Applying Neural Networks to Minesweeper for Mine Detection

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1. Title page.
2. Minesweeper is a popular gamed where, in order to win, players need to reveal spaces on a grid while avoiding spaces with mines. In order to be successful, players need to apply various different problem solving techniques and strategies. Utilizing probabilistic decision making and reasoning is crucial to avoid game ending mines. Applying these sorts of methods to win the game becomes more challenging as you increment the difficulty. As the difficulty increases, so does the grid size and the number of mines on the board, making Minesweeper a challenging problem to tackle. Our solution would aim to solve minesweeper boards to a decent degree of consistency.
3. We aim to take a supervised learning approach to solve this problem. Our main objective is to create an agent which can win a game of minesweeper more than the average human player, which is approximately 20% of the time.
4. Our implementation of the minesweeper agent would be a supervised binary classification task, implementing a convolutional neural network (CNN) to find possible mine positions on a game board. CNN’s are widely known and used commonly in image tasks due to their ability to capture and recognize spatial relationships, something crucial for finding patterns in matrix shaped inputs. In this context, providing our model the game grid at any state, it will be able to provide the probability of each space on the board being a mine or clear.   
     
   Apart from this, we will be implementing a minesweeper board generation module. This module will likely end up using a variation of DFS to explore nodes to uncover based off an initial starting node on the grid, clearing out nodes which have no adjacent mines. This is a smaller part of the project, part of data preprocessing/generation, however worth mentioning as DFS is something we did cover in earlier portions of the course.
5. The data required for this project is rather simple. We will need different boards of minesweeper in various states; partially covered, fully uncovered, etc. Each of these boards will be labeled with a grid of the same size, where spaces with 1’s are the mines on that grid, and spaces with 0 are the empty spaces. There is no dataset available for this sort of data, however minesweeper is a game which is rather easy to develop states for. We plan to create a large dataset in the range of 5000 to 20,000 different minesweeper boards. This will be done via development of a minesweeper board generation module which will create the dataset which the model will be trained on.