West Windsor-Plainsboro Regional School District
AP Computer Science Principles

Unit 1: Computational Thinking

Content Area: Computer Science

Course & Grade Level: AP Computer Science Principles – Grades 9 through 12

Summary and Rationale

In order to successfully master the art of creating computational artifacts, it is important that students develop a clear understanding of the complex processes and structures that make up an algorithmic solution to a given problem. In addition, it is critical that they be able to formally express those solutions clearly and unambiguously, such as what can be achieved through the use of pseudocode or a well-specified programming language. This unit focuses on introducing students to these concepts and helping them to develop the skills that they will rely on throughout the remainder of the course.

Recommended Pacing

15 days

State Standards

8.1 Educational Technology	
CPI #	**Cumulative Progress Indicator (CPI)**
A. Technology Operations and Concepts	
8.1.12.A.1	Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.
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.
8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
CPI #	**Cumulative Progress Indicator (CPI)**
B. Creativity and Innovation	
8.1.12.B.2	Apply previous content knowledge by creating and piloting a digital learning game or tutorial.
CPI #	**Cumulative Progress Indicator (CPI)**
C. Communication and Collaboration	
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.
CPI #	**Cumulative Progress Indicator (CPI)**
E: Research and Information Fluency	
8.1.12.E.1	Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
CPI #	**Cumulative Progress Indicator (CPI)**
F: Critical thinking, problem solving, and decision making	
8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.

8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming	
CPI #	**Cumulative Progress Indicator (CPI)**
D. Abilities for a Technological World	
8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
E. Computational Thinking: Programming	
8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
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).
9.3 – Career & Technical Education (CTE) Information Technology Career Cluster	
CPI #	**Cumulative Progress Indicator (CPI)**
9.3.IT.1	Demonstrate effective professional communication skills and practices that enable positive customer relationships.
9.3.IT.2	Use product or service design processes and guidelines to produce a quality information technology (IT) product or service.
9.3.IT.3	Demonstrate the use of cross-functional teams in achieving IT project goals.
9.3.IT.6	Describe trends in emerging and evolving computer technologies and their influence on IT practices.
9.3.IT.8	Recognize and analyze potential IT security threats to develop and maintain security requirements.

Unit Enduring Understandings

- Multiple levels of abstraction are used to write programs or create other computational artifacts. EU 2.2
- Algorithms are precise sequences of instructions for processes that can be executed by a computer and are implemented using programming languages. EU 4.1
- Algorithms can solve many, but not all, computational problems. EU 4.2
- People write programs to execute algorithms. EU 5.2
- Cybersecurity is an important concern for the Internet and the systems built on it. EU 6.3
- Computing enables innovation in nearly every field. EU 7.2

Unit Essential Questions

- What is abstraction?
- How do high-level and low-level programming languages differ?
- What is an algorithm?
- How is an algorithm developed?
- What makes an algorithm efficient?
- What types of problems can be solved by algorithms?
- What types of problems are solvable by programming?
- What is cybersecurity, and what are its components?

- What are the impacts of breaches of cyber security?
- How can cyber security be improved?
- What is Moore's law?

Objectives

Students will know:

- Different programming languages offer different levels of abstraction.
- How to approach large scale problems using algorithmic thinking.
- Developing a new algorithm to solve a problem can yield insight into the problem.
- Determining an algorithm's efficiency is done by reasoning formally or mathematically about the algorithm.
- How to clearly and precisely communicate algorithmic solutions to problems.
- How to analyze programming languages.
- How to use pseudocode to express algorithmic ideas.
- How to identify problems that can and cannot be solved by algorithms.
- How to compare algorithms.
- Executable programs increase the scale of problems that can be solved.
- The trust model of the Internet involves trade-offs.
- Cybersecurity threats and solutions.
- Moore's Law.

Students will be able to:

- Identify multiple levels of abstractions that are used when writing programs.
- Design an algorithm for implementation in a program.
- Express an algorithm in a language.
- Explain the difference between algorithms that run in a reasonable time and those that do not run in a reasonable time.
- Explain the difference between solvable and unsolvable problems in computer science.
- Explain the existence of undecidable problems in computer science.
- Evaluate algorithms analytically and empirically for efficiency, correctness and clarity.
- Strategically approach large-scale problems using algorithmic thinking.
- Examine methods of comparing equivalent algorithms for relative efficiency.
- Identify the needs and applications of cryptography in our digital world.
- Clearly and precisely communicate an algorithmic solution to a problem.
- Analyze programming ideas.
- Use pseudocode to express algorithmic ideas.
- Explain Moore's Law.

Evidence of Learning

Assessment

- Unit Project
- Quizzes
- Problem Sets
- Small Group Research and Presentation
- Individual teacher feedback
- Student self-assessment and assessment of peers

- Exam

Competencies for 21st Century Learners

	Collaborative Team Member		Effective Communicator
	Globally Aware, Active, & Responsible Student/Citizen		Information Literate Researcher
	Innovative & Practical Problem Solver		Self-Directed Learner

Resources

Core Text: UTeach CS Principles. The University of Texas at Austin. Unit 1.
https://uteachcs.gitbooks.io/uteach-cs-principles/content/?key=5c24-736d-802f
Suggested Resources: Scratch (block programming) https://scratch.mit.edu/

Unit 2: Programming

Content Area: Computer Science

Course & Grade Level: AP Computer Science Principles, Grades 9 - 12

Summary and Rationale

When used correctly, computational technologies can prove to be extremely powerful and effective tools for solving a wide range of problems. But in order to fully harness that power, an individual needs to be proficient in instructing those tools to perform highly precise operations in well-structured and logical sequences. This unit seeks to ease students into this new, structured, and more formalized way of thinking about problem solving and programming through the use of a block-based, visual programming language.

Recommended Pacing

15 days

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8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
CPI #	**Cumulative Progress Indicator (CPI)**
B. Creativity and Innovation	
8.1.12.B.2	Apply previous content knowledge by creating and piloting a digital learning game or tutorial.
CPI #	**Cumulative Progress Indicator (CPI)**
C. Communication and Collaboration	
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.
CPI #	**Cumulative Progress Indicator (CPI)**
D. Digital Citizenship	
8.1.12.D.1	Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
8.1.12.D.2	Evaluate consequences of unauthorized electronic access (e.g. hacking) and disclosure, and on dissemination of personal information.

8.1.12.D.5	Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.
CPI #	**Cumulative Progress Indicator (CPI)**
F: Critical thinking, problem solving, and decision making	
8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming	
CPI #	**Cumulative Progress Indicator (CPI)**
A. Technology Operations and Concepts	
8.2.12.A.2	Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability, and waste.
8.2.12.A.3	Research and present information on an existing technological product that has been repurposed for a different function.
CPI #	**Cumulative Progress Indicator (CPI)**
B. Technology and Society	
8.2.12.B.3	Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs.
CPI #	**Cumulative Progress Indicator (CPI)**
C. Design	
8.2.12.C.6	Research an existing product, reverse engineer, and redesign it to improve form and function.
8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify trade-offs and constraints, and document the process through drawings that include data and materials.
CPI #	**Cumulative Progress Indicator (CPI)**
D. Abilities for a Technological World	
8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
8.2.12.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
8.2.12.D.6	Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society, or the environment and publish conclusions.
CPI #	**Cumulative Progress Indicator (CPI)**
E. Computational Thinking: Programming	
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).
9.3 – Career & Technical Education (CTE) Information Technology Career Cluster	
CPI #	**Cumulative Progress Indicator (CPI)**
Pathway: Programming & Software Development (IT-PRG)	
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9.3.IT.2	Use product or service design processes and guidelines to produce a quality information technology (IT) product or service.
9.3.IT.3	Demonstrate the use of cross-functional teams in achieving IT project goals.
9.3.IT.6	Describe trends in emerging and evolving computer technologies and their influence on IT practices.
9.3.IT.12	Demonstrate knowledge of the hardware components associated with information systems.
9.3.IT-PRG.3	Analyze system and software requirements to ensure maximum operating efficiency.
9.3.IT-PRG.4	Demonstrate the effective use of software development tools to develop software applications.
9.3.IT-PRG.5	Apply an appropriate software development process to design a software application.
9.3.IT-PRG.6	Program a computer application using the appropriate programming language.
9.3.IT-PRG.7	Demonstrate software testing procedures to ensure quality products.

