next Generation Science Standards (NGSS)
- Standard 8.1 (Education Technology)
  - Updates technology skills sets and terminologies
  - Allows greater cross curricular applications
  - Addresses Legislation (A3292 Sca (1R)) that requires schools to provide instruction on the responsible use of social media for middle school students
  - Aligns more closely with the most recent International Society for Technology in Education (ISTE) Standards
- Standard 8.2 (Technology Education)
  - Adds a new strand entitled "Computational Thinking: Programming"
  - Aligns more closely with International Technology and Engineering Educators Association (ITEEA) Standards
  - Correlates where possible with the NGSS

Section III: Links—State and National Standards and the College Board

The following links to state and national standards will confirm the alignment between the *AP Computer Science Curriculum* and the performance expectations that have been established by governing agencies and authorities.

- *Mathematics Standards – Common Core*
  - http://www.corestandards.org/Math/
- *2014 New Jersey Core Curriculum Content Standards (Technology)*
  - http://www.state.nj.us/education/cccs/2014/tech/
- *College Board Course Description: AP Computer Science (Fall 2014)*

- http://media.collegeboard.com/digitalServices/pdf/ap/ap-computer-science-a-course-description-2014.pdf

This curriculum is subject to case-by-case modifications to support and advance the needs of all students, including special education students, English language learners, students at risk of school failure, and gifted students. These modifications are based on the requirements of *Individualized Learning Programs* (IEP's), recommendations made by the district's *English Language Learners* (ELL) coordinator, feedback from members of the *Intervention & Referral Services Team* (*I&RS*) for at-risk students, and input from the department Supervisor —working in conjunction with other district personnel—in cases involving gifted students.

Section IV: College Board Syllabus

The following syllabus has been submitted to *The College Board* and approved for implementation.

Advanced Placement Computer Science A
Course Syllabus
Approved August 22, 2014

Section V: Course Topics: *AP Computer Science*

Course topics for *AP Computer Science A* are outlined in *College Board Course Description: (Fall 2014).*

I. Object-Oriented Program Design
   A. Program and class design
II. Program Implementation
   A. Implementation techniques
   B. Programming constructs
   C. Java library classes and interfaces included in the AP Java Subset
III. Program Analysis
   A. Testing
   B. Debugging
   C. Runtime exceptions
   D. Program correctness
   E. Algorithm analysis
   F. Numerical representations of integers
IV. Standard Data Structures
   A. Primitive data types (int, boolean, double)
   B. Strings
   C. Classes
   D. Lists
   E. Arrays (1-dimensional and 2-dimensional)
V. Standard Operations and Algorithms
   A. Operations on data structures
   B. Searching
   C. Sorting
VI. Computing in Context
   A. System reliability
   B. Privacy
   C. Legal issues and intellectual property
   D. Social and ethical ramifications of computer use

Section VI: End-Of-Course Assessment: *AP Computer Science*

Students in *AP Computer Science* are expected to take the *AP Computer Science A* exam in May. This assessment is approximately three hours in length: it includes a 75-minute multiple choice section with 40 questions and a 105-minute free-response section with 4 questions. The multiple choice section counts for fifty percent of the student's examination score, and the free response section counts for fifty percent. The *AP Computer Science* A exam is written and does not allow the use of technology during the exam.

When answering the free response questions on the *AP Computer Science A* exam, students are required to demonstrate the ability to solve problems involving more extended reasoning. The multiple–choice and free-response sections of the AP Computer Science A exam require students to demonstrate their ability to solve problems, including their ability to design, write and analyze programs and subprograms. Minor points of syntax are not tested on the exam.

All code given is consistent with the AP Java subset. Students are expected to be familiar with and able to use the standard Java classes and interfaces listed in the AP Java subset. All student responses involving code must be written in Java.

