Quiz
Artificial Intelligence – CSCE 523

Name: _____

1) Indicate for the following environments their: Observability, Agency, Determinism, Episodic, Static/Dynamic, and Discrete/Continuous.

a) Playing Checkers

Fully, Multiagent, Deterministic, Sequential, Static, and Discrete

b) Playing Table Tennis

Partially, Multiagent, Stochastic, Sequential, Dynamic, Continuous

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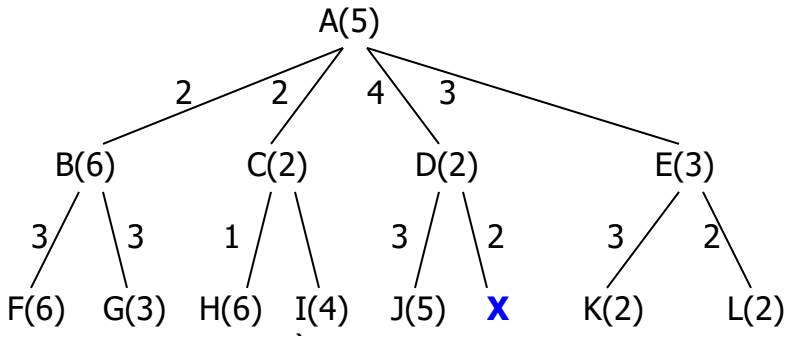
For the following tree, show the lists of open and visited nodes (with their associated costs and heuristic estimates) for each cycle of the breadth first search and the depth first search algorithms. The goal node is **X**, the numbers next to the edges indicate the associated cost, and the number in parenthesis next to the nodes are their heuristic values. Nodes are inserted from *right* to *left*.



Breadth First Search:

OPEN	VISITED
A	-
EDCB	A
DCBLK	AE
CBLK**X**J	AED (GOAL FOUND!)
BLKXJIH	AEDC
LKXJIHGF	AEDCB
KXJIHGF	AEDCBK
XJIHGF	AEDCBK**X** (GOAL POPPED)

Depth First Search:

OPEN	VISITED
A	-
BCDE	A
FGCDE	AB
GCDE	ABF
CDE	ABFG
HIDE	ABFGC
IDE	ABFGCH

DE	ABFGCHI
JXE	ABFGCHID
XE	ABFGCHIDJ
E	ABFGCHIDJ**X (GOAL FOUND!)**

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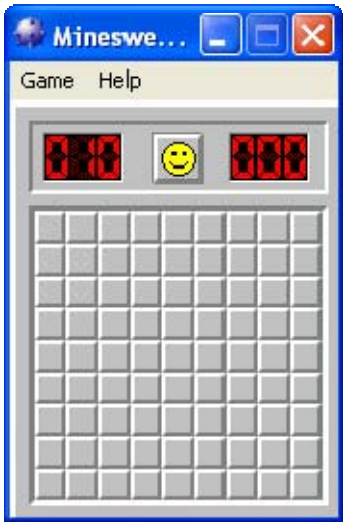
For Minesweeper:



1) What type of agent is needed to solve the problem?

Goal Based Agent

2) Define the search problem (PEAS):

Performance Measure: fewest number of clicks to clear all non-mine squares
Environment: Square state for all squares {clicked, unclicked},{flag type}, {mine/no mine}
Action: click a square or place a flag
Sensors: Square state for all squares {clicked, unclicked},{flag type}, Dead?

3) Define a state:

Square state for all squares {clicked, unclicked},{flag type}

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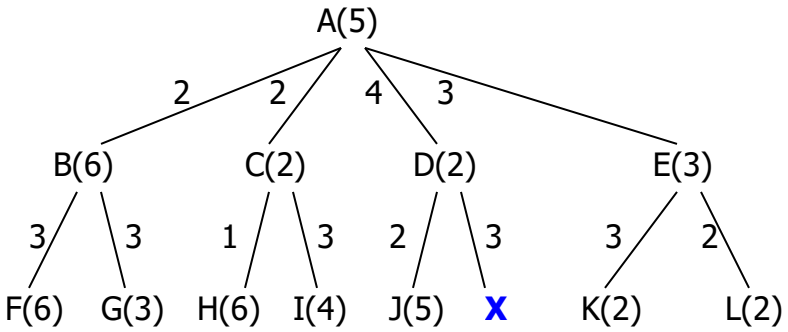
For the following tree, show the lists of open and visited nodes (with their associated cost estimates) for each cycle of the A* Search algorithm. The goal node is **X**, the numbers next to the edges indicate the associated cost, and the number in parenthesis next to the nodes are their heuristic values. Ties should be broken alphabetically.



