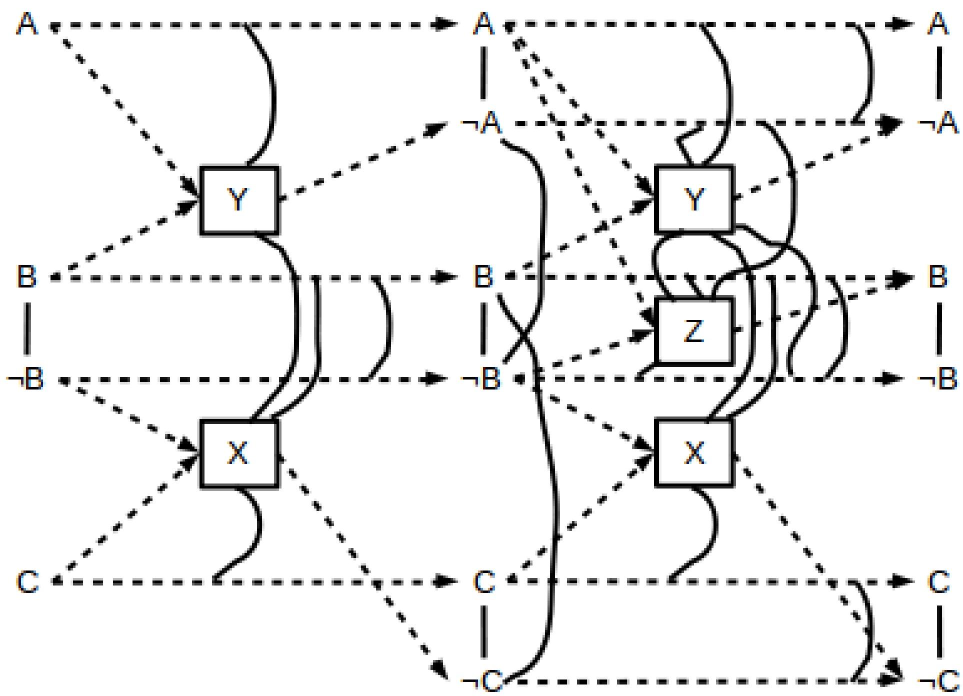
CSci 4511
Final

Name: ______________________________

Student ID: ______________________

Instructions: The time limit is 120 minutes. The exam is open book and notes. You may not use the internet, program/run code or any other outside resources. For all questions you must **show work**.

Problem (1) [15 points]
Find 3 independent errors with the following graphplan. Preconditions and effects are shown in dashed lines, while mutexes are in solid lines. You must clearly state why the places you indicate are errors.



Problem (2) [20 points]
When using resolution (in first order logic) the rigorous way is to try and combine all possible pairs of sentences. In class we described an approximate method that only tries to compare sentences with the sentence we are checking for entailment negated (i.e. the "proof by contradiction" sentence). In other works when deciding $KB \models \alpha$, on the first round we would only combine sentences with $\neg\alpha$. Then on the second round we would only combine sentences with the result of the first round (and so on). What other algorithm that we discussed in class is this process most similar to? Justify your answer and show with a small example.

Problem (3) [15 points]
(1) Convert this sentence into first-order logic: "Every dog barks at a cat".

(2) Convert the following sentence from first-order logic to propositional logic:
"$\forall x (\forall y A(x) \wedge B(x, y)) \Rightarrow (\exists y C(x, y))$ ". Assume that there are two objects: {R, T}.

Problem (4) [20 points]
Suppose you have the knowledge base (KB) below and wanted to ask: $KB \models (G \wedge P)$. Describe what you think is the most efficient method for a computer to solve this query (you do not need to actually find the entailment). Justify why your answer is better than other options.

KB = {
$\neg A \vee \neg B \vee C$
$\neg A \vee \neg D \vee E$
$\neg A \vee D$
$\neg B \vee \neg D \vee F$
$\neg B \vee \neg C \vee D$
$\neg B \vee \neg C \vee \neg E \vee G$
$\neg C \vee F$
$\neg C \vee \neg D \vee \neg E \vee G$
$\neg E \vee \neg F \vee G$
A
$\neg J \vee \neg K \vee L$
$\neg J \vee M$
$\neg J \vee \neg M \vee N$
$\neg K \vee \neg L \neg O \vee P$
$\neg K \vee \neg L \vee \neg M \vee \neg O \vee P$
$\neg K \vee N \vee \neg O$
$\neg L \vee O$
$\neg L \vee M \vee \neg O$
$\neg M \vee \neg O \vee \neg N \vee P$
J
K
$\neg R \vee T$
$\neg R \vee S \vee \neg T$
$\neg R \vee \neg U \vee V$
$\neg T \vee \neg S \vee \neg U \vee V$
$\neg U \vee \neg V \vee W$
$\neg U \vee V \vee \neg W$
R
$\neg B \vee \neg U \vee \neg X \vee Z$
$\neg C \vee \neg K \vee \neg Y \vee Z$
$\neg D \vee \neg K \vee Z$
$\neg G \vee \neg P \vee \neg W \vee X$
$\neg G \vee \neg P \vee \neg R \vee Y$

