Proposed Undergraduate Announcement Listing for the Minor in Robotics

Introduction

Robotic systems offer the promise of transformative technological and societal impact. They hold the potential for a world where drones and legged robots conduct regular inspections and repairs of city infrastructure, fleets of autonomous vehicles fundamentally transform transportation, and mobile manipulators deployed across millions of homes help with common household tasks such as cooking and cleaning. They also promise new opportunities for taking care of our planet, ranging from environmental monitoring to hazard and waste remediation, and for exploring the unknown, from the deep sea to the solar system. However, for such systems to achieve mainstream deployment in both human-centered and remote environments, we must overcome major technical, systems-level, and societal challenges.

The minor in robotics seeks to provide students from a diverse range of majors an opportunity to gain an appreciation for these challenges, develop an understanding of the current state of the art, explore the multidisciplinary and interdisciplinary nature of robotics, consider issues of societal significance, and put these lessons into practice through project-based assignments in courses and through an independent work project or thesis.

Goals for Student Learning

- Students gain an appreciation for fundamental technical, system-level, and societal/economic challenges in robotics.
- Students develop an understanding of the current state of the art in different sub-areas (e.g., perception, planning, control, bio-inspired design, and multi-agent interaction) of this rapidly evolving field, by exploring both cutting edge academic research and field-deployed systems.
- Students explore the multidisciplinary and interdisciplinary nature of robotics by connecting questions, challenges, and solutions in the field to other disciplines in engineering, natural sciences, social sciences, humanities, and the arts.
- Students consider issues of societal significance (e.g., privacy, fairness, economic challenges, challenges to the environment, and policy), with opportunities for focused course work on these issues.
- Students put these lessons into practice through project-based assignments in courses that include hands-on experiences with design and robotic hardware, and through a senior independent work project or thesis.
Prerequisites

The minor is open to students from any major who have a satisfactory background in mathematics, physics, and computing. Students should have successfully completed or placed out of:

- Mathematics through multivariable calculus (MAT 201/203 or equivalent) and linear algebra (MAT 202/204 or equivalent).
- Introductory physics, including mechanics (PHY 103/105 or equivalent) and electromagnetism (PHY 104/106 or equivalent).
- Introductory computer science (COS 126, ECE 115, or equivalent).

Admission to the Program

Students enroll in the minor, no earlier than the spring of the sophomore year and no later than the spring of the junior year, by filling out a form via an online portal.

Program of Study

Students in this minor program must satisfy both program and departmental requirements. The detailed program for each student is worked out by the student and the student's departmental academic advisor. The requirements for the minor are as follows.

Courses

All students must take five courses, including two core courses and three electives, selected from the lists of courses below. To qualify for the minor, a minimum grade average of B- in the five program courses is required. Program courses may not be taken on a Pass/D/Fail basis, unless that is the only grading alternative for the course. If a student places out of a course, another must be substituted to reach five. Students may use at most three courses to simultaneously satisfy requirements for this program and their major.

Senior Independent Work or Thesis

A one-term senior independent work project or two-term senior thesis whose topic is relevant to robotics must be completed and approved by the director through the online portal. Junior independent work projects do not fulfill the minor requirement. A minimum grade of B- for the project or thesis is required to qualify for the minor.

Seminar Attendance

Students are required to attend a minimum of five seminars in the Princeton Robotics Seminar series during their course of study, and to fill out an online attendance sheet.
Lists of courses

Core — two courses required:

MAE 345 / COS 346 / ECE 345 - Introduction to Robotics
ECE 346 / COS 347 / MAE 346 - Intelligent Robotic Systems
ARC 380 - Introduction to Robotics for Digital Fabrication
CEE 374 / STC 374 - Autonomous Fabrication and Robotics
ECE 302 - Robotic and Autonomous Systems Lab
MAE 412 - Microprocessors for Measurement and Control
MAE 416 / EEB 416 - Bioinspired Design

Electives – three courses required:

Any of the courses in the “core” list may be counted as electives if a student takes more than two courses from that list. Additional accepted courses are listed below.

ARC 374 - Computational Thinking for Design, Architecture, and Engineering
CBE 430 / MAE 430 / MSE 430: Squishy Engineering: Using Soft Materials to Solve Hard Problems
CEE 345, MAE 327, MSE 345, STC 345 - Origami Engineering
COS 324 - Introduction to Machine Learning
COS 350 - Ethics of Computing
COS 429 - Computer Vision
COS 484 - Natural Language Processing
ECE 206 / COS 306 - Contemporary Logic Design
ECE 302 - Building Real Systems
ECE 482 - Digital Signal Processing
EEB 325 - Mathematical Modeling in Biology and Medicine
EEB 329 - Sensory Ecology
MAE 321 - Engineering Design
MAE 322 - Mechanical Design
MAE 341 - Space Flight
MAE 342 - Space System Design
MAE 432 - Deep Learning and Physical Systems
MAE 433 - Automatic Control Systems
MAE 434 - Modern Control
ORF 307 / EGR 307 - Optimization
ORF 467 - Transportation System Analysis
PSY 360 / COS 360 - Computational Models of Cognition
PSY 454 / COS 454 - Probabilistic Models of Cognition
PSY 475 / ENE 475 - Human Factors 2.0-Psychology for Engineering, Energy, and
Environmental Decisions
SPI 365 - Tech Ethics
SPI 370 / POL 308 / CHV 301 - Ethics and Public Policy