CSci 4511
Final

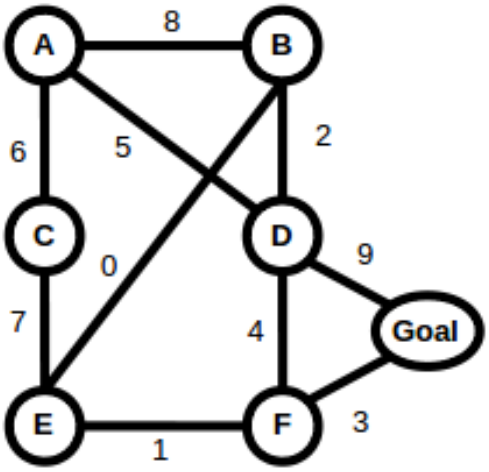
Name: _____

Student ID: _____

Instructions: The time limit is 120 minutes. Please write your answers in the space below. If you need more space, write on the back of the paper. The exam is open book and notes. You may not use the internet or any other outside resources. Usage of phones during the test is not allowed. For all questions you must **show work** to receive full credit.

Problem (1) [15 points]
(1) Run A^* on the graph below, where 'A' is the initial state. (2) Then answer: Which state heuristic can be changed (and to what value) to make the heuristic listed consistent?

Heuristic
h(A)=10
h(B)=3
h(C)=10
h(D)=5
h(E)=2
h(F)=2
h(Goal)=0



Problem (2) [15 points]
Consider the payoff matrix below, with rewards as (row player, column player). (1) Find **all** Nash equilibrium. (2) Which action should each player pick? (Make sure to justify your answer.)

(4,1)	(3,0)
(2,5)	(5,7)

Problem (3) [15 points]
Use resolution to determine if $KB \models \alpha$, where $\alpha = A \wedge \neg B$.

KB:
1.$(A \vee B \vee \neg C \vee \neg E \vee F)$
2.$(\neg A \vee \neg B \vee C \vee E \vee \neg F)$
3.$(\neg B \vee \neg C \vee D)$
4.$(A \vee C \vee \neg D \vee \neg E \vee F)$
5.$(A \vee C \vee D)$
6.$(B \vee \neg C \vee E \vee \neg F)$
7.$(\neg A \vee B \vee C \vee \neg D \vee \neg E \vee F)$
8.$(\neg A \vee \neg B \vee \neg C)$
9.$(C \vee \neg D \vee \neg E \vee F)$
10.$(A \vee \neg D \vee E \vee \neg F)$

Problem (4) [15 points]
Use backwards chaining to determine if $KB \models \alpha$, where $\alpha = \exists x\ G(Cat, x)$.

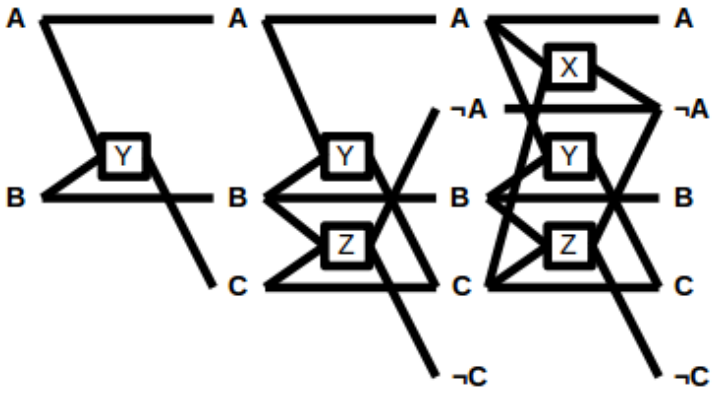
KB:
1.$\forall x\ (A(x) \Rightarrow B(x))$
2.$\forall x\ (B(x) \wedge C(x) \Rightarrow D(x))$
3.$\forall x, y\ (D(x) \wedge E(y) \wedge F(x) \Rightarrow G(y, x)$
4.$\exists x\ A(x)$
5.$\exists x\ A(x) \wedge C(x)$
6.$\exists x\ A(x) \wedge F(x)$
7.$E(Cat)$

Problem (5) [10 points]
Convert the KB below into CNF:

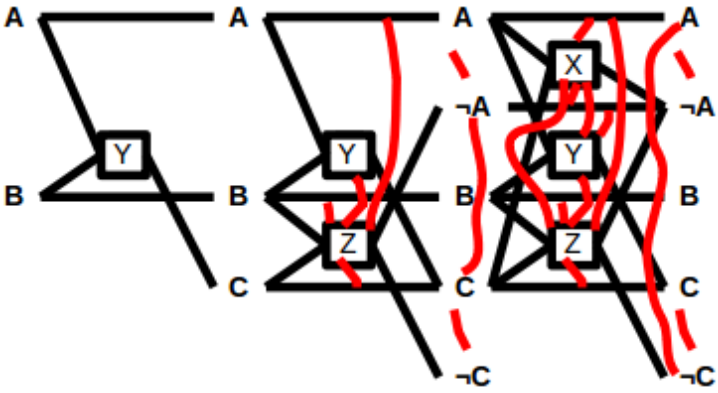
KB:
1.$\forall x\ (A(x) \wedge \Big(\neg B(x) \Rightarrow C(x)\Big))$
2.$\forall x\ (B(x) \wedge \Big((\forall y\ D(x,y)) \Rightarrow (\exists y\ E(y,x))\Big))$
3.$\exists x\ B(x) \wedge (\forall y\ D(y,x))$

Problem (6) [15 points]
Suppose we had a matching problem. There are "n" people in group A ($A_1, A_n, ...A_n$) and also in group B ($B_1, B_2, ...B_n$). Each person in group A needs to be matched to a single person in group B (likewise, a person in group B needs a single person from group A). Initially no one is matched and the goal is to have everyone matched. As an action, you can match any two people from the separate groups that are not already matched. Formulate this problem as a planning problem (in PDDL) and define (1) the action(s), (2) the initial state and (3) the goal state. (Note: this is similar to how you were expected to represent hw 6 problem 1.)

Problem (7) [15 points]
Find 3 errors in the following graphplan along with a justification why it is an error. These errors must be unrelated (i.e. if the error is fixed (everywhere possible if it is a general error), (1) your other answers must still be errors and (2) you cannot claim an additional error on anything your 'fix' caused that was not originally an error).
No mutexes:



With mutexes:



Mutex list:
State 0:
Action 1:
State 1:
Action 2: $(Y, Z), (Z, A), (Z, B), (Z, C)$
State 2: $(A, \neg A), (C, \neg C), (\neg A, C)$
Action 3: $(X, Y), (X, Z), (X, A), (X, \neg A), (Y, Z), (Y, \neg A), (Z, A), (Z, B), (Z, C)$
State 3: $(A, \neg A), (C, \neg C), (A, \neg C)$