EE 449: Robotics & Controls Capstone

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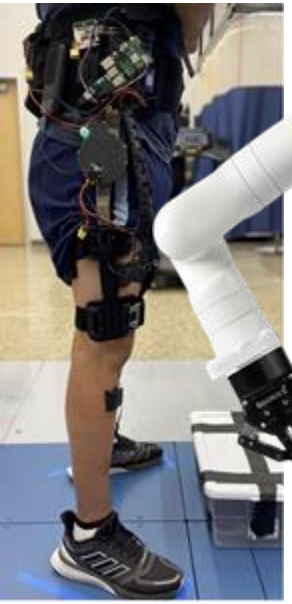
Context

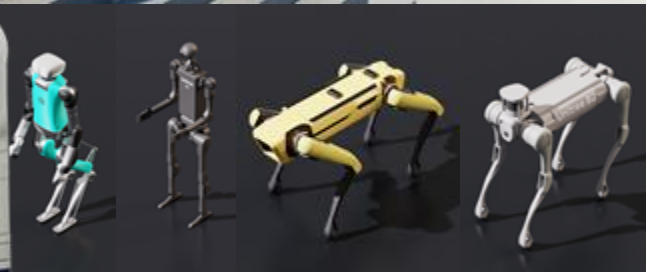
- Currently*, we have three courses in the controls / robotics area:
  - 347: Introduction to Robotics
  - 447: Control Systems Analysis
  - 448: Control Systems Lab (* being taught for the first time in Wi26)
- In the past (10+ years ago), we had 449 (Control Systems Capstone), but this was merged into ENGINE
- Students regularly express interest in continuing their education in this pathway, and have been frustrated at the lack of options
- Department recently awarded a course development grant to recreate 449 as a Robotics & Controls Capstone, leading to today's proposal

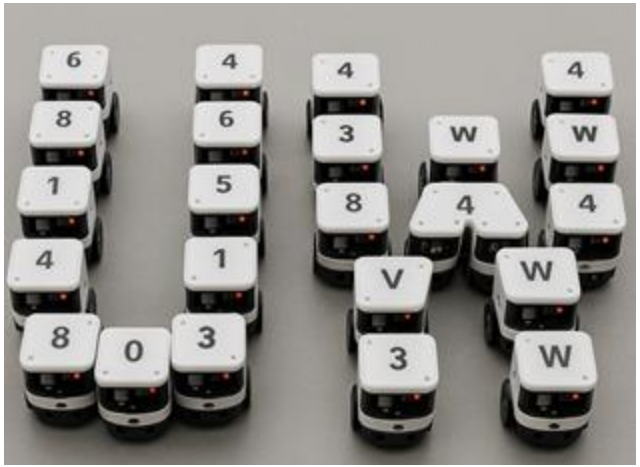
Proposal: EE 449 (Robotics & Controls Capstone)

Goals: To provide students with engineering design experience with robots including team dynamics, project management, real-world considerations, and technical communication. Student teams design, build, and test robot hardware that involves feedback in a fundamental way. Builds on background knowledge in control systems, programming, circuits, and fabrication. The final product demonstrates technical proficiency but also a nuanced understanding of ethical, societal, and environmental impacts.

Prerequisites: 447 (Control Systems Analysis) but *not* 448 (Control Systems Lab)







Research and Development Project Report Guide

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Proposal: EE 449 (Robotics & Controls Capstone)

Topics:

- *Project management*, including a Gantt chart detailing deliverables.
- *Product requirements*, including an assessment of the business rationale and technical feasibility.
- *Real-world constraints*, including economic, environmental, and societal.
- *Engineering standards*, including safety, environmental, communication, physical.
- *System requirements*, including mechanical, communication, control, computation, software, data, interface, and safety.
- *Prototyping*, including design, fabrication, assembly, and test.
- *Experimentation*, including hypothesis testing, outcome measures, and uncertainty.
- *Real-world consequences*, including ethics, economics, environment, and society.

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Learning objectives: At the end of this course, students will be able to:

- *Manage* a 10-week project including a timeline with many deliverables.
- *Manage* team dynamics including roles and responsibilities, conflicts, and equitable workloads.
- *Construct* testable hypotheses about the outcome of simulation and hardware experiments.
- *Interpret* the result of experiments with respect to a prototype's design.
- *Compare* candidate designs on the basis of their technical and societal merits.
- *Assemble* hardware and software components into a functional robot.
- *Present* project outcomes in written and oral communication.

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Grading: The grade is determined from four main elements

- Meetings and project management: 20%
  - ...
- Project Report: 40%
  - ...
- Documentation on course wiki: 20%
  - ...
- Demonstration: 20%
  - ...

ABET outcomes

(1) *An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.* **(**H**)**
(2) *An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.* (H)
(3) *An ability to communicate effectively with a range of audiences.* (H)
(4) *An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.* (H)
(5) *An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.* (H)
(6) *An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions* (H)
(7) *An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.* (M)