Section VII: Textbooks & Instructional Resources: *AP Computer Science*

The following core textbook and complementing reader will be used in *AP Computer Science*:

- Horstmann, Cay. *Big Java.* Hoboken, NJ: Wiley, (2012)
- Lambert, Ken, and Martin Osborne. *Fundamentals of Java: AP Computer Sceince Essentials.* Boston: Course Technology, (2010)

The following College Board-released *AP Computer Science Examinations* will be used as instructional resources in *AP Computer Science*:

- *AP Computer Science Examination (Secure)*

The following labs will be used as instructional resources and practice in *AP Computer Science*. The three labs are supplied by College Board.

- Magpie (Computer Bot)
- PixLab (Photo Analysis)
- Elevens Activity (Card Game)

The following website are used as resources and practice throughout the *AP Computer Science* curriculum:

- Code.org
- CodingBat.com/Java
- JavaDocs Version 7

Section VIII: Grading Formula and Assessment Modes: *AP Computer Science*

Marking Period grades in *AP Computer Science* are calculated via an established percentage weighting model that is comprised of five grading categories.

Grading Category	Percentage
Homework/Participation	10%
Projects	25%
Quizzes	15%
Assessments	30%
Marking Period Assessment	20%

Summer Assignment: *AP Computer Science*

A Summer Assignment is required for *AP Computer Science*. The Summer Assignment for *AP Computer Science* is posted on the school district's website.

Section IX: Unit Sequence: *AP Computer Science*

The following unit sequence is in place for *AP Computer Science*:

- *Unit I: Introduce objects and inheritance*
- *Unit II: Java Basics*
- *Unit III: Defining Variables, Arithmetic Expressions*
- *Unit IV: Introduction to Classes and Object Oriented Programming*
- *Unit V: Conditions and Looping*
- *Unit VI: The String Class*
- *Unit VII: Array List*
- *Unit VIII: Arrays*
- *Unit IX: Two-dimensional Arrays*
- *Unit X: Searching and Sorting Arrays*
- *Unit XI: Elevens Lab*
- *Unit XII: More on Classes, Inheritance, Interfaces*
- *Unit XIII: Inheritance*
- *Unit XIV: Recursion (and Merge Sort)*
- *Unit XV: Review*

Unit I: Introduce objects and inheritance

Topics:
• Objects
• Classes
• Looping
• Conditionals
 	
Objectives:
• Write and use simple classes with a graphical interface using Code.org
• Learn the basics of conditionals and looping
 	
Assessments:
• Program-specific
  • Create graphical applications of code using drag and drop components to represent logic, loops, and conditions.
• Clear a field of holes (using loops)
• Create a field of holes (using loops and conditionals)
• Complete a maze:
  o Different variations of mazes presented – Simple to Complex;

State Standards

Content Area	**Technology**
Standard	**8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming:** **All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.**
Strand	**A. The Nature of Technology: Creativity and Innovation** *Technology systems impact every aspect of the world in which we live.*

Grade Level bands	**Content Statement Students will be able to understand:**	**Indicator**	**Indicator**
9-12	The characteristics and scope of technology.	**8.2.12.A.1**	Propose an innovation to meet future demands supported by an analysis of the potential full costs, benefits, trade-offs and risks, related to the use of the innovation.

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Strand	**C. Design:** *The design process is a systematic approach to solving problems.*

Grade Level bands	**Content Statement**	**Indicator**	**Indicator**
9-12	The application of engineering design.	**8.2.12.C.4**	Explain and identify interdependent systems and their functions.
	The role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.	**8.2.12.C.6**	Research an existing product, reverse engineer and redesign it to improve form and function.

