MASTERY
— CODING —

Computer Science Principles

Course Syllabus

Computer Science Foundations

General Overview

Computer Science Principles is a comprehensive introduction to computer science and programming, designed for high school students. Through engaging projects and clear, step-by-step guidance, students will learn to code in Python while exploring the exciting world of computer science.

This course covers fundamental programming concepts and aligns to the AP Computer Science Principles Exam and prepare students for the Certiport IT Specialist Programmer Exam, IT Specialist Computational Thinking and the PCEP Certified Entry-Level Python Programmer certifications.

Course Objectives

In this course, students will:

- Learn Python basics, including syntax, variables, and data types, setting a foundation for programming.
- Explore control structures, loops, and basic algorithms, enhancing problem-solving skills.
- Understand data structures and file I/O operations, crucial for practical Python applications.
- Delve into functions, object-oriented programming, and Python modules, advancing coding proficiency.
- Study the history and societal impact of computing, along with fundamental software design principles.
- Prepare for the AP Computer Science Principles exam.
- Prepare for Certiport IT and PCEP Python Programmer exams through hands-on projects and analysis techniques.

Mission and Goals

In accordance with the Mission of Mastery Coding, the faculty, staff, and students understand and declare our purpose to be the encouragement of life-long learning, academic excellence, the education of the whole person, and future readiness in a world changed by technology.

Value and respect for all individuals

We believe in the worth of each individual. We affirm the inherent dignity and value of each person. Therefore, we believe that all individuals have the potential to be successful learners with unique characteristics and experiences that bring positive value and meaning to the learning experience.

All students will be:

- Offered a challenging learning experience that will help to maximize their individual achievement and provide meaningful opportunities for students to excel
- Offered diverse instructional suggestions and strategies that address the specific needs of the United State's diverse population
- Provided a clear instructional goal
- Afforded an instructional program that preserves the balance of conceptual understanding and problem solving of the subject area.
- Provided the learning in each instructional year that lays the necessary groundwork for success in subsequent years of study
- Provided a learning environment that fosters a genuine understanding and confidence in all students that through hard work and sustained effort, they can achieve or exceed the learning objectives
- Provided a cogent balance theory, research, and practice.

Develop moral, intellectual, responsible, and caring citizens

We are committed to the preparation of students who will be exemplars in the field, and who reflect high standards of ethics and values. We seek to be, and to encourage others to be, people who have the intellectual skills to critically evaluate important issues, have the moral conviction to respond as agents of change, and exhibit an ethic of care in the service of others

**The instructor retains the right to make changes, additions or deletions to the syllabus during the course of the learning period.*

Course Breakdown

Unit 1: Hello, World

Students will learn the basics of computer programming with Python including code, variables, data types, debugging, operations, branching logic, lists, loops, and even create a Rock, Paper, Scissors game in this comprehensive unit.

Chapters

- Chapter 1: Hello, World (Duration: 2 hr 0 min)
    - In this chapter, students will learn about the basics of computer programming using Python. This includes understanding code, variables, data types, debugging, setting up their programming environment, writing their first program, and testing their understanding of Python fundamentals.
- Chapter 2: Operations (Duration: 2 hr 15 min)
    - Students will learn about sequence, order of operations, control flow, control structures, string concatenation, basic arithmetic operations, and key math concepts in a chapter covering fundamental programming structures and operations.
- Chapter 3: Branching Logic (Duration: 2 hr 45 min)
    - Students will learn about conditions, comparison operators, conditional logic, nested conditionals, and how to implement them in Python to control program flow and make decisions based on different conditions.
- Chapter 4: Lists and Loops (Duration: 1 hr 30 min)
    - In this chapter, students will learn about lists and loops in Python, including how to analyze sports scores using lists and loops, create complex patterns with nested loops, and review concepts on loops and lists manipulation.
- Chapter 5: Rock, Paper, Scissors Project (Duration: 1 hr 0 min)
    - Students will learn how to build a game of Rock, Paper, Scissors in Python, defining constants, handling user input, generating random choices for the computer, determining winners, and implementing game logic with functions and loops.

Course Breakdown

Unit 2: Hello, Data

In this unit, students will learn about bits, bytes, binary numbers, ASCII encoding/decoding, data types in Python, collections, input/output operations, and build a word guessing game project in Python.

