SCHOOL DISTRICT OF THE CHATHAMS

AP Computer Science Principles
Grades 10 - 12
Full Year

Course Overview

In this course, students will be learning about programming concepts, using block based language (MIT App Inventor) eliminating the need to deal with syntax. The major focus of this class is to discuss computing concepts in an approachable way, how computing is a creative process, how we use abstraction to model real world behavior and how to write algorithms to program those abstractions. In addition, a major component of the class is to talk about the Internet, from the functional to the ethical as well as other general computing innovations and their global impact.

New Jersey Student Learning Standards
The New Jersey Student Learning Standards (NJSLS) can be located at www.nj.gov/education/cccs/2020/.

Computing Systems
8.1.12.CS.1: Describe ways in which integrated systems hide underlying implementation details to simplify user experiences.
8.1.12.CS.2: Model interactions between application software, system software, and hardware.
8.1.12.CS.3: Compare the functions of application software, system software, and hardware.
8.1.12.CS.4: Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors.

Networks and the Internet
8.1.12.NI.1: Evaluate the scalability and reliability of networks, by describing the relationship between routers, switches, servers, topology, and addressing.
8.1.12.NI.2: Evaluate security measures to address various common security threats.
8.1.12.NI.3: Explain how the needs of users and the sensitivity of data determine the level of security implemented.
8.1.12.NI.4: Explain how decisions on methods to protect data are influenced by whether the data is at rest, in transit. or in use.

Impacts of Computing
8.1.12.IC.1: Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices.
8.1.12.IC.2: Test and refine computational artifacts to reduce bias and equity deficits.
8.1.12.IC.3: Predict the potential impacts and implications of emerging technologies on larger social, economic, and political structures, using evidence from credible sources.

Data & Analysis
8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
8.1.12.DA.2: Describe the tradeoffs in how and where data is organized and stored.
8.1.12.DA.3: Translate between decimal numbers and binary numbers.

8.1.12.DA.4: Explain the relationship between binary numbers and the storage and use of data in a computing device.
8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
8.1.12.DA.6: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process.

Technology Standards
9.4.12.DC.3: Evaluate the social and economic implications of privacy in the context of safety, law, or ethics.
9.4.12.DC.4: Explain the privacy concerns related to the collection of data (e.g. cookies) and generation of data through automated processes that may not be evident to users.
9.4.12.DC.5: Debate laws and regulations that impact the development and use of software

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9.4.12.CI.1: Demonstrate the ability to reflect, analyze and use creative skills and ideas.
9.4.12.CI.2: Identify career pathways that highlight personal talents, skills and abilities.
9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
9.3.IT.12 Demonstrate knowledge of the hardware components associated with information systems.

Career Ready Practices
CRP2. Apply appropriate academic and technical skills.
CRP4. Communicate clearly and effectively and with reason.
CRP6. Demonstrate creativity and innovation
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP11. Use technology to enhance productivity.

Interdisciplinary Connections
Science
- HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Units of Study

Unit 1: Intro, Mobile Computers and Mobile Apps (~24 days)
- What are Mazes, Algorithms and Programs?
- How do we set up a portfolio?
- What is App Inventor and how do we use it?
- What is Blown to Bits about?
- What are some of the App Inventor controls?
- What are applications?
- What are devices?
- What is abstraction?
- What are binary numbers?
- How is the digital explosion affecting us?
- What are hardware and software abstractions?

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Unit 2: Graphics and Drawing (~20 days)

- What is a bit?
- How do we represent information (images, text, etc) as bits?
- How do we transform an algorithm into one that is more flexible?
- How do we detect transmission errors?
- What is parity? What is a hamming code?
- How do we make data persist from one application session to another?

Unit 3: Animation, Simulation and Modeling (~28 days)

- What are the limits and expectations of privacy when using the Internet?
- What is randomness?
- How do computers model randomness?
- How can randomness be applied to model real world problems?
- How does a CPU function?
- How is abstraction applied in the function of a CPU?

Unit 4: Algorithms and Procedural Abstraction (~20 days)

- How does searching the web work?
- What is a search algorithm?
- What is a sort algorithm?
- How do we analyze the efficiency of search and sort algorithms?
- What are the limits of what algorithms can do?

Unit 5: Using and Analyzing Data and Information (~32 days)

- What is a data set?
- How has data collection evolved?
- How can lines of communication create problems in programming?
- How are more complex data structures created and worked with?

Unit 6: The Internet (~16 days)

- What are the core components of the Internet?
- How does the Internet function?
- What is cryptography?
- How does cryptography work?
- How is the government involved in cryptography?

