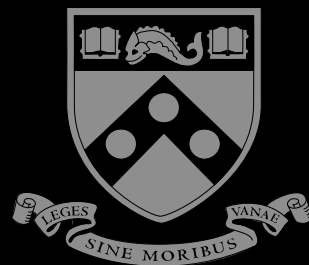


# MEAM 520

## Introduction to Robotics

Katherine J. Kuchenbecker, Ph.D.

General Robotics, Automation, Sensing, and Perception Lab (GRASP)  
MEAM Department, SEAS, University of Pennsylvania



Lecture 1: September 6, 2012

# What is this class about?

---

Robots, particularly manipulator arms and mobile robots

Tentative list of topics:

- Translation and Rotation in 2D and 3D
- Forward and Inverse Kinematics of Serial Manipulators
- Velocity Kinematics
- Path and Trajectory Planning (maybe)
- Joint Control and Dynamics
- Simple Computer Vision
- Vision-Based Control (maybe)



# What is this class about?

---

There is a lab component!

Simulating robots in Matlab

Hands-on experience with an industrial manipulator

Hands-on experience with a haptic interface

Hands-on experience with a vision-guided mobile robot



# Caveat

---

This is my first time teaching this class.

I sat through MEAM 520 in Spring 2012 and will largely be following the way Dr. Fiene taught the course.

I will do my best, but things may not be perfectly organized; we will all be learning and adapting together.



# Who am I?

---



**Katherine J. Kuchenbecker, Ph.D.**

Skirkanich Assistant Professor of Innovation  
in Mechanical Engineering and Applied Mechanics

Part of the General Robotics, Automation, Sensation, and  
Perception (GRASP) Laboratory and the Institute for  
Research on Cognitive Science (IRCS)



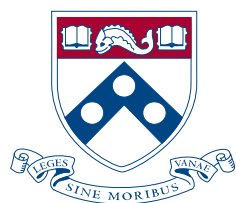
# Who am I?

---

- Kuchenbecker is best pronounced *Kook-en-beck-er*
- Kuchenbecker means “Cake Baker” in German
- You can address me as any of the following.  
Pick the one with which you are most comfortable.
  - Professor
  - Professor Kuchenbecker
  - Dr. Kuchenbecker
  - Dr. K
  - Katherine
- I often refer to myself with my initials (KJK)

# Who am I?

---



- I joined the Penn faculty in July 2007; this is my sixth year here.



- From 2006 to 2007 I was a postdoctoral scholar with Allison Okamura at Johns Hopkins University.



- I earned my doctorate in June 2006 at Stanford University, where I worked with Günter Niemeyer.
- My primary research interests are:
  - Creating highly realistic haptic interfaces for virtual environments and teleoperation.
  - Making autonomous robots that can capably accomplish physical tasks and understand the world around them.
  - Understanding and aiding human upper-limb movement.
  - Developing medical devices and medical robotic systems.

# How do you contact me?

---

**Email:** [kuchenbe@seas.upenn.edu](mailto:kuchenbe@seas.upenn.edu)

**Office:** 224 Towne Building

**Office Phone:** (215) 573-2786



# Where is my office?

---



# What's inside my office?

---



Office hours will be announced...

# Who are you?

---

Masters?

Ph.D.?

Undergraduate?

New to Penn?

Second year?

Third or later years?

Mechanical Engineering?

Robotics?

Computer Science?

Electrical and Systems Engineering?

Other?

U.S.A.?

North America?

Asia?

Europe?

Other?

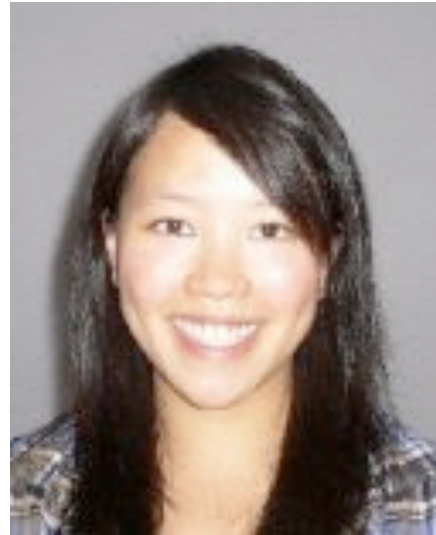
There are a lot of you...

