CMSC 479/679
Fall 2014

Dr. Cynthia Matuszek

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My Research Topics

- **Robotics**
  - How can we go from industrial robots to useful robots in human environments? (Schools, cars, homes…)
- **Natural Language Processing**
  - How can computers learn to understand and speak human languages (English)?
- **Artificial intelligence**
  - How can we get computers to behave in ways that we would consider to be "intelligent?"
- **Human-Robot Interaction (HRI)**

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Today: Intro & Overview

- Review of syllabus and schedule
  - Academic honesty
  - Expectations and conduct
  - Policies, grading, etc.

🙄 but important

- Overview of Robotics and Topics
  - What is a robot? (And why is robotics so cool?)
  - What's the state of robotics now?
- What is 'intelligence'? Autonomy?

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Resources

- The syllabus is longish, but important:
  - http://tiny.cc/479-class
- Lecture topics and reading on the schedule:
  - You'll want to check this every single class.
  - http://tiny.cc/479-schedule
- We will use Piazza extensively:
  - So get your account sorted right away!
  - http://tiny.cc/479-piazza
- **The class slides are intended to be the notes**

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Classroom Policies

- Be courteous to classmates and instructors.
- No devices in use except when specified.
  - You don't learn as much.
  - People around you don't learn as much.
  - http://tiny.cc/devices-in-class
- No food in this classroom.

vectorstock.com, KSPprints.com

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Harassment and Inclusivity

- All students are entitled to a safe, respectful, and inclusive learning environment both inside and outside the classroom.
- No discrimination, exclusion, or harassment
- Respectful, inclusive discussion
  - Use one another's preferred names, pronouns, etc.
- If there are problems
  - Talk to me, the TA, or someone else
  - There are resources on the syllabus

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Grading

- Grades in Blackboard
  - Know your grades
    but also
  - Keep track of what's left

Homework: ***20***
Course project: ***30%***
Midterm exam: ***15%***
Final exam: ***20%***
Class participation: ***15%***

- Grade questions:
  - 24-hour "cooling" period before *any* discussion
- Grade changes/regrades:
  - Requests to **professor and TA**
  - TA cannot change grades!

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Participation

- Attend class.
  - The program (and I) expect you to be here for the entire semester.
- Speak up.
  - Ask & answer questions
  - Tell us your thoughts
- Be active on Piazza.
  - Ask and answer questions.
  - Post links to interesting material.
- Do any take-home quizzes and/or surveys.

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5-6 Homework Assignments

- Written text, problem sets, and programming
  - Due at 11:59 PM the day before class
  - Late: 25% off /day
  - **If Blackboard says it's late, it's late.**
- Assignments will be turned in electronically
  - Assignment will specify Blackboard, forms, or email
  - Sometimes 10% penalty for not following instructions
    - Example: Wrong file type
- Questions? Piazza, then TA

These policies are firm. Please don't ask for exceptions.

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Time Management

- Some things can be rescheduled
  - E.g., overlapping exams
    - If enough people have them
- Individual extensions may be given:
  - With reasonable cause
  - When made in advance
- Talk to me!

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A Word About This Class

- The biggest complaint people have had:

There's way too much math in this class!

- Take it as a warning: modern robotics is mathy.
  - Linear algebra, calculus, probability
  - The second half will be much more mathematical than the first
  - This is not an easy class!
- You do not need hardware experience.

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Reading

- Readings: Do these after class
  - More detail on concepts
  - You need to know the content!
- We use SNS more during the first half

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Academic Integrity

- Instructor's responsibilities:
  - Be respectful
  - Be fair
  - Be available
  - Tell the students what they need to know
- Students' responsibilities:
  - Be respectful
  - Do not cheat, plagiarize, or lie, or help anyone else do so
  - Do not interfere with other students' academic activities

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Summary and Links

- Before next class!
- Sign up for Piazza:
  http://tiny.cc/479-piazza
- Read the syllabus:
  http://tiny.cc/479
- Read the integrity policy:
  http://tiny.cc/479-integrity
- Read SNS Chapter 1

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Today in Detail

- Introduction and goals
- Review of syllabus and schedule
- Academic honesty policy
- Expectations
- Topics we'll cover
- What is a robot?

