Project 3 - Minesweeper Game
CmpE 230, Systems Programming, Spring 2024

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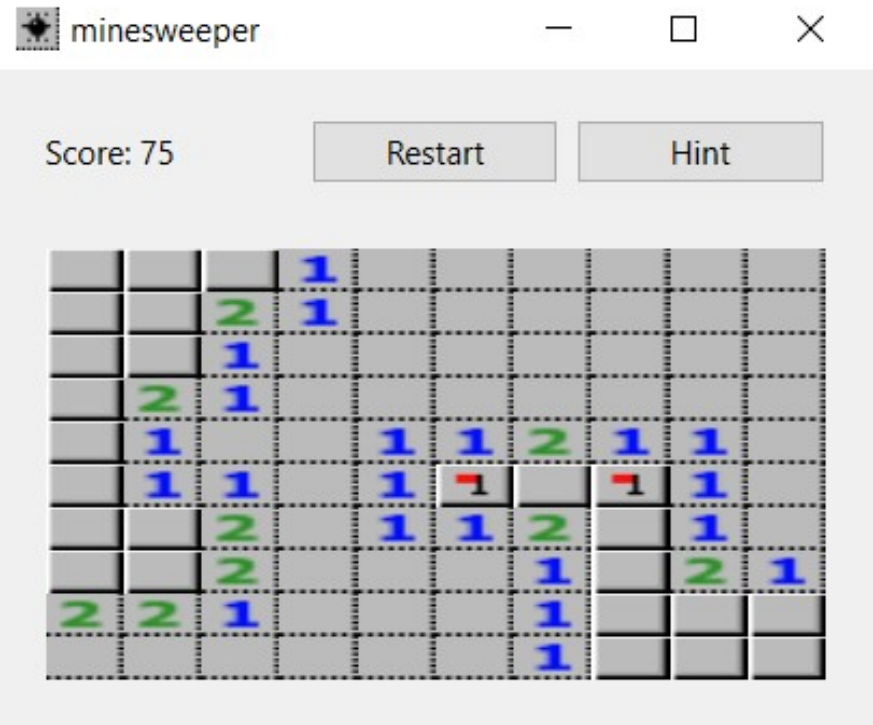
Due: May 20, 2024, 09:00 (Strict)

1 Introduction

In this project, you will implement a Minesweeper game. Your objective is to reveal all cells while avoiding mines. Each cell is numbered based on the total number of neighboring mines. For the game rules and strategies, you can refer to this link. Additionally, you can play Minesweeper online on this website to observe the game mechanics.



2 Functionalities

2.1 Game Mechanics

- Only unrevealed cells should be clickable (right or left-click).
- Left-clicking a cell should reveal either a number indicating neighboring mines, an empty cell, or a mine.
- Numbers should display the total number of neighboring mines.
- Cells with no neighboring mines should be revealed as empty.
- Revealing an empty cell should also reveal neighboring cells recursively.

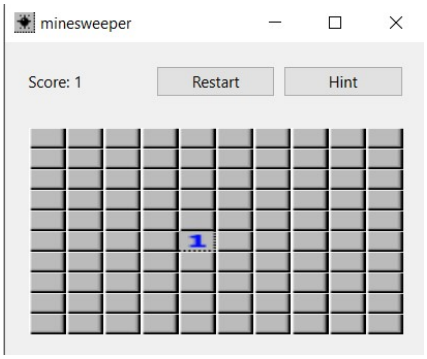


Figure 1: We are clicking on the cell adjacent to the left of the revealed '1'.

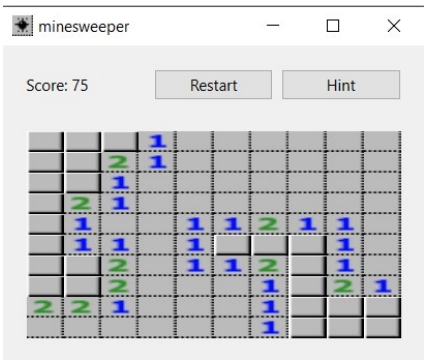


Figure 2: After we click, all neighboring cells are revealed recursively.

- Right-clicking should toggle the flag on unrevealed cells.
- Once revealed, cells must not be clickable (right or left-click).
- A restart button should initiate a new game with a different mine layout.
- A label should show the number of revealed cells as score.
- There should be hint button.
- Number of rows, columns, and mines in the game should be easily configurable with variables N, M and K. We will ask you to distribute K mines randomly in $N \times M$ grid. For example, we may ask you to start the game with 10 mines in 10×10 grid or another different configuration. So, be prepared.

2.2 End Game

- Left-clicking a mine is a losing condition.
- Revealing all cells without mines, is a win condition.
- After winning or losing the game, all mines must be revealed. A pop-up or notification should appear.
- The restart button must still be clickable after closing the pop-up.
- All cells must be unclickable until a new game starts.

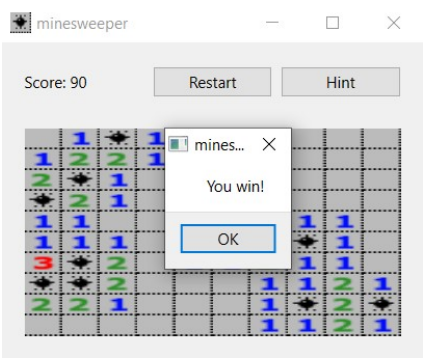


Figure 3: Avoided all mines, won the game.