# Who else will be teaching us?

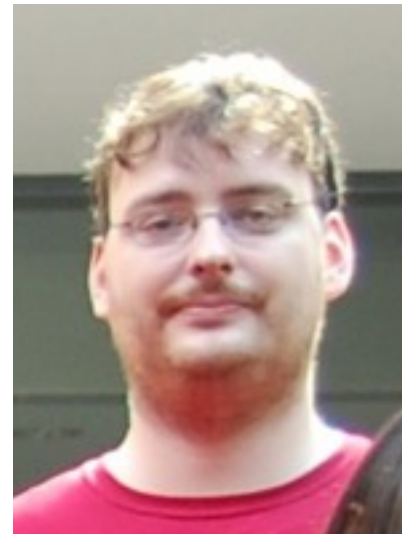
---



Philip Dames



Denise Wong



Ryan Wilson



Someone Else?

Office and lab hours will be announced...



# Course Logistics

---

- You should be a junior undergraduate, senior undergraduate, or graduate student in STEM (science, technology, engineering, or math).
- I listed MEAM 211 as a prerequisite, but it is not strictly required. Previous experience in kinematics will be useful, but you can make this up if you lack it.
- This class is worth one credit unit.
- We meet two days a week.
- Tuesday and Thursday classes are from noon to 1:20 p.m. in LRSM Auditorium.
- No scheduled recitations; we can hold review sessions when needed.

# Attendance

---

- I want to see you in class every day.
- You are expected to participate actively in lectures, homework assignments, and projects.
- If you have to miss class, you should make up the lecture by getting notes from a classmate and listening to the lecture online.
- Links are automatically posted on Blackboard.
- Recording includes slides and audio, but no video.
- Late arrivals and unexcused absences will get in the way of understanding and enjoying the material.



# Participate Actively!

---

| <b>Learning Method</b>                 | <b>Retention</b> | <b>Class Activity</b>                          |
|--|------------------|--|
| What one reads                         | _____            | Readings                                       |
| What one hears                         | _____            | Lectures, discussions                          |
| What one sees                          | _____            | Figures, drawings, slides                      |
| What one sees and hears                | _____            | Lectures with visuals                          |
| What one says                          | _____            | Asking questions,<br>discussing class topics   |
| What one says while<br>doing something | _____            | Hands-on assignments,<br>project demonstration |

# Class Components

---

- Written assignments
- Programming assignments in simulation
- Programming assignments on real robots (projects)
- Midterm
- Final exam

# Course Website: Lore

<http://lore.com/Introduction-to-Robotics.2>



LOG IN



# Introduction to Robotics

MEAM 520 | University of Pennsylvania | Instructor: Katherine J. Kuchenbecker

## Instructors



**Katherine J. Kuchenbecker**

## Details

University of Pennsylvania  
Fall 2012

# Lore Access

---

- Later today, I will invite all enrolled students to the Lore site using the email address you have listed in the Penn student directory.
- You can also join this class on your own:  
[join.lore.com/8GMYVB](http://join.lore.com/8GMYVB)
- You will need to make a Lore account. You do not need to use your real name.
- Our Lore site is currently private.

# Course Gradebook: Blackboard

<https://courseweb.library.upenn.edu>



Blackboard Learn

⏪ ⏩ 🏠 + 🔍 [https://courseweb.library.upenn.edu/webapps/portal/frameset.jsp?tab\\_tab\\_group\\_id=](https://courseweb.library.upenn.edu/webapps/portal/frameset.jsp?tab_tab_group_id=) Reader ↻

🔍 Google

👤 Katherine Kuchenbecker

🏠 My Places

🏠 Home

❓ Help

🚪 Logout

**Bb Penn Libraries**

Penn Courseweb

Courses

MEAM 520: Introduction to Robotics

Announcements

Edit Mode is: ☐ OFF

☰ 📁 🖨️ ↻

⌵ MEAM 520: Introduction to Robotics

Announcements

COURSE MANAGEMENT

⌵ Control Panel

⌵ Files

⌵ Course Tools

⌵ Evaluation


⌵ Grade Center

⌵ Users and Groups

⌵ Customization

⌵ Packages and Utilities

⌵ Help

 **Announcements**

**Lore Site**

Posted on: Thursday, September 6, 2012

This class will use Lore (not Blackboard) for most web functions. You can join the MEAM 520 Lore site at: <http://join.lore.com/8GMYVB>