Unit Enduring Understandings

- Creative development can be an essential process for creating computational artifacts. EU 1.1
- Computing enables people to use creative development processes to create computational artifacts for creative expression or to solve a problem. EU 1.2
- Algorithms are precise sequences of instructions for processes that can be executed by a computer and are implemented using programming languages. EU 4.1
- Programs can be developed for creative expression, to satisfy personal curiosity, to create new knowledge or to solve problems (to help people, organizations or society). EU 5.1
- People write programs to execute algorithms. EU 5.2
- Computing has global effects - both beneficial and harmful - on people and society. EU 7.3

Unit Essential Questions

- What is a computational artifact?
- What steps make up the creative process in the development of a computational artifact and how are they implemented?
- What understandings and tools are needed to create computational artifacts?
- What are the building blocks of algorithms and how do the building blocks work?
- How are new algorithms developed?
- What languages are used to express algorithms and how do they differ?
- How does a programmer's knowledge impact the development of a program?
- How has computer programming impacted creative expression?
- How does a computer understand and execute a program?

- What legal and ethical concerns are raised by innovations in computing?
- What are the benefits and drawbacks to open source and free software?

Objectives

Students will know:

- A computational artifact is something created by a human using a computer and can be a program, an image, an audio, a video, a presentation or a Web page file.
- A creative process in the development of a computational artifact can include employing nontraditional, non-prescribed techniques, the use of novel combinations of tools and the exploration of personal curiosities.
- Collaboration facilitates the application of multiple perspectives and diverse talents and skills in developing computational artifacts.
- Creating digital effects, images, audio, video and animations has transformed industries.
- Sequencing, selection and iteration are building blocks of algorithms.
- Different algorithms can be developed to solve the same problem.
- Different languages are better suited for expressing different algorithms.
- Programs developed for creative expression, to satisfy personal curiosity, or to create new knowledge may have visual, audible or tactile inputs and outputs.
- An iterative process of program development helps in developing a correct program to solve problems.
- An understanding of instruction processing and program execution is useful for programming.
- Innovations in computing raise legal and ethical concerns.
- Privacy and security concerns arise in the development and use of computational systems and artifacts.
- Creation of digital audio, video and textual content by combining existing content has been impacted by copyright concerns.

Students will be able to:

- Apply a creative development process when creating computational artifacts.
- Create a computational artifact for creative expression.
- Collaborate in the creation of computational artifacts.
- Analyze the correctness, usability, functionality and suitability of computational artifacts.
- Develop an algorithm for implementation in a program.
- Express an algorithm in a language.
- Develop a program for creative expression, to satisfy a personal curiosity or to create a new knowledge.
- Collaborate to develop a program.
- Explain how programs implement algorithms.
- Analyze the beneficial and harmful effects of computing.

Evidence of Learning

Assessment

- Block programming project
- Quizzes
- Problem Sets
- Small Group Research and Presentation

- Individual teacher feedback
- Student self-assessment and assessment of peers
- Exam

Competencies for 21st Century Learners

	Collaborative Team Member		Effective Communicator
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	Innovative & Practical Problem Solver		Self-Directed Learner

Resources

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Unit 3: Data Representation

Content Area: Computer Science

Course & Grade Level: AP Computer Science Principles, Grades 9 - 12

Summary and Rationale

In order to make the most effective use of computational tools and data-driven applications, students need to have a clear awareness and sense of comfort with the diverse kinds of information that may be available for use by these programs and the various ways that information may be digitally represented, stored and manipulated within the computer. This unit focuses on providing students with an overview of the various abstractions that are used in the digital representation of discrete data and information.

Recommended Pacing

15 days

State Standards

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A. Technology Operations and Concepts	
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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.
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B. Creativity and Innovation	
8.1.12.B.2	Apply previous content knowledge by creating and piloting a digital learning game or tutorial.
CPI #	**Cumulative Progress Indicator (CPI)**
C. Communication and Collaboration	
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.
CPI #	**Cumulative Progress Indicator (CPI)**
D. Digital Citizenship	
8.1.12.D.1	Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
8.1.12.D.2	Evaluate consequences of unauthorized electronic access (e.g. hacking) and disclosure, and on dissemination of personal information.
8.1.12.D.3	Compare and contrast policies on filtering and censorship both locally and globally. Exhibit leadership for digital citizenship.

8.1.12.D.4	Research and understand the positive and negative impact of one's digital footprint.
8.1.12.D.5	Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.
CPI #	**Cumulative Progress Indicator (CPI)**
F: Critical thinking, problem solving, and decision making	
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8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming	
CPI #	**Cumulative Progress Indicator (CPI)**
A. Technology Operations and Concepts	
8.2.12.A.2	Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
8.2.12.A.3	Research and present information on an existing technological product that has been repurposed for a different function.
CPI #	**Cumulative Progress Indicator (CPI)**
B. Technology and Society	
8.2.12.B.1	Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.
8.2.12.B.3	Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs.
CPI #	**Cumulative Progress Indicator (CPI)**
C. Design	
8.2.12.C.1	Explain how open source technologies follow the design process.
8.2.12.C.6	Research an existing product, reverse engineer and redesign it to improve form and function.
8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify trade-offs and constraints, and document the process through drawings that include data and materials.
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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).
9.3 – Career & Technical Education (CTE) Information Technology Career Cluster	
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Pathway: Programming & Software Development (IT-PRG)	
9.3.IT.1	Demonstrate effective professional communication skills and practices that enable positive customer relationships.
9.3.IT.2	Use product or service design processes and guidelines to produce a quality information technology (IT) product or service.
9.3.IT.6	Describe trends in emerging and evolving computer technologies and their influence on IT practices.
9.3.IT.7	Perform standard computer backup and restore procedures to protect IT information.
9.3.IT.12	Demonstrate knowledge of the hardware components associated with information systems.
9.3.IT-PRG.3	Analyze system and software requirements to ensure maximum operating efficiency.
9.3.IT-PRG.4	Demonstrate the effective use of software development tools to develop software applications.
9.3.IT-PRG.5	Apply an appropriate software development process to design a software application.
9.3.IT-PRG.6	Program a computer application using the appropriate programming language.

Instructional Focus

Unit Enduring Understandings

- A variety of abstractions built on binary sequences can be used to represent all digital data. EU 2.1
- Multiple levels of abstraction are used to write programs or create other computational artifacts. EU 2.2
- Models and simulations use abstraction to generate new understanding and knowledge. EU 2.3
- There are trade-offs when representing information as digital data. EU 3.3
- Algorithms are precise sequences of instructions for processes that can be executed by a computer and are implemented using programming languages. EU 4.1
- Programs can be developed for creative expression, to satisfy personal curiosity, to create new knowledge or to solve problems (to help people, organizations or society). EU 5.1
- Programming is facilitated by appropriate abstractions. EU 5.3
- Programming uses mathematical and logical concepts. EU 5.5

Unit Essential Questions

- What are abstractions?
- What are binary sequences, how are they created and translated?
- How do abstractions work?
- How are abstractions created?
- What are the shortcomings of utilizing abstractions and binary sequences?
- How are abstractions and binary sequences implemented?
- Why program?
- What makes a program efficient or inefficient?

