For each problem on this test, below “Perfect” gives the percentage who received full credit, “Partial” gives the percentage who received partial credit, and “Zero” gives the percentage of students who received zero credit.

(Due to rounding, values below may be only approximate estimates.)

(We will provide these statistics as they become available.)

Problem 1
Perfect: ~97.5% (~197 students), Partial: ~1.5% (~3 students), Zero: ~1% (~2 students)

Problem 1.a
Perfect: ~97.5% (~197 students), Partial: ~1% (~2 students), Zero: ~X% (~3 students)

Problem 1.b
Perfect: ~98% (~198 students), Partial: ~0% (~0 students), Zero: ~2% (~4 students)

Problem 1.c
Perfect: ~98% (~198 students), Partial: ~0% (~0 students), Zero: ~2% (~4 students)

Problem 2
Perfect: ~68% (~137 students), Partial: ~24.5% (~50 students), Zero: ~7.5% (~15 students)

Problem 3
Perfect: ~81.5% (~165 students), Partial: ~13% (~26 students), Zero: ~5.5% (~11 students)

CS-171, Intro to A.I. — Quiz#2 — Fall Quarter, 2015 — 20 minutes

YOUR NAME: ____

YOUR ID: ______________ ID TO RIGHT: _______________ ROW: __________ SEAT: __________

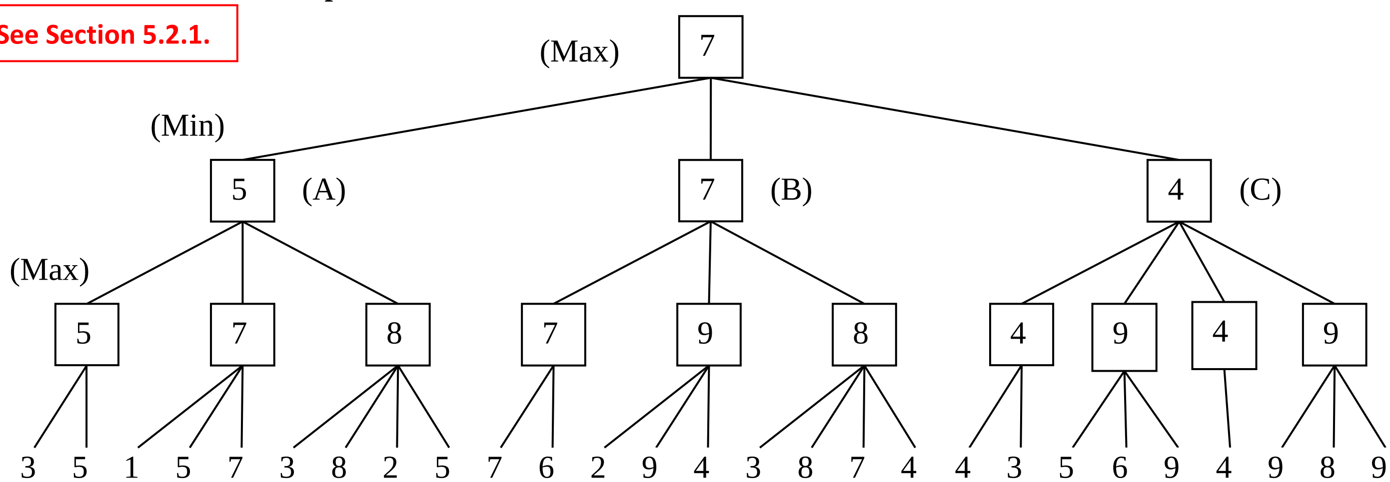
1. (35 pts total, -5 pts for each error, but not negative) MINI-MAX SEARCH IN GAME TREES. The game tree below illustrates a position reached in the game. Process the tree left-to-right. It is **Max**'s turn to move. At each leaf node is the estimated score returned by the heuristic static evaluator.

1.a. Fill in each blank square with the proper mini-max search value.

1.b. What is the best move for Max? (write A, B, or C) __B_____

1.c. What score does Max expect to achieve? ________7______

See Section 5.2.1.

