



# E11: Autonomous Vehicles

Fall 2010

Harris & Lape with Keeter & Ong

## Syllabus

### Teaching Staff

|                 |                    |              |        |  |
|-----------------|--------------------|--------------|--------|--|
| Faculty:        | David Money Harris | Parsons 2374 | x73623 | <a href="mailto:David_Harris@hmc.edu">David_Harris@hmc.edu</a> |
|                 | Nancy Lape         | Parsons 2360 | x73886 | <a href="mailto:Nancy_Lape@hmc.edu">Nancy_Lape@hmc.edu</a>     |
|                 | Zach Dodds         |              | x71813 | <a href="mailto:dodds@cs.hmc.edu">dodds@cs.hmc.edu</a>         |
| Lab Assistants: | Matthew Keeter     |              |        | <a href="mailto:mkeeter@hmc.edu">mkeeter@hmc.edu</a>           |
|                 | Madeleine Ong      |              |        | <a href="mailto:mong@hmc.edu">mong@hmc.edu</a>                 |



David Money Harris



Nancy Lape



Matthew Keeter



Madeleine Ong

### Schedule

|                        |                |           |          |  |
|------------------------|----------------|-----------|----------|--|
| Lecture:               | MW 12:10-1:00  |           |          | Parsons 1287   |
| Office Hours:          | TBD            |           |          |  |
| Lab Hours:             | Keeter Section | Monday    | 6 – 9 pm | Parsons 1287   |
|                        | Lape Section   | Tuesday   | 1 – 4 pm | Parsons 1287   |
|                        | Harris Section | Tuesday   | 6 – 9 pm | Parsons 1287   |
|                        | Ong Section    | Wednesday | 6 – 9 pm | Parsons 1287   |
| Arduino Tutoring Hours |                | Saturday  | 1 – 3 pm | Linde Computer Lab<br>(during weeks when programming problem sets are due) |

Feel free to stop by even if we do not have official office hours. One of the main reasons that we teach at Harvey Mudd is that we value working with students one-on-one and in small groups.

### Text and Supplies

There is no textbook for this course, but readings will be distributed. **You will need to purchase a lab kit before your lab on the week of September 6.** The kit contains components for your Mudduino embedded processor board and other items for your autonomous vehicle. The college has partially subsidized the kits, so your cost is \$100. To purchase a kit, bring cash or a check made out to Harvey Mudd College to Cynthia Wheeler in the Engineering Department Office (Parsons 2373).

### Electronic Communication

Class web page: <http://www3.hmc.edu/~harris/class/e11>

Class email list: eng-11-l

Be sure to check that you are on the class email list. You should have received email before the beginning of classes. If you did not receive mail, add yourself to the list or risk missing important late-breaking announcements. To subscribe, send email to [listkeeper@hmc.edu](mailto:listkeeper@hmc.edu) with one line in the body:

subscribe eng-11-1

You also will need a Harvey Mudd College computer to complete your labs. If you are not a HMC student, email me your full name and school affiliation and I will request an account for you.

## Course Objectives

Autonomous Vehicles is a hands-on interdisciplinary introduction to mechanical, chemical, electrical, and computer engineering, computer science, design, controls, and energy. The course has a variety of objectives including

- Giving students a taste of what engineers and computer scientist do to help make informed decisions about majors
- Provide practical technical skills relevant to subsequent projects including
  - Machine shop
  - 3D CAD and printing
  - Soldering
  - C programming
  - Sensors and actuators
  - Analog and digital interfacing
  - Embedded control systems
- Whet students' appetite to learn more advanced topics
- Develop design – build – test – debug skills
- Develop teamwork, presentation, and technical writing skills
- Just plain fun!

By the end of this course, you and your teammate will have built your own autonomous vehicle and programmed it to play Capture the Flag.

## Grading

E11 is offered on a pass/fail basis. To pass the class, you are expected to:

- regularly attend class and lab
- complete all but one of the weekly labs
- complete at least five of the six homework assignments
- deploy an operational autonomous vehicle to play Capture the Flag
- make a presentation about your vehicle
- complete a final report documenting your vehicle

If you have a medical issue or other emergency, please notify your instructor when you will be missing class.

You will complete the labs before Fall Break on your own but are welcome to consult your classmates and your instructor. You and a teammate will jointly design and program your autonomous vehicle to play Capture the Flag in the weeks after Fall Break, and then will jointly prepare your presentation and final report.

Your problem sets may be done on your own or with a partner. Both of you should be involved in and understand all aspects of the work; it misses the point to simply split the assignment and do two halves independently. You are welcome to discuss the assignments with other students or with the instructor or lab assistants after you have made an effort by yourself. Be sure to credit at the top of your assignment anyone classmates with whom you discussed ideas. **It is an honor code violation to simply copy someone else's work.**

## Tentative Schedule

| Week      | Mon  | Wed                     | Lab                                  | Problem Set (Due Mondays in class)    |
|-----------|--|-------------------------|--------------------------------------|---------------------------------------|
| 0: 8/30   | No class   | Big Picture, Energy (L) | Shop safety briefing                 |                                       |
| 1: 9/6    | Arduino Board (H)                                  | C Programming I (D)     | Arduino Board Assembly               |                                       |
| 2: 9/13   | Design Representation,<br>Gold Codes (H)           | C Programming II (D)    | Shop tutorial<br>3D CAD & Printing   | Programming I: Welcome to Arduino     |
| 3: 9/20   | Fuel Cells (L)                                     | C Programming III (D)   | Fuel Cell Assembly                   | Programming II: Arrays & Feedback     |
| 4: 9/27   | Energy (L)   | Circuit Analysis (H)    | Fuel Cell Characterization           | Programming III: Gold Code Generation |
| 5: 10/4   | Motors (L)   | Sensors (H)             | Robot Assembly &<br>Characterization | Programming IV: Gold Code Detection   |
| 6: 10/11  | TBD  | TBD                     | Motors & Sensors                     | Energy                                |
| 7: 10/18  | Fall Break   | Break week: no class    |                                      |                                       |
| 8: 10/25  | Feedback Control (H)                               | Game Kickoff            | Line-Following Robot                 | Circuit Analysis                      |
| 9: 11/1   | Line Following Race (H)                            |                         | Robot Design I                       |                                       |
| 10: 11/8  |  |                         | Robot Design II                      |                                       |
| 11: 11/15 | Scrimmage (L)                                      |                         | Robot Design III                     |                                       |
| 12: 11/22 | Capture the Flag Game (5:30 pm<br>in Galileo) (LH) | Thanksgiving: no class  | No lab                               |                                       |
| 13: 11/29 | Technical Writing (L)                              | Presentation Skills (L) | Peer Editing                         |                                       |
| 14: 12/6  | Robotics Show & Tell                               | Eng & CS Outlook        | Presentations                        | Project Report                        |

Note that students registered for the Monday lab are asked to attend one of the other lab sessions on 8/31 or 9/1 to receive a shop safety briefing.