A* Search

OPEN	VISITED
A_5	
$C_4D_6E_6B_8$	A_5
$D_6E_6B_8H_9I_9$	A_5C_4
$E_6X_7B_8H_9I_9E_3I_4J_{11}$	$A_5C_4D_6$
$L_7X_7B_8K_8H_9I_9E_3I_4J_{11}$	$A_5C_4D_6E_6$
$X_7B_8K_8H_9I_9E_3I_4J_{11}$	$A_5C_4D_6E_6L_7$
$B_8K_8H_9I_9E_3I_4J_{11}$	$A_5C_4D_6E_6L_7X_7$ <= GOAL FOUND

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For the Missionaries and Cannibals problem:

> Given *n* missionaries and *n* cannibals on a river bank (left bank) that desire to cross the river (right bank) using a boat that can carry at most 2 people. The constraint is that the number of missionaries must be greater or equal to the number of cannibals on both banks and the boat. If the missionaries become outnumbered, the cannibals will eat them. Additionally, the boat can only traverse the river if a person is in the boat.

3) What type of agent is needed to solve the problem?
   Agent Type: Goal-directed

4) Define the search problem
   States: number of cannibals and missionaries on each bank and position of boat

   Initial state: n cannibals and n missionaries on the left bank

   Actions: {1,2} missionaries and {0,1} cannibals crossing river (from left to right or right to left)

   Goal: All n cannibals and n missionaries on the right bank

   Action Cost: 1 per operator

3) Create an informative non-trivial (i.e. not NULL) admissible heuristic

   Heuristic: a) (# of cannibals + # missionaries on left bank) – 1
   b) (# of cannibals + # missionaries on left bank)/2

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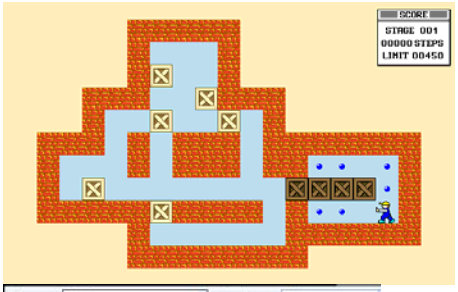
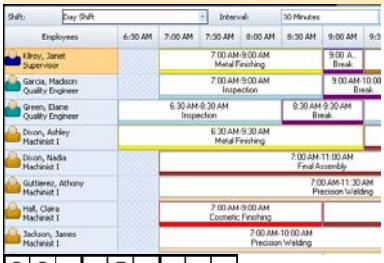
3) For each of the following problems, indicate if it would be best solved with a state space search or local search. Circle your answer.

state / local Sokoban



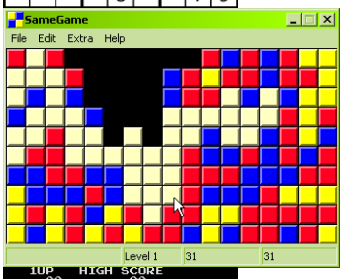
state / local Shift Scheduling



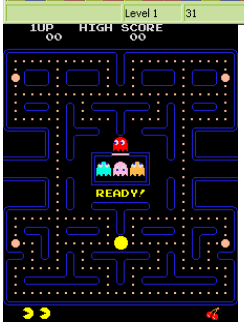
state / local Sudoku

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

state / local Same Game

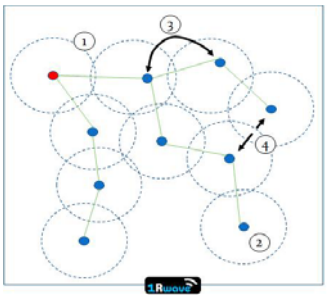


state / local PacMan



Continues on back

state / local Sensor Network Coverage



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What is the danger in searching a game tree to a fixed ply (describe the danger and provide the name of this problem), and what are two ways of reducing this danger?

