CS 4100/5100 – Foundations of Artificial Intelligence

Assignment 3: Planning

Due: November 5th, 11:59pm

Learning Objectives

- Explain progressive and regressive planning
- Explain the difference between an interleaved and non-interleaved planner
- Be able to design STRIPS planning domains

Assignment Description

This is a written assignment, with no programming involved. You will be writing STRIPS-style planning operators and answering written questions. Answers to written questions should be somehow digitized, either by producing a PDF from writing/diagramming software or by scanning in your *clearly handwritten* solution. We should not have to exert effort to read your handwriting!

Part 1: The Sussman Anomaly

Early planners from the early 1970s were predominantly what are now known as non-interleaved planners. They would work by splitting up the goal state into several subgoals, finding a plan for each subgoal independently, and then concatenating the solutions. This does not work, for reasons we are about to discover. Gerald Sussman identified this problem, which is now called the Sussman Anomaly.

Consider the blocks world discussed in class. There are three blocks, A, B, and C, that can be stacked on top of each other or onto the table directly.

Here are diagrams describing the initial and goal states:

on(C, A), onTable(A), onTable(B), clear(C), clear(B), handempty

on(A, B) on(B, C)

Question 1: Define the STRIPS operators for blocks world in terms of their preconditions and add/delete lists. [If you were following along in class, yes, this comes for free!]

Question 2: Solve the planning problem of satisfying goal on(A, B) by hand using progressive search, and show the search tree.

Question 3: Solve the planning problem of satisfying goal on(B, C) by hand using regressive search, and show the search tree.

Question 4: Explain why using a non-interleaved planner will not work for this problem.

Part 2: Building a Domain Description

Captain Picard has found himself in a bit of a quandary: he needs to go to a formal dinner with the Klingon ambassador tonight, but has two big problems facing him first. His ceremonial phaser is locked in a drawer that he's lost the key to, and he's forgotten how to say "hello" in Klingon. Dinner will be held in Ten Forward, which is accessible from his quarters via a turbolift (it's good to be the captain). But sometimes the turbolift is broken (Geordi is working on it), in which case he has to request a site-to-site transport. He has a replicator in his quarters, which can create one item at a time, and items it creates must be picked up it before it can create a new one.

Sadly, the great Captain Picard has also forgotten how to plan his own actions. Your job is to determine, using STRIPS planning concepts, how he can get to dinner without causing a diplomatic incident. From there, he's on his own.

This problem is intentionally (slightly) underspecified. Your role as an AI designer is to build the formal specification – to define an environment and agent that can act within that environment. Feel free to expand upon the environment as much as needed for your domain to work.

Question 1: What is the planning domain description for your world? You may find it useful to define objects as well as states—for example, item(key) or room(tenforward)—so that your operators can check appropriate pre-conditions. Make sure to clearly state any objects (which are predicates that are assumed to be true for the duration of the plan – i.e. a key is always an item), the initial state, the goal state, and full STRIPS descriptions of any operators required.

Question 2: Write out two potential plans that Picard can follow using the operators you have defined. Make sure that any operators you use can legally be applied. You should show the initial state, operators applied, and updated states until you reach the goal. You do not need to draw the search tree.

Submission Instructions

Create a PDF document that contains your answers to these questions, your name, how many late days you intend to apply to the assignment, and the names of anyone you worked with to come up with a solution. Upload the PDF to Blackboard by November 5th at 11:59pm. All materials must be submitted through Blackboard. **Assignments emailed to me will not be accepted.**