**CS249r: Special Topics in Edge Computing**  
*Topic: Autonomous Machines*

**Special Topics:** Broadly, the course covers a range of hardware and software topics in the context of smart/intelligent embedded systems. Traditional embedded systems are passive electronic devices that perform a single task and operate in isolation. In contrast, modern embedded systems are intelligent devices that involve complex hardware and software to perform a multitude of cognitive functions collaboratively. Designing such systems requires us to have deep understanding of the target application domains, as well as an appreciation for the coupling between the hardware and the software subsystems. To this end, the course is designed to help students come up to speed on various aspects of edge computing hardware and software, including interactions with remote cloud computing systems and microcontroller edge endpoints. Each year the course focuses on one or more emerging areas, including but not limited to autonomous vehicles, robotics, mobile, etc. It is a seminar-style course so students are expected to discuss and interact after reading the assigned research papers. At the end of the semester, students will present their work based on a class research project.

The Fall 2019 edition of this course will focus on Autonomous Machines (autonomous cars, drones, ground robots, etc.). The course is primarily structured around building “systems” for autonomous machines. For example, we will discuss what are all the hardware and software components that are involved in developing the intelligence required for an autonomous car?

We will cover seminal research papers and influential material on traditional and emerging, paradigms for enabling autonomy. This means we will learn about the traditional pipelines (perception, localization, planning, control etc.), as well as emerging paradigms such as end-to-end learning involving pixel-2-control in the context of intelligent robot decision making.

The course is ideal for students that are interested in cross-layer and interdisciplinary work.

**Teaching Fellow:**  
Brian Plancher (brian_plancher@g.harvard.edu)

**Course Meeting Times:**  
TBD

**Webpage:**  
Coming soon.
Prerequisites: CS141 and/or basic computer architecture and digital design, CS 161 or some other course where the student has had some level of systems programming experience.

Please contact the instructor or the teaching fellow if you are interested in taking the course but are unsure about whether the background you have is suitable to take this course.

Topics: The course will cover a range of topics that include but are not limited the following:
- System design, architecture and implementation for autonomous machines/systems (simulators, physics engines, robot model, hardware, etc.)
- Runtime systems for multi-agent intelligence, and power and performance efficiency
- Algorithms for decision making (reinforcement learning, supervised learning, etc.)

The course will require students to read a variety of different papers from top conferences. A detailed list of the papers will be updated in due time.

Grade Formula:
- Homework – 25% (3 assignments including programming exercises)
- Exam – 15% (30 minute oral exam, to be scheduled)
- Class Participation – 25%, Including:
  - Discussion Participation (throughout semester during class)
  - Discussion Leadership (you will be assigned certain papers to lead the class through the in-class discussions)
  - Paper Reviews (Highlight the key positives/negatives in papers)
- Project (including final project presentation) – 35%
  - Students will undertake an in-depth course project on a topic of their choosing. The project will introduce the students to research in the field of computer architecture. Project proposals will be due about midway through the class and regular meetings with the teaching staff will help refine the goals and milestones. Final output of the project is a presentation to the class and a project write up in the form of a research style paper.