Objectives

Students will know:

- Digital data is represented by abstraction at different levels.
- A finite representation is used to model the infinite mathematical concept of a number.
- In many programming languages, the fixed number of bits used to represent characters or integers limits the range of integer values and mathematical operations; this limitation can result in overflow, rounding or other errors.
- The process of developing an abstraction involves removing detail and generalizing functionality.
- Software is developed using multiple levels of abstractions, such as constants, expressions, statement, procedures and libraries.
- Code in a programming language is often translated into code in another (lower-level) language to be executed on a computer.
- Applications and systems are designed, developed and analyzed using levels of hardware, software and conceptual abstractions.
- Models may use different abstractions or levels of abstraction depending on the objects or phenomena being posed.
- The results of simulations may generate new knowledge and new hypotheses related to the phenomena being modeled.
- Digital data representation involve trade-offs related to storage, security and privacy concerns.
- Algorithms can be combined to make new algorithms.
- Clarity and readability are important considerations when expressing an algorithm in a language.
- Programs developed for creative expression, to satisfy personal curiosity, or to create new knowledge may be developed with different standards or methods than programs developed for widespread distribution.
- Procedures are reusable programming abstractions.
- Using lists and procedures as abstractions in programming can result in programs that are easier to develop and maintain.
- Logical concepts and Boolean algebra are fundamental to programming.
- Basic operations on collections include adding elements, removing elements, iterating over all elements and determining whether an element is in a collection.

Students will be able to:

- Describe the variety of abstractions used to represent data.
- Explain how binary sequences are used to represent digital data.
- Develop an abstraction when writing a program or creating other computational artifacts.

- Use multiple levels of abstraction to write programs.
- Identify multiple levels of abstractions that are used when writing programs.
- Use models and simulations to represent phenomena.
- Use models and simulations to formulate, refine and test hypotheses.
- Analyze how data representation, storage, security and transmission of data involve computational manipulation of information.
- Develop an algorithm for implementation in a program.
- Express an algorithm in a language.
- Develop a program for creative expression, to satisfy a personal curiosity or to create a new knowledge.
- Develop a correct program to solve problems.
- Collaborate to develop a program.
- Use abstraction to manage complexity in programs.
- Employ appropriate mathematical and logical concepts in programming.

Evidence of Learning

Assessment

- Block programming project
- Quizzes
- Problem Sets
- Small Group Research and Presentation
- Individual teacher feedback
- Student self-assessment and assessment of peers
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Competencies for 21st Century Learners

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Suggested Resources: *Blown to Bits* (Abelson, Ledeen, Lewis). Chapter 3: Ghosts in the Machine - Secrets and Surprises of Electronic Documents http://www.bitsbook.com/wp-content/uploads/2008/12/B2B_3.pdf
Scratch (block programming) https://scratch.mit.edu/

Unit 4: Digital Media Processing

Content Area: Computer Science

Course & Grade Level: AP Computer Science Principles, Grades 9 - 12

Summary and Rationale

Building upon their earlier, visual programming experiences with a block programming language, this unit guides students through the transition to programming in a high-level, procedural language. By familiarizing themselves with text-based environment that more precisely reflects the actual programming tools used in industry (such as Java, C++ or Python), students will be better equipped for continuing their studies in computer science beyond the scope of this course.

Recommended Pacing

15 days

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8.2.12.B.3	Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs.
CPI #	**Cumulative Progress Indicator (CPI)**
C. Design	
8.2.12.C.1	Explain how open source technologies follow the design process.
8.2.12.C.4	Explain and identify interdependent systems and their functions.
8.2.12.C.6	Research an existing product, reverse engineer and redesign it to improve form and function.
8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify trade-offs and constraints, and document the process through drawings that include data and materials.
CPI #	**Cumulative Progress Indicator (CPI)**
D. Abilities for a Technological World	
8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
8.2.12.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
8.2.12.D.6	Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society, or the environment and publish conclusions.
CPI #	**Cumulative Progress Indicator (CPI)**

E. Computational Thinking: Programming	
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).
9.3 – Career & Technical Education (CTE) Information Technology Career Cluster	
CPI #	**Cumulative Progress Indicator (CPI)**
Pathway: Programming & Software Development (IT-PRG)	
9.3.IT.1	Demonstrate effective professional communication skills and practices that enable positive customer relationships.
9.3.IT.2	Use product or service design processes and guidelines to produce a quality information technology (IT) product or service.
9.3.IT.3	Demonstrate the use of cross-functional teams in achieving IT project goals.
9.3.IT.4	Demonstrate positive cyber citizenry by applying industry accepted ethical practices and behaviors.
9.3.IT.6	Describe trends in emerging and evolving computer technologies and their influence on IT practices.
9.3.IT.7	Perform standard computer backup and restore procedures to protect IT information.
9.3.IT.12	Demonstrate knowledge of the hardware components associated with information systems.
9.3.IT-PRG.3	Analyze system and software requirements to ensure maximum operating efficiency.
9.3.IT-PRG.4	Demonstrate the effective use of software development tools to develop software applications.
9.3.IT-PRG.5	Apply an appropriate software development process to design a software application.
9.3.IT-PRG.6	Program a computer application using the appropriate programming language.

Instructional Focus

Unit Enduring Understandings

- Computing enables people to use creative development processes to create computational artifacts for creative expression or to solve a problem. EU 1.2
- Computing can extend traditional forms of human expression and experience. EU 1.3
- Multiple levels of abstraction are used to write programs or create other computational artifacts. EU 2.2
- There are trade-offs when representing information as digital data. EU 3.3
- Algorithms are precise sequences of instructions for processes that can be executed by a computer and are implemented using programming languages. EU 4.1
- Programs can be developed for creative expression, to satisfy personal curiosity, to create new knowledge or to solve problems (to help people, organizations or society). EU 5.1

- Programming is facilitated by appropriate abstractions. EU 5.3
- Programs are developed, maintained and used by people for different purposes. EU 5.4
- Computing has global effects - both beneficial and harmful - on people and society. EU 7.3

Unit Essential Questions

- How can I use technology to creatively express myself?
- What practices are implemented by effective groups?
- How is text-based programming different from and similar to block-based programming?
- How can digital audio and visual files be manipulated?
- How and why are programs properly documented?
- How is the debugging process implemented?
- What are the positive and negative consequences of digitally altering images and sound?

Objectives

Students will know:

- Creating computational artifacts requires understanding of and use of software tools and services.
- Computation facilitates the creation and modification of computational artifacts with enhanced detail and precision.
- Effective collaborative teams practice interpersonal communication, consensus building, conflict resolution and negotiation.
- Digital images can be created by generating pixel patterns, manipulating existing digital images or combining images.
- Being aware of and using multiple levels of abstractions in developing programs help to more effectively apply available resources and tools to solve problems.
- There are trade-offs in using lossy and lossless compression techniques for storing and transmitting data.
- Sequencing is the application of each step of an algorithm in the order in which the statements are given.
- Using existing correct algorithms as building blocks for constructing a new algorithm helps ensure the new algorithm is correct.
- Nearly all programming languages are equivalent in terms of being able to express any algorithm.
- Developing correct program components and then combining them helps in creating correct programs.
- A programmer designs, implements, tests, debugs and maintains programs when solving problems.
- Procedures are reusable programming abstractions.
- Documentation for an API/library is an important aspect of programming.
- Program style can affect the determination of program correctness.
- Knowledge of what a program is supposed to do is required in order to find most program errors.
- Access to digital content via peer-to-peer networks raises legal and ethical concerns.
- Commercial and governmental censorship of digital information raises legal and ethical concerns.

Students will be able to:

- Create a computational artifact using computational tools and techniques to solve a problem.
- Collaborate in the creation of computational artifacts.
- Use computing tools and techniques for creative expression.
- Use multiple levels of abstraction to write programs.

- Analyze how data representation, storage, security and transmission of data involve computational manipulation of information.
- Express an algorithm in a language.
- Develop a correct program to solve problems.
- Use abstraction to manage complexity in programs.
- Evaluate the correctness of a program.
- Analyze the beneficial and harmful effects of computing.

