

Robotics, SCS Concentration

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Robotics Concentration

This concentration is available to SCS students only.

The SCS Robotics Concentration provides an opportunity for SCS undergraduate students at Carnegie Mellon to learn the principles and practices of robotics through theoretical studies and hands-on experience with robots. Students initially learn the basics of robotics in an introductory robotics overview course. Additional required courses teach control systems and robotic kinematics. Students also choose from a wide selection of electives in mobile systems, machine learning, computer vision, cognition and cognitive science, or computer graphics. Students have a unique opportunity to undertake independent research projects, working under the guidance of Robotics Institute faculty members; this provides an excellent introduction to robotics practice, for those considering industry and research for those considering graduate studies.

Learning Objectives

Students completing this concentration will be able to demonstrate the following skills and learning:

- construct robots which are driven by a microcontroller through several projects, with each project reinforcing the basic principles of: vision, motion planning, mobile mechanisms, kinematics, inverse kinematics, and sensing
- apply feedback control theory to the development of robotic systems, including the principles of classical linear control theory, linear state-space methods, nonlinear systems theory, and elementary control using computer learning techniques
- program a robot arm using the principles of kinematics and dynamics: transformations, forward kinematics, inverse kinematics, differential kinematics (Jacobians), manipulability, and the basic equations of motion
- apply related fields of computing to the construction and testing of robotic solutions: machine learning, AI, graphics and computer vision, cognitive science and learning models, cyber-physical and embedded systems
- work effectively in a team include computer and mechanical engineers to solve challenging robotics problems

Curriculum

Prerequisites

To be eligible for the Robotics Concentration, students must complete 15-112 Fundamentals of Programming and Computer Science. We also strongly recommend taking 15-122 Principles of Imperative Computation, as it builds skills in C programming and algorithms and is a prerequisite for several Robotics Institute courses

Course Requirements

The Robotics Concentration requires that students complete three core courses and their choice of two elective courses of at least 9 units each. The electives can be chosen from a specific set of stand-alone courses. Students can opt to do an undergraduate research project as one of their electives.

Required Core Courses (36 units)

One of the following courses:

16-280	Intelligent Robot Systems	12
16-281	General Robotics (formerly 16-311)	12

plus the following two courses:

16-299	Introduction to Feedback Control Systems	12
16-384	Robot Kinematics and Dynamics	12

Electives

Two general robotics electives	Units
16-3xx and 16-4xx are pre-approved. Students may count up to 12 units of either 16-597 Undergraduate Reading and Research or 99-270 Summer Undergraduate Research Apprenticeship towards the major requirements. Graduate-level Robotics courses and electives outside the Robotics Institute may be used to fulfill elective requirements with prior approval from the RI Undergraduate Program Director.	18-24

Double Counting

Courses being used to satisfy the requirements for the Robotics Concentration may not be counted towards another minor or concentration. A minimum of 27 units must be completed that is not double counted with any other program. This allows a maximum of 2 courses that can double count with other programs.