Challenge Q9 HW3

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Collaborators: None

Q9. Multi-Agent Search

9.1) For one turn, the branching factor for PacAdv is $M = 5$ and the branching factor for PacMax is $MN = 15$. Assume we know nothing about the upper and lower bounds of the utility scores, the lower bound for pruning is 0 when $\alpha - \beta$ pruning is inconclusive about the leaf nodes given the current information on nodes, and the upper bound for pruning is $(M - 1)(MN - 1) = 56$ because we need to look at the first intermediate branch completely to establish α/β values and we need to at least look at one leaf node in all other intermediate branches before deciding to prune the remaining leaves.

9.2) Following the logic in 9.1), the upper bound is $(6 - 1)(6 * 10 - 1) = 295$.

9.3) One 1 leaf node (5 next to 7) will be pruned in alpha-beta pruning due to $(7) < (8)$.

9.4) If the first and the third branch of the root minimizing node are switched, the number of leaf nodes to be pruned increases to 4. Since the swapped first branch evaluates to 3 first, leaf 5 next to 4 can be pruned, leaf 8 can be pruned (due to it being next to evaluated 6), and leaf 7 and 5 can be pruned all together.

9.5) The list of possible values are $2, 3, 4, 5, 5, 6, 6, 7, 7, 8, 10$. Since the root node is minimizing, the largest value it can take is 7 ($7, 8, 10$ as children), which rules out option G and H. The smallest value the root node can take is 3, because the minimizing combination for the middle maximizing node is $(2, 3)$. Thus, option A is ruled out. Therefore, the possible values are:

    B. 3 is possible. An example sequence is $4, 5, 5, 6, 6, 2, 3, 7, 7, 8, 10$.

    C. 4 is possible. An example sequence is $3, 5, 5, 6, 6, 2, 4, 7, 7, 8, 10$.

    D. 5 is possible. An example sequence is $3, 4, 5, 6, 6, 2, 5, 7, 7, 8, 10$.

    E. 6 is possible. An example sequence is $3, 4, 6, 5, 5, 2, 6, 7, 7, 8, 10$.

    F. 7 is possible. An example sequence is $3, 4, 7, 5, 5, 2, 7, 6, 6, 8, 10$.