# ECS170 Winter 14 – MidTerm Exam

NAME: **Write your name on the top of the second page as well**

STUDENT ID:

Worth 20% of Grade

*Instructions*

**Do not take this list of exam questions from the class.**

You are allowed 5 single-sided pages of notes.

Do not talk or try to communicate during the exam.

You are allowed fifty minutes for this exam, including reading time.

Be sure you understand the question before answering it. There are no marks for correctly answering the wrong question.

Show all working, but keep answers short and concise. There are no marks for padding answers.

The Short Question Section is worth 20 points (2 points per question)
The Long Question Section is worth 30 points (10 points per question)

Approximately 1 minute per point.

NAME:
STUDENT ID:

*Short Questions (2 point each question part)*

**Uninformed/Informed Search**

1. With A* using an admissible heuristic, what property will all the nodes expanded by the algorithm share?

   **All nodes expanded must have a f value (where f(n) = g(n)+h(n) less than or equal to the optimal cost C*. Formally \forall n \in CLOSED f(n) <= C***

2. If for a problem an admissible heuristic h1 dominates another h2 what is the benefit of using h1 over h2.

   1) **Any nodes expanded using h1 must be expanded by h2, hence CLOSED(h1) is a subset of CLOSED(h2)**
   2) **Using h1 is more efficient than using h2**
   3) **Using h1 expands less nodes than h2**

3. When searching a graph using A*, what is the primary benefit of using a consistent heuristic over just an admissible heuristic?

   1) **The first time you visit a node is the shortest path to that node.**
   2) **Hence there is no need to search through the closed list to update the shortest path to the node**

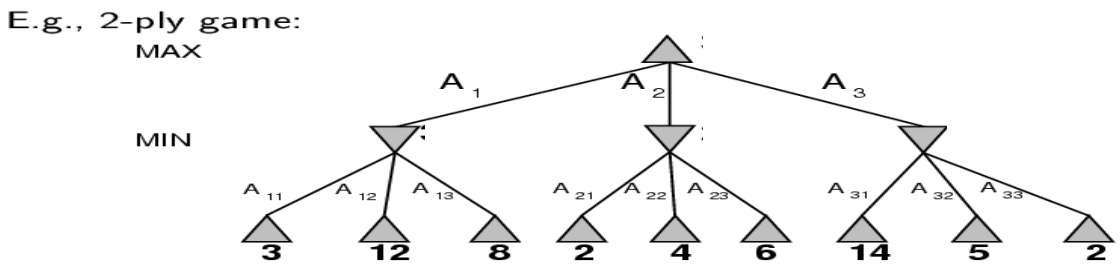
**Adversarial Search**

4. For the following game tree fill in pay offs propagated up the tree?

   **Values are as follows. Half a mark for each correct value.**

   **3**

   **3 2 2**



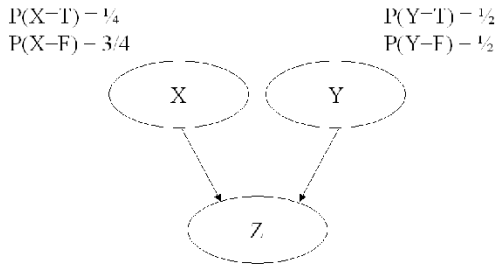
5. The mini-max algorithm makes very strong assumptions of the game being played. Name two?
   **Turn taking**
   **Two player**
   **Zero-sum**
   **Perfect information**
   **Player is rational**
   **Game has a finite branching factor**

6. For a given node *n*, what does the alpha and beta term associated with that node mean in the alpha-beta pruning algorithm?

