Massachusetts Institute of Technology

16.412J/6.834J Cognitive Robotics

Problem Set #1   Due: in class Wed, 2/16/05

Background

The purpose of this problem set is two fold. First it will help me to get a sense of the kinds of cognitive robots that you are particularly interested in, and the types of reasoning methods you would like to learn more about. Second, it will help you to start thinking about the topic you would like to present in your advanced lecture, to think about the project you would like to pursue, and to think about the advanced reasoning methods you will want to learn in order to support these two objectives.

Note that parts B-E do not commit you to a final project; they are thought exercises. You will have the first third of the course to think much more about your project. The purpose of this question is to get you thinking from day one about what you would like to accomplish in this course, and to keep this in mind as you attend future lectures.

Finally, for this exercise please go the extra mile. I expect you to push your thinking, creativity, and literature investigation beyond what is obvious. This is a prerequisite to do well in this course.

Submitting Your Problem Set

Please turn in a hardcopy of your problem set at lecture on the due date. In addition, in order to help you pick partners for your advanced lecture and for your final project, we will be posting your answers to parts A, D and E on the class web page. Please email these three parts to the course secretary, Brian O' Conaill (oconaill@mit.edu) by the due date of this problem set. Please put:
        "16.412J/6.834J Problem Set 1"
in the message's header, and include your name and email address at the start of your message.

Part A: Topics of Fascination

Please list three topics in reasoning applied to robotics or embedded systems that you would like to learn more about. Please write at least a paragraph for each topic, being as specific and as current as possible. To familiarize yourself with the major topics of reasoning, you can review an Artificial Intelligence text book, such as Artificial Intelligence a Modern Approach, by Russell and Norvig, and by looking at the beginning and ends of the chapters. Next use the web to explore advanced aspects of these topics in further detail. You might want to try sites like www.aaai.org, which includes an archive of AI topics, or the online journal, www.jair.org. These are just a few of the online resources available. You might also want to use the web to follow the trail of some of the authors referenced by Russell and Norvig. Most authors post their papers on the web.

Part B: Your Cognitive Robot

Describe your dream scenario for a cognitive robot that you would like to invent. It could be anything that strikes your fancy. For example, it could be a colony of rovers exploring Mars, an intelligent kitchen that is expert in the culinary arts, a micro robot navigating space station, a nano-tech mouse trap, a high tech Shakespearean theatre, or some other clever device. Describe what the system is and scenarios in which it would act intelligently. Next describe the basic, top-level functions that the system performs. Finally, describe the different reasoning capabilities that the robot will require in order to provide these functions. Include a description of each capability and a software architecture diagram for how these functions are combined together.

Part C: Making your Cognitive Robot

Pick **one** form of reasoning that you feel is the most important for making your system act capably. Argue why this aspect is of particular importance. Describe this capability as precisely as you can.

Part D: Researching a Critical Reasoning Method

Explore this form of reasoning in greater detail. Identify three papers on this topic that were published within the last five years. In addition to the web, I suggest you familiarize yourself with the LCS (Lab for Computer Science) Reading room, on the first floor of NE43. There should be a range of journals and conference proceedings, such as the journal of machine learning, artificial intelligence journal (AIJ), journal of artificial intelligence research (JAIR), the national conference on artificial intelligence (AAAI), international joint conference on artificial intelligence (IJCAI), European conference of artificial intelligence (ECAI), international conference on automated planning and scheduling (ICAPS/AIPS), conference on reasoning about uncertainty in AI (UAI), conference on neural information processing systems (NIPS), internationals conference on multi-agent systems (ICMAS), conference on autonomous agents, and a host of others.

Write a brief critique (~ 1 typed page per paper) of the three papers. For each paper include why you selected the paper, summarize its major contributions, strengths and weaknesses, describe its relationship to the other two papers, and describe how it applies to the cognitive robotic system that you proposed in part B.

Part E: A Simple Project For Your Cognitive Robot

Describe a manageable project that you might pursue during the last third of the semester. This project should embody the salient features of the embedded system described in Part B, and should demonstrate the reasoning capability in Part C.

The project proposed in this part does not need to be the final project that you will pursue in the course; this is your choice. However, the purpose of this problem set is to get you thinking about your final project from the start, hence I encourage you to pick something that you consider to be close. Please be as detailed as possible in your project description. Your effort here will help you to focus your efforts during the remainder of the semester.

Finally, please indicate the likelihood that you will actually pursue this project during this course.