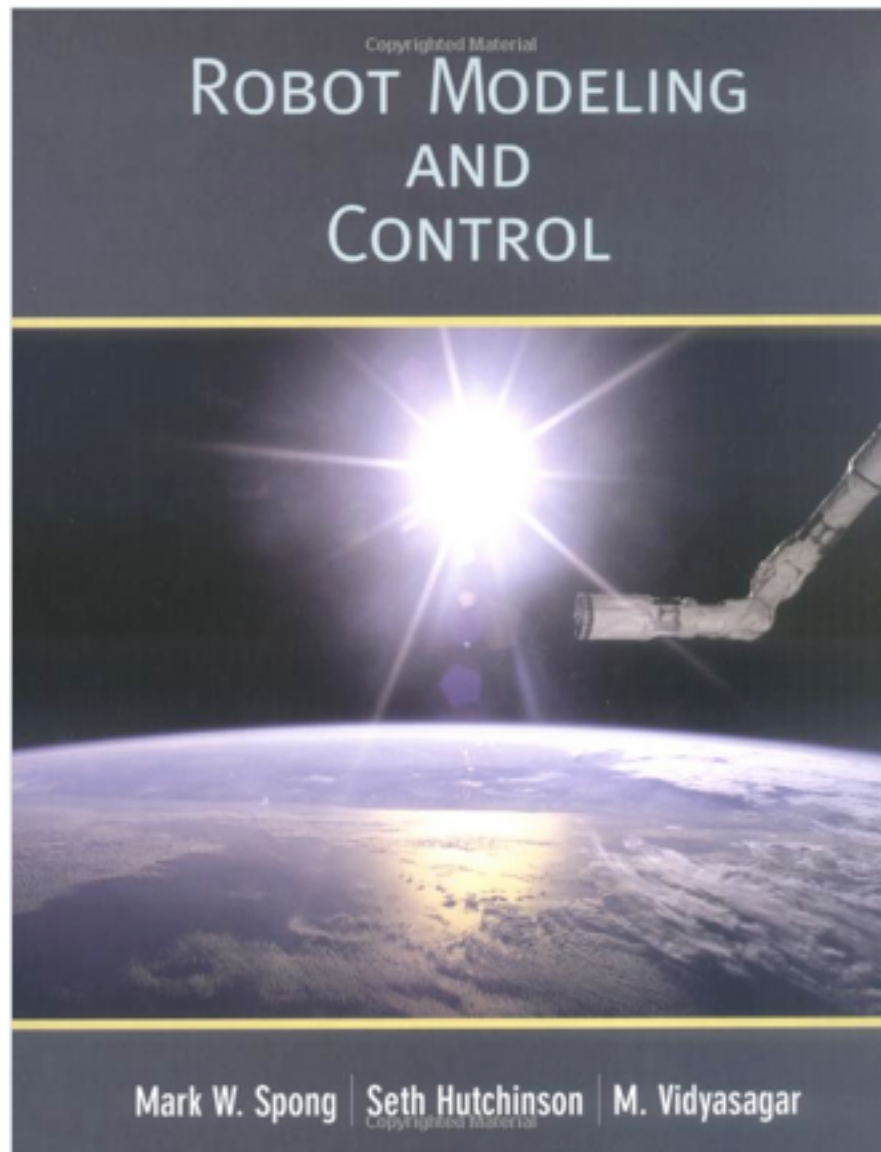
The only two parts of Blackboard we will use are the gradebook and the posting of lecture recordings.