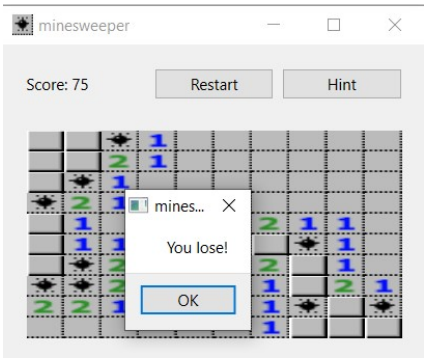


Figure 4: Clicked a mine, lost the game.

2.3 Hints

- Clicking the hint button should suggest an unrevealed cell that does not contain a mine.
- If the suggested cell hasn't been revealed by player, the second click should reveal it.

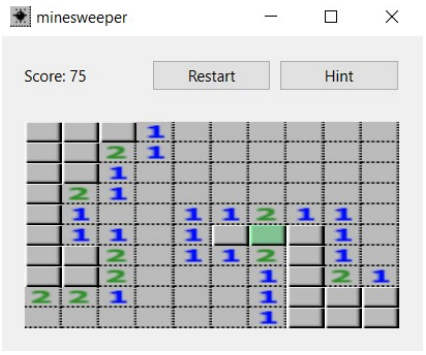


Figure 5: First click on hint

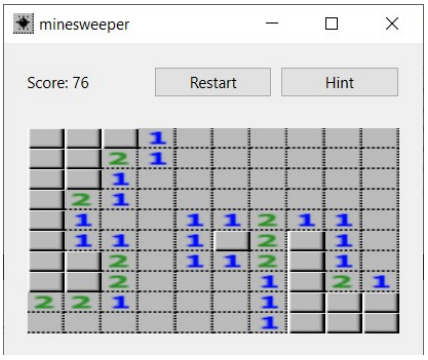


Figure 6: Second click on hint

- The hint button should provide a hint based on the information visible to the player. Each hint should reveal a safe move, indicating a cell that is guaranteed not to contain a mine from the player's perspective.
- If no safe move exists, the hint button should not suggest any move.

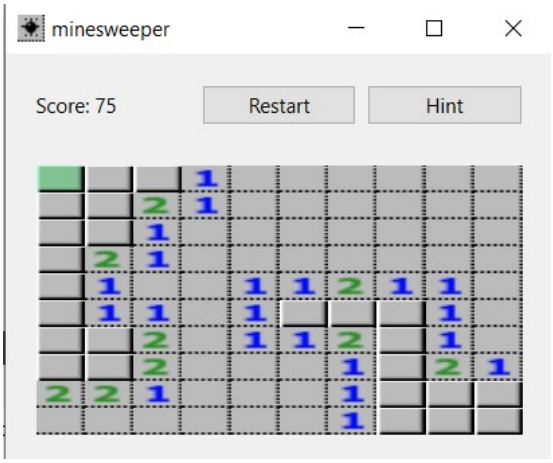


Figure 7: This is an invalid hint because we don't know certainly whether there is a mine in that cell at the current state visible to player.

3 Submission

The root folder for the project should be named according to your student id numbers. If you submit individually, name your root folder with your student id. If you submit as a group of two, name your root folder with both student ids separated by an underscore. You will compress this root folder and submit it with the `.zip` file format. Other archive formats will not be accepted. The final submission file should be in the form of either `2020400144.zip` or `2020400144_2020400099.zip`.

Late Submission

If the project is submitted late, the following penalties will be applied:

Hours late	**Penalty**
0 < hours late <= 24	25%
24 < hours late <= 48	50%
hours late > 48	100%

4 Grading

Your project will be graded according to the following criteria:

- **Code Comments (8%):** Write code comments for discrete code behavior and method comments. This sub-grading evaluates the quality and quantity of comments included in the code. Comments are essential for understanding the code's purpose, structure, logic, and any complex algorithms or data structures used. The code should be easily readable and maintainable for future developers.

- **Documentation (12%):** A written document describing how you implemented your project. This sub-grading assesses the quality and completeness of the written documentation accompanying the project. Good documentation should describe the purpose, design, and implementation details, as well as any challenges encountered and how they were addressed. The documentation should also include examples of input/output and how to use the program. Students should aim to write clear, concise, and well-organized documentation that effectively communicates the project's functionality and design decisions.

- **Implementation and Demo Sessions (80%):** The submitted project should be implemented following the guidelines in this description and should pass testing. This sub-grading assesses the quality and correctness of the implementation.

5 Demo Sessions

There will be live demo sessions where you will showcase your project on your own computer. Dates and locations for the demo sessions will be announced later.

6 Warnings

- You can submit this project either individually or as a group of two.
- All source codes are checked automatically for similarity with other submissions and exercises from previous years. Make sure you write and submit your own code. Any sign of cheating will be penalized with an F grade.
- Do not use content from external AI tools directly in your code and documentation. Doing so will be viewed as plagiarism and thoroughly investigated.
- Project documentation should be structured in a proper manner. The documentation must be submitted as a .pdf file, as well as in raw text format.
- Make sure you document your code with necessary inline comments and use meaningful variable names. Do not over-comment, or make your variable names unnecessarily long. This is very important for partial grading.
- Do not start coding right away. Think about the structure of your program and the possible complications resulting from it before coding.
- Questions about the project should be sent through the discussion forum on Piazza.