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Strand		**E. Computational Thinking: Programming:** *Computational thinking builds and enhances problem solving, allowing*	
Grade Level bands	**Content Statement Students will be able to understand:**	**Indicator**	**Indicator**
9-12	**Computational thinking and computer programming as tools used in design and engineering.**	**8.2.12.E.1**	Demonstrate an understanding of the problem-solving capacity of computers in our
		8.2.12.E.2	Analyze the relationships between internal and
		8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games)
		8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic

Unit II: Java Basics

Topics:

- Computer basics
- Java basics
- Using the compiler
- Input and output

Objectives:

- Understand terminology: CPU, system and application software, primary and secondary memory, LAN, WAN, hard disk, CD-ROM
- Understand computer ethics such as acceptable use policies, copyright, intellectual property, freeware, shareware, downloading music
- Understand how all the different parts of the computer work together
- Understand terminology: compiler, IDE, JVM
- Edit, compile, and run a simple program in Java
- Understand the different compile time errors, runtime errors, and logic errors
- Use `BufferedReader` for input
- Use output with `System.out` using `print` and `println` and `format output` to look nice

Assessments:

- Labs: Triangle, rectangle, square; area; and perimeter program
- Get input for the registrar's office program
- Label the parts of the computer

Strategies:

- To discuss computer ethics, begin by looking at the school's acceptable use policy, then go to the Web and look at the ACM's code of ethics. Students will write a small paper in favor of or against something related to computer ethics, such as making copies of a copyrighted program and giving it away for free.
- Assign a lot of small programs that illustrate different types of input and output—make sure students have used every type of input and displayed it in different ways.

State Standards

Content Area	**Technology**
Standard	**8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.**
Strand	**A. Technology Operations and Concepts:** *Students demonstrate a sound understanding of technology concepts, systems and operations.*

Grade Level bands	**Content Statement** **Students will:**	**Indicator**	**Indicator**
9-12	Select and use applications effectively and productively.	8.1.12.A.2 Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.	

Content Area	**Technology**
Standard	**8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.**
Strand	**D. Digital Citizenship:** *Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.*

Grade Level bands	**Content Statement**	**Indicator**	**Indicator**
9-12	Advocate and practice safe, legal, and responsible use of information and technology.	8.1.12.D.1	Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.

Content Area	**Technology**
Standard	**8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.**
Strand	**F: Critical thinking, problem solving, and decision making:** *Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.*

Grade Level bands	Content Statement Students will:	Indicator	Indicator
9-12	Identify and define authentic problems and significant questions for investigation. Plan and manage activities to develop a solution or complete a project. Collect and analyze data to identify solutions and/or make informed decisions.	8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.

Content Area	**Technology**
Standard	**8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming:** **All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.**

Grade	**Content Statement**	**Indicator**	**Indicator**
Level bands	**Students will be able to understand:**		
9-12	The effects of technology on the environment.	**8.2.12.B.2**	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.
	The role of society in the development and use of technology.	**8.2.12.B.3**	Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs.

Content Area	**Technology**

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Strand	**E. Computational Thinking: Programming:** *Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.*		
Grade Level bands	**Content Statement Students will be able to Understand:**	**Indicator**	**Indicator**
9-12	**Computational thinking and computer programming as tools used in design and engineering.**	**8.2.12.E.1**	Demonstrate an understanding of the problem-solving capacity of computers in our world.
		8.2.12.E.2	Analyze the relationships between internal and
		8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games) functions, website designs, applications, and games).
		8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

Unit III: Defining Variables, Arithmetic Expressions

Topics:

- Using and understanding variables
- Comments
- Arithmetic expressions in Java programs
- Representing numbers in different bases

Objectives:

- Understand terminology: comments, variables, constants, reserved words, literals
- Declare and initialize variables and constants in Java
- Understand mathematical expressions in Java and their precedence
- Understand how to change bases of numbers
- Use casting to make their data more accurate
- Understand limitations of finite representations of numbers such

as the range of integers, real, and float
- Use the assignment operator correctly

Assessments:
- Labs:
  - `Paycheck` program; have employee information entered and calculate pay
  - Modify the `paycheck` program to also include any overtime hours in the calculations

Strategies:
- Students need practice with how the different types, `double` and `int`, relate when they are used in mathematical operations
- Present a lot of small program examples in which they have to find the errors

State Standards

The Real Number System N -RN

Extend the properties of exponents to rational exponents.