Posted by: Katherine Kuchenbecker

Posted to: MEAM 520: Introduction to Robotics

# Textbook

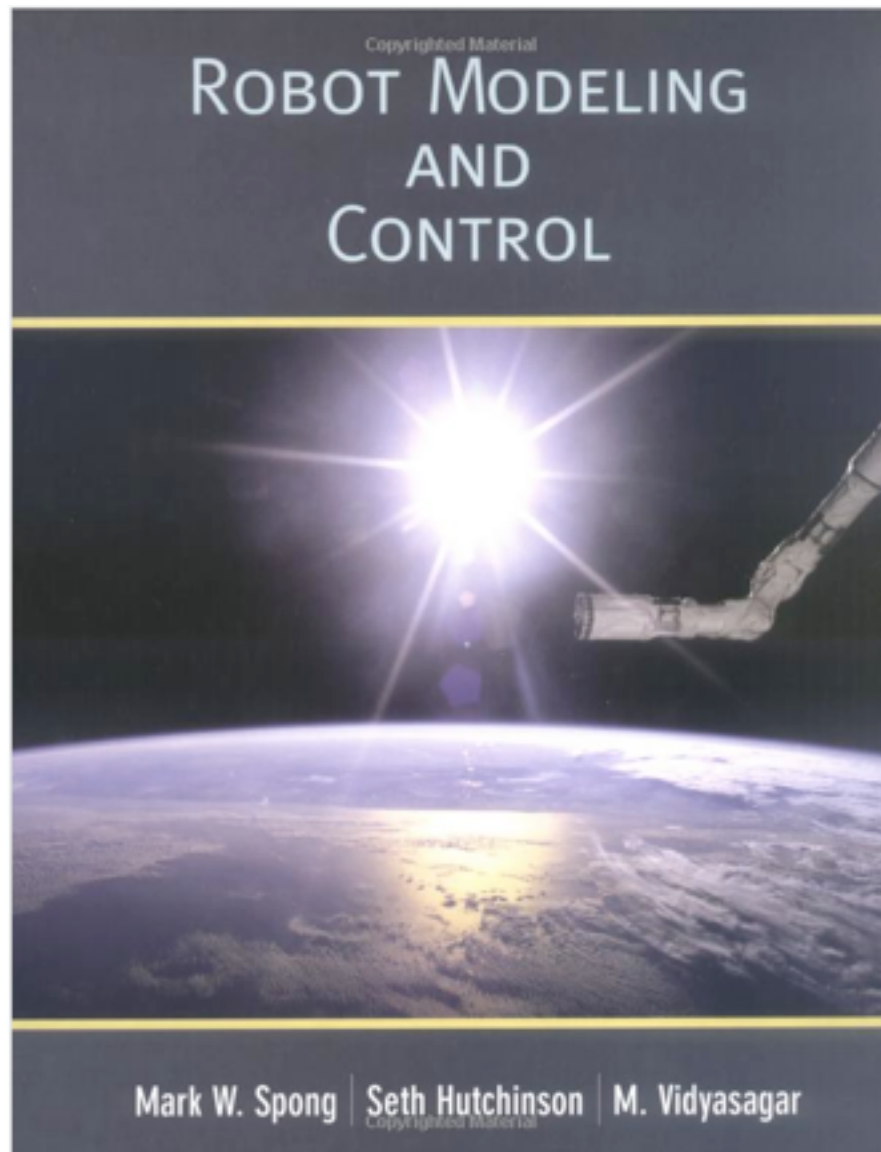
---



- “Robot Modeling and Control” by Spong, Hutchinson, and Vidyasagar.
- You should get your own copy.
- Two copies of the book are on reserve at the Engineering Library (Towne 2nd floor)
- Other robotics textbooks also on reserve in the library.

