Name: _____ eid: _____

Abidement by the Honor Code:

I have abide by the guidelines of the honor code at JMU with regards to this exam.

Signature: _____

Instructions:

- Do not proceed with the exam until directed to do so.

- You have a total of 120 minutes.

- The exam is closed book, but you are allowed one page (front and back) of typed and or hand written notes.

- Write your answers in the space provided. If you need more space, you can write on the back of the page. Should you need more space, blank pages are provided for you at the end.

- Do not spend a lot of time on a particular problem. Read all problems first. Then, attack them in the order that you think allows you to accumulate most points. I allocated 10, 20, 15, 10, and 20 minutes for problems 1-5 respectively.

- You will be graded on both correctness and clarity. Show your work but be concise!
  Points will be deducted for rambling.

1. **Search Problems**

   (a) What are the bounds of A*Star search (big-O). Compare it to breadth-first search and depth-first search. (10 pts)

   (b) We have used A*Star to solve problems. Use A* to solve this problem using a manhatten (city-block) heuristic. Show **all** costs on the graph.

   (c) You have an idea of adapting A* to use a bidirectional search. Would this improve the big-Oh bounds? Would it have practical implications? Explain. distance
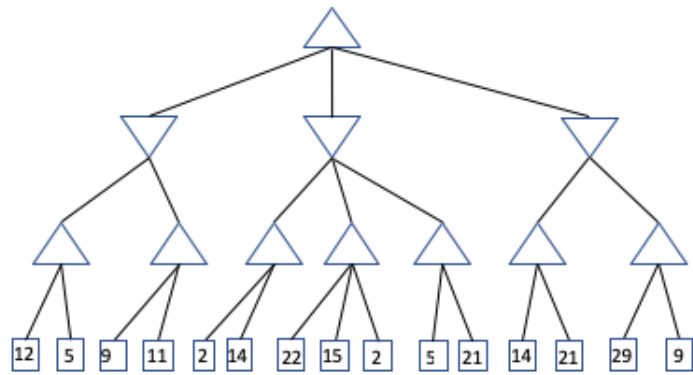
1	-	2
4	5	3
7	8	6

Start State

1	2	3
4	5	6
7	8	-

Goal State

2. In adversarial games, AI agents search the move that will yield the most utility.

(a) What is the utility value of the following minimax tree. Recall that triangles are MAX and upside down triangles are MIN.

(b) Utilize α/β pruning by drawing cutlines in the search tree above.

(c) Discuss how the successor states impact α/β pruning, give an example of how successor state ordering can impact the effectiveness of α/β pruning.

3. **CSPs**

    (a) Show how different techniques can be used to solve the 4-queens placement problem. Solve this problem using the following techniques:

        i. Backtracking search

       ii. min-conflicts. Initial placement is all queens on the diagonal of the board.

4. **Logic**

   (a) Tony, Mike, and John belong to the Alpine Club. Every member of the Alpine Club is either a skier or a mountain climber or both. No mountain climber likes rain, and all skiers like snow. Mike dislikes whatever Tony likes and likes whatever Tony dislikes. Tony likes rain and snow.

   Represent this information by FOL sentences in such a way that you can represent the question:

   "Is there a member of the alpine club who is a skier but not a mountain climber?"

   as a FOL expression. Use resolution refutation to answer it.

5. **Probability**

(a) Be able to apply and compare/contrast direct, rejection, likelihood weighted sampling.

(b) Using Figure 13.5 and 13.6 in the book, show that the probability of a pit being in [2,2] that is, $P(P_{2,2}, |known, b)$ is $\approx 86\%$. See the section 13.6 for more info.

(c) Using the BN below, compute the following probabilities.

  i. P(A)

  ii. $P(E|A)$

Burglary	P(B)
	.001

Earthquake	P(E)
	.002

Alarm

B	E	P(A)
t	t	.95
t	f	.94
f	t	.29
f	f	.001

JohnCalls	A	P(J)
	t	.90
	f	.05

MaryCalls	A	P(M)
	t	.70
	f	.01