Unit 7: CS Exploration (~20 days)

- Why is this topic important (to the student)?
- What is the student's goal in the time available?
- What has the student accomplished towards meeting that goal on a weekly basis?

Learning Objectives/Discipline Standards of Practice

Learning Objectives:

- Understand the difference between a maze, algorithm and program.
- Setup and configure a portfolio.
- Understand the relevance of reading Blown to Bits.
- Become familiar with App Inventor controls.
- Understand the difference between applications and devices.

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- Recognize abstraction.
- Understand the binary number system.
- Recognize the effect of the digital explosion.
- Understand hardware and software abstractions.
- Understand the function of logic gates.
- Understand binary digital images representation.
- Understand image compression techniques.
- Recognize encoding manipulation.
- Understand how binary errors can be detected simply or using parity.
- Create models of scenarios.
- Implement a simulation to test theories.
- Identify the uses and limitations of pseudo randomness.
- Reflect on privacy issues and their effect on society.
- Understand the three basic control structures of algorithms.
- Become familiar with various search algorithm methodology.
- Familiarize with various sort algorithm methodology.
- Analyze algorithm efficiency.
- Reflect on the effect of search engines on society.
- Understand the role of data in computer programs.
- Understand the development and current role of big data.
- Understand the difference between synchronous and asynchronous communication and the problems that can arise.
- Understand the complexity of creating and working with data sets.
- Recognize the differences between the world wide web and the Internet.
- Understand how the world wide web and Internet interact.
- Understand cloud computing.
- Understand the client/server model.
- Recognize the structure of the Internet (packets, TCP/IP).
- Implement basic cryptography methods.
- Reflect on ethical use of the Internet.
- Select a computer science topic of their choosing to investigate beyond the scope of the course.
    - Topics can include (but are not limited to):
        - Learning a new programming language
        - Animation/Graphics programming
        - CyberSecurity

<u>Discipline Standards of Practice</u>:

- Computing Systems
    - People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.
- Networks and the Internet
    - Computing devices typically do not operate in isolation. Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world.
- Impacts of Computing
    - Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their

behaviors and cultural and social interactions, and, in turn, computing influences new cultural practices.

- Data & Analysis
    - Computing systems exist to process data. The amount of digital data generated in the world is rapidly expanding, so the need to process data effectively is increasingly important. Data is collected and stored so that it can be analyzed to better understand the world and make more accurate predictions.
- Algorithms & Programming
    - An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing devices. Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems.
- Engineering Design
    - People design for enjoyment and to solve problems, extend human capabilities, satisfy needs and wants, and improve the human condition. Engineering Design, a systematic approach to creating solutions to technological problems and finding ways to meet people's needs and desires, allows for the effective and efficient development of products and systems.
- Interaction of Technology and Humans
    - Societies influence technological development. Societies are characterized by common elements such as shared values, differentiated roles, and cultural norms, as well as by entities such as community institutions, organizations, and businesses. Interaction of Technology and Humans concerns the ways society drives the improvement and creation of new technologies, and how technologies both serve and change society.
- Nature of Technology
    - Human population, patterns and movement focus on the size, composition, distribution, and movement of human populations and how they are fundamental and active features on Earth's surface. This includes understanding that the expansion and redistribution of the human population affects patterns of settlement, environmental changes, and resource use. Patterns and movements of population also relate to physical phenomena including climate variability, landforms, and locations of various natural hazards and their effects on population size, composition, and distribution.
- Effects of Technology on the Natural World
    - Many of engineering and technology's impacts on society and the environment are widely regarded as desirable. However, other impacts are regarded as less desirable. Effects of Technology on the Natural World concerns the positive and negative ways that technologies affect the natural world.
- Ethics & Culture
    - Ethics and Culture concerns the profound effects that technologies have on people, how those effects can widen or narrow disparities, and the responsibility that people have for the societal consequences of their technological decisions.

Instructional Resources and Materials
Whole class resources have been identified with an asterisk.

Resources

- *Blown to Bits: Your Life, Liberty, and Happiness After the Digital Explosion* by Hal Abelson & Ken Ledeen
- *Program or Be Programmed* by Douglas Rushkoff

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Materials

- Online documentation for MIT App Inventor

Assessment Strategies

Assessment is designed to measure a student's mastery of a course standard and learning objective. Assessment can be used for both instructional purposes (formative assessment) and for evaluative purposes (summative assessment).

The following is a general list of the many forms assessment may take in learning.

- Create programs to solve basic problems using App Inventor programming

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