The danger is that what appears to be a good leaf state could in another move actual be very bad. This is the fixed horizon problem.

Solutions:
Quiescent search/Secondary search
Feedover
Progressive deepening search

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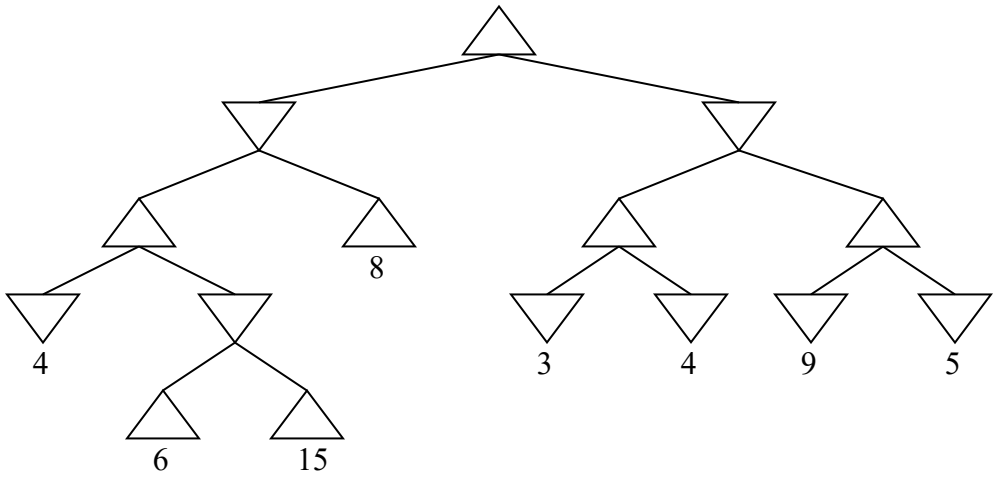
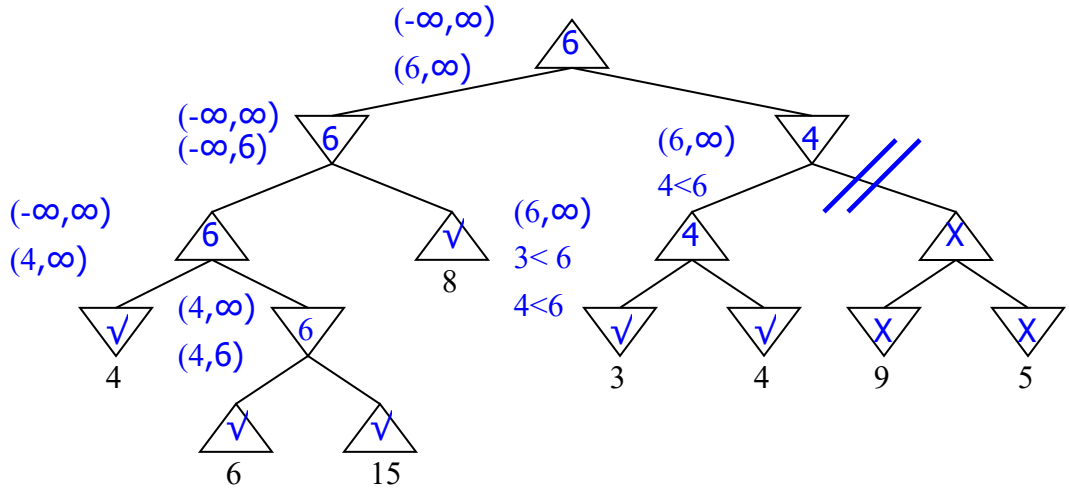
Perform minimax search with alpha-beta pruning for the following game tree. Indicate the nodes that are never visited and those branches pruned (assume that ties are broken from left to right). Also indicate next to each node either its true value, or its α or β value. The utilities of terminal nodes are shown below the leaf nodes. (To help, the up triangles are max levels, the down triangle are min levels).





