Minesweeper Final AI Report

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I. Minimal AI

I.A. Briefly describe your Minimal AI algorithm. What did you do that was fun, clever, or creative?

For our minimal AI algorithm, we used the UCS algorithm taught in lecture. Since the minimal AI requirements only needed to be able to solve a 5x5 with one mine, we created a simple UCS algorithm that will have a priority queue that will put all neighbors of tiles with a percept of 0 at the front of the priority queue to uncover first. The algorithm simply chooses a tile from the front of the priority queue as the next tile to uncover. Once we reach any tiles with a percept of 1, we put it at the end of the priority queue, uncovering all the 0 percept tiles first before we worry about the tiles with percept of 1. Once we have uncovered all tiles with percept of 0, we then find a single tile with percept 1 that is diagonal to the mine. That is, that tile will only have one covered neighbor left, so the covered neighbor must be marked as a bomb. Once the bomb is marked, then we can safely uncover all the other tiles that have not been reached yet to complete the world. This algorithm worked 100% for all the worlds we needed to be able to complete for the minimal AI requirements.

We took advantage of the fact that the worlds for the minimal AI will only have one bomb to create a simple algorithm that can, without a doubt, solve all worlds. We thought it was clever to find one tile of percept 1 with only one covered neighbor, because that guarantees the covered neighbor as the bomb. This is the basis and foundational rule of the game of Minesweeper that we were able to use with our minimal AI algorithm.

I.B Describe your Minimal AI algorithm's performance:

Board Size	Sample Size	Score	Worlds Complete
5x5	1000	1000	1000
8x8	N/A	N/A	N/A
16x16	N/A	N/A	N/A
16x30	N/A	N/A	N/A
Total Summary	1000	1000	1000

II. Final AI

II.A. Briefly describe your Final AI algorithm, focusing mainly on the changes since Minimal AI:

While the UCS algorithm worked for the first submission, it became too complicated to manage the ordering of the priority queue because we had to assign a cost to each tile for the ordering of the priority queue. The matter of how to assign the cost of each tile became disorganized and more complicated the further we tried to expand our Minimal AI to work with harder problems. This mainly became problematic because we were using the priority queue to handle the tiles that needed to be uncovered/flagged and also tiles that needed to be expanded.

In an effort to move away from the priority queue used in our Minimal AI algorithm, we switched to using three separate linked lists: tiles to uncover, tile to flag, and tiles on border (tiles yet to be expanded). The algorithm still placed all the neighbors of tiles with percept of 0 to be uncovered as soon as a 0 percept is found. We then used two basic rules for the Minesweeper game for finding tiles to uncover or flag. The first rule states that if the number of covered neighbors is equal to the percept of the tile minus the flagged neighbors, then all remaining covered neighbors must be flagged. The second rule states that if the percept of the tile is equal to the number of neighboring tiles already flagged, then all other tiles can be safely opened. However, since the rules cannot completely solve all worlds, we also implemented a way to guess the best next tile to uncover. Our method of guessing the next tile to be able to open was simply by calculating the likelihood that any of the covered neighboring tiles of the tiles along the border would have a bomb. Since tiles could be neighbors for multiple tiles on the border, we simply kept the probability with the worst-case scenario. Then, after calculating all the probability, we then choose the next tile to uncover by choosing the tile with the lowest probability.

II.B Describe your Final AI algorithm's performance:

Board Size	Sample Size	Score	Worlds Complete
5x5	N/A	N/A	N/A
8x8	1000	670	670
16x16	1000	1138	569
16x30	1000	165	55
Total Summary	3000	1973	1294

III. In about 1/4 page of text or less, provide suggestions for improving this project (*this section does NOT count as past of your two-page total limit.*)

The project in itself is already really easy to understand and at just the right difficulty for an introduction to AI class. However, we think that the one thing that may be better for the project in the future is to change the requirements for the Minimal AI. Since the 5x5 board is not going to be used as part of the grade for the Final AI, we find that it's not beneficial to students to work on it. Instead, the requirements for a Minimal AI could probably be just having 10% completed for an Easy world, or something along the lines of that. Another possibility would be for the timeline of the project to be moved up, so that the Minimal AI is due earlier, so that students get more time between the Draft AI and the Final AI to increase their AI's performance.