CS188 Fall 2015 Section 2: Non-Classical Search and Games

1 Battleship: Partial Observability

You are playing a modified version of Battleship on a 3x3 board. Your opponent places a length-3 ship somewhere on the board, unknown to you. Ships can be oriented vertically or horizontally.

Every turn, you choose one location on the board to attack. If you attack a location containing part of the ship, you receive the percept "Hit" and win the game.

If you miss, your percept will be "Near" if the ship is one unit away from your attack location, and "Far" if it's two units away. Your goal is to use *offline belief state search* to come up with a plan to hit your opponent's ship with the fewest attacks.

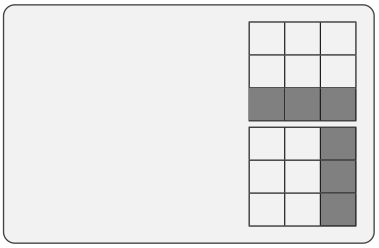
1. How would the *physical state* be represented in this game? What is the size of the state space?

2. What is the initial belief state (before you make any actions)? How many elements does it have?

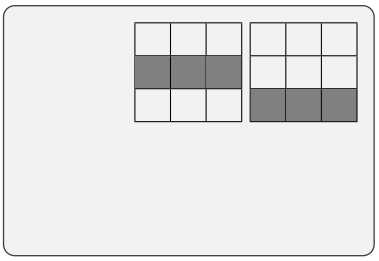
3. What is the size of the belief state space?

4. A *reachable* belief state is any belief state that can result from a sequence of actions starting at the initial belief state. Below, we show two possible belief states with no attack information marked. Your job is to determine the sequence of attack attempts and corresponding percepts that make each belief state reachable, or else explain why the belief state is not reachable.

   (a)



   (b)



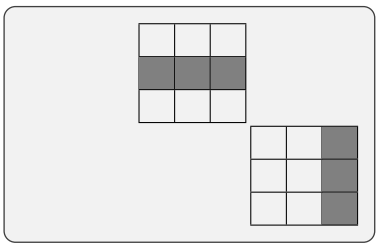
5. From the initial belief state, suppose you choose to attack the bottom left corner. What percepts could you experience at this point? What belief states would they lead to?

6. What is the optimal contingent plan if we begin by attacking the bottom left square?

2 More Battleship: Nondeterminism

Now, we allow your opponent to move their ship if your attack misses. If the ship is oriented horizontally, it may move one unit up or down. If it's oriented vertically, it may move one unit right or left. Your new percepts are "Hit", "Far", "Move" if the ship was one away when you attacked and has moved, and "Stay" if the ship was one away when you attacked and did not move.

1. Suppose you are currently in this belief state (attack sequence not indicated):



   What is your belief state immediately after you attack the top middle square, before seeing any percepts?

2. Was your resulting belief state larger or smaller than your initial belief state? Why?

3. What is the difference between partial observability and non-determinism?

3 Alpha Beta Expinimax

In this question, player A is a minimizer, player B is a maximizer, and C represents a chance node. All children of a chance node are equally likely. Consider a game tree with players A, B, and C. In lecture, we considered how to prune a minimax game tree - in this question, you will consider how to prune an expinimax game tree (like a minimax game tree but with chance nodes). Assume that the children of a node are visited left to right.

For each of the following game trees, give an assignment of terminal values to the leaf nodes such that the bolded node can be pruned (it doesn't matter if you prune more nodes), or write "not possible" if no such assignment exists. You may give an assignment where an ancestor of the bolded node is pruned (since then the bolded node will never be visited). You should not prune on equality, and your terminal values *must* be finite (including negative values).