ROB 538: Multiagent Systems

Week 0, Lecture 1:

Introduction

Announcements:
HW 1 Due on 10/3

Today

• Syllabus

• About course
  – Expectations
  – Project
  – Topics

• Overlap with other classes:
  – ROB 537: Learning Based Control
  – CS 533: Intelligent Agents

• Questions ??
Syllabus

• ROB 538: 4 credits
  – 4 lecture hours
  – 3 lecture hours + lab
  – 3 lecture hours + project

• Class time: M W 10-11:15

• Course website:
  – http://classes engr.oregonstate.edu/mime/fall2016/rob538/
  – Announcements
  – Homework/Project info

Prerequisites:
• Comfort in programming (C/C++, Java, Python)

Office hours:
• M W 11:15-12:15
• By email appointment

Graduate Teaching Assistant
• Carrie Rebhuhn: rebhuhnc@onid.orst.edu
• Monday PM
• Thursday PM
• Location: TBD
Books


How do you spell that?

Multi agent ?

Multi-agent ?

Multiagent
ROB 538: This course is about ...

- Agents: Sensing, reasoning, acting (week 1)
- Multiagent systems properties (weeks 2, 3)
- Reward functions (week 4)

- Dealing with systems with interactions
  • Cooperative
    - Swarms (week 6)
    - Planning (week 7)
  • Competitive
    - Game theory (week 5)
    - Auctions (week 6)
  • Verification and validation (week 9)

- Applications
  • Tensegrity Robots (week 8)
  • Air traffic (week 8)
  • Multirobot systems (week 10)

ROB 538: This course is about ...

- Doing Research. You will learn to:
  • Perform a literature review
  • Formulate a problem statement
  • Identify a “gap”
  • Perform research (algorithm, theory, coding)
  • Generate Results
  • Generate a “story”
  • Write a paper
  • Present your results
Multiagent Systems: Think Big and Small

- Controlling multiple autonomous vehicles
- Managing traffic congestion
- Routing data over a network
- Controlling constellations of satellites
- Coordinating thousands of simple devices
- Managing power distribution
- Stabilizing wings with tiny flaps
- Flying in formation
- Morphing matter: Smart structures
- Coordinating micro air vehicles
- Managing system health
- Controlling nano/micro devices
- Managing air traffic flow

Motivation: Why Study Multiagent Systems?

• Current trends:
  - Systems are becoming more interconnected
    • Larger, more distributed, more stochastic
  - Hybrid systems are emerging
    • Biological/nano/electronic systems??
  - Computation is entering new niches
    • more powerful, cheaper, smaller devices

• We need new approaches to optimization and control for:
  - Thousands of robots/devices
  - Failing components
  - Dynamic and stochastic environments
  - Hierarchical/hybrid systems
Final Project

- Continuous Rover Domain:


- if you want to do a project related to your research, talk to me after class
Final Project: Continuous Rover Problem

• Basic Problem Example [Agogino, Tumer 2008]:
  • Rovers autonomously move around in the world
  • Rovers need to observe points of interest
  • Need to maximize collective performance

• System reward: Only closest observation counts
• Agent Reward: Difference rewards
• Agent inputs: World around each rover split into quadrants
• Agent algorithm: Neuro-evolutionary


Final Project: Investigate ...

• Systems Reward:
  – What are the rovers trying to achieve?
  – Closest observation?
  – Multiple observations?

• Agent Reward:
  – What are the rovers’ training signal?
  – Modifications to difference rewards

• Agent input:
  – What are agent states?

• Agent learning algorithm:
  – Reinforcement learning?
  – Neuro-evolutionary
  – Deep learning?
Final Project: Investigate ...

• For each of those questions, investigate:
  - Agent team performance
  - Scaling: Performance with 100 rovers? 1000?
  - Performance with sensor or actuator noise?
  - Performance with limited observation?
  - Performance with rover-to-rover communication?
  - ...
  - ...

Syllabus

http://classes.engr.oregonstate.edu.mime/fall2016/rob538/
Homework & Project Assignments

Due Mondays

(at 11:59 PM)

How do you coordinate US air traffic for 50,000 flights/day