Evidence of Learning

Assessment

- Text-based programming project
- Quizzes
- Problem Sets
- Small Group Research and Presentation
- Individual teacher feedback
- Student self-assessment and assessment of peers
- Exam

Competencies for 21st Century Learners

	Collaborative Team Member		Effective Communicator
	Globally Aware, Active, & Responsible Student/Citizen		Information Literate Researcher
	Innovative & Practical Problem Solver		Self-Directed Learner

Resources

Core Text: UTeach CS Principles. The University of Texas at Austin. Unit 4. https://uteachcs.gitbooks.io/uteach-cs-principles/content/?key=5c24-736d-802f

Suggested Resources: *Blown to Bits* (Abelson, Ledeen, Lewis). Chapter 6: Balance Toppled - Who Owns the Bits? http://www.bitsbook.com/wp-content/uploads/2008/12/B2B_3.pdf

Processing (text-based programming) https://processing.org/

Unit 5: Big Data

Content Area: Computer Science

Course & Grade Level: AP Computer Science Principles, Grades 9 - 12

Summary and Rationale

One of the most powerful applications of computational thinking relates to the creation and analysis of large data sets. In this unit students will explore the complete set of processes and techniques that are involved in collecting large volumes of raw data and extracting new and useful information. Students will look at a variety of ways that data scientists use techniques such as statistical analysis, data mining, clustering, classification and automatic summarization to construct and visualize new knowledge. And finally, students will perform their own analysis on a sample data set to discover new insights, which they will share with the class through a formal Technology, Entertainment, Design (TED)-style presentation.

Recommended Pacing

15 days

State Standards

8.1 Educational Technology	
CPI #	**Cumulative Progress Indicator (CPI)**
A. Technology Operations and Concepts	
8.1.12.A.1	Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.
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.
8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
CPI #	**Cumulative Progress Indicator (CPI)**
B. Creativity and Innovation	
8.1.12.B.2	Apply previous content knowledge by creating and piloting a digital learning game or tutorial.
CPI #	**Cumulative Progress Indicator (CPI)**
C. Communication and Collaboration	
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.
CPI #	**Cumulative Progress Indicator (CPI)**
D. Digital Citizenship	
8.1.12.D.1	Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.

8.1.12.D.2	Evaluate consequences of unauthorized electronic access (e.g. hacking) and disclosure, and on dissemination of personal information.
8.1.12.D.3	Compare and contrast policies on filtering and censorship both locally and globally. Exhibit leadership for digital citizenship.
8.1.12.D.4	Research and understand the positive and negative impact of one's digital footprint.
8.1.12.D.5	Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.
CPI #	**Cumulative Progress Indicator (CPI)**
E: Research and Information Fluency	
8.1.12.E.1	Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
8.1.12.E.2	Research and evaluate the impact on society of the unethical use of digital tools and present your research to peers.
CPI #	**Cumulative Progress Indicator (CPI)**
F: Critical thinking, problem solving, and decision making	
8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming	
CPI #	**Cumulative Progress Indicator (CPI)**
A. Technology Operations and Concepts	
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.
8.2.12.A.2	Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
8.2.12.A.3	Research and present information on an existing technological product that has been repurposed for a different function.
CPI #	**Cumulative Progress Indicator (CPI)**
B. Technology and Society	
8.2.12.B.1	Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.
8.2.12.B.3	Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs.
CPI #	**Cumulative Progress Indicator (CPI)**
C. Design	
8.2.12.C.1	Explain how open source technologies follow the design process.
8.2.12.C.2	Analyze a product and how it has changed or might change over time to meet human needs and wants.

8.2.12.C.3	Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors engineering (ergonomics).
8.2.12.C.4	Explain and identify interdependent systems and their functions.
8.2.12.C.6	Research an existing product, reverse engineer and redesign it to improve form and function.
8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify trade-offs and constraints, and document the process through drawings that include data and materials.
CPI #	**Cumulative Progress Indicator (CPI)**
D. Abilities for a Technological World	
8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
8.2.12.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
8.2.12.D.6	Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society, or the environment and publish conclusions.
CPI #	**Cumulative Progress Indicator (CPI)**
E. Computational Thinking: Programming	
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.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).
9.3 – Career & Technical Education (CTE) Information Technology Career Cluster	
CPI #	**Cumulative Progress Indicator (CPI)**
Pathway: Programming & Software Development (IT-PRG)	
9.3.IT.1	Demonstrate effective professional communication skills and practices that enable positive customer relationships.
9.3.IT.2	Use product or service design processes and guidelines to produce a quality information technology (IT) product or service.
9.3.IT.3	Demonstrate the use of cross-functional teams in achieving IT project goals.
9.3.IT.4	Demonstrate positive cyber citizenry by applying industry accepted ethical practices and behaviors.
9.3.IT.5	Explain the implications of IT on business development.
9.3.IT.6	Describe trends in emerging and evolving computer technologies and their influence on IT practices.
9.3.IT.8	Recognize and analyze potential IT security threats to develop and maintain security requirements.

9.3.IT.9	Describe quality assurance practices and methods employed in producing and providing quality IT products and services.
9.3.IT.12	Demonstrate knowledge of the hardware components associated with information systems.
9.3.IT-PRG.2	Demonstrate the use of industry standard strategies and project planning to meet customer specifications.
9.3.IT-PRG.3	Analyze system and software requirements to ensure maximum operating efficiency.
CPI #	**Cumulative Progress Indicator (CPI)**
Pathway: Web & Digital Communications (IT-WD)	
9.3.IT-WD.1	Analyze customer requirements to design and develop a Web or digital communication product.
9.3.IT-WD.2	Apply the design and development process to produce user-focused Web and digital communications solutions.
9.3.IT-WD.4	Demonstrate the effective use of tools for digital communication production, development and project management.
9.3.IT-WD.6	Design, create and publish a digital communication product based on customer needs.
9.3.IT-WD.7	Evaluate the functionality of a digital communication product using industry accepted techniques and metrics.
9.3.IT-WD.8	Implement quality assurance processes to deliver quality digital communication products and services.
9.3.IT-WD.9	Perform maintenance and customer support functions for digital communication products.
9.3.IT-WD.10	Comply with intellectual property laws, copyright laws and ethical practices when creating Web/digital communications.

Instructional Focus

Unit Enduring Understandings

- Computing enables people to use creative development processes to create computational artifacts for creative expression or to solve a problem. EU 1.2
- Models and simulations use abstraction to generate new understanding and knowledge. EU 2.3
- People use computer programs to process information to gain insight and knowledge. EU 3.1
- Computing facilitates exploration and the discovery of connections in information. EU 3.2
- There are trade-offs when representing information as digital data. EU 3.3
- Algorithms can solve many, but not all, computational problems. EU 4.2
- Programs can be developed for creative expression, to satisfy personal curiosity, to create new knowledge or to solve problems (to help people, organizations or society). EU 5.1
- Computing enhances communication, interaction and cognition. EU 7.1
- Computing enables innovation in nearly every field. EU 7.2
- Computing has global effects - both beneficial and harmful - on people and society. EU 7.3

Unit Essential Questions

- What tools are available to facilitate collaboration?
- How is data collected, extracted and stored?
- What makes a source credible?
- How is data analyzed efficiently, and what tools are used to do so?
- How are conclusions drawn from data analyses?
- What is data mining?
- What are the causes and impacts of data breaches?

Objectives

Students will know:

- A collaboratively created computational artifact reflects effort by more than one person.
- Effective collaborative teams consider the use of online collaborative tools.
- Models and simulations facilitate the formulation and refinement of hypotheses related to the objects or phenomena under consideration.
- Simulations allow hypotheses to be tested without the constraints of the real world.
- Rapid and extensive testing allows models to be changed to accurately reflect the objects or phenomena being modeled.
- Computers are used in an iterative and interactive way when processing digital information to gain insight and knowledge.
- Insight and knowledge can be obtained from translating and transforming digitally represented information. Collaboration facilitates solving computational problems by applying multiple perspectives, experiences and skill sets.
- Large data sets provide opportunities and challenges for extracting information and knowledge.
- Search tools are essential for efficiently finding information.
- Metadata is data about data.
- Structuring large data sets for analysis can be challenging.
- Security and privacy concerns arise with data containing personal information.
- Empirical analysis of an algorithm is done by implementing the algorithm and running it on different inputs.
- Distributed solutions must scale to solve some problems.
- Crowdsourcing offers new models for collaboration, such as connecting people with jobs and businesses with funding.
- The move from desktop computers to a proliferation of always-on mobile computers is leading to new applications.
- Machine learning and data mining have enabled innovation in medicine, business and science.
- Aggregation of information, such as geolocation, cookies and browsing history, raises privacy and security concerns.
- Online databases and libraries catalog and house secondary and some primary sources.
- Determining the credibility of a source requires considering and evaluating the reputation and credentials of the author(s), publisher(s), site owner(s) and/or sponsor(s).