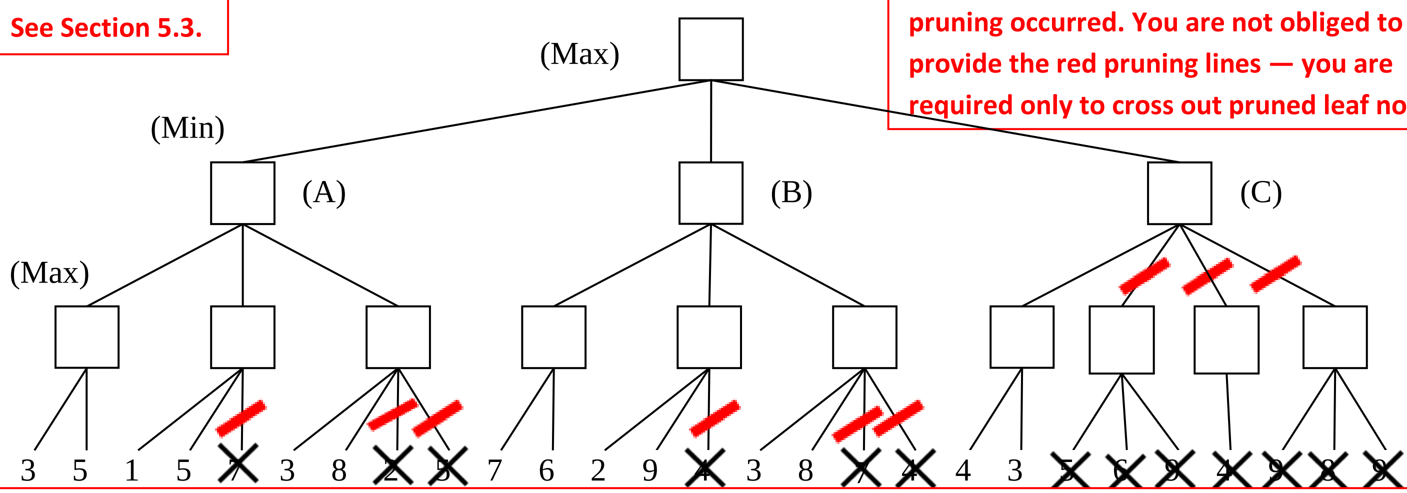


2. (35 pts total, -5 for each error, but not negative) ALPHA-BETA PRUNING. Process the tree left-to-right. This is the same tree as above (1.a). You do not need to indicate the branch node values again.

<u>Cross out</u> each leaf node that will be pruned by Alpha-Beta Pruning. Do not just draw pruning lines.

Red pruning lines indicate where in the tree pruning occurred. You are not obliged to provide the red pruning lines — you are required only to cross out pruned leaf nodes.

See Section 5.3.



Despite the clearly written instructions

"<u>Cross out</u> each leaf node that will be pruned by Alpha-Beta Pruning. Do not just draw pruning lines."

more than one student just drew pruning lines, and then was horrified that they might lose points. To temper justice with mercy, no points will be lost. <u>PLEASE follow instructions.</u> Industry is much less forgiving than is your kind and safe academic environment. Future bosses might be <u>very unhappy</u> with employees who do not follow instructions.

3. (30 pts total, -5 for each error, but not negative) RESOLUTION THEOREM PROVING. You are engaged

See Sections 7.2 and 7.5.2.

...r the Wum... told you, among other things, "A stench ... (1,3). A stench in square (2,1) is equiva... into propositional logic as

(S12 ⇔ W11 ∨ W22 ∨ W13)

and then into Conjunctive Normal Form (CNF) as

(1) If you used a wrong resolution in your proof of the final result, for each wrong resolution, you lost 5 points from your score.
(2) If your answer was incomplete and far away from the proof path, you lost more points.

A common mistake on this problem was to resolve two complementary literals simultaneously, e.g.,

Resolve (¬s12 w11 w22 w13) and (s12 ¬ w22) to give (w11 w13)

If you made this mistake, please review the class lecture notes for Propositional Logic B, Tue., 20 Oct., slide #21, "Only Resolve ONE Literal Pair!" That slide shows clearly that two clauses with two complementary literal pairs never should be resolved. If you resolve both complementary literal pairs simultaneously, the result is always an error, and if you resolve only one pair, the result always simplifies to a useless "TRUE." Please, don't do it.

propositional logic as the goal sentence "(W13)." You form the negated goal as "(¬ W13)." Now your knowledge base plus the negated goal, expressed in clausal form, is:

STRATEGY HINTS: Always try to reduce the number of literals. Look for cases where the number of literals will decrease (eventually, you need to decrease the number of literals to zero!). Note that in every line in the proof below, the resolvent has fewer literals than in the longest clause that produced it. Look for cases where the two input clauses share other literals, which will be simplified afterward. Look for cases where one clause is a singleton, which always reduces the number of literals that result in the resolvent. Look for opportunities to produce new singleton clauses, which can be used later to reduce the number of literals in other resolvents.

More generally, think carefully about why you believe the goal/query sentence to be true. What information did you use? What constraints did you exploit? Find a proof that mirrors how you think about the problem.

Think about what you are trying to prove, and find a proof that mirrors how you think. You know S12 and (S12 ⇒ W11 ∨ W22 ∨ W13). You know (¬W11). It is easy to prove (¬W22), so (W13) is the only possibility left. Your negated goal is (¬W13). You seek ( ). Think about it.

Resolve (S21 ¬W22) and (¬S21) to give (¬W22)

Resolve (¬S12 W11 W22 W13) and (S12) to give (W11 W22 W13)

Resolve (W11 W22 W13) and (¬W11) to give (W22 W13)

Resolve (W22 W13) and (¬W22) to give (W13)

Resolve (W13) and (¬ W13) to give ( )

Resolve ______ and ______

Other proofs are OK as long as they are correct. For example, you might perform the resolution steps above in any other order you choose.

A proof that mirrors the suggested strategy above appears below:

***"**You know S12 and (S12 ⇒ W11 ∨ W22 ∨ W13). You know (¬W11). It is easy to prove (¬W22), so (W13) is the only possibility left. Your negated goal is (¬W13). You seek ( )."*

***"**You know S12 and (S12 ⇒ W11 ∨ W22 ∨ W13)."*

Resolve _____(¬S12 W11 W22 W13)__ and ______(S12)_______ to give (W11 W22 W13)____

"You know (¬W11)."

Resolve _____(W11 W22 W13)_______ and ______(¬W11)______ to give ______(W22 W13)__

"It is easy to prove (¬W22)"

Resolve _____(S21 ¬W22)__________ and ______(¬S21)______ to give ______(¬W22)______

"so (W13) is the only possibility left."

Resolve _____(W22 W13)__________ and ______(¬W22)______ to give ______(W13)_______

"Your negated goal is (¬W13). You seek ( )."

Resolve _____(W13)______________ and _______(¬ W13)_____ to give ______( )__________

Of course, there are always many different proofs. Any proof that is correct is OK.

The quickest way to find a proof is to analyze why you believe the goal/query sentence to be true. What information did you use? What constraints did you exploit? Find a proof that mirrors how you think.