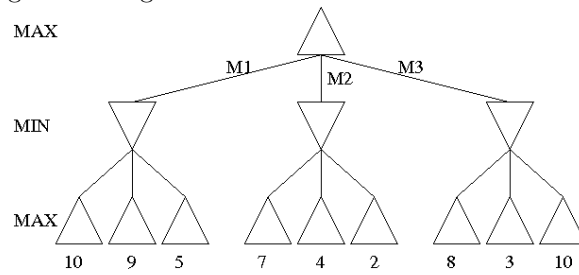Answer all questions on the exam. You may use the back for additional space. Total: 100 points. Good Luck.

1. (20 pts) Given the following minimax game tree:

(a) Perform alpha-beta pruning and cross out the nodes (in the diagram) that are pruned from evaluation.

(b) Draw the above tree and rearrange, if necessary, the leaf values such that maximum pruning can be achieved. Cross out leaves that are pruned.

(c) What do a leaf and its value represent? Considering tic-tac-toe, provide an example for a leaf and its value.

2. (30 pts) On search:

   (a) Discuss two different ways of formulating the N-queen problem into a search problem so that one can use non-local search algorithms (aka systematic or classical search, e.g. Breadth-first Search) and another can use local search algorithms (aka iterative refinement or non-classical search, e.g. Hill Climbing). [The N-queen problem is to find a configuration of N queens in an NxN chess board such that none of the queens can attack/capture another.]

   (b) Discuss two key advantages of Iterative Deepening Search.

   (c) Discuss why Uniform-cost Search can be considered as a special case of A*.

   (d) Given multiple admissible heuristic functions $(h_1, h_2, ..., h_n)$, discuss how one can construct an admissible heuristic function that dominates the original admissible heuristic functions?

3. (25 pts) Formulate as a Constraint Satisfaction Problem (CSP) the scheduling problem where 6 classes, each taught twice during the week (1 hour each time), have to be scheduled in 2 classrooms from 8 to 11 am. The first two classes are taught by the same professor. Classroom 1 is too small and cannot accommodate the 3rd class.

4. (25 pts) On Learning:

    (a) Give the formula for computing the "information gained" from considering an attribute, when using decision trees.

    (b) How does "information gain" use the principle of maximum expected utility?

    (c) Explain the difference between supervised and unsupervised learning.

    (d) Given data about students (name, address, age, SAT score, GPA, earned credits, marital status),

        • discuss an example of a problem that is appropriate for being approached using supervised learning
        • discuss an example of a problem that is appropriate for being approached using unsupervised learning