CSCE420: Introduction to Artificial Intelligence
Programming Assignment 5 : PDDL

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1   Problem Domain

The Tower of Hanoi problem is a puzzle of the following form: we are given three rods, and a collection of disks of different sizes which can slide onto any rod. The puzzle starts with the disks in a stack in a conical shape owning to their ascending ordering of size on one rod. The objective is to move the entire stack of disks to another rod, obeying the following rules:

1. Only one disk may be moved at a time.

2. Each move involves taking the upper disk from one of the stacks and placing it on top of another stack.

3. No disk may be placed on top of a smaller disk.

Paul Stockmeyer wrote a paper entitled "Variations on the Four-Post Tower of Hanoi Puzzle" (appearing in *Congressus Numerantium* volume 103, pages 3–12, 1994) which poses a generalization called the **Star Puzzle**. He defines the puzzle this way:

> "This new puzzle consists of three posts, labeled A, B, and C, arranged in an equilateral triangle, and a fourth post, labeled O in the middle. Every disk move must be either to or from post O; direct moves between any two posts A, B, and C are prohibited. Thus the allowable move graph is a star. The task is to transport a tower of n disks from post A to, say, post C."

2   Project Infrastructure

You will be asked to submit a specification of the Star Puzzle in PDDL; in order to do so, you should download and use a planner that solves problems specified in that description language. I recommend blackbox:

1. Blackbox is available from `http://www.cs.rochester.edu/˜kautz/satplan/blackbox/blackbox-download.html`

The textbook gives an example problem in the Air Cargo Domain. This can be written in PDDL in two pieces:

The Domain Definition File

```
;; STRIPS domain of the Air cargo transport

(define (domain air-cargo)
  (:requirements :strips)
  (:predicates (In ?obj ?place)
          (At ?obj ?place)
          (Cargo ?obj)
          (Plane ?obj)
          (Airport ?obj))

  (:action LOAD
    :parameters (?c ?p ?a)
    :precondition (and (At ?c ?a) (At ?p ?a)
          (Cargo ?c) (Plane ?p) (Airport ?a))
    :effect (and (not (At ?c ?a)) (In ?c ?p)))

  (:action UNLOAD
    :parameters (?c ?p ?a)
    :precondition (and (In ?c ?p) (At ?p ?a)
          (Cargo ?c) (Plane ?p) (Airport ?a))
    :effect (and (not (In ?c ?p)) (At ?c ?a)))

  (:action FLY
    :parameters (?p ?from ?to)
    :precondition (and (At ?p ?from)
          (Plane ?p) (Airport ?from) (Airport ?to))
    :effect (and (not (At ?p ?from)) (At ?p ?to)))
  )
```

The Problem Instance Definition File

```
;; STRIPS Instance problem for the Air cargo transport

(define (problem pb1)
  (:domain air-cargo)
  (:objects C1 C2
       P1 P2
       SFO JFK)
  (:init
   ;; types
   (Cargo C1) (Cargo C2)
   (Plane P1) (Plane P2)
   (Airport SFO) (Airport JFK)

   ;; locations
   (At C1 SFO) (At C2 JFK) (At P1 SFO) (At P2 JFK))

  (:goal
   (and (At C1 JFK) (At C2 SFO))))
```

3 Submission

Due date: 28 March at 11:59pm.
Submission method: Via e-mail to the professor.

Submit in the following (electronic) form:

- Turn in a zip file which includes all the source files and a documentation like pdf file, with the items below. (Do not describe your results in the e-mail)

- The zip file should be named `student-last-name_hw-number.zip` *e.g.,* `Jim_hw5.zip`

- Subject of e-mail should be named as `[csce420]last-name_hw-number` *e.g.,* `[csce420]Jim_hw5`

The zip should include the following:

1. The code you wrote for this assignment. This should be your pddl files with (1.) a domain definition of the star puzzle; (2.) definitions for the problem with 4, 5, and 6 disks.

2. A description of how to run the submission.

3. A list of the resources used (*e.g.*, online forums, links to example code on the web, *etc.*).

4. A statement of the Aggie Code of Honor.

You are encouraged to discuss this with your friends and classmates, but are expected to write your own code.

4 Potentially Links

- `http://en.wikipedia.org/wiki/Planning_Domain_Definition_Language`

- `http://users.cecs.anu.edu.au/~patrik/pddlman/writing.html`

- `http://www.cs.toronto.edu/~sheila/384/w11/Assignments/A3/veloso-PDDL_by_Example.pdf`