1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*
2. Rewrite expressions involving radicals and rational exponents usingthe properties of exponents.

Use properties of rational and irrational numbers.

3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Quantities N -Q

Reason quantitatively and use units to solve problems.

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
2. Define appropriate quantities for the purpose of descriptive modeling.
3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Seeing Structure in Expressions A-SSE

Interpret the structure of expressions

1. Interpret expressions that represent a quantity in terms of its context.⋆
   a. Interpret parts of an expression, such as terms, factors, and coefficients.
   b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.*
2. Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.*

Write expressions in equivalent forms to solve problems

3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
   a. Factor a quadratic expression to reveal the zeros of the function it defines.
   b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
   c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*
4. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.*

Content Area	**Technology**		
Standard	**8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.**		
Strand	**A. Technology Operations and Concepts:** *Students demonstrate a sound understanding of technology concepts, systems and operations.*		
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Strand	**C. Communication and Collaboration:** *Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.*		
Grade Level bands	**Content Statement**	**Indicator**	**Indicator**
9-12		8.1.12.C.1	Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.

Content Area	Technology		
Standard	**8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming:** **All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.**		
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		8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
		8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

Unit IV: Introduction to Classes and OOP

Topic:

- Creating and using classes

Objectives:

- Understand terminology: constructor, accessor, mutator, instance variable, encapsulation, information hiding, procedural abstraction
- Understand the difference between public and private access in a class
- Use and comprehend the `DecimalFormat` class and the `Random` class
- Write classes from scratch, choosing appropriate data representation
- Understand how to declare a method and declare parameters in that method
- Understand the use of preconditions, postconditions and assertions when designing methods
- Understand the difference between OOP development and top-down development

Assessments:

- Labs: `Purse` class and `StampMachine` class

Strategies:

- Give students classes to complete, in which they are given a description and they must choose appropriate representation for that class

State Standards

The Real Number System N -RN

Extend the properties of exponents to rational exponents.

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Use properties of rational and irrational numbers.

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Quantities N -Q

Reason quantitatively and use units to solve problems.

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
2. Define appropriate quantities for the purpose of descriptive modeling.
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Seeing Structure in Expressions A-SSE

Interpret the structure of expressions

1. Interpret expressions that represent a quantity in terms of its context.⋆
   a. Interpret parts of an expression, such as terms, factors, and coefficients.
   b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.*
2. Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.*

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4. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.*

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Unit V: Conditional and Looping

Topics:

- if, if-else, while, for

Objectives:

- Understand terminology: control statements, counter, infinite loop, iteration, nested loops, logical operators, truth tables
- Construct syntactically correct loops and conditional statements
- Understand the different errors that may occur with loops and employ helpful debugging techniques such as hand-tracing and extra print statements to figure out errors
- Use logical operators to make programs more robust
- Construct truth tables
- Be able to calculate statement execution counts, e.g., how many times did the loop execute?

Assessments:

- Labs:
  - Approximate PI using Leibniz's method
  - Base Conversion: Convert from base
  - 10 to base 2
  - Guess My Number game
  - Euclidean algorithm program
  - Perimeter and area of rectangles using all combinations of certain range

Strategies:

- Students need practice writing different types of loops and conditionals

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Unit VI: The String Class

Topic:

- `String` class

Objectives:

- Instantiate `String` objects
- Understand that Strings are immutable
- Use appropriate Stringmethods to solve problems

Assessments:

Lab: Magpie

Strategies:

- Work several examples using the `substring` method

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Use properties of rational and irrational numbers.

3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

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Reason quantitatively and use units to solve problems.