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Goals of This Course

- Provide an overview of big problems in robotics
- Understand the elements of a robot system
- Get hands-on experience with robot software, hardware, and problem-solving
- Understand what robots can do now, could do better, and will be doing in future

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Teamwork

- Projects will be done in teams of 4-5
- Teams will be assigned based on skills and interests
- Teams will:
  - Meet regularly
  - Do in-class *and* out-of-class group assignments
  - Share effort on project elements reasonably
  - Occasionally describe who's doing what

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Academic Integrity

- I hate policing students. But… I take integrity very seriously.
  - Fabrication: Fabricating sources or any other information.
  - Aiding and abetting: Providing another student with answers, or helping them to cheat.
  - Plagiarism: Using a source (for code, blocks of text, images, or designs) without appropriate citations and recognition.
  - Copying: Using another student's work for an assignment, exam, or project without acknowledgment.
- You can do a LOT of collaboration in this class!

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Integrity and Teamwork

- A lot of your grade involves teamwork.
- How can teamwork be unethical?
  - Not sharing the workload evenly
  - Not contributing to the group
  - Misrepresenting who did what
  - Working together on individual assignments
- Falsely claiming someone contributed to the group.

Don't make me handle a cheating case.

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Expectations

- Attend class regularly
  - DO NOT come to class sick.
  - Make sure you follow up on the notes.
- Complete the assigned reading
- Participate
  - Participate actively in class discussions
  - Let other people participate, and listen attentively
  - Ask questions!
  - Read and post to the forum

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Communications

- For help:
  - Post to Piazza (if appropriate)
  - Come to office hours
  - Email the TA (if appropriate)
- Email:
  - 24-hour cooling period
  - Always Cc the TA
  - *Email should include a link to your Piazza post.*

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General Topics

- Overview and Concepts
- Sensing
- Actuators
- Control software
- Motors/motor control
- Locomotion
- Manipulation
- Kinematics
- Localization
- Motion planning
- Machine learning
- Hardware Design
- Cognition
- Human-robot interaction

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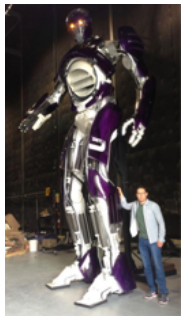
Familiar Robots



Sentinel. X-Men, Days of Future Past: 2014

ED-209. Robocop: 2014

Data. Star Trek: TNG: 1987

Wall•E: 2008

Optimus Prime. Transformers: 2007-current

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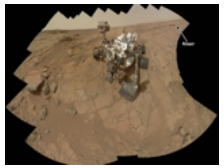
Some 21st century robots



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What is a Robot?

"A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks."
(Robot Institute of America)

- Autonomous?
- Physical?
- Human-friendly?
- Humanoid?
- Sensory?
- Intelligent?
- Mobile?
- Manipulative?
- What else?

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Robots Up to Now

- Robots now:
  - Expensive
  - Complex
  - Special-purpose
- Environments
  - Dedicated
  - Constrained
- Use and Management
  - Controlled by trained experts
  - Slow and expensive to reconfigure/repurpose

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Robots Now

- As technology improves:
  - Smaller
  - Cheaper
  - More broadly capable
- Can consider deploying in human-centric environments
  - Homes
  - Schools
  - Care facilities
- Requires: flexibility and human-robot interaction (HRI).

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What Should They Do?

- Robots are moving away from factory floors to…
  - Entertainment, toys
  - Homes (personal robotics)
  - Medical, surgery
  - Industrial automation (mining, harvesting, warehouses, …)
  - Hazardous environments (space, underwater, battlefields, …)
  - Roads
- Research Trends
  - Manipulation of everyday objects
  - Complex household tasks
  - Object recognition, mapping, interaction
  - Human robot interaction

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What Subsystems Are There?

- Or: what does a robot need to kno
  - Where am I?
  - What's around me?
  - How am I posed?
    - How do I change it?
  - What do I want to do?
    - With respect to the environment?
    - Where do I go, and how?
    - What do I want to change?
  - How do I do that?
  - Who needs to be involved?
    - People? Other robots?

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What Subsystems Are There?

- Sensing
  - Perceiving the world
  - Creating a *world model*
- Actuation
  - Doing something in the (physical) world
  - Mobility, manipulation, …
- Control
  - Navigation, motion planning, kinematics, dynamics
- Cognition and Learning
- Interfaces

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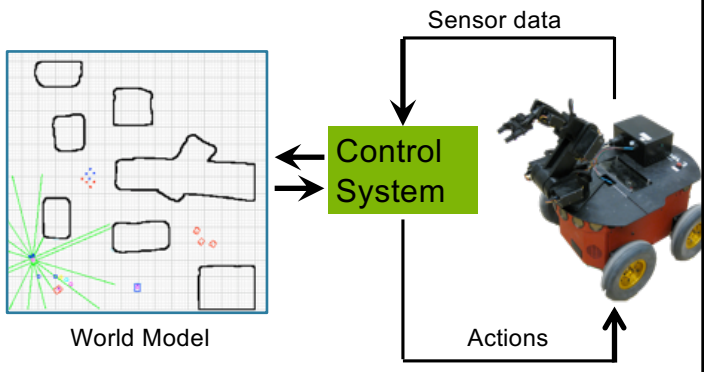
High Level View