   **The lower bound on the best result and the upper bound on the [best result/Nash-equilibrium/payoffs] that can be achieved by playing this node in the tree.**

**Reasoning in the Presence of Uncertainty**

Consider the belief graph:




7. For the graph calculate P(Z = F)?

   **P(Z=F) = 1-P(Z=T)**
   **= 1-P(Z=T|X=T,Y=T)*P(X=T)*P(Y=T) + all other combinations of X and Y in {T, F}.**
   **= 1 – 1/4*1/2*1/4 + 1/4 *1/2*3/4 + 3/4 *1/2*1/2 +3/4*1/2*1/4**
   **= 1 – 1/32 – 3/32 – 6/32 – 3/32**
   **= 1 – 13/32 = 19/32**

   *½ a point for product rule*
   *½ a point for marginalization*
   *½ a point for 1 – P(Z=T)*
   *½ a point for the correct calculation.*

8. Name the three type of reasoning that can occur in a belief network.

   **a) Predictive/Causal: Reasoning from "causes to effects"**

**b) Abductive/Diagnostic: Reasoning from "effects to causes"**
**c) Intercausal (Reasoning/Explaing away): Reasoning that one cause is less likely because of the presence of another cause**

*1 out of 3 gets 1 point*
*2 out of 3 gets 1.5 points*
*3 out of 3 gets 2 points*

9. a) If Z occurs and we know X occurs what should happen to our belief in Y occurring.

**It *decreases* due to the other cause occurring and the effect occurs. (1 out of 2)**

b) A belief network is a compact representation of what distribution?

**The *joint* distribution over all node combination values. (1 out of 2)**

10. Name **one** limitation each for the i) prior, ii) rejection and iii) likelihood Markov chain Monte Carlo samplers?

**i)** **Need to generate/store all samples. Takes lots of memory.**
ii) **Need to generate all samples. If evidence is small most samples are thrown away. Query specific.**
**iii)** **Query specific. Can't reuse results for another query. Only works if distribution is ergotic.**

*Moderate/Difficult Questions (10 point each question part)*

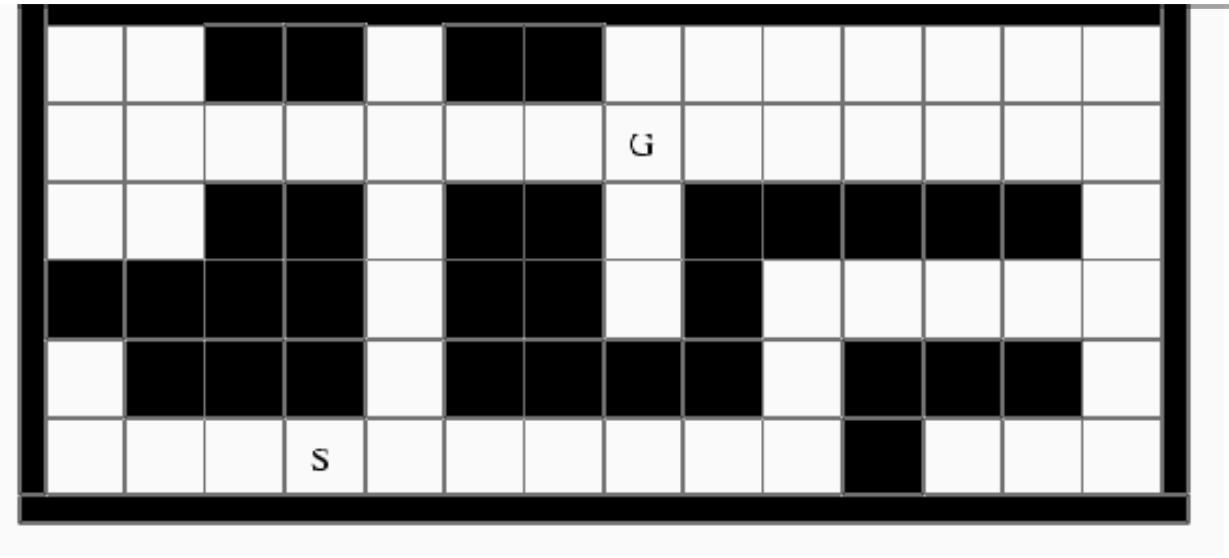
**Uninformed/Informed Search**

11. Use A* with the Manhattan distance as an admissible heuristic for this problem.

Imagine a scenario with a robot trying to navigate in the following maze from the start position marked S to the end position marked G. At each step the robot can move in one of the four compass directions. The robot contemplates alternatives in the following order:

