

# 91.549, Mobile Robotics, Fall 2004

## Syllabus

### Contact Information

Prof. Holly Yanco  
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### Class Meetings

Thursdays, 5:30-8:30, Olsen 414 (lecture) and 304 (lab)

### Office Hours

Tuesdays 10:15 to 11:15 in Olsen 304  
Thursdays 3:00 to 4:00 in Olsen 304  
And by appointment.

### Course Description

In this course, we will focus on artificial intelligence for mobile robots. You will be programming Pioneer robots using Pyro (*Python for robots*). These robots have a fixed sensor set and fixed sensor placement – the course will be more of a software course than a hardware course.

Topics to be covered during the course include robot architectures, vision (including color vision processing, edge detection, and optical flow), machine learning (including reinforcement learning and neural networks), mapping and localization, and multi-agent robotics.

### Textbook and Readings

*Computational Principles of Mobile Robotics*  
Gregory Dudek and Michael Jenkin  
Cambridge University Press, 2000, ISBN 0-521-56876-5

We will also read research papers during the term. Links to these papers will be placed on the course web site.

### Course Website

<http://www.cs.uml.edu/~holly/91.549>

## Software

We will be using Pyro for programming in this course, which is available on all of the computers in the robotics lab (Olsen 304). You will have 24 hour access to the lab using your id. If you're like to install Pyro on your own linux system at home or work, you can download Pyro for free. The installation and details about how to install Pyro can be found at <http://www.pyrorobotics.org/index.cgi/PyroInstallation>

## Hardware

We will use Pioneer robots, built by ActivMedia, in the course. These are research grade robots that include 16 sonar sensors (8 in the front and 8 in the back), a color camera, an array of bumpers in the back, and a gripper. You will need to be in the lab to use the robots – they can't go home with you. This will mean that you should expect to spend significant time outside of class working in the lab for robot-based labs and projects (most will require the use of the robot rather than the use of the simulator).

## Course Requirements

### *Assignments (Labs):*

There will be weekly assignments, mostly consisting of a laboratory portion using the Pyro software to develop code for simulated and real robots. Some of the labs will require you to demonstrate your code running on the robot for me. For these labs, there will be sign up sheets

### *Projects:*

The second half of the term will be spent developing a project. You'll choose the topic consultation with me. Project meetings will be held in lab on October 12<sup>th</sup>. Project proposals will be due on October 28<sup>th</sup>.

On the last day of class (December 16<sup>th</sup>), you'll give a 15 minute presentation on your project work. For the project presentations, you will need to make a video of your robot project – we will not run live demonstrations during the class (you'll learn that robots don't necessarily cooperate for demos). The lab has a video camera and a Mac for this purpose.

Your project report will need to describe the problem you were trying to solve, your approach to solving the problem, and discuss related research on the topic. When writing this report, you should think about modeling it on the research papers that you'll be reading during the term. Including figures, both diagrams and photos, is highly encouraged. An appendix to your report should contain the complete code for your project, even if you have included smaller portions of the code in the paper.

*Exam:*

There will be an in-class exam in the lecture room on October 14<sup>th</sup>, covering all material in the course up to and including October 7<sup>h</sup>.

**Grading**

Assignments (Labs)	40%
Project	35%
Exam	25%

**Collaboration Policy**

Depending upon the size of the class, there may be enough computers for each person to have their own workstation. If this is the case, there will be some individual assignments and some assignments that may be done in a group, if desired. Assignments indicated as individual assignments are to be completed by one person. You may discuss assignments, but you must write your own robot code and write your own answers to questions. To learn, you'll need to program robots, not just copy someone else's code.

**Homework Policy**

All work must be turned in at the start of class on the date it is due in order to receive credit. If a demo is required, it must also occur before class starts (talk to me if this is a problem with your commuting schedule.) This policy is to prevent people from working on old assignments when new material is being taught in lab.

## Schedule

<b>Date</b>	<b>Lecture Topic</b>	<b>Lab Topic</b>
9/9	Intro to Robotics	Pyro, Pioneers, Direct Control
9/16	Vision I and Manipulation	State Based Control Phission Object tracking Manipulating objects
9/23	Robot Architectures	Fuzzy Control Subsumption Vector Field Histogramming
9/30	Vision II	Motion tracking
10/7	Machine Learning	Neural Networks Reinforcement Learning
10/12	Evolutionary Robotics	Project Meetings
10/14	Midterm	
10/21	No class. Rescheduled to 12/16.	
10/28	Mapping and Localization	Mapping
11/4	Planning and Reasoning	Project Work
11/11	Veterans' Day	
11/18	Multi-Agent Robotics	Multi-Agents
11/25	Thanksgiving	
12/2	Human-Robot Interaction	Project Work
12/9	Current Research in Robotics	Project Work
12/16	(Make-up for 10/21) Project Presentations	End of term celebration