National University of Computer & Emerging Sciences

(Karachi Campus)

<u>Midterm Examination II – Spring 2015-SOL</u>

Artificial Intelligence (CS401)

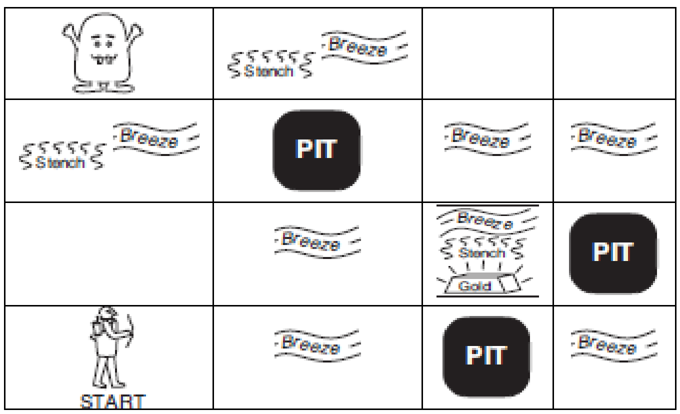
Time Allowed: 60 Min. Max. Marks: 50

Dated: April 07, 2015

Instructions: Attempt all questions. Be to the point, there is a penalty for wild guesses. Draw neat and clean diagram/code where necessary.

Question No. 1	[20 Points] [Time: 20 Min.]

Consider an instance of the famous Wumpus World problem below:



We have already discussed the description+ rules of the problem.

a. Using Propositional Logic (PL), provide the minimal set of propositional literals, and rules for setting up initial grounding for the problem. [5]

(a) Let

$C_{x,y}$ for $1 \le x \le 4$ and $1 \le y \le 4$ represents each cell is a literal for propositional calculus.

Let

Breeze = B — Breeze is present
Stench = S — Stench " "
Wumpus = W — Wumpus " "
Pit = P — pit " "
Gold or Glitter = G — Gold " "
Scream = K are propositional literals

Hence, for $C_{1,1}$ we have the following percept sequence for our agent, let the sequence has a fixed order.

$C_{1,1} \leftarrow (\neg B, \neg S, \neg W, \neg P, \neg G, \neg K)$

we know therefore $C_{1,1}$ is safe by definition of the problem.

Similarly,

- There are sentence in KB, which support that there is a Wumpus in the Grid.
- The only discovered cell is $C_{1,1}$
- Here the percept sequence is
  $(\neg B, \neg S, \neg W, \neg P, \neg G, \neg K)$

b. Illustrate how our agent will follow the first three steps(excluding "turn" move), using the local percept sequence. provide the content of knowledge base and agent available set of move at each step. [10]

(b) Step1

Agent is initially Present at $C_{1,1}$ by definition of the problem, The percept seque he received is

$(\neg B, \neg S, \neg W, \neg P, \neg G, \neg K)$

Hence, $\neg B \Rightarrow$ no pit in (1,2) and (2,1)

$\neg S \Rightarrow$ no Wumpus in (1,2) and (2,1)

with this minimal info. it is easy to Conclude $C_{1,2}$ and $C_{2,1}$ are Safe, move to any one.

Step2

our agent arbitrarily move to $C_{1,2}$ and update the KB accordingly. Here the percept Sequence is

$C_{1,2} \leftarrow (B, \neg S, \neg W, \neg P, \neg G, \neg K)$

$B \Rightarrow C_{1,3}$ or $C_{2,2}$ Can have pits, not Safe to move.

Here, at this point available Safe cells are still $C_{1,1}$ and $C_{2,1}$ moving back to $C_{1,1}$ in Next step.

let in step3, our agent tries the next unvisited option $C_{2,1}$

Step3.

In cell $C_{2,1}$ the percept Sequence is $C_{2,1} \leftarrow (\neg B, \neg S, \neg W, \neg P, \neg G, \neg K)$

updating KB, we can Conclude

$C_{2,2}$ is Safe and $C_{1,3}$ is Safe. After getting percept from cell $C_{2,1}$ our agent is sure about $C_{2,2}$ is Safe. Available moves are $C_{2,2}$ and $C_{1,3}$.

c. How many distinct solutions(where our agents can achieve the goal) are there for this instance of the Wumpus world? [3]

There is no solution for this instance. As there is no percept sequence that resolve the uncertainty about the path.

d. Is fourth step(excluding "turn" move) of the agent always produce the goal state? Explain with a sequence of move that does not produce so. [2]

There is no guarantee that at least four steps of our agent always produce the goal state. A sequence four steps of move with local percept and KB is as follow

$C_{1,1}$ --> $C_{1,2}$ --> $C_{1,1}$ --> $C_{2,1}$-> $C_{2,2}$

Question No. 2	[15 Points] [Time: 20 Min.]

a. What are the problems of state-space search?

The state -space search even for a moderate size problem produce large search space. A systematic exploration of this space via state-space search requires to generate all possible next states from any current state. Hence it has two main problems time and space require to generate and explore all possibilities.

b. How local search algorithms are different from state-space search?