Problem (5) [15 points]
Use alpha-beta pruning on the tree below. Assume the tree is searched left to right. Clearly indicate which parts of the tree do not need to be searched (show work to receive full credit). As with all problems you should show work, but here you specifically need to show the final alpha-beta values on all min/max nodes. How many nodes are pruned? What is the best action of the root node?

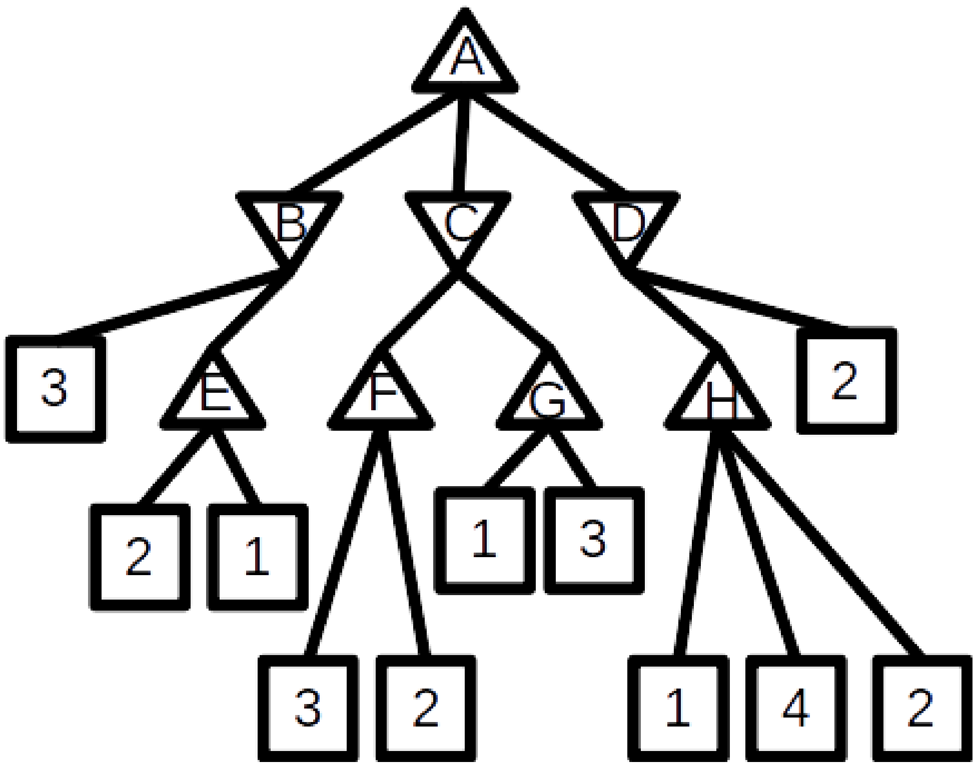


Figure 1: Tree for alpha-beta pruning. Triangles pointing up are maximization nodes and triangles pointing down and minimization nodes.

Problem (6) [15 points]
Consider the following pay-off matrix for a game, where you are player 1. (Positive numbers mean you gain money, negative numbers mean you lose money.)

	Player 2, Action A	Player 2, Action B
Player 1, Action A	(P1=4, P2=4)	(P1=-8, P2=4)
Player 1, Action B	(P1=-1, P2=-2)	(P1=2, P2=-1)

(1) Suppose your opponent is going to play the mixed Nash equilibrium. Should you play this game (i.e. will you make money)? If so, how would you? If not, why not?

(2) Suppose your opponent now realizes that you're pretty smart and says "I'm going to play action A 75% of the time and action B 25% of the time". Assume the opponent is telling the truth, should you play this game? If so, how would you? If not, why not?

(3) Was the opponent wise or not to announce their strategy like this? Why or why not?