Minesweeper

Jeremy Tsang

December 7, 2020

Contents

This repo can also be read at `https://github.com/jeremytsang1/minesweeper/`

1 Description

My personal implementation of the classic Minesweeper game.

2 Rules

- The objective of the game is to open all cells not containing mines. If the player opens a cell containing a mine they lose the round. Note that when opening a cell there are three options to its contents:

  1. containing a bomb
  2. containing a the number of adjacent cells that contain bombs
  3. empty (no adjacent cells contain bombs)

- The player is capable of the 3 following actions

2.1 Opening a cell

This will open a single cell. If the cell contains a bomb the player dies. If it contains a number then only the opened cell is opened. If is empty all adjacent cells are opened. That is empty cells can perform a Depth First Search that terminates on number cells.

2.2 Toggling a flag on a cell

This can be used to mark a cell as having a bomb. This is useful for *chording* as seen below.

2.3 Chording a cell

If a given number cell has a number of flags adjacent equal to its number it can be chorded. This means all non-flagged unopened cells will be opened as if they were opened as in (1). If a flag is not properly assigned (i.e. flagging a cell that does not contain a bomb) this could lead to the player's death.

3 Generation of random boards

Note that in this particular implementation mines will not be laid until the player firsts opens a cell. This is a usability measure to prevent the player from dying on their first cell opening. A random puzzle of a board with m rows, n columns, and k (with $k < m \cdot n$) mines is generated by taking a list all cell coordinates ($(m \cdot n) - 1$ to be exact as we exclude the player's first choice), shuffling said list, and then placing mines on the first k coordinates in the list. Since a shuffle of l items can be done in $\mathcal{O}(l)$ time (See the Fisher Yates algorithm) this would mean that our puzzle generation would take at most $\mathcal{O}(m \cdot n)$.

This particular generates random boards of the following preset difficulties (EASY, MEDIUM, HARD) as well as user specified row, col, mine counts. A summary is listed in the table below

difficulty	rows	cols	mines
EASY	10	10	10
MEDIUM	16	16	40
HARD	16	30	99
CUSTOM	user specified	user specified	user specified

4   Requirements

- Python `>= 3.6`

- For specific Python packages see `requirements.txt`.

5   Installation

5.1   Option 1: Local

- Unzip the `.zip` file.

- `cd` into the top root directory of the unzipped file.

