

# COMS 4701 - Homework 3 - Written

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March 2, 2020

## Question 1

a)  $A > 5$

Between  $\{5, 0\}$  of the leftmost internal node, Max will choose 5. Max will then choose the maximum of  $\{A, B\}$ . If  $A > 5$  and  $B \leq 5$ , then Max will choose  $A$ —and  $B$  will be irrelevant. If  $B > A > 5$  then Max will choose  $B$ . Next, Min will choose between  $\{5, B\}$  where  $B > 5$ . Min will choose 5 over  $B$ , and  $B$  again is irrelevant. Therefore,  $B$  can be pruned when  $A > 5$ .

b)  $C = 1, D = 2$

The nodes at height 2 will be:  $\max\{5, 0\}$ ,  $\max\{5, 5\}$ ,  $\max\{1, 2\}$ ,  $\max\{E, F\}$ . This makes the nodes at height 1:  $\min\{5, 5\}$ ,  $\min\{2, \max\{E, F\}\}$ . If  $\max\{E, F\} < 2$ , nodes at height 1 become: (5) and ( $< 2$ ). Max will choose 5—both  $E$ , and  $F$  are irrelevant. If  $\max\{E, F\} \geq 2$ , the nodes at height 1 become: (5),  $\min\{2, \max\{E, F\} \geq 2\}$  and min will choose 2 making  $E$  and  $F$  irrelevant again. Therefore, when  $C = 1$ , and  $D = 2$ ,  $E$  and  $F$  can be pruned.

Note: This works anytime  $C = D < 5$

## Question 2

**Reason 1:** IDS “asymptotically minimizes time and space for any given search depth.” In two player games, “the accuracy of the static evaluation increases with increasing search depth.” Therefore, IDS is useful in solving adversarial two-player games because it is comparatively one of the fastest algorithms for depth searches for games that require deeper searches for greater winning chances.

**Reason 2:** “The amount of time required to search the next deeper level in the tree is not known when the ply begins, and the search ply may have to be aborted due to time constraints. In this case, the complete search at the next

shallower depth can be used to make the move.”<sup>1</sup> In a game like chess, if IDS runs out of search time, it still has a sufficient move to offer because it has searched the entire upper levels of the tree.

### Question 3

a)

	Positive	Negative
True	10	70
False	20	0

b)

Accuracy = 80%

Precision = 33%

Recall = 100%

Specificity = 78%

**Precision** is the clear indicator that the model has poor prediction. The others are deceived by the amount of correctly predicted negative values and the correctly predicted positive values, but ignores the amount of miss-predicted negative values. This is due to having 90% of the examples as negatives.

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<sup>1</sup> Richard E. Korf. *Depth-First Iterative-Deepening: An Optimal Admissible Tree Search*