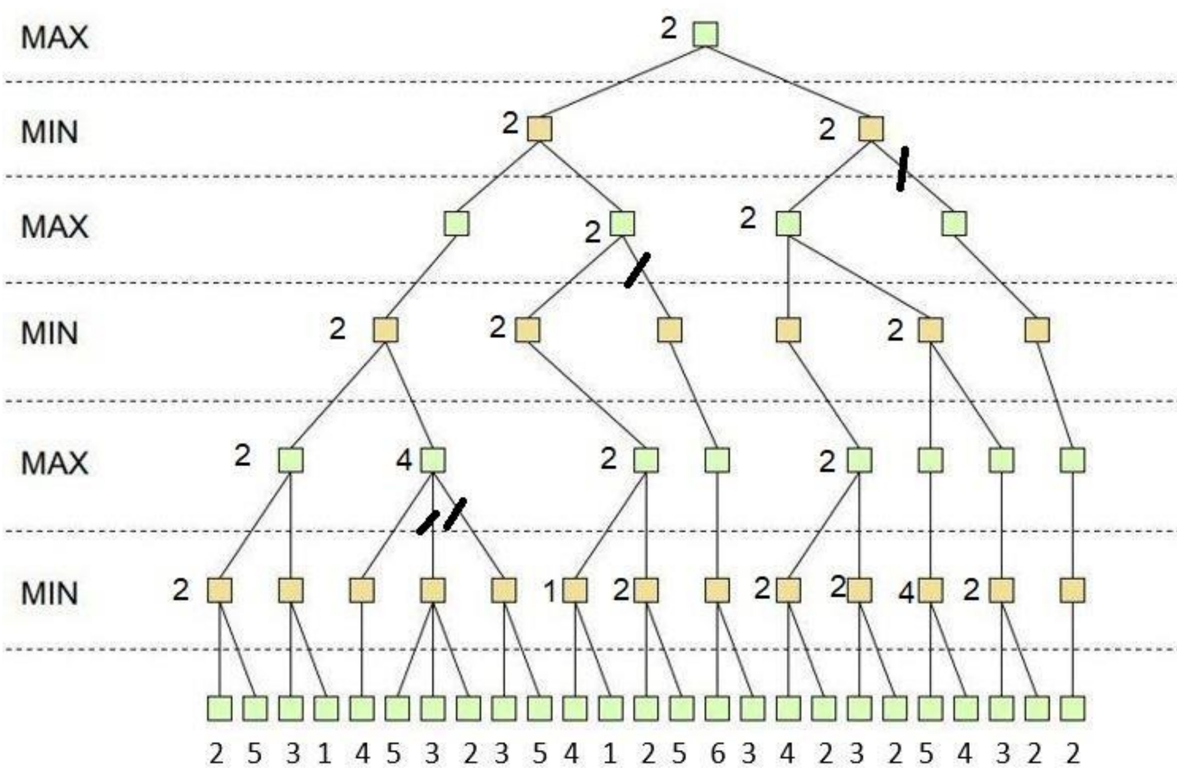
Midterm Exam **Name:**
SIN:

Problem 1:
Follow alpha-beta strategy for the min-max tree below.
Show which nodes the strategy will not visit (place cats).



Problem 2:
Follow RS method to check if (¬a → b) → ((¬b → c) → (¬c → ¬a)) is a tautology.

Solution (Not Tautology).

(¬a → b) → ((¬b → c) → (¬c → ¬a))

¬ (¬a → b), ((¬b → c) → (¬c → ¬a))

¬a, ((¬b → c) → (¬c → ¬a)) ; ¬b, ((¬b → c) → (¬c → ¬a))

¬a, ¬ (¬b → c), (¬c → ¬a)) ; ¬b, ¬ (¬b → c), (¬c → ¬a))

¬a, ¬b, (¬c → ¬a); ¬a, ¬c, (¬c → ¬a); ¬b, ¬b, (¬c → ¬a)); ¬b, ¬c, (¬c → ¬a))

¬a, ¬b, c, ¬a;	¬a, ¬c, c, ¬a ;	¬b, ¬b, c, ¬a ;	¬b, ¬c, c, ¬a
not fundamental	fundamental	not fundamental	fundamental

Problem 3:

In what order the nodes of the graph GR will be visited by the shortest path algorithm using heuristic distance measure f(n) from the start node A to the goal node K passing through a node n in GR where f(n) is defined as f(n)=g(n)+h(n).

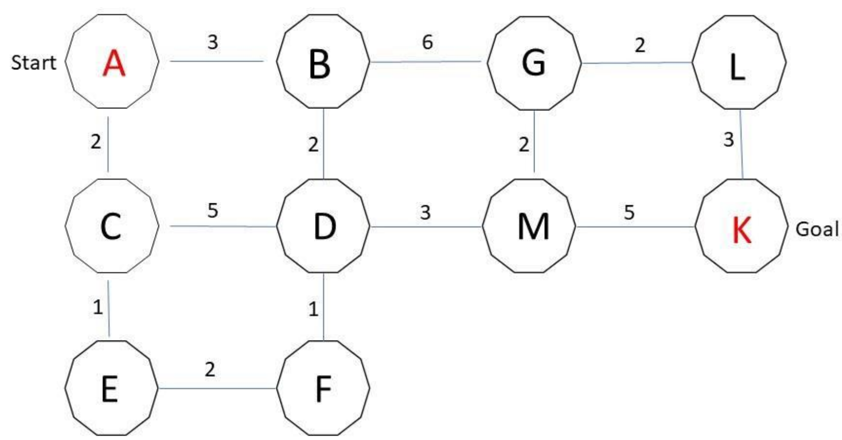
We assume that:

(1) g(n) is the shortest distance from the start node A to the node n

(2) h(n) is a heuristic estimation of the distance from node n to the final node K.