Students will be able to:

- Collaborate in the creation of computational artifacts.
- Use models and simulations to formulate, refine and test hypotheses.

- Find patterns and test hypotheses about digitally processed information to gain insight and knowledge.
- Collaborate when processing information to gain insight and knowledge.
- Explain the insight and knowledge gained from digitally processed data by using appropriate visualizations, notations and precise language.
- Extract information from data to discover and explain connections or trends.
- Determine how large data sets impact the use of computational processes to discover information and knowledge.
- Analyze how data representation, storage, security and transmission of data involve computational manipulation of information.
- Evaluate algorithms analytically and empirically for efficiency, correctness and clarity.
- Develop a program for creative expression, to satisfy a personal curiosity or to create a new knowledge.
- Collaborate to develop a program.
- Explain how people participate in a problem-solving process that scales.
- Explain how computing has impacted innovations in other fields.
- Analyze the beneficial and harmful effects of computing.

Evidence of Learning

Assessment

- Technology, Entertainment, Design (TED)-style presentation
- Quizzes
- Problem Sets
- Small Group Research and Presentation
- Individual teacher feedback
- Student self-assessment and assessment of peers
- Exam

Competencies for 21st Century Learners

	Collaborative Team Member		Effective Communicator
	Globally Aware, Active, & Responsible Student/Citizen		Information Literate Researcher
	Innovative & Practical Problem Solver		Self-Directed Learner

Resources

Core Text: UTeach CS Principles. The University of Texas at Austin. Unit 5.
https://uteachcs.gitbooks.io/uteach-cs-principles/content/?key=5c24-736d-802f

Suggested Resources: *Blown to Bits* (Abelson, Ledeen, Lewis). Chapter 2: Naked in the Sunlight - Privacy Lost, Privacy Abandoned http://www.bitsbook.com/wp-content/uploads/2008/12/B2B_3.pdf

Unit 6: Innovative Technologies

Content Area: Computer Science

Course & Grade Level: AP Computer Science Principles, Grades 9 - 12

Summary and Rationale

As a way of further expanding upon the applications of computer science in the advancement of computational technologies, this unit aims to broaden students' awareness of the computing tools they use and rely on every day and to encourage them to start thinking about the decisions and processes that go into the creation of these technologies.

Students will begin by exploring many of the key roles that technology plays in their lives, including social networking, online communication, search, commerce and news and examining the ways these ever-evolving technologies have impacted individuals and societies in recent years. With so many of these technologies relying on the Internet to connect users and data across varied and remote locations, the students will then "take a peek under the hood" to examine the systems and protocols that make up the global infrastructure of the Internet. Finally, students will turn their attention to the past, present, and future of computing to begin imagining the technology that might exist in their future and the role that they might play in bringing it about.

Recommended Pacing

15 days

State Standards

8.1 Educational Technology	
CPI #	**Cumulative Progress Indicator (CPI)**
A. Technology Operations and Concepts	
8.1.12.A.1	Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.
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.
8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
CPI #	**Cumulative Progress Indicator (CPI)**
B. Creativity and Innovation	
8.1.12.B.2	Apply previous content knowledge by creating and piloting a digital learning game or tutorial.
CPI #	**Cumulative Progress Indicator (CPI)**
C. Communication and Collaboration	
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.

CPI #	Cumulative Progress Indicator (CPI)
D. Digital Citizenship	
8.1.12.D.1	Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
8.1.12.D.2	Evaluate consequences of unauthorized electronic access (e.g. hacking) and disclosure, and on dissemination of personal information.
8.1.12.D.3	Compare and contrast policies on filtering and censorship both locally and globally. Exhibit leadership for digital citizenship.
8.1.12.D.4	Research and understand the positive and negative impact of one's digital footprint.
8.1.12.D.5	Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.
CPI #	**Cumulative Progress Indicator (CPI)**
E: Research and Information Fluency	
8.1.12.E.1	Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
8.1.12.E.2	Research and evaluate the impact on society of the unethical use of digital tools and present your research to peers.
CPI #	**Cumulative Progress Indicator (CPI)**
F: Critical thinking, problem solving, and decision making	
8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming	
CPI #	**Cumulative Progress Indicator (CPI)**
A. Technology Operations and Concepts	
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.
8.2.12.A.2	Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
8.2.12.A.3	Research and present information on an existing technological product that has been repurposed for a different function.
CPI #	**Cumulative Progress Indicator (CPI)**
B. Technology and Society	
8.2.12.B.1	Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.
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.
8.2.12.B.3	Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs.

8.2.12.B.4	Investigate a technology used in a given period of history, e.g., stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.
8.2.12.B.5	Research the historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product, and present the competing viewpoints to peers for review.
CPI #	**Cumulative Progress Indicator (CPI)**
C. Design	
8.2.12.C.1	Explain how open source technologies follow the design process.
8.2.12.C.2	Analyze a product and how it has changed or might change over time to meet human needs and wants.
8.2.12.C.3	Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors engineering (ergonomics).
8.2.12.C.4	Explain and identify interdependent systems and their functions.
8.2.12.C.6	Research an existing product, reverse engineer and redesign it to improve form and function.
8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify trade-offs and constraints, and document the process through drawings that include data and materials.
CPI #	**Cumulative Progress Indicator (CPI)**
D. Abilities for a Technological World	
8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
8.2.12.D.2	Write a feasibility study of a product to include: economic, market, technical, financial, and management factors, and provide recommendations for implementation.
8.2.12.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
8.2.12.D.4	Assess the impacts of emerging technologies on developing countries.
8.2.12.D.6	Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society, or the environment and publish conclusions.
CPI #	**Cumulative Progress Indicator (CPI)**
E. Computational Thinking: Programming	
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).
9.3 – Career & Technical Education (CTE) Information Technology Career Cluster	
CPI #	**Cumulative Progress Indicator (CPI)**
Pathway: Programming & Software Development (IT-PRG)	
9.3.IT.1	Demonstrate effective professional communication skills and practices that enable positive customer relationships.
9.3.IT.2	Use product or service design processes and guidelines to produce a quality information technology (IT) product or service.
9.3.IT.3	Demonstrate the use of cross-functional teams in achieving IT project goals.
9.3.IT.4	Demonstrate positive cyber citizenry by applying industry accepted ethical practices and behaviors.
9.3.IT.5	Explain the implications of IT on business development.
9.3.IT.6	Describe trends in emerging and evolving computer technologies and their influence on IT practices.
9.3.IT.7	Perform standard computer backup and restore procedures to protect IT information.
9.3.IT.8	Recognize and analyze potential IT security threats to develop and maintain security requirements.
9.3.IT.9	Describe quality assurance practices and methods employed in producing and providing quality IT products and services.
9.3.IT.12	Demonstrate knowledge of the hardware components associated with information systems.
9.3.IT-PRG.1	Analyze customer software needs and requirements.
9.3.IT-PRG.2	Demonstrate the use of industry standard strategies and project planning to meet customer specifications.
9.3.IT-PRG.3	Analyze system and software requirements to ensure maximum operating efficiency.
9.3.IT-PRG.4	Demonstrate the effective use of software development tools to develop software applications.
9.3.IT-PRG.5	Apply an appropriate software development process to design a software application.
9.3.IT-PRG.6	Program a computer application using the appropriate programming language.
9.3.IT-PRG.7	Demonstrate software testing procedures to ensure quality products.
9.3.IT-PRG.8	Perform quality assurance tasks as part of the software development cycle.
9.3.IT-PRG.9	Perform software maintenance and customer support functions.
CPI #	**Cumulative Progress Indicator (CPI)**
Pathway: Web & Digital Communications (IT-WD)	
9.3.IT-WD.1	Analyze customer requirements to design and develop a Web or digital communication product.
9.3.IT-WD.2	Apply the design and development process to produce user-focused Web and digital communications solutions.