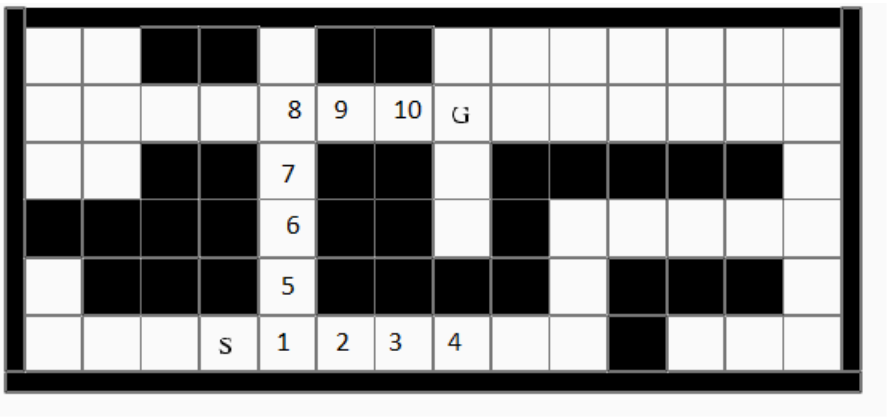
1. Move South
2. Move East (i.e. Right on this picture)
3. Move North
4. Move West (i.e. Left on this picture)

Mark the set of states that are expanded during the search, in the order they are expanded, by putting a 1 in the first state, a 2 in the second, and so forth. (Hint: put "1" in the cell marked "S").




Scrap work place

Write your final answer here.