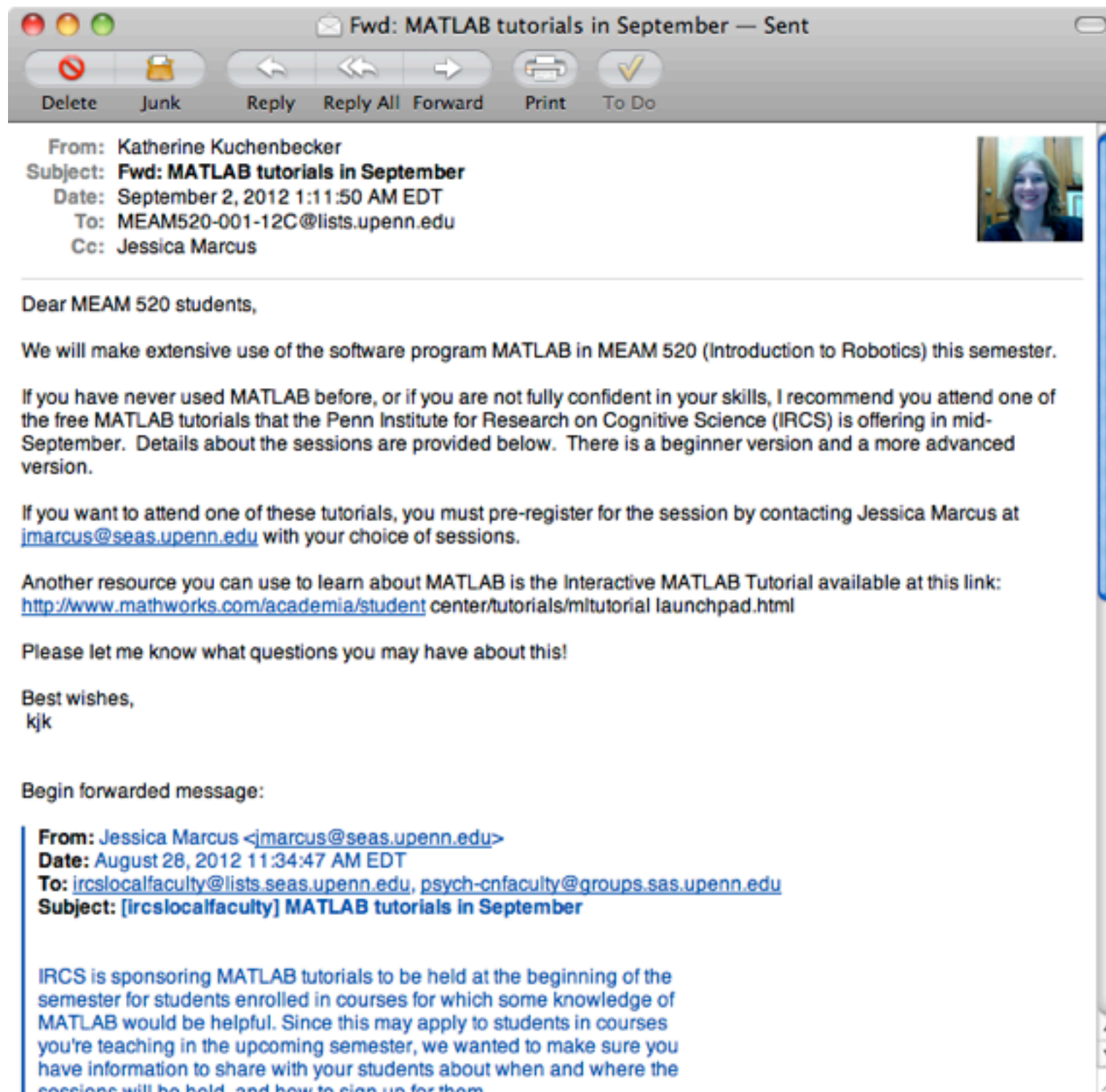
# Reading Assignment

---



- Chapter 1, “Introduction,”
- Read pages 1 to 19 in the textbook, and skim from page 19 to 33.
- Do this before lecture on Tuesday.