Chapters

- Chapter 1: Bits and Bytes (Duration: 2 hr 30 min)
    - Students will learn about fundamental concepts of bits and bytes, the binary number system, and encoding/decoding data using ASCII. They will also gain hands-on experience creating a Caesar Cipher program in Python and converting between binary and ASCII formats.
- Chapter 2: Data Types (Duration: 2 hr 30 min)
    - In this chapter, students will learn about the primary numeric data types in Python, strings, reversing word order in sentences, working with variables, and practicing data type manipulation through a palindrome detector activity.
- Chapter 3: Collections (Duration: 2 hr 30 min)
    - In this chapter, students will learn about organizing data structures in Python by exploring lists, tuples, dictionaries, and sets. They will also practice transforming data and using collections to manipulate and store information efficiently.
- Chapter 4: Input / Output (Duration: 2 hr 45 min)
    - In this chapter, students will learn about input and output in computing, file operations in Python, creating a Mad Libs game, practicing with digital journal creation, encoding/decoding data, reviewing input/output concepts in programming, and the importance of data in generative AI.
- Chapter 5: The Guessing Game Project (Duration: 2 hr 10 min)
    - Students will learn how to build a word guessing game in Python step by step, from storing words in a dictionary to implementing player input, completing game turns, and creating a fully functional game with win or lose conditions.

Course Breakdown

Unit 3: Programming Programs

Students will learn the basics of defining functions, Object-Oriented Programming concepts, working with modules, writing programs with error handling, and creating a Tic Tac Toe game in Python.

Chapters

- Chapter 1: Functions (Duration: 2 hr 30 min)
    - Students will learn the basics of defining functions in Python, including how to use the 'def' keyword, structure of a function, calling functions, and creating functions with parameters. They will also learn how to create a "First Letter Counter" function, practice writing new functions, and review evaluating, graphing, and manipulating functions.
- Chapter 2: Objects (Duration: 2 hr 30 min)
    - In this chapter, students will learn about objects, classes, and core concepts of Object-Oriented Programming (OOP). They will also practice creating a `Deck` class in Python, working with inheritance, and creating a game character generator.
- Chapter 3: Modules (Duration: 2 hr 30 min)
    - Students will learn about the concept of modules in Python, including how to import built-in modules like `math`, `random`, and `statistics`, create custom modules, and practice working with modules through a weather forecasting simulator.
- Chapter 4: Writing Programs (Duration: 1 hr 55 min)
    - Students will learn about the importance of testing and debugging in programming, error handling using exceptions, the concept of recursion, and practical examples like creating a to-do list application. They will also review key programming concepts such as variables, data types, control structures, and functions.
- Chapter 5: Tic Tac Toe (Duration: 2 hr 10 min)
    - Students will learn how to build a game of Tic Tac Toe, including creating a Board class, implementing Player classes, checking for winners, and controlling the game flow using a Game class.

Course Breakdown

Unit 4: Data Structures

Students will learn about data and information, data structures like linked lists and binary trees, and apply their knowledge by building a Connect Four game in Python.

Chapters

- Chapter 1: Data and Information (Duration: 1 hr 0 min)
    - Students will learn about the concepts of data and information, their differences, the types of data (structured and unstructured), common data formats, metadata, and data processing operations.
- Chapter 2: Introducing Data Structures (Duration: 1 hr 0 min)
    - Students will learn about the definition and core components of data structures, explore linear data structures and arrays, understand memory management and implementation in Python, review basic concepts of different types of data structures.
- Chapter 3: Linked Lists (Duration: 1 hr 15 min)
    - Students will learn the basics of linked lists, including node structure, traversal, insertion, and deletion operations. They will also understand the advantages and disadvantages of using linked lists in their implementations.
- Chapter 4: Binary Trees (Duration: 1 hr 15 min)
    - In this chapter, students will learn about binary trees, Binary Search Trees (BSTs), and their properties, including the structure, types, and traversal techniques used in various applications.
- Chapter 5: Connect Four Project (Duration: 2 hr 40 min)
    - In this chapter, students will learn how to build a game of Connect Four, creating a Board class for game logic, understanding game pieces, determining the winner, and implementing player classes for human input and computer AI strategy.

