Lecture 1: Introduction to the course

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Outline

• Introduction
  • Examples of autonomy in aerospace systems and robotics

• Syllabus
  • Course Objectives
  • Course Staff
  • Logistics
  • Assignments and Grading

• Course Overview
Textbooks and programming languages

- **Primary textbook:**

- **Other recommended textbooks:**

- **Programming:**
  - All programming in this course will be done in Java.
  - A good Java reference is **[JINS]** “Java in a Nutshell” by D. Flanagan (O'Reilly).
Assignments and Grading

• Reading assignments
  • We highly recommend reading the assigned material before the lecture in which it will be covered

• Problem sets:
  • Problem sets are released weekly, and will include
    • modeling/analysis problems;
    • programming assignments;
  • Problem sets are due in class, or to the course administrator by 4:45pm of the due date, unless otherwise indicated, or arranged in advance with the instructors.

• Exams:
  • There will be a mid-term exam on Oct 20 (mark the date), and a final exam
Assignments and grading (cont’d)

• Term project:
  • Students in 16.413 will be required to complete a project (to be discussed)

• Grading schemes:
  • Your grade in 16.410 or 16.413 will be determined according to the following approximate weights (adjustments may be made based on factors such as, e.g., class participation):
    • 16.410: mid-term (25%), final (40%), and psets (35%)
    • 16.413: mid-term (20%), final (35%), project (20%), and psets (25%)

• Furthermore:
  • Must complete all assignments for a passing grade.
  • Late assignments lose 20% per day (or fraction) after the deadline.
  • Exams will be closed-book, with one sheet of handwritten notes allowed
Tentative Schedule

• **Introduction:**
  - 9/8, W: Course objectives, logistics, and overview

• **State-space search:**
  - 9/13, M: Formulating problem solving as state-space search
  - 9/15, W: Analysis of uninformed search

• **Global path planning:**

• **Constraint Programming**
  - 9/22, W: Visual interpretation and scheduling
  - 9/27, M: Constraint satisfaction
Tentative schedule

• **Propositional Logic**
  • 9/29, W: Propositional Formulas, Models and Propositional Satisfiability, Propositional Inference and Entailment

• **Activity Planning and Execution**
  • 10/6, W: Planning and Execution in a Changing World.

• **Autonomy architecture and case studies**
  • 10/13, W: Space probes, vehicles and human-robot coordination
  • 10/18, M: TBD

• **10/20, W: Midterm Exam**
Tentative schedule

• **Constraint Optimization**
  • 10/25, M: Finite-domain constraint optimization, Conflict learning.
  • 10/27, W: Consistency-based diagnosis, Multiple-fault diagnosis, Mode estimation and active probing

• **Global Path Planning (cont’d)**
  • 11/1, M: Exploring Roadmaps using Informed Search. Weighted graphs; shortest path problems; DP, A*, B&B.
  • 11/3, W: Incremental sampling methods, PRM/RRT/RRT*

• **Mathematical Programming**
  • 11/8, M: Formulating planning, scheduling, and resource allocation problems as mathematical programs
  • 11/10, W: Linear Programs (LPs): The simplex algorithm.
  • 11/15, M: Mixed-Integer Linear Programs (MILPs)
Tentative schedule

• Reasoning in an uncertain world
  • 11/17, W: Probabilistic Inference, graphical models.

• Sensing in an uncertain world
  • 11/22, M: Hidden Markov Models (HMMs): robot localization and mapping
  • 11/24, W: HMMs: algorithms

• Acting in an uncertain world
  • 11/29, M: Dynamic programming and stochastic control, Markov Decision Processes (MDPs)

• Acting in an adversarial world
  • 12/6, M: Matrix and sequential games, alpha-beta pruning
  • 12/8, W: Mechanism design and auctions. Introduction to differential games, pursuit-evasion, and collision avoidance.
16.410 / 16.413 Principles of Autonomy and Decision Making
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