Computer Science at Poly

Polytechnic School currently offers four Computer Science courses in the Upper School.

Introduction to Computer Science

Prerequisite. *Open to sophomores, juniors, and seniors.*

The *Introduction to Computer Science* course presents students with an opportunity to learn computational thinking and computer programming using the Python language. Topics of study include problem analysis, data structures, control structures, program design, and basic algorithms. The course also examines some of the legal, social, and ethical issues associated with use of technology in modern society. Assignments consist of short programming exercises, readings, and larger-scale programming projects. For this course each student needs a laptop computer with an Apple, Microsoft, or Linux operating system installed. Some class time is available for working on assignments, but students also spend significant time working on projects outside of class.

Notes

Both this class and the *AP Computer Science A* course are considered introductory classes, and this one is the gentler of the two. It's a one-semester inauguration into *computational thinking* and *computer science*, and it uses the Python programming language which was specifically designed as an educational language. The course is technical in nature, of course, but students get plenty of support in this class as they wrestle with the material. No prior programming knowledge is necessary for enrolling in this course. It is is ideal for students who want to learn a little bit about programming, but aren't ready to commit to the full year of the more technical *AP Computer Science A* course.

Exploring Math with Programming

Prerequisite. *Open to sophomores, juniors, and seniors.*

The *Exploring Math with Programming* course uses Python programming as a tool to explore specific math concepts—trigonometry, matrices, and complex numbers—in a project-based format. We use trig functions to rotate and transform geometric shapes to make Spirograph and harmonograph designs. In addition, we create the Mandelbrot and the Julia set by manipulating complex numbers. We will also use matrices to create and transform 2D and 3D objects. If time permits, we will explore advanced topics such as fractals and genetic algorithms. Through these applications, students will gain deeper insights into these concepts and have the motivation for further studies. While the course will review basic programming concepts such as loops, variables, conditionals, Boolean, and functions, the main focus will be on exploring the math concepts mentioned above. As a result, some familiarity with Python will be helpful for the enjoyment of the course.

Notes

This single-semester elective course is meant to explore topics that sit in the middle between math and computer science: things that require too much math to cover in a regular CS course and require too much programming to cover in a math class! This course is taught in Python and makes use of a couple different graphics programs including Turtle and Processing. The beginning of the course will quickly cover Python fundamentals and more advanced features of the language, including lists, dictionaries and object-oriented design are introduced over time to aid in structuring projects. Each unit covers a different mathematical idea and there is flexibility from year to year to cover different topics depending on class interest. This class is ideal for students with previous exposure to some computer science concepts and are interested in working on mathematical explorations that allow them to design their own creative implementations.

AP Computer Science A

Prerequisite. *Conversation with the instructor, open to juniors and seniors.*

T**he** *AP Computer Science A* **course is designed to provide students with an introduction to topics in computer science and software engineering, including problem analysis, design of algorithms, data structures, control structures, and writing computer programs using the Java programming language.** Advanced topics in the course include object-oriented programming, recursion, and searching and sorting algorithms. The course will be centered on the College Board's *AP Computer Science A* curriculum, with supplementary study of graphical interfaces, game design, design and use of databases, designing and coding for the web, and technology in modern culture. Assignments, projects, and assessments will be both hand-written and coded on computers, and will range from short, individual assignments to long-term, team-based projects. Some class time is available for working on assignments, but students also spend significant time working on projects outside of class. Taking the AP Examination is a requirement of the course.

Notes

Both this class and the single-semester *Computer Science* course are considered introductory classes, with this one the more challenging of the two. It's a one-year exploration of some of the fundamental topics in *computer science* and *object-oriented design*, and it uses Java, a popular but relatively technical language. The pace of this course is faster than the Intro class, and it is expected that students will spend more time on their own working with the material. Although some students come into the course having experimented with Python or Java, no prior programming knowledge is necessary. This course is ideal for students who have a passion for computers, who enjoy problem-solving, and who are comfortable committing to a full year of technical AP-level study.

Advanced Topics in Computer Science

Prerequisite. *an A- or better in Computer Science or AP Computer Science A and conversation with the instructor*

The one-semester *Advanced Topics in Computer Science* **course offers highly motivated students the opportunity to study topics that continue where the introductory** *Computer Science* **and** *AP Computer Science A* **courses leave off.** Subjects of study include sorting and searching, algorithm analysis with Big O-notation, stacks, queues, and linked lists, recursion, trees, and graphs. Development of these theoretical topics is reinforced by assignments, projects, and assessments that are hand-written and/or coded on computers using the Python language. (Prior experience with the Python language is helpful but not mandatory.) Some class time is available for working on assignments, but students also spend significant time working on projects outside of class.

Notes

Either one of the introductory courses—*Computer Science* or *AP Computer Science A*—is a prerequisite for taking this course, which is more advanced and abstract, and an excellent option for students leaning towards majoring in computer sciences. The course begins with a one-week Python "bootcamp" to bring everyone up to speed in that language, and from there we'll immediately jump into the course material.

For further information, please contact:
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