Course Breakdown

Unit 5: Algorithms

In this unit, students will learn the fundamentals of algorithms, including search and sorting algorithms, implementing linear search in Python, understanding algorithmic efficiency, time and space complexity, Big O notation, and analyzing the efficiency of various algorithms.

Chapters

- Chapter 1: Introducing Algorithms (Duration: 1 hr 50 min)
    - Students will learn about the fundamentals of algorithms in computer science, including search and sorting algorithms. They will also implement and analyze the efficiency of the linear search algorithm in Python.
- Chapter 2: Search and Sort Algorithms (Duration: 1 hr 15 min)
    - Students will learn about search algorithms like linear search and binary search, sorting algorithms such as Bubble Sort, and their applications in efficiently organizing and retrieving data from data structures.
- Chapter 3: Algorithmic Efficiency (Duration: 1 hr 45 min)
    - Students will learn about algorithmic efficiency, time and space complexity, Big O notation, search algorithms, bubble sort, and how to analyze and compare the efficiency of algorithms in this chapter.

Course Breakdown

Unit 6: Computer Systems

In this unit, students will learn about the basics of computers, logic gates, truth tables, binary representation, and arithmetic circuits in digital electronics.

Chapters

- Chapter 1: What is a Computer? (Duration: 2 hr 45 min)
    - In this chapter, students will learn about the basics of computers, including core components, data processing, CPU architecture, memory, logic gates, and fundamental principles of computer systems.
- Chapter 2: Logic Gates and Truth Tables (Duration: 1 hr 0 min)
    - Students will learn about logic gates, the basic building blocks of digital circuits, and how they process binary inputs to produce binary outputs. They will also gain an understanding of truth tables and how they represent logic gate behaviors.
- Chapter 3: Circuits and Bits (Duration: 1 hr 15 min)
    - Students will learn about bits, binary, and arithmetic circuits in computing, exploring how data is represented and processed using binary digits, logic gates, and adder circuits in digital electronics.

Course Breakdown

Unit 7: Computer Networks

Students will learn about computer networks, internet structure, routing algorithms, OSI model layers, distributed systems, and parallel computing in a comprehensive unit covering key networking concepts and technologies.

Chapters

- Chapter 1: Networks and the Internet (Duration: 1 hr 45 min)
    - Students will learn the basics of computer networks, including communication using binary, protocols, routing data, and the role of routers and switches. They will also explore the structure of the internet, including connectivity layers, packets, protocols, and IP addresses, as well as review fundamental network concepts and the Internet's structure and function.
- Chapter 2: Graphs and Routing (Duration: 1 hr 45 min)
    - In this chapter, students will learn about the concept of graphs, routing in computer networks, setting up routing tables in Python, implementing routing logic in Python, and reviewing routing algorithms such as Dijkstra's and Bellman-Ford for network efficiency.
- Chapter 3: Open Systems Interconnection (Duration: 3 hr 15 min)
    - In this chapter, students will learn about the layers of computer networks including Physical, Data Link, Network, Transport, and Application layers. They will understand the roles of each layer in managing communication, data transmission, and network functionality within the OSI model.
- Chapter 4: Distributed Systems and Parallel Computing (Duration: 1 hr 15 min)
    - Students will learn about distributed systems, parallel computing, and their role in technology. They will explore concepts, benefits, challenges, and practical applications in modern systems.

Course Breakdown

Unit 8: Impacts of Computing and Computing Security

In this unit, students will explore cutting-edge topics in computer science such as AI and robotics, while also learning about computer security basics, encryption, authentication methods, and common security threats. They will also delve into ethical considerations in emerging technology fields.

Chapters

- Chapter 1: Exploring Computer Science (Duration: 2 hr 15 min)
    - In this chapter, students will learn about cutting-edge topics in computer science such as AI, machine learning, extended reality, and robotics. They will also delve into the intersection of ethics and computing, exploring key ethical questions and considerations in emerging technology fields like artificial intelligence.
- Chapter 2: Computer Security (Duration: 1 hr 15 min)
    - Students will learn about the basics of computer security, encryption types, authentication methods, password protection, multi-factor authentication, and common security threats in this chapter. They will also practice implementing encryption algorithms using Python.