Check if this algorithm is admissible and monotonic (is it A*-algorithm?).

Graph GR



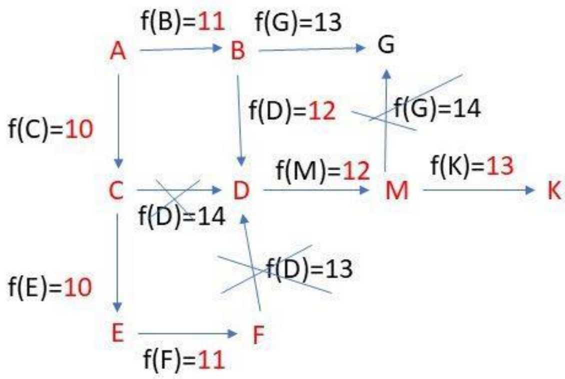
H(A)	H(B)	H(C)	H(D)	H(E)	H(F)	H(G)	H(M)	H(L)	H(K)
9	8	8	7	7	6	4	4	3	0

Solution.

Admissible: YES

H(A) $\leq$ d(A,K)=13, H(B) $\leq$d(B,K)=10, H(G) $\leq$d(G,K)=5, H(L) $\leq$d(L,K) =3, H(C) $\leq$d(C,K) =12, H(D) $\leq$d(D,K) = 8, H(M) $\leq$d(M,K) = 5, H(E) $\leq$d(E,K) = 11, H(F) $\leq$d(F,K) = 9

Monotonic: YES



Path: A -> C -> E -> F -> B -> D -> M -> K

Problem 4.

Consider the following statements:

Every child sees some witch.

It is not true that no witch has both a black cat and a pointed hat.

Every witch is good or bad.

Every child who sees any good witch gets candy.

It is not true that every witch that is bad has a black cat.

If every witch seen by any child has a pointed hat, then every child gets candy.

1) Convert them to formulas in Predicate Calculus and then convert your predicate calculus formulas to CNF.
2) Form a Knowledge Base containing all obtained disjuncts.

Hint: You can use the following constants, functors, & predicates.

Constants: BC – black cat, PH – pointed hat

Functors: W(x) – x is a witch, C(x) – x is a child

Predicates: SE(x,y) – x sees y, GETS(x) – x gets candy, GOOD(x) – x is good, BAD(x) – x is bad

HAS(x,y) - x has y

Solution:

(1) $(\forall x)(\exists y)SE(C(x),W(y)) = (\forall x)SE(C(x),W(f(x))) = SE(C(x),W(f(x)))$

(2) $(\exists x)[HAS(W(x),BC) \wedge HAS((W(x), PH)] = [HAS(W(A),BC) \wedge HAS((W(A), PH)]$, where A is a constant

(3) $GOOD(W(x)) \vee BAD(W(x))$

(4) $[SE(C(x),W(y)) \wedge GOOD(W(y))] \rightarrow GETS(C(x)) = \neg[SE(C(x),W(y)) \wedge GOOD(W(y))] \vee GETS(C(x)) =$
$\neg SE(C(x),W(y)) \vee \neg GOOD(W(y)) \vee GETS(C(x))$

(5) $\neg[BAD(W(x)) \rightarrow HAS(W(x),BC)] = \neg[\neg BAD(W(x)) \vee HAS(W(x),BC)] = BAD(W(x)) \wedge \neg HAS(W(x),BC)$

(6) $(\exists x)(\forall y)[SE(C(x),W(y)) \rightarrow HAS(W(Y),PH)] \rightarrow (\forall z)GETS(C(z)) =$
$\neg(\exists x)(\forall y)[SE(C(x),W(y)) \rightarrow HAS(W(Y),PH)] \vee (\forall z)GETS(C(z)) =$
$\neg(\exists x)(\forall y)[\neg SE(C(x),W(y)) \vee HAS(W(Y),PH)] \vee (\forall z)GETS(C(z)) =$
$[SE(C(x),W(f(x))) \wedge \neg HAS(W(f(x)),PH)] \vee GETS(C(z)) =$
$[SE(C(x),W(f(x))) \vee GETS(C(z))] \wedge [\neg HAS(W(f(x)),PH)] \vee GETS(C(z))]$

Knowledge Base:

SE(C(x),W(f(x)))

HAS(W(A),BC)

HAS((W(A), PH)

GOOD(W(x)) ∨ BAD(W(x))

¬SE(C(x),W(y)) ∨ ¬GOOD(W(y)) ∨ GETS(C(x))

BAD(W(x))

¬HAS(W(x),BC)

SE(C(x),W(f(x))) ∨ GETS(C(z))

¬HAS(W(f(x)),PH)] ∨ GETS(C(z))