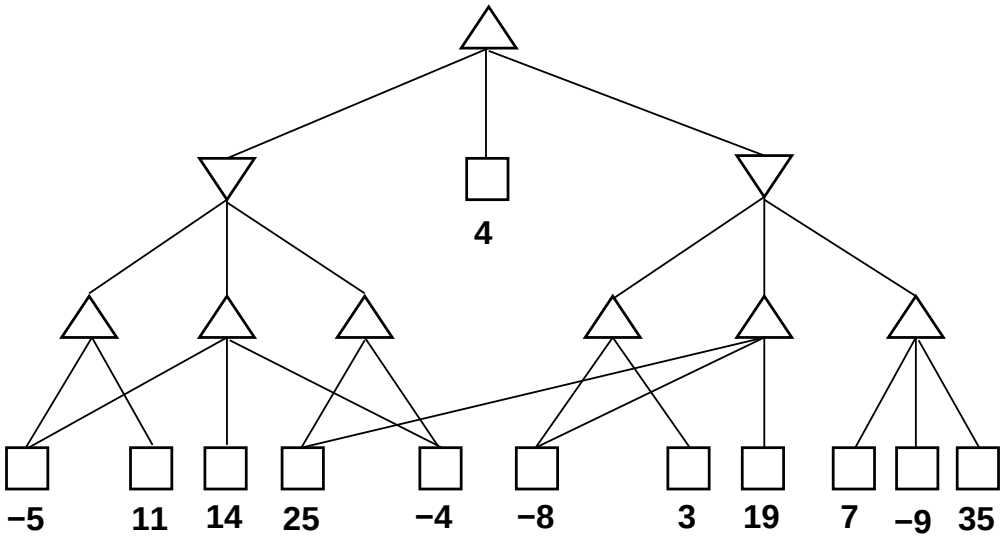
Homework 4

Due: Apr 17, 2003

1. Run the minimax and alpha-beta game search algorithms on the following game graph, assuming a left-to-right expansion of children. $\triangle$ nodes are played by MAX and $\triangledown$ are played by MIN. For each node, label it with its minimax value, the $[\alpha, \beta]$ bounds, and the optimal action from that state (for the appropriate player, of course). Indicate which *arcs* are pruned and why (i.e., whether it was pruned because of α or β). How many total *nodes* (including internal nodes) are pruned? What is the value of the game? (Hint: it might be worth your effort to make a couple of copies of this diagram as a worksheet before you do your final version. Also, colored pens are useful for marking all the different necessary information.)



2. Show that if you replace every leaf payoff x in a two-player game tree with a linear transformation of that payoff $ax + b$, then the minimax optimal strategy remains the same.

3. You're in the new "Neon Swamp" casino and, as you wander through the crowds and beeping machines, you come to a series of tables, each of which is offering a different form of bet. Each table costs \$1 per play. For each bet, specify which action you should take (in a decision-theoretic sense) and justify why.

   (a) The first table offers a \$5 prize if you roll exactly a 3 on one standard die. Should you take the bet?

   (b) The second table offers a \$2 prize if you can draw a red card (i.e., heart or diamond) from a standard deck with no jokers. Should you take the bet?

   (c) The third table offers a more complex bet. You can choose whether to roll a die or draw a card. If you roll the die and get a prime number[1], the payoff is \$2.25. If you draw a card and get a face card (Jack, King, Queen of any suit), the payoff is \$4. If you draw

[1] Recall that 1 is not prime.

an Ace, then you must roll a die and if you roll a 1 then the payoff is \$50. Otherwise, the payoff is 0 and you lose your initial money. Should you take the bet? If so, which action should you take (i.e., initially roll the die or draw a card)?

4. Write pseudocode for minimax and alpha-beta search routines for a two-player *non-zero-sum* game. I.e., assume that each leaf n has a an arbitrary real vector payoff $\langle v_a(n), v_b(n)\rangle$ giving the reward for players a and b, respectively. If there are no bounds on v_a and v_b, can alpha-beta still prune nodes?