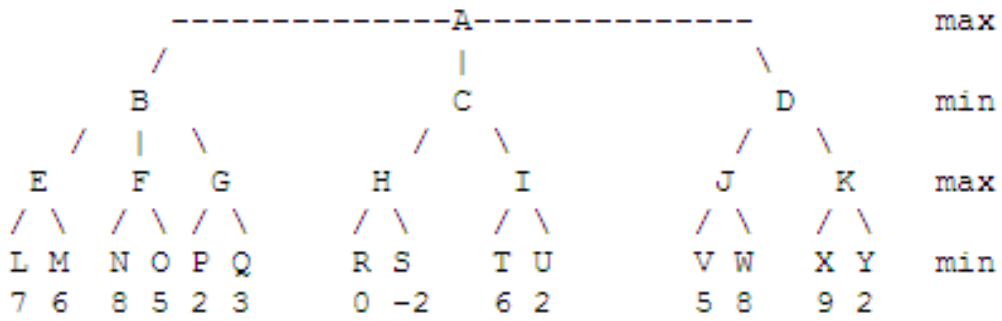



*1 point per correct answer*

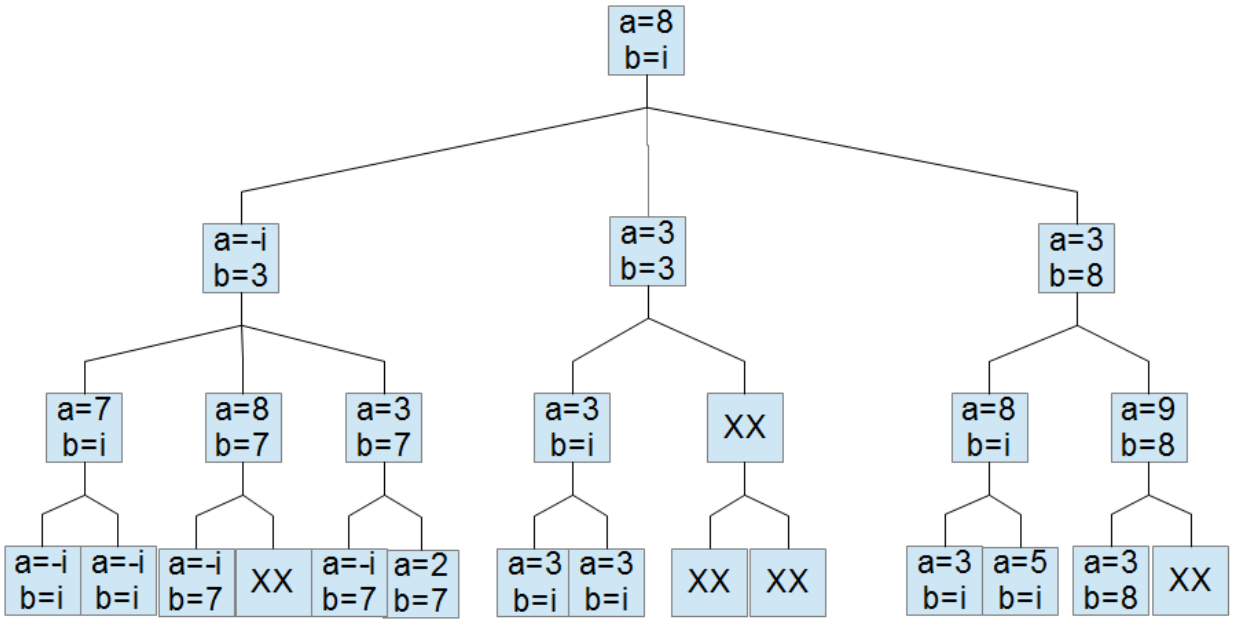
**Adversarial Search**

12. For the following game tree show a) what nodes alpha-beta pruning will expand and b) the alpha and beta values throughout the tree.