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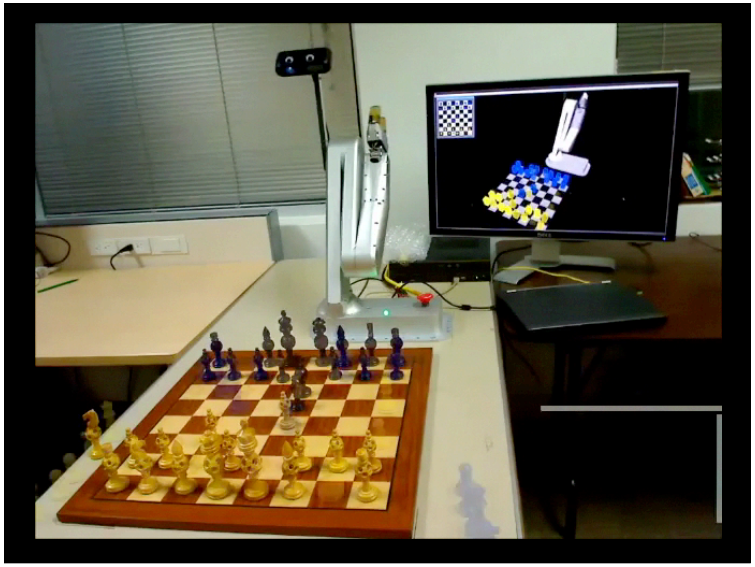

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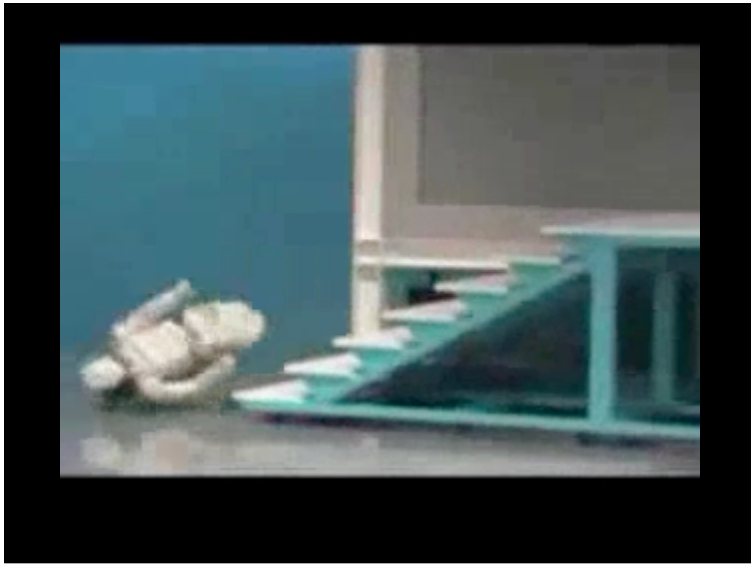

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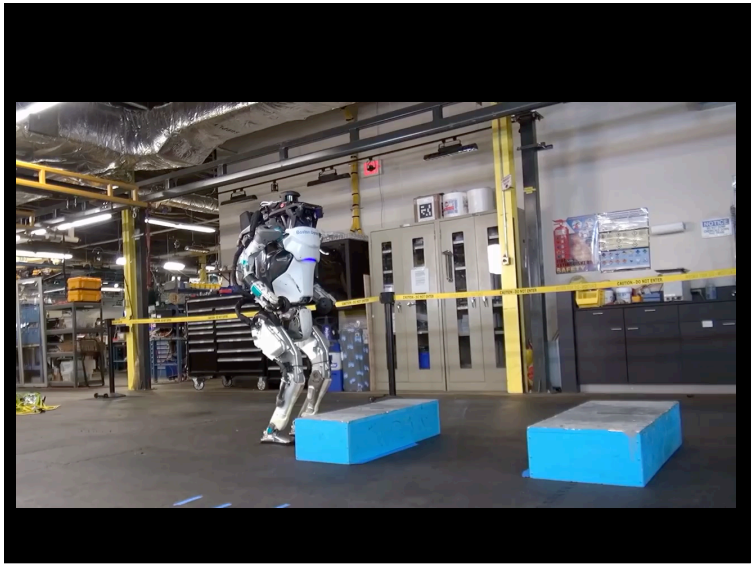

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