9.3.IT-WD.3	Write product specifications that define the scope of work aligned to customer requirements.
9.3.IT-WD.4	Demonstrate the effective use of tools for digital communication production, development and project management.
9.3.IT-WD.6	Design, create and publish a digital communication product based on customer needs.
9.3.IT-WD.7	Evaluate the functionality of a digital communication product using industry accepted techniques and metrics.
9.3.IT-WD.8	Implement quality assurance processes to deliver quality digital communication products and services.
9.3.IT-WD.9	Perform maintenance and customer support functions for digital communication products.
9.3.IT-WD.10	Comply with intellectual property laws, copyright laws and ethical practices when creating Web/digital communications.

Instructional Focus

Unit Enduring Understandings

- Creative development can be an essential process for creating computational artifacts. EU 1.1
- Computing enables people to use creative development processes to create computational artifacts for creative expression or to solve a problem. EU 1.2
- Programs can be developed for creative expression, to satisfy personal curiosity, to create new knowledge or to solve problems (to help people, organizations or society). EU 5.1
- The Internet is a network of autonomous systems. EU 6.1
- Characteristics of the Internet influence the systems built on it. EU 6.2
- Computing enhances communication, interaction and cognition. EU 7.1
- Computing innovations influence and are influenced by the economic, social and cultural contexts in which they are designed and used. EU 7.4

Unit Essential Questions

- How does the Internet work?
- How does the Internet and computing impact individuals and communities?
- What is the history of modern-day computing?
- How will computing affect our future?
- What are the shortcomings of existing technologies?
- What existing technological resources can be used for innovation?
- How can effective collaboration impact innovation?

Objectives

Students will know:

- Creating computational artifacts employs an iterative and often exploratory process to translate ideas into tangible form.
- A collaboratively created computational artifact reflects effort by more than one person.
- Effective collaboration strategies enhance performance.
- Programs developed for creative expression, to satisfy personal curiosity or to create new knowledge may have visual, audible or tactile inputs and outputs.

- Additional desired outcomes may be realized independently of the original purpose of the program.
- Collaboration in the iterative development of a program requires different skills than developing a program alone.
- The Internet connects devices and networks all over the world.
- Devices and networks that make up the Internet are connected and communicate using addresses and protocols.
- The Internet is built on evolving standards, including those for addresses and names.
- The Internet and the systems built on it are hierarchical and redundant.
- Hierarchy and redundancy help systems scale.
- Open standards fuel the growth of the Internet.
- The size and speed of systems affect their use.
- Social media continues to evolve and fosters new ways to communicate.
- Widespread access to information facilitates the identification of problems, development of solutions and dissemination of results
- The Internet and the Web have impacted productivity, positively and negatively, in many areas.
- The innovation and impact of social media and online access varies in different countries and in different socioeconomic groups.

Students will be able to:

- Apply a creative development process when creating computational artifacts.
- Collaborate in the creation of computational artifacts.
- Develop a program for creative expression, to satisfy a personal curiosity or to create new knowledge.
- Collaborate to develop a program.
- Explain the abstractions in the Internet and how the Internet functions.
- Explain characteristics of the Internet and the systems built on it.
- Explain how the characteristics of the Internet influence the systems built on it.
- Explain how computing innovations affect communication, interaction and cognition.
- Explain the connections between computing and real-world contexts, including economic, social and cultural contexts.

Evidence of Learning

Assessment

- Technology, Entertainment, Design (TED)-style presentation
- Quizzes
- Problem Sets
- Small Group Research and Presentation
- Individual teacher feedback
- Student self-assessment and assessment of peers
- Exam

Competencies for 21st Century Learners			
	Collaborative Team Member		Effective Communicator
	Globally Aware, Active, & Responsible Student/Citizen		Information Literate Researcher
	Innovative & Practical Problem Solver		Self-Directed Learner

Resources

Core Text: UTeach CS Principles. The University of Texas at Austin. Unit 6.
https://uteachcs.gitbooks.io/uteach-cs-principles/content/?key=5c24-736d-802f

Suggested Resources: *Blown to Bits* (Abelson, Ledeen, Lewis). Chapter 1: Digital Explosion - Why is it Happening, and What is at Stake?

Blown to Bits (Abelson, Ledeen, Lewis). Appendix - The Internet as System and Spirit
http://www.bitsbook.com/wp-content/uploads/2008/12/B2B_3.pdf

Unit 7: Performance Tasks

Content Area: Computer Science

Course & Grade Level: AP Computer Science Principles, Grades 9 - 12

Summary and Rationale

This unit serves to fulfill the Performance Task requirements of the AP Computer Science Principles exam. This externally moderated assessment will account for 40% of the student's AP exam score. As such, the work produced in this unit should reflect the sole work of the student and performed in-class with minimal involvement from the classroom teacher. For the "Create" Performance Task, the student may receive collaborative support from a fellow student, but the work submitted should be the individual student's own work.

Recommended Pacing

25 days

State Standards

8.1 Educational Technology	
CPI #	**Cumulative Progress Indicator (CPI)**
A. Technology Operations and Concepts	
8.1.12.A.1	Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.
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.
8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
CPI #	**Cumulative Progress Indicator (CPI)**
B. Creativity and Innovation	
8.1.12.B.2	Apply previous content knowledge by creating and piloting a digital learning game or tutorial.
CPI #	**Cumulative Progress Indicator (CPI)**
C. Communication and Collaboration	
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.
CPI #	**Cumulative Progress Indicator (CPI)**
D. Digital Citizenship	
8.1.12.D.1	Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
8.1.12.D.2	Evaluate consequences of unauthorized electronic access (e.g. hacking) and disclosure, and on dissemination of personal information.

8.1.12.D.3	Compare and contrast policies on filtering and censorship both locally and globally. Exhibit leadership for digital citizenship.
8.1.12.D.4	Research and understand the positive and negative impact of one's digital footprint.
8.1.12.D.5	Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.
CPI #	**Cumulative Progress Indicator (CPI)**
E: Research and Information Fluency	
8.1.12.E.1	Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
8.1.12.E.2	Research and evaluate the impact on society of the unethical use of digital tools and present your research to peers.
CPI #	**Cumulative Progress Indicator (CPI)**
F: Critical thinking, problem solving, and decision making	
8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming	
CPI #	**Cumulative Progress Indicator (CPI)**
A. Technology Operations and Concepts	
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.
8.2.12.A.2	Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
8.2.12.A.3	Research and present information on an existing technological product that has been repurposed for a different function.
CPI #	**Cumulative Progress Indicator (CPI)**
B. Technology and Society	
8.2.12.B.1	Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.
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.
8.2.12.B.3	Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs.
8.2.12.B.4	Investigate a technology used in a given period of history, e.g., stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.
8.2.12.B.5	Research the historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product, and present the competing viewpoints to peers for review.