**Scrap work place**




**Write your final answer here**



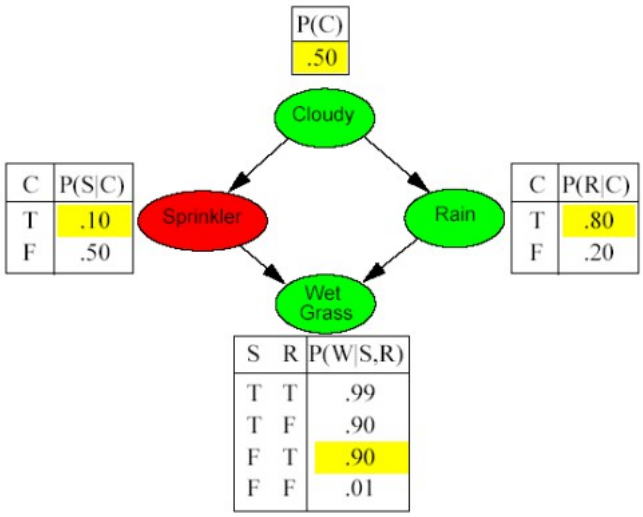

**1: Getting alpha = 8 at top**
**4: Pruning**
**5: Correct alpha beta values throughout tree**

**Note: We went easy on solutions that don't properly update alpha and beta of nodes after evaluating their last child**

**Reasoning in the Presence of Uncertainty**

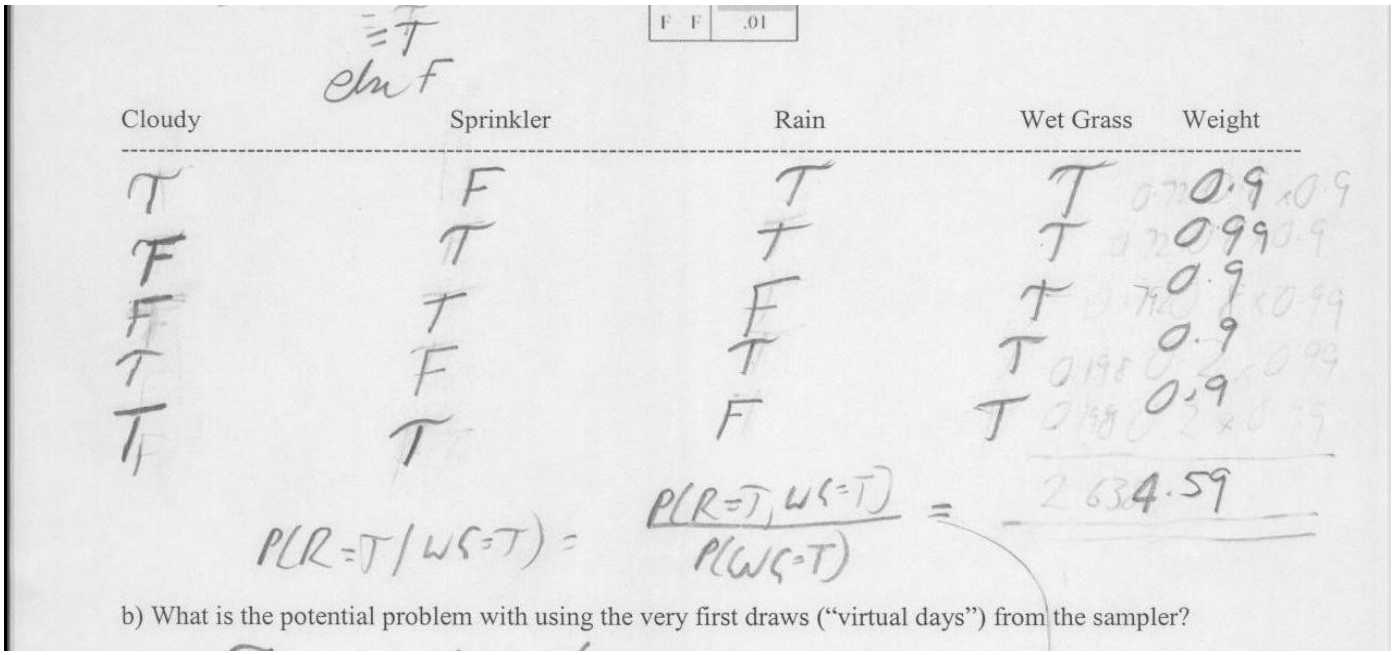
18.

For the following belief network consider the query P(Rain =T | Wet Grass = T). a) show the workings of five draws from the joint distribution using **the likelihood weighting MCMC sampler**? b) What is your estimate of P(Rain =T | Wet Grass = T)? Use the random number stream: 0.3 0.7 0.4 0.9 0.2 0.1 0.9 0.3 0.8 0.2 0.5 0.2 .3 0.1 0.9 0.3 0.2 0.6 0.3 0.2 0.4 0.6 0.8 0.2 0.5 0.2 0.6.




| Cloudy | Sprinkler | Rain | Wet Grass | Weight |
|---|---|---|---|---|

*1 points for each correct draw (total of 5 points)*
*3 points for correct weights (You may get full points on this even if you get the incorrect answer)*
*2 points for correct calculation (You may get full points on this even if you get the incorrect answer)*
*1 point: Correctly summing number of times Rain=T*
*1 point: Correctly using weights*



| Cloudy | Sprinkler | Rain | Wet Grass | Weight |
|---|---|---|---|---|
| T | F | T | T | 0.9 |
| F | T | T | T | 0.99 |
| F | T | F | T | 0.9 |
| T | F | T | T | 0.9 |
| T | T | F | T | 0.9 |

$P(R=T \mid WG=T) = \frac{P(R=T, WG=T)}{P(WG=T)} = \frac{2634.59}{}$

b) What is the potential problem with using the very first draws ("virtual days") from the sampler?

P(Wet Grass=T|Rain=T) = P (Wet Grass=T, Rain=T)/P(Wet Grass=T) = (2*.9+.99)/(4*.9+.99)