Advanced Computer Science - Scope and Sequence

Course Description

This course serves as an engaging journey into the foundational principles of computing and computer science, providing students with the essential knowledge and skills to navigate the digital world with confidence. Designed to cultivate computational thinking and programming proficiency, the curriculum explores the far-reaching impact of technology on society while fostering creativity, logical reasoning, and problem-solving.

Through a hands-on, project-based approach, students will delve into coding, data analysis, and cybersecurity, gaining practical experience in designing and implementing computational solutions. Beyond technical skills, the course encourages critical discussions on the ethical and societal implications of computing, preparing students to think analytically about the role of technology in shaping the future. With an emphasis on real-world applications, this course lays a strong foundation for students pursuing college-level computer science studies and careers in the ever-evolving field of technology.

Module 1: Introduction to Computing and Digital Information

Key Topics:
- The Role of Computing in Society – How computing affects communication, business, education, and entertainment.
- Binary and Number Systems – Converting between binary, decimal, and hexadecimal.
- Data Representation – How text, images, and sound are stored as binary.
- Abstraction in Computing – How layers of abstraction simplify complexity.
- Computer Hardware & Software – Basics of CPUs, RAM, storage, and operating systems.

Skills Developed:

- Understanding and converting between number systems.
- Recognizing different data representations.
- Identifying abstraction levels in software and hardware.

Assignments/Projects:

- Binary Conversion Worksheet – Convert numbers between decimal, binary, and hexadecimal.
- Data Representation Challenge – Encode an image or a short sound clip using binary.
- Tech in Society Research Paper – Explore how computing has impacted a specific industry.

Module 2: The Internet and Cybersecurity

Key Topics:

- Structure of the Internet – Packets, routing, and redundancy.
- Protocols & Layers – HTTP, TCP/IP, DNS, and how they enable communication.
- Cybersecurity – Encryption, hashing, and public/private key cryptography.
- Cyber Threats & Safety – Phishing, malware, and methods of protection.

Skills Developed:

- Understanding how the internet enables global communication.
- Applying cybersecurity principles to personal and professional contexts.
- Identifying risks and implementing safety measures online.

Assignments/Projects:

- Packet Routing Simulation – Track how a message moves across the internet.
- Encryption Activity – Use basic ciphers to encrypt and decrypt messages.
- Cybersecurity Awareness PSA – Create a short video or presentation on online safety.

Module 3: Algorithms and Problem Solving

Key Topics:

- What is an Algorithm? – Definitions and real-world examples.
- Algorithm Efficiency – Analyzing algorithms for time and space complexity.
- Pseudocode & Flowcharts – Representing algorithms visually.
- Iterative vs. Recursive Approaches – When and how to use recursion.

Skills Developed:

- Writing and analyzing algorithms.
- Understanding computational efficiency.
- Representing algorithms in multiple formats.

Assignments/Projects:

- Algorithm Race – Compare different search and sorting algorithms.
- Pseudocode Design Challenge – Develop and present a solution for a common problem.
- Flowchart Coding Project – Convert a flowchart into a working program.

Module 4: Programming Fundamentals

Key Topics:

- Programming Basics – Variables, data types, and control structures.
- Functions & Modular Programming – Breaking down programs into reusable functions.
- Loops and Conditionals – Implementing decision-making structures.
- Debugging and Testing – Identifying and fixing errors.

Skills Developed:

- Writing structured code in a high-level programming language.
- Using loops and conditionals effectively.
- Debugging programs systematically.

Assignments/Projects:

- Interactive Quiz Program – Create a multiple-choice quiz using loops and conditionals.
- Debugging Challenge – Fix errors in a pre-written program.
- Text-Based Game – Develop a simple adventure game with user input.

Module 5: Working with Data

Key Topics:

- Big Data Concepts – How large datasets are collected and analyzed.
- Data Visualization – Graphs, charts, and infographics.
- Bias in Data – Ethical considerations and the impact of biased data.

Skills Developed:

- Analyzing real-world datasets.
- Creating visualizations to interpret data.
- Understanding the ethical implications of data use.

Assignments/Projects:

- Data Analysis Project – Work with a dataset to find trends and insights.
- Infographic Challenge – Create a visual representation of an important dataset.
- AI & Bias Discussion – Research and present on bias in artificial intelligence.

Module 6: Creating Computational Artifacts

Key Topics:

- Creativity in Computing – How programming enables artistic expression.
- Interactive Media – Graphics, animation, and sound.
- User Experience Design – Creating intuitive and engaging interfaces.

Skills Developed:

- Designing user-friendly applications.
- Implementing interactivity in code.
- Understanding human-computer interaction principles.

Assignments/Projects:

- Digital Art Project – Use code to generate an artistic visual.
- Interactive Storytelling – Develop an interactive fiction game.
- UX Redesign Challenge – Improve the design of an existing app or website.

Module 7: Impact of Computing and Ethics

Key Topics:

- Social and Ethical Issues – Digital privacy, AI ethics, and misinformation.
- Computing for Good – How technology is used for social change.
- Careers in Computer Science – Exploring different pathways in technology.

Skills Developed:

- Discussing ethical implications of technology.

- Understanding the role of technology in social good.
- Identifying career pathways in computer science.

Assignments/Projects:

- Tech Ethics Debate – Discuss an ethical dilemma in computing.
- Computing Careers Research – Explore various CS career paths and required skills.
- Social Impact App – Design an app concept that addresses a social issue.

Module 8: Final Project and Course Review

Key Topics:

- Project Planning & Development – Organizing a final computational artifact.
- Peer Review & Feedback – Refining work based on critique.
- Presentation & Documentation – Effectively communicating technical ideas.

Skills Developed:

- Applying all previously learned concepts to a final project.
- Writing project documentation and explaining decisions.
- Presenting computational work to an audience.

Assignments/Projects:

- Capstone Project – A final independent project demonstrating skills learned throughout the course.