CPI #	Cumulative Progress Indicator (CPI)
C. Design	
8.2.12.C.1	Explain how open source technologies follow the design process.
8.2.12.C.2	Analyze a product and how it has changed or might change over time to meet human needs and wants.
8.2.12.C.3	Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors engineering (ergonomics).
8.2.12.C.4	Explain and identify interdependent systems and their functions.
8.2.12.C.6	Research an existing product, reverse engineer and redesign it to improve form and function.
8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify trade-offs and constraints, and document the process through drawings that include data and materials.
CPI #	**Cumulative Progress Indicator (CPI)**
D. Abilities for a Technological World	
8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
8.2.12.D.2	Write a feasibility study of a product to include: economic, market, technical, financial, and management factors, and provide recommendations for implementation.
8.2.12.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
8.2.12.D.4	Assess the impacts of emerging technologies on developing countries.
8.2.12.D.6	Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society, or the environment and publish conclusions.
CPI #	**Cumulative Progress Indicator (CPI)**
E. Computational Thinking: Programming	
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).
9.3 – Career & Technical Education (CTE) Information Technology Career Cluster	
CPI #	**Cumulative Progress Indicator (CPI)**
Pathway: Programming & Software Development (IT-PRG)	
9.3.IT.1	Demonstrate effective professional communication skills and practices that enable positive customer relationships.

9.3.IT.2	Use product or service design processes and guidelines to produce a quality information technology (IT) product or service.
9.3.IT.3	Demonstrate the use of cross-functional teams in achieving IT project goals.
9.3.IT.4	Demonstrate positive cyber citizenry by applying industry accepted ethical practices and behaviors.
9.3.IT.5	Explain the implications of IT on business development.
9.3.IT.6	Describe trends in emerging and evolving computer technologies and their influence on IT practices.
9.3.IT.7	Perform standard computer backup and restore procedures to protect IT information.
9.3.IT.8	Recognize and analyze potential IT security threats to develop and maintain security requirements.
9.3.IT.9	Describe quality assurance practices and methods employed in producing and providing quality IT products and services.
9.3.IT.12	Demonstrate knowledge of the hardware components associated with information systems.
9.3.IT-PRG.1	Analyze customer software needs and requirements.
9.3.IT-PRG.2	Demonstrate the use of industry standard strategies and project planning to meet customer specifications.
9.3.IT-PRG.3	Analyze system and software requirements to ensure maximum operating efficiency.
9.3.IT-PRG.4	Demonstrate the effective use of software development tools to develop software applications.
9.3.IT-PRG.5	Apply an appropriate software development process to design a software application.
9.3.IT-PRG.6	Program a computer application using the appropriate programming language.
9.3.IT-PRG.7	Demonstrate software testing procedures to ensure quality products.
9.3.IT-PRG.8	Perform quality assurance tasks as part of the software development cycle.
9.3.IT-PRG.9	Perform software maintenance and customer support functions.
CPI #	**Cumulative Progress Indicator (CPI)**
Pathway: Web & Digital Communications (IT-WD)	
9.3.IT-WD.1	Analyze customer requirements to design and develop a Web or digital communication product.
9.3.IT-WD.2	Apply the design and development process to produce user-focused Web and digital communications solutions.
9.3.IT-WD.3	Write product specifications that define the scope of work aligned to customer requirements.
9.3.IT-WD.4	Demonstrate the effective use of tools for digital communication production, development and project management.
9.3.IT-WD.6	Design, create and publish a digital communication product based on customer needs.
9.3.IT-WD.7	Evaluate the functionality of a digital communication product using industry accepted techniques and metrics.

9.3.IT-WD.8	Implement quality assurance processes to deliver quality digital communication products and services.
9.3.IT-WD.9	Perform maintenance and customer support functions for digital communication products.
9.3.IT-WD.10	Comply with intellectual property laws, copyright laws and ethical practices when creating Web/digital communications.

Instructional Focus

Unit Enduring Understandings

- Computing enables people to use creative development processes to create computational artifacts for creative expression or to solve a problem. EU 1.2
- Multiple levels of abstraction are used to write programs or create other computational artifacts. EU 2.2
- There are trade-offs when representing information as digital data. EU 3.3
- Algorithms are precise sequences of instructions for processes that can be executed by a computer and are implemented using programming languages. EU 4.1
- Programs can be developed for creative expression, to satisfy personal curiosity, to create new knowledge or to solve problems (to help people, organizations or society). EU 5.1
- People write programs to execute algorithms. EU 5.2
- Programming is facilitated by appropriate abstractions. EU 5.3
- Programs are developed, maintained and used by people for different purposes. EU 5.4
- Programming uses mathematical and logical concepts. EU 5.5
- Computing enhances communication, interaction and cognition. EU 7.1
- Computing enables innovation in nearly every field. EU 7.2
- Computing has global effects - both beneficial and harmful - on people and society. EU 7.3
- Computing innovations influence and are influenced by the economic, social and cultural contexts in which they are designed and used. EU 7.4

Unit Essential Questions

- What are the social, economic and cultural impacts of my chosen technological innovation?
- How does my chosen innovation consume, produce and/or transform data?
- What concerns regarding storage, privacy or security are raised by my chosen innovation?
- How can I creatively develop a computational artifact that is representative of the features of my chosen innovation?
- How can I use what I have learned to solve or explore a problem of personal interest to me?
- How do I effectively demonstrate my learning via the creation of an original computational work?

Objectives

Students will know:

- A computational artifact is something created by a human using a computer and can be a program, an image, an audio, a video, a presentation or a Web page file.
- Creating computational artifacts requires understanding of and use of software tools and services.
- Computing tools and techniques are used to create computational artifacts and can include, but are not limited to, programming integrated development environments (IDEs), spreadsheets, three-dimensional (3-D) printers or text editors.

- A creatively developed computational artifact can be created by using nontraditional, non-prescribed computing techniques.
- Creative expression in a computational artifact can reflect personal expressions of ideas or interests.
- Computing tools and techniques can enhance the process of finding a solution to a problem.
- Combining or modifying existing artifacts can show personal expression of ideas.
- A collaboratively created computational artifact reflects effort by more than one person.
- An abstraction extracts common features from specific examples in order to generalize concepts.
- The choice of storage media affects both the methods and costs of manipulating the data it contains.
- Programs developed for creative expression, to satisfy personal curiosity or to create new knowledge may have visual, audible or tactile inputs and outputs.
- A programmer's knowledge and skill affects how a program is developed and how it is used to solve a problem.
- Additional desired outcomes may be realized independently of the original purpose of the program.
- Collaboration in the iterative development of a program requires different skills than developing a program alone.
- Computing enables innovation by providing the ability to access and share information.
- Plagiarism is a serious offense that occurs when a person presents another's ideas or words as his or her own.
- Information for a source is considered relevant when it supports an appropriate claim or the purpose of the investigation.

Students will be able to:

- Create a computational artifact for creative expression.
- Create a computational artifact using computing tools and techniques to solve a problem.
- Create a new computational artifact by combining or modifying existing artifacts.
- Collaborate in the creation of computational artifacts.
- Analyze the correctness, usability, functionality and suitability of computational artifacts.
- Develop an abstraction when writing a program or creating other computational artifacts.
- Identify multiple levels of abstractions that are used when writing programs.
- Analyze how data representation, storage, security and transmission of data involve computational manipulation of information.
- Develop an algorithm for implementation in a program.
- Express an algorithm in a language.
- Develop a program for creative expression, to satisfy a personal curiosity or to create new knowledge.
- Develop a correct program to solve problems.
- Collaborate to develop a program.
- Explain how programs implement algorithms.
- Use abstraction to manage complexity in programs.
- Evaluate the correctness of a program.
- Employ appropriate mathematical and logical concepts in programming.
- Explain how computing innovations affect communication, interaction and cognition.
- Explain how computing has impacted innovations in other fields.
- Analyze the beneficial and harmful effects of computing.

- Explain the connections between computing and real-world contexts, including economic, social and cultural contexts.

