Artificial Intelligence

Final Exam (Fall 2012)

Time Allowed: 180 Minutes

Maximum Marks: 100

Q No 1: A* Search

Draw a search tree for the 8-puzzle problem up to depth 4 (start state is depth 0) using the A* algorithm (omit repeated states). g(n) is the number of steps from the start state and h(n) is the number of misplaced tiles. Note that the actions for sliding tiles should be used in this order: right, left, up and down. [10 Marks]

Start state

1	2	3
4	8	5
7	6	

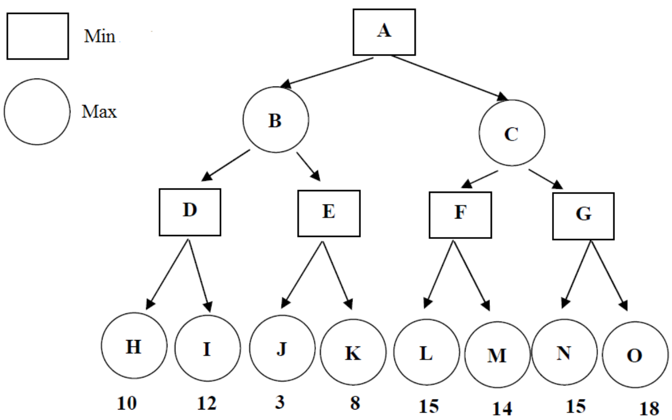
$\longrightarrow$

Goal state

1	2	3
4	5	6
7	8	

Q No 2: Alpha Beta Pruning

Given the following search tree, apply the alpha-beta pruning algorithm to it and show the search tree that would be built by this algorithm. Make sure that you show where the alpha and beta cuts are applied and which parts of the search tree are pruned as a result. [10 Marks]



Q No 3: First Order Logic

(a)

Say *Attract* is a relation from *x* to *y*, i.e., *Attract*(*x*,*y*) means that *x* attracts *y*. Translate the following sentences into First Order Logic sentences. [10 Marks]

1- Everything attracts something.
2- There is something that is attracted by everything.
3- Everything is attracted by something.
4- Something attracts everything.

(b)

We have the following general knowledge about flipping a coin:

1- It can be Heads or Tails
2- IWin means YouLose
3- YouLose means IWin

Having this knowledge in the knowledge base, and from the sentence "Heads I win, tails you lose," prove using the resolution method that "I win." [10 Marks]

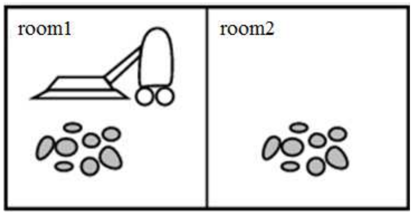
Q No 4: Partial-Order Planning

Consider the vacuum cleaner domain (Use this domain for questions 4, 5 and 6). It consists of two rooms room1 and room2 and a vacuum cleaner agent which can be either in room1 or in room2 represented by In(room1) and In(room2) respectively. Each room can be clean or dirty. room1 being clean is represented as Clean(room1), and room 2 being clean is represented as Clean(room2). The vacuum cleaner agent has three actions: Left and Right for moving between the rooms and Suck for cleaning up dirt.

Left:
PRECOND: In(room2)
EFFECT: In(room1) $\wedge$ $\neg$In(room2)

Right:
PRECOND: In(room1)
EFFECT: In(room2) $\wedge$ $\neg$In(room1)

Suck (x):
PRECOND: In(x)
EFFECT: Clean(x)



Now assume that the initial state is In(room1), the goal state is Clean(room1), Clean(room2). Trace partial order planner solving this problem. Mark all the causal links as well as other ordering constraints. [15 Marks]

Q No 5: GraphPlan

(a) Assume that the initial state is In(room1), the goal state Clean(room1). Draw the planning graph that the GraphPlan algorithm would draw in order to find the solution of the given planning problem. [10 Marks]

(b) Write down the types of mutex relations. Give examples (where possible) from the planning graph that you have drawn for part a of this question. [5 Marks]

Q No 6: SATPLAN

Assume that the initial state is In(room1), the goal state Clean(room1). Give a description of this planning problem in terms of propositional formulas, suitable as an input to the SATPLAN algorithm when searching for a plan consisting of 1 action. [15 Marks]

Q No 7: Proactive-Reactive Coordination Problem

(a) What is proactive-reactive coordination problem?
(b) Write down the plan merging algorithm that is used to solve this problem.

Note: Write down the solution of different cases that can arise while analyzing the First Possibly Valid Time Stamp returned for a particular action. [15 Marks]