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		8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
		8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

Unit VII: Array List

Topic:

- Using `ArrayList` class

Objective:

- Use the `ArrayList` methods

Assessments:

- WordList (2004 AP Computer Science A Exam, Free-Response Question 1, AP Central®)

Strategies:

- Stress the difference between `add` and `set`
- Draw pictures of the `ArrayList` after `add`, `set`, and `remove` have been performed

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Unit VIII: Arrays

Topics:

- Declaring and initializing arrays
- Manipulating arrays with loops
- Creating parallel arrays

Objectives:

- Understand terminology: array, element, index, logical size, physical size, parallel arrays
- Declare one-dimensional arrays in Java
- Use initializer lists when declaring arrays
- Manipulate arrays using loops and array indices
- Use the physical and logical size of an array together to guarantee they do not go beyond the bounds of their array by identifying the boundary cases and using test data to verify results
- Understand how parallel arrays can be useful when processing certain types of data
- Work with arrays of primitive data types as well as arrays of objects while understanding the difference between the two types of data
- Understand when to choose an array to represent data instead of an `ArrayList`

Assessments:

- Lab:
  - For one-dimensional arrays, read in numbers and place each one in an even, odd, and/or negative list

Strategies:

- Students need practice manipulating loops that work with arrays
- Students also need to be reminded about the indexing of arrays beginning at zero

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Unit IX: Two-dimensional Arrays
Topics: • Using 2-D arrays • Introduction to inheritance and interfaces • Class diagrams **Objectives:** • Understanding that 2-D arrays are stored as arrays of arrays • Understand the meaning of row-major order • Traversing all and part of a two-dimensional arrays

- Using nested loops to manipulate objects in a two-dimensional array

Assessments:

- Lab:
  - `Picture` and Picture lab activities 1-9
  - Picture lab extensions: steganography and chromakey

Strategies:

- Focus on the order in which Java stores the elements of a two-dimensional array in the computer's memory.
- Learn how to write code that corresponds to a class diagram and learn how to draw a class diagram that describes code.

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Unit X: Searching and Sorting Arrays

Essential Question(s):

What are the applications of searching and sorting techniques? What are the advantages and pitfalls of recursive programming techniques?

Topic:

- Bubble, Selection, Insertion sorts
- Sequential and Binary searches

Objectives:

- Write a method for searching an array
- Perform insertions and deletions at given positions in arrays
- Trace through sorting and searching algorithms and understand time constraints of each
- Understand the algorithms behind each of the following searching and sorting techniques: bubble, selection, and insertion sorts; sequential search and binary search
- Understand the time efficiency of each sort and search and when it is desirable to use each one
- Identify reusable components from existing code using classes and class libraries
- Given different scenarios, students should be able to choose the most appropriate sort or search

Assessments:

- Lab:
  - Students make their own "utility" class that includes all of these sorts and searches

Strategies:

- Students need practice tracing through sorts and searches and determining the runtime of each
- Students also do well with a worksheet that addresses the efficiency of each of the strategies they have learned, efficiency for a sorted versus unsorted list, and "best," "worst," and "average" efficiency

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Unit XI: Elevens Lab

Topics:

- Game design and development
- Experimenting with a large program
- Using classes
- Modifying classes
- Inheritance

Objectives:

- Design a class that models a deck of cards
- Analyze and discuss the efficiency of shuffling algorithms
- Extend an abstract Board class

Assessments:

- Lab: Elevens

Strategies:

- Be familiar with all the classes and interfaces discussed
- Focus on the how the classes are related to one another and the reasons for preferring one algorithm over another

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Unit XII: More on Classes, Inheritance, Interfaces
Topics:

- Classes
- Inheritance
- Abstract classes
- Interfaces

Objectives:

- Demonstrate inheritance by extending a class
- Understand polymorphism and know when it is appropriate to override methods in a super class
- Create and extend an abstract class
- Create and extend a class given class specifications with the relationships among the classes described
- Implement an interface

Assessments:

- Create an abstract `Shape` class
- Pet Parade (2004 AP Computer Science A Exam: Free-Response Question 2, on AP Central)

Strategies:

- Draw pictures of the inheritance hierarchy

State Standards

Content Area	**Technology**		
Standard	**8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.**		
Strand	**A. Technology Operations and Concepts:** *Students demonstrate a sound understanding of technology concepts, systems and operations.*		
Grade Level	**Content Statement** **Students will:**	**Indicator**	**Indicator**
9-12	Select and use applications effectively and productively.	8.1.12.A.2 Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.	

