

# COMS 4701 Artificial Intelligence

## Homework 3 - Conceptual

Due date: November 4, 2021

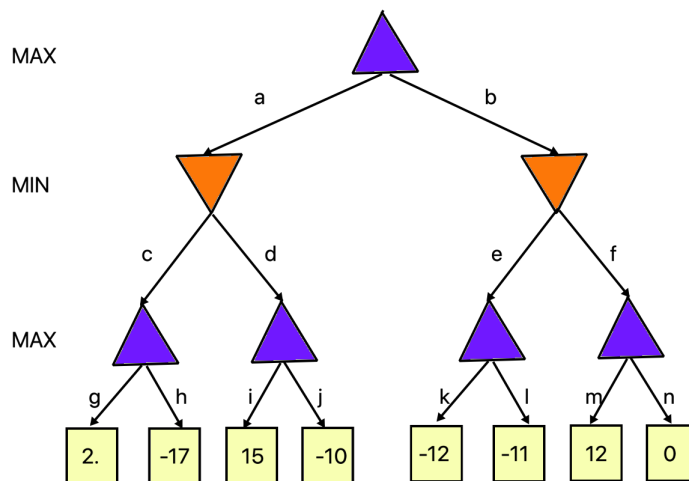
### 1. Adversarial Search

Select all that are true about adversarial search. No need to justify.

- ☐ In zero-sum games with two players, one agent maximizes one single value, while the other minimizes it.
- ☐ We can't always search the leaves in game trees because we may be limited in time.
- ☐ Both Alpha and Beta are sent down the tree
- ☐ Min updates Alpha and Max updates Beta
- ☐ Alpha is the current lower bound on MAX's outcome and Beta is the current upper bound on MIN's outcome

### 2. Adversarial search

Consider the following game tree.



- (a) What is the value of Max at the root?
- (b) Using alpha beta pruning, what branches are cut? Justify your answer. Give all branches even if you gave their parents.

### 3. Knowledge-based agents

Consider the two sentences:

“If it is Heads then I win”  
“If it is Tails then you lose”

1. Use the atomic propositions **HEADS**, **TAILS**, **IWIN**, **YOULOSE** to write the sentence in propositional logic (PL) as implications. Add these two propositions to your knowledge base KB.
2. Add to KB the general knowledge that:

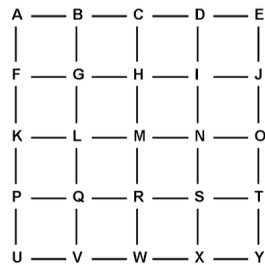
- (a) The outcome of a coin toss is either HEADS or TAILS (“or” here is the disjunction  $\vee$ , not the exclusive or).
- (b) if YOULOSE then IWIN,
- (c) if IWIN then YOULOSE.

This general knowledge should be expressed in PL before you add it to KB. Your KB should now have 5 PL sentences.

3. Replace every PL sentence in KB by its equivalent disjunctive clause.
4. Using resolution, prove the goal sentence IWIN.

#### 4. KNN

Consider the following grid that represents examples A through Y. Let the coordinates  $x_1$  and  $x_2$  represent the features of the examples. Suppose A...L are positive examples and N...Y are negative examples.



- (a) What are the 5 nearest neighbors of example  $M$ ? Use the Euclidean distance and the alphabetical ordering for breaking any tie.
- (b) Using these neighbors, what is the class of  $M$ .
- (c) In addition to  $x_1$  and  $x_2$  coordinates, we include the “mass” in grams of each example as an additional feature. The standard deviation of mass is  $stdev_m = 100$ . Explain the consequences of using the mass feature along with the  $x_1$  and  $x_2$  coordinates on the Euclidean distance between examples. How would you address any problem that might arise.