Local search algorithm generally keep only one state while state-space search maintains large possible states to explore. One of the problem of local search is local maxima which make these local searches incomplete or not optimal.

c. Comments on "Hill Climbing is a greedy search".

Yes. Hill climbing is a greedy search. The hill climbing approach start with an initial state and generate sequence of state systematically to only move uphill as soon as it finds a low value. it stops. It is greedy in this sense and it may stuck in local maxima.

d. Comments on "Random Restart Hill Climbing is complete".

Random Restart Hill Climbing tries to generate all random points for hill climbing with some probability say (p). It conducts a series of hill-climbing searches from randomly generated initial states, until a goal is found. It is obviously complete.

e. What is the main problem of Local Beam Search?

Local beam search can suffer from a lack of diversity among the k states, it explore—they can quickly become concentrated in a small region of the state space, making the search little more than an expensive version of hill climbing.

f. How constraint satisfaction is different from search?

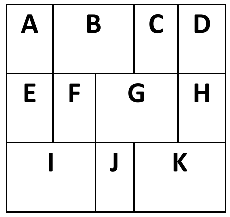
CSP search algorithms take advantage of the structure of states and use general-purpose rather than problem-specific heuristics to enable the solution of complex problems. The main idea is to eliminate large portions of the search space all at once by identifying variable/value combinations that violate the constraints.

g. Explain how 'crossover' and 'mutation' operators effect Genetic Algorithm (GA).

The crossover operator mix the two chromosomes to produce the qualities of parents. The mutation operator tries to bring divergent from the parents. These two operators can be used to control the output of the GA

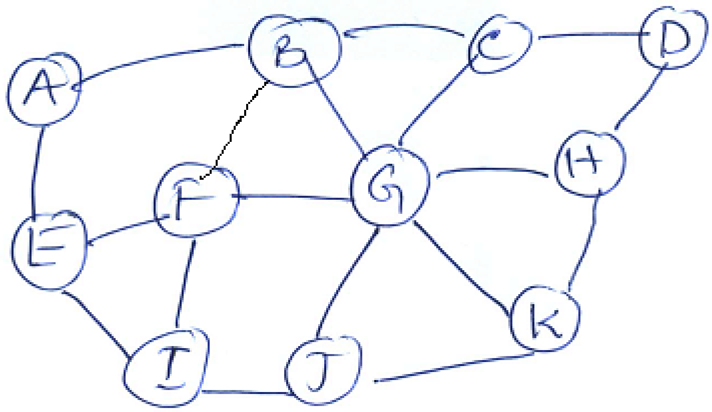
Question No. 3	[15 Points] [Time: 20 Min.]

Consider the following map for the problem of map coloring with three colors (Red, Blue and Green).



a. Lets Constraint satisfaction approach is used to solve it, Draw a constraint graph for the above map. [5]

(a)



b. Illustrate the possible value for each node, after running node consistency algorithm. [3]

(b)

A	B	C	D	E	F	G
RBG	RBG	RBG	RBG	RBG	RBG	RBG

H	I	J	K	
RBG	RBG	RBG	RBG	

c. Illustrate the possible value for each node, after running an arc consistency algorithm. [3]

(c) For arc-consistent, we need to get all pair of Binary Constraints. So, (AB) can not have same color.
(AB) is a Binary Constraint, Hence possible value of assignments for (AB) will be
{ (R,B), (R,G), (G,R), (G,B), (B,R), (B,G) }
while producing all such binary constraints, we can then run arc-consistency algorithm.

Now, Consider the node 'G' which has a higher degree. Making 'G' consistent with all pair of node through arc-consistency algo. Give us maximum assignments.

G	F	B	C	H	K	J	
R B G							

Let G assigned a color "green". Hence to make all pair of node consistent with G. we run the algorithm and get.

G	F	B	C	H	K	J
R B G	R	B	R	R	B	R

Similarly, for making a choice for 'A' will produce.

There are other possible options for each node. Like a choice between R and B for node F.

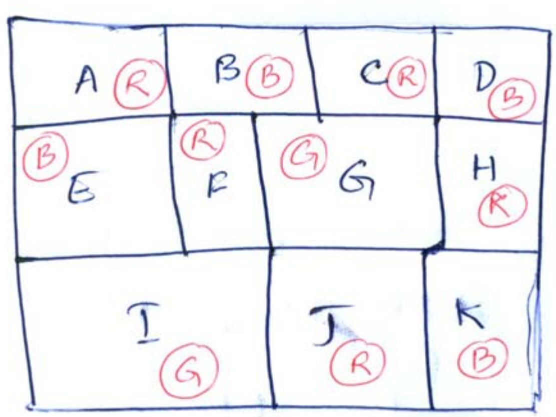
A	B	C	D	E	F	G
R BG	B	R	B	B	R	G RB

H	I	J	K	
R	G	R	B	

Hence, all the arc are consistent after this.

d. Provide one complete and consistent coloring assignment for above graph. [4]

(d)
One complete and consistent assignment for the given map with three colors (RBG) is given below:



<Best of Luck>