

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?

My minimal AI algorithm was very simple and straight forward compare to what I designed later for the draft AI and Final AI which were both completed and improved versions of the minimal AI. Furthermore, I implemented my minimal AI based on the Professor's techniques which he mentioned in his discussion section. I used rules of thumb which was using effective label to mark and unmark for mines on the board in order to reduce effective labels of other close uncovers squares so I could use the rule of thumb again and again in my process. I also add more constraints to my algorithms to check the squares more precisely in order to improve it to solve more effiecntly. Another important addition to my algorithm was the part when I added the guessing aspect to my AI code which helped my minimal AI as well to solve more efficiently which I done it by using probability in order to find and guess the square with a low chance of having mine under it. From my point of view, since this was my first project in gaming area therefore researching to get the game logic was the best enjoyable part of this project from my perspective because I had to first understand how all of this modules are working and connecting together in order to start designing my own AI module. After I understood this implementation and connection parts, I start to find effective algorithms in order to improve my AI efficiency and make it faster in solving each board which was really essential for our project since we had a time limit for solving each board.

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

Board Size	Sample Size	Score	Worlds Complete
5x5	1000	1000	1000
8x8	1000	69	69
16x16	1000	0	0
16x30	1000	0	0
Total Summary	4000	1069	1069

II. Final AI

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

For improvement in the final AI I used three by three greedy method in which it uncovers all the squares that have zero as neighbors then it goes further to neighbors with one as their probability. In addition, I change my heuristics to be more precise and added more constraints to check more accurately for the mines implemented in the current board. After some research online, I was able to implement multi square algorithm which is very helpful when the three by three algorithm fails and became handy when the uncovered squares were more than one which was beyond the three by three algorithm. Furthermore, this algorithm simply checks at multiple various tiles at once therefore it can make similar deduction to the board and results to more efficiency and time reduced for solving each board. I also found row echelon form concept from matrix multiplication in linear algebra very useful and efficient in order to uncover safe squares and avoid the mines in each board which significantly increased my AI score in all levels (easy, beginner, intermediate, and expert) and also made my implementation faster than before. At last, I tried to implement the gaussian elimination algorithms as well which was very complex to implement and I only used some aspect of it in order to improve my AI code and algorithms. It was going hand to hand with the multi tiles algorithm which I completely implemented it in my implementation. The gaussian algorithm basically creates a matrix of uncovered squares in each of it columns and the last column would be the limits and solving the matrix can change the matrix to row echelon form which simply means the simplification of the matrix for the solution and it is coming from the linear algebra concepts.

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

Board Size	Sample Size	Score	Worlds Complete
5x5	1000	1000	1000
8x8	1000	763	763
16x16	1000	1258	629
16x30	1000	711	237
Total Summary	4000	3732	2629

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

First step I would make is the complete implementation Gaussian Elimination algorithm which is very effective and useful for these types of the board games since it can significantly reduce the time for solving each board and increase the choice efficiency as well. Furthermore, since I couldn't complete my research on other algorithms due to the time limit in this quarter and heavy load of the material, I would go ahead and search for all other example and ways of implementations of this particular game in order to find more effective algorithms to implement in my implementation to increase the time efficiency of my AI and the its choices.