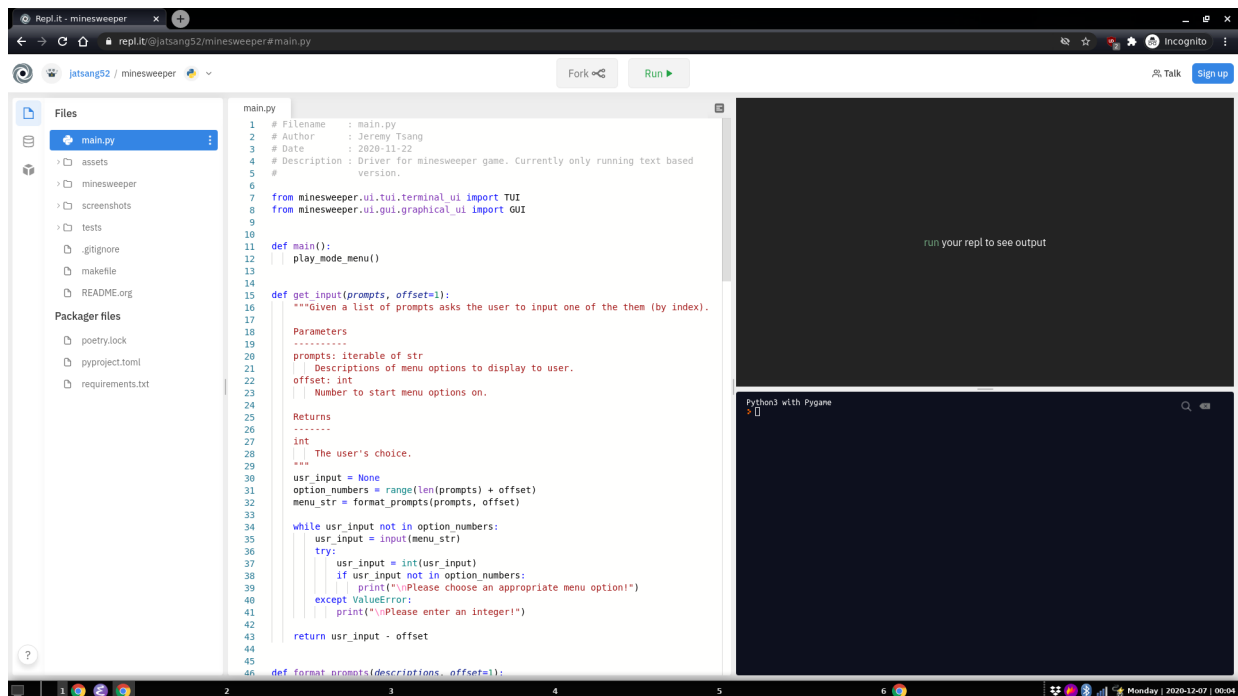- Install dependencies

  `pip install -r requirements.txt`
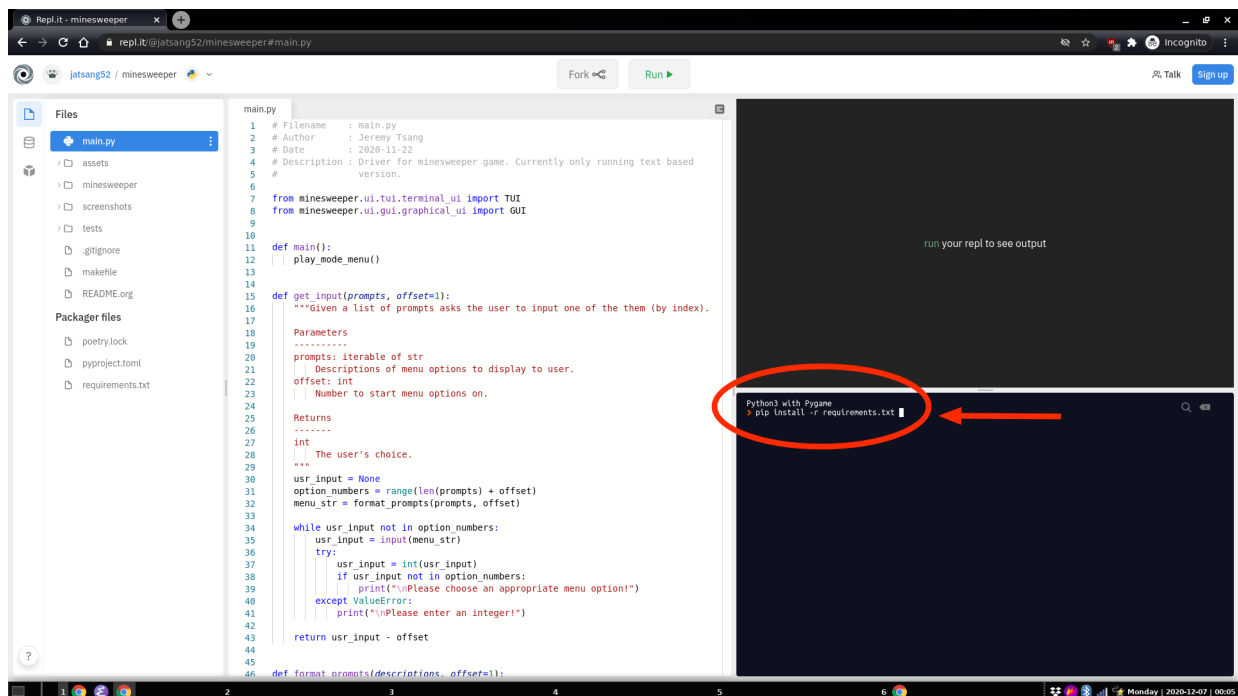
- Run the main script

  `python3 main.py`