# MATLAB



# MATLAB

---

Session 1: Thursday, 9/13: 6-8pm

Session 1: Saturday, 9/15: 3-5pm

Session 2: Thursday, 9/20: 6-8pm

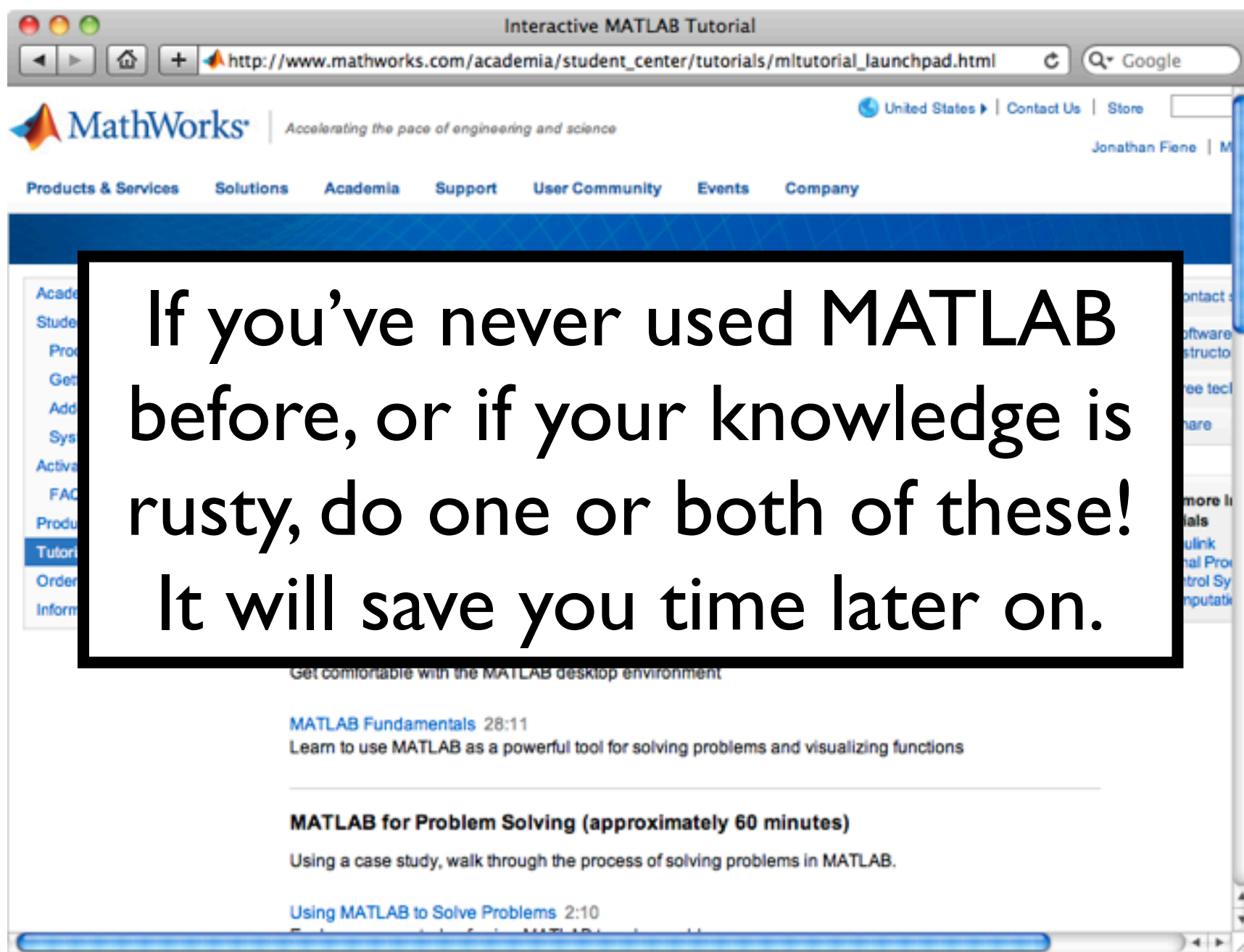
Session 2: Saturday, 9/22: 3-5pm

email [jmarcus@seas.upenn.edu](mailto:jmarcus@seas.upenn.edu) to sign up



# MATLAB

Free online tutorial: [http://www.mathworks.com/academia/student\\_center/tutorials/mltutorial\\_launchpad.html](http://www.mathworks.com/academia/student_center/tutorials/mltutorial_launchpad.html)





# Mechatronics vs. Robotics

---

Which should you take?  
MEAM 410/510 or MEAM 520

# Enrollment

---

How many people are not yet registered but want to be in the class?

Anyone who is registered but plans to drop?

Questions ?

