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RBE470 Bomberman Project 1
2/5/2023

Bomberman's Spooky Adventures 👻

Our Program :

This assignment was to design an AI to complete each gameboard and monster type variant. Our team first set out to design an A* program, then create an expectimax and minimax algorithm to solve each variant by fine tuning our value functions, but we ended up doing things a bit differently from how we initially planned.

Our end program uses a state machine to change the behavior of the little guy. The two states used are defined as "little guy cares about how far away the monster is", and "little guy is going on his merry little way". When the little guy is far away from the monster, or his ship's sensors aren't seeing the monster, little guy runs A* with the current position as the start and the goal as the end point as inputs. The program itself is rather basic. The little guy can move to any of the 8 spaces around them and the heuristic is the hypotenuse distance from the goal. The algorithm chooses the next neighboring cell to explore based on which one is closest to the goal. Since each cell is weighed the same, the oath found is just the least amount of cells it takes to reach the goal.

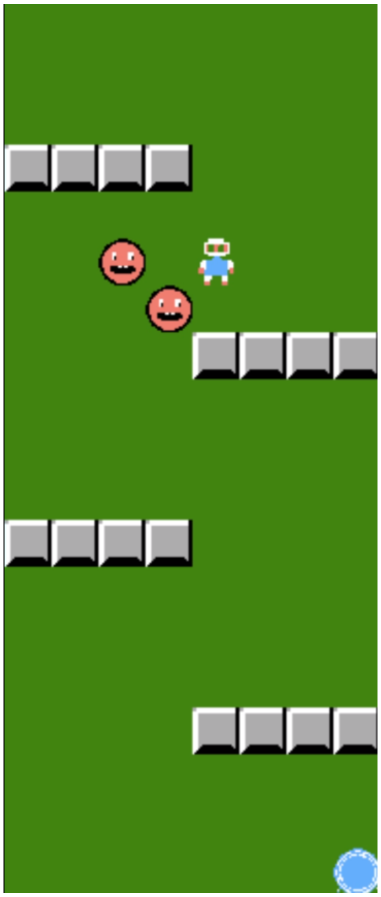
When the monster is within a certain range, or the little guy's ship is sensing the monster, we use a customized expectimax algorithm to avoid the monster while making our way towards the goal if it is safe enough to do so. This expectimax algorithm weighs each possible move the monster can take and the A* distance of those moves in respect to the moves that the little guy can make, and then chooses the best move the little guy can make from the maximum of those values. The value function looks something like this : Value of move = A* from goal * Scalar - Σlength(A* from each monster move), but is a bit more complicated than that due to the nature of the necessary looping we need to go through to find this value. With the combination of this and our A* * a scalar, we end up with an algorithm which shows the behavior of staying away from the monster, waiting for a safe enough pathway to be opened for the little guy to zoom through.

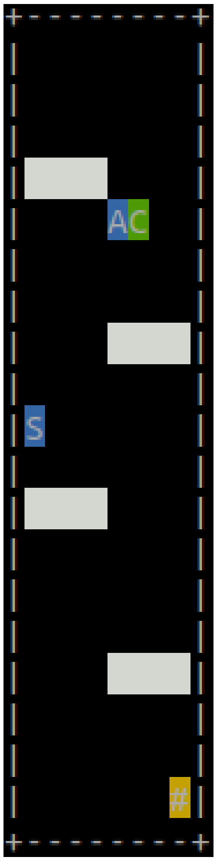
Interesting Tidbits:

The original plan was to implement A*, then Expectimax, and finally Minimax. We ended up not implementing Minimax at all because the expectimax algorithm works for both the stupid, self-preserving, and aggressive monster. The algorithm prioritizes keeping a safe distance from the monster and occasionally will make a huge gamble on making a break for the exit in a risky situation.

In variant 5, the little guy does spend a decent amount of time dancing around the two monsters, but it does reach the goal in a reasonably timely manner without being eaten.

To our surprise, it was able to evade all matter of monsters with this algorithm. Sometimes, we see the bomberman jumping directly next to the monster, making a very risky move kind of like Tom Cruise in any of his movies, but we wouldn't watch them without the thrill of that, so our monster is really just mimicking human behavior.





Despite how close the little guy is in both of these situations, they are able to survive both of these encounters and reach the goal.

Experimental Evaluation:

Each variant or situation was tested 10 times with random seeds 69, 120-129, and 420

a. Variant 1: The first situation has no monster in it and the only task is for the character to get from the start to the finish. This scenario only needs A* and since there is no monster or danger it works exactly the same every time.
b. Variant 2: This situation has a stupid monster that moves around randomly, and is the easiest of the variants with monsters. Worked 12/12 times
c. Variant 3: The self preserving monster is able to attack the character if it is within one tile. Worked 12/12 times
d. Variant 4: A smarter self preserving monster has a range of two tiles instead of one: Seed 121 takes a long time because the monster is basically camping the finish but eventually it finishes, worked 12/12 times
e. Variant 5: The final variant includes a self preserving monster and stupid monster, making it the most challenging variant for bomberman: Worked 12/12 times