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Transform the following sentence into Conjunctive Normal Form (CNF)

$$\forall x\,(\exists y\,(\mathrm{P}(x,y) \Rightarrow \mathrm{R}(y) \vee \neg\exists y\,\mathrm{Q}(x,y)))$$

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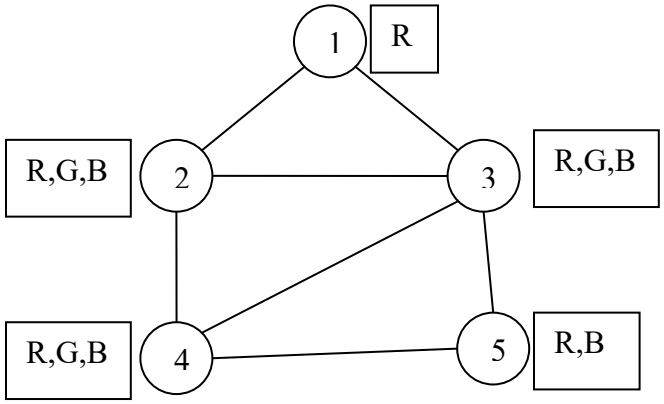
Consider the following constraint graph for a graph coloring problem (the constraints indicate that connected nodes cannot have the same color). The domains are shown in the boxes next to each variable node.

Show the sequence of variable assignments during backtracking with forward checking, assume that the variables are examined in numerical order and the values are assigned in the order shown next to each node. Show assignments by writing the forward checking graph.



	Cell->	1	2			3			4			5		Backtrack
Step	Val ->	R	R	G	B	R	G	B	R	G	B	R	B	
1		✓	×			×								
2		✓	×	✓	×	×	×			×				
3		✓	×	✓	×	×	×	✓		×	×		×	
4		✓	×	✓	×	×	×	✓	✓	×	×	×	×	No val for 5, backtrack to 2
5		✓	×	×	✓	×		×			×			
6		✓	×	×	✓	×	✓	×		×	×	×		
7		✓	×	×	✓	×	✓	×	✓	×	×	×		
8		✓	×	×	✓	×	✓	×	✓	×	×	×	✓	Done
9														
10														
11														
12														
13														
14														
15														

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In planning, what is the difference between a state-space planner and a plan-space planner?

A state-space planner has instantiated states as nodes in the search, plan-space planner has partially order plans as the nodes in the search.

Define the Closed World assumption in planning.

If a variable is undefined, it is assumed false.

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What is Decision Theory?

Probability Theory + Utility Theory

What are two methods for setting an a priori probability of an event?

Quantitative: maximum likelihood via experimentation
Qualitative: subject expert opinion

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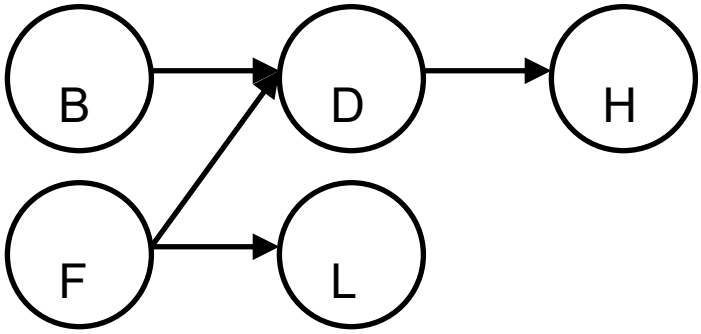
For the Bayesian network below, write out the factorization (i.e. $\Sigma P()P()$) for each requested probability calculation.



1. P(D|b)

$P(D|b) = \sum_F Pr(D|b,F)Pr(F)$

2. P(F|h,b)

$P(F|h,b) = \alpha\sum_D Pr(D|b,F)Pr(h|D)$