Content Area	**Technology**
Standard	**8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.**

Strand	C. Communication and Collaboration: *Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.*

Grade Level bands	Content Statement	Indicator	Indicator
9-12		8.1.12.C.1	Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.

Unit XIII: Inheritance

Topic:

- Inheritance

Objective:

- Use inheritance to extend the `Critter` class by making new types of `Employees`

Assessments:

- Exercises from the text

Strategies:

- Have fun with this chapter
- Allow the students to be creative after working through the exercises and analysis
- Create different kinds `Employees`

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Unit XIV: Recursion (and Merge Sort)
Topics: • Recursion • Merge Sort **Objectives:** • Create a recursive method to solve a problem • Understand the difference between recursive and iterative solutions to a problem • Understand and use the `Merge Sort` • Understand how to calculate the informal runtime of `merge sort` and compare it's running time to the other sorts already learned **Assessments:** • Factorial program • Rewrite loop programs with recursion **Strategies:** • Ask, "What is returned by this method?"
State Standards

The Real Number System N -RN

Extend the properties of exponents to rational exponents.

1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*
2. Rewrite expressions involving radicals and rational exponents usingthe properties of exponents.

Use properties of rational and irrational numbers.

3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Quantities N -Q

Reason quantitatively and use units to solve problems.

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
2. Define appropriate quantities for the purpose of descriptive modeling.
3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Seeing Structure in Expressions A-SSE

Interpret the structure of expressions

1. Interpret expressions that represent a quantity in terms of its context.⋆
   a. Interpret parts of an expression, such as terms, factors, and coefficients.
   b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.*
2. Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.*

Write expressions in equivalent forms to solve problems

3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
   a. Factor a quadratic expression to reveal the zeros of the function it defines.
   b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
   c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*
4. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.*

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Content Area	Technology		
Standard	**8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming:** **All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.**		
Strand	**E. Computational Thinking: Programming:** *Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.*		
Grade Level bands	**Content Statement Students will be able to understand:**	**Indicator**	**Indicator**
9-12	**Computational thinking and computer programming as tools used in design and engineering.**	**8.2.12.E.1**	Demonstrate an understanding of the problem-solving capacity of computers in our world.
		8.2.12.E.2	Analyze the relationships between internal and external computer components.
		8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
		8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

Unit XV: Review

Topics:

- Review AP Computer Science A topics

Objective:

- Prepare for the AP Computer Science A Exam by reviewing material and taking practice exams

Assessments:

- Practice exams

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		8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

Section X: *Unit Reflection*

The _____*Instructional Team* must confer upon the completion of each instructional unit in the *English II Curriculum* and rate the degrees to which the instructional units meet performance criteria established by the New Jersey Department of Education using the *Unit Reflection Form*. Completed *Unit Reflection Form*s must be submitted to the Department Supervisor for approval upon completion of curriculum implementation with a complementing list of suggested modifications to the _____ *Curriculum*.

Lesson Activities:	Strongly	Moderately	Weakly
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills;			
Are challenging and require higher order thinking and problem solving skills;			
Allow for student choice;			
Provide scaffolding for acquiring targeted knowledge/skills;			
Integrate global perspectives;			
Integrate 21st century skills;			
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills;			
Are varied to address different student learning styles and preferences;			
Are differentiated based on student needs;			
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process;			
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives;			
Provide opportunities for student reflection and self-assessment;			
Provide data to inform and adjust instruction to better meet the varying needs of learners;			