COMPSCI 370 **Instructor:** Ronald Parr

Homework 2 **Due:** Monday, February 24, 2025

1 Alpha-beta Warm Up (10 points)

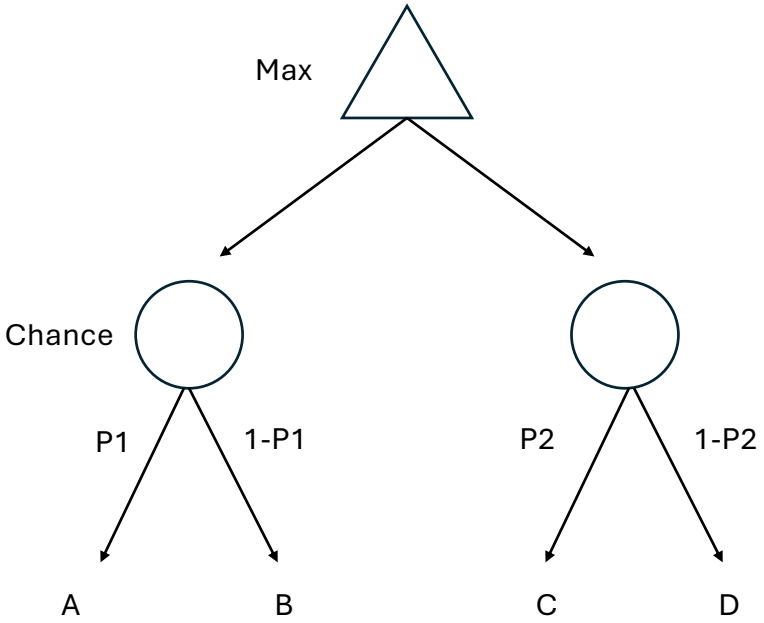
Consider the simple tree from page 10 (top) of the game search slides. a) What would need to change for you alpha-beta to be able to prune the rightmost branch in the tree? Give a brief explanation for your answer in English. (5 points) b) Starting from the values currently shown on the slide, what is the largest integer value you can assign to the leaf currently assigned value 12 such that it becomes impossible for alpha-beta to prune anywhere in the rest of the tree? Explain in English why this is the case. (5 points)

2 Evaluation Functions (10 points)

One of the nice properties of evaluation functions is that they can be useful even if they aren't perfect. To see how this works out, we will consider two trees, $T1$ and $T2$, and assume that $T1$ is the "correct" tree. Suppose $T2$ is created by copying and modifying $T1$ so that for any leaf in $T1$ with value x, the corresponding leaf in $T2$ has value $\text{sgn}(x) * x^2$, where $\text{sgn}(x)$ is $+1$ if $x > 0$, -1 if $x < 0$, and 0 if $x = 0$. a) Provide a simple, inductive proof that for any node at any point in the tree, if the minimax value in $T1$ is x, then the corresponding node in $T2$ has value $\text{sgn}(x) * x^2$. (5 points) b) Prove that the optimal action at the root is the same (up to ties) in both $T1$ and $T2$ - this is sort of trivial if you do the previous part carefully. (5 points)

3 Evaluation Functions and Chance Nodes (10 points)

In class, we mentioned that expectiminimax is less forgiving than minimax because changes in the evaluation function can have a bigger impact. In this problem, you will a construct a simple example where changing the evaluation function as described in the previous problem, i.e, $x \rightarrow \text{sgn}(x) * x^2$ causes the optimal action at the root to change. To make this easy for you (and easier for us to grade), we're requesting that you use the simple tree shown below:



To get full credit for this question, all you need to do is to provide values for P_1, P_2, A, B, C, and D, which result in a change in the optimal choice at the root.

4 Bayes Rule (10 points)

Some people may be confused about how the following both be true:

- Vaccination reduces the risk of infection.
- Most people who are infected are vaccinated.

Let's look at some numbers to see how this can be. Suppose that the probability of getting a disease if you are vaccinated is reduced by a factor of 4, i.e., $P(d|v) = \frac{1}{4} \times P(d|\overline{v})$, $P(d|\overline{v})$ is 0.4, and $P(d) = 0.15$. Use these to compute $P(v|d)$.