Evidence of Learning

Assessment

- A student-produced computational artifact with written responses to questions about the artifact and computing innovation
- An individually or collaboratively produced program with documenting video and written response detailing the development process

Competencies for 21st Century Learners

	Collaborative Team Member		Effective Communicator
	Globally Aware, Active, & Responsible Student/Citizen		Information Literate Researcher
	Innovative & Practical Problem Solver		Self-Directed Learner

Resources

Core Text: UTeach CS Principles. The University of Texas at Austin. Unit 7.
https://uteachcs.gitbooks.io/uteach-cs-principles/content/?key=5c24-736d-802f
Suggested Resources: Miscellaneous, student-selected resources (varies by student)

Unit 7a: Artificial Intelligence

Content Area: Computer Science

Course & Grade Level: AP Computer Science Principles, Grades 9 - 12

Summary and Rationale

As computing devices grow more powerful, they are increasingly used to augment or replace human labor through the simulation of human skills and behaviors. In this unit, students will explore some of the ways in which computer scientists incorporate "artificial intelligence (AI)" into their algorithms, and what the philosophical implications of these advances may mean for the future. Students will examine the use of a number of AI-infused applications, and finally, evaluate these applications using the standard metric for general AI—the Turing Test.

Recommended Pacing

10 days

State Standards

8.1 Educational Technology	
CPI #	**Cumulative Progress Indicator (CPI)**
A. Technology Operations and Concepts	
8.1.12.A.1	Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.
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.
8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
CPI #	**Cumulative Progress Indicator (CPI)**
B. Creativity and Innovation	
8.1.12.B.2	Apply previous content knowledge by creating and piloting a digital learning game or tutorial.
CPI #	**Cumulative Progress Indicator (CPI)**
C. Communication and Collaboration	
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.
CPI #	**Cumulative Progress Indicator (CPI)**
D. Digital Citizenship	
8.1.12.D.1	Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
8.1.12.D.5	Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.

CPI #	Cumulative Progress Indicator (CPI)
E: Research and Information Fluency	
8.1.12.E.1	Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
8.1.12.E.2	Research and evaluate the impact on society of the unethical use of digital tools and present your research to peers.
CPI #	**Cumulative Progress Indicator (CPI)**
F: Critical thinking, problem solving, and decision making	
8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming	
CPI #	**Cumulative Progress Indicator (CPI)**
A. Technology Operations and Concepts	
8.2.12.A.2	Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
8.2.12.A.3	Research and present information on an existing technological product that has been repurposed for a different function.
CPI #	**Cumulative Progress Indicator (CPI)**
B. Technology and Society	
8.2.12.B.1	Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.
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.
8.2.12.B.3	Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs.
8.2.12.B.4	Investigate a technology used in a given period of history, e.g., stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.
CPI #	**Cumulative Progress Indicator (CPI)**
C. Design	
8.2.12.C.2	Analyze a product and how it has changed or might change over time to meet human needs and wants.
8.2.12.C.3	Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors engineering (ergonomics).
8.2.12.C.4	Explain and identify interdependent systems and their functions.
8.2.12.C.6	Research an existing product, reverse engineer and redesign it to improve form and function.
8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify trade-offs and constraints, and document

	the process through drawings that include data and materials.
CPI #	**Cumulative Progress Indicator (CPI)**
D. Abilities for a Technological World	
8.2.12.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
8.2.12.D.4	Assess the impacts of emerging technologies on developing countries.
8.2.12.D.6	Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society, or the environment and publish conclusions.
CPI #	**Cumulative Progress Indicator (CPI)**
E. Computational Thinking: Programming	
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).
9.3 – Career & Technical Education (CTE) Information Technology Career Cluster	
CPI #	**Cumulative Progress Indicator (CPI)**
Pathway: Programming & Software Development (IT-PRG)	
9.3.IT.1	Demonstrate effective professional communication skills and practices that enable positive customer relationships.
9.3.IT.2	Use product or service design processes and guidelines to produce a quality information technology (IT) product or service.
9.3.IT.3	Demonstrate the use of cross-functional teams in achieving IT project goals.
9.3.IT.4	Demonstrate positive cyber citizenry by applying industry accepted ethical practices and behaviors.
9.3.IT.6	Describe trends in emerging and evolving computer technologies and their influence on IT practices.
9.3.IT.8	Recognize and analyze potential IT security threats to develop and maintain security requirements.
9.3.IT.9	Describe quality assurance practices and methods employed in producing and providing quality IT products and services.
9.3.IT.12	Demonstrate knowledge of the hardware components associated with information systems.
9.3.IT-PRG.1	Analyze customer software needs and requirements.
9.3.IT-PRG.2	Demonstrate the use of industry standard strategies and project planning to meet customer specifications.
9.3.IT-PRG.3	Analyze system and software requirements to ensure maximum operating efficiency.

9.3.IT-PRG.4	Demonstrate the effective use of software development tools to develop software applications.
9.3.IT-PRG.5	Apply an appropriate software development process to design a software application.
9.3.IT-PRG.6	Program a computer application using the appropriate programming language.
9.3.IT-PRG.7	Demonstrate software testing procedures to ensure quality products.
9.3.IT-PRG.8	Perform quality assurance tasks as part of the software development cycle.
9.3.IT-PRG.9	Perform software maintenance and customer support functions.
CPI #	**Cumulative Progress Indicator (CPI)**
Pathway: Web & Digital Communications (IT-WD)	
9.3.IT-WD.1	Analyze customer requirements to design and develop a Web or digital communication product.
9.3.IT-WD.2	Apply the design and development process to produce user-focused Web and digital communications solutions.
9.3.IT-WD.3	Write product specifications that define the scope of work aligned to customer requirements.
9.3.IT-WD.4	Demonstrate the effective use of tools for digital communication production, development and project management.
9.3.IT-WD.6	Design, create and publish a digital communication product based on customer needs.
9.3.IT-WD.7	Evaluate the functionality of a digital communication product using industry accepted techniques and metrics.
9.3.IT-WD.8	Implement quality assurance processes to deliver quality digital communication products and services.
9.3.IT-WD.10	Comply with intellectual property laws, copyright laws and ethical practices when creating Web/digital communications.

Instructional Focus

Unit Enduring Understandings

- Computing enables people to use creative development processes to create computational artifacts for creative expression or to solve a problem. EU 1.2
- Programs can be developed for creative expression, to satisfy personal curiosity, to create new knowledge or to solve problems (to help people, organizations or society). EU 5.1
- Computing enhances communication, interaction and cognition. EU 7.1
- Computing innovations influence and are influenced by the economic, social and cultural contexts in which they are designed and used. EU 7.4

Unit Essential Questions

- How does Artificial Intelligence work?
- Can computer software ever rival human intelligence?
- Will computers replace doctors, educators, or even artists?
- What is a chatterbot?
- What is the history of modern-day computing?

- How will computing affect our future?
- What are the shortcomings of existing technologies?
- What existing technological resources can be used for innovation?
- How can effective collaboration impact innovation?

Objectives

Students will know:

- How to black-box test a chatterbot, ask it a list of questions, and record and compare its responses to possible reasonable answers.
- Chatterbots' automated reasoning can be analyzed for patterns.
- Artificial Intelligence comes in many forms.
- Robots use a multi-modal approach to "understand".
- How AI systems utilize probability and statistics to behave "intelligently".

Students will be able to:

- Comprehend how the mechanical manipulation of symbols is a form of problem solving.
- Analyze a "chatterbot" for pattern recognition and manipulation.
- Evaluate multiple approaches for designing a Turing Test for both effectiveness and generalizability.
- Differentiate between "strong" and "weak" AI.
- Identify relationships between the AI subfield of Natural Language Processing (NLP) and Human-Computer Interface (HCI).
- Describe visual and speech recognition as a form of multi-modal AI.
- Discover, implement, and exploit strategies to discern between human and artificial intelligences.

Evidence of Learning

Assessment

- Quizzes
- Problem Sets
- Small Group Research and Presentation
- Individual teacher feedback
- Student self-assessment and assessment of peers
- Exam

Competencies for 21st Century Learners

	Collaborative Team Member		Effective Communicator
	Globally Aware, Active, & Responsible Student/Citizen		Information Literate Researcher
	Innovative & Practical Problem Solver		Self-Directed Learner

Resources

Core Text: UTeach CS Principles. The University of Texas at Austin. Unit A1.
https://uteachcs.gitbooks.io/uteach-cs-principles/content/?key=5c24-736d-802f