# Activity

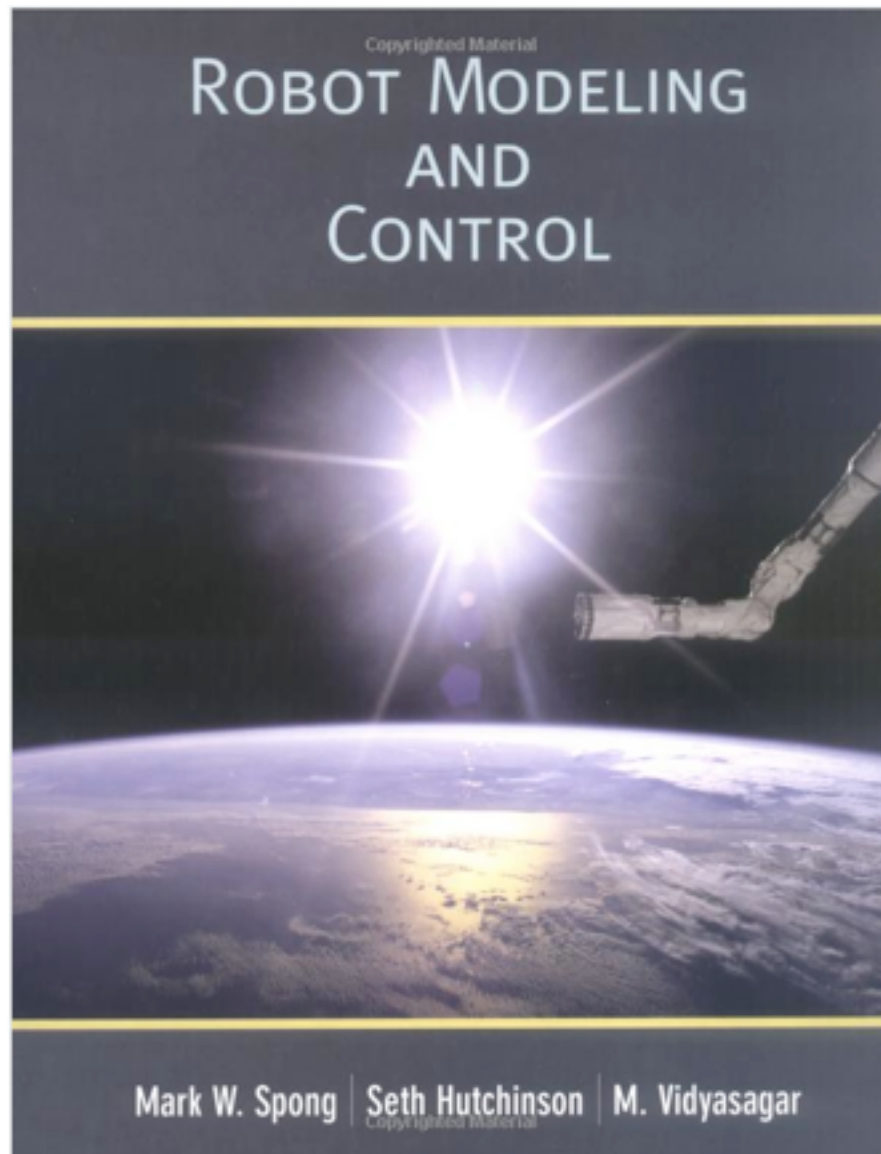
---

1. Pick a partner sitting near you.
2. Get a blindfold, a handful of target objects (candy), and a few obstacles (cups)
3. Move so you and your partner are sitting in chairs directly next to one another, and set up the desks attached to your chairs.
4. Work together to plan a communication scheme that will enable you to accomplish the following steps. Your communication scheme must be auditory only without language of any kind. Saying words and touching your teammate are strictly forbidden. Clapping, snapping, and voicing nonsense sounds are acceptable, as are any other sounds you can make with the materials you have available to you. Test out your scheme a bit and modify it to make it better.
5. Blindfold one member of your team so they cannot see at all.
6. The non-blindfolded individual should quietly set up one target object and three obstacles on the desk in front of the blindfolded individual. Do a new configuration every time.
7. Use your communication scheme (no speaking words or touching) to guide your blindfolded person to pick up the target object with their hand without touching any of the obstacles.
8. Keep track of how many successes and failures your team has, and pay attention to what seems to work well for accomplishing this task.
9. Reset after each success and failure, and switch who is blindfolded and who is not.
10. After time is called, participate in the class discussion on this activity.

# Discussion

# Reading Assignment

---



- Chapter 1, “Introduction,”
- Read pages 1 to 19 in the textbook, and skim from page 19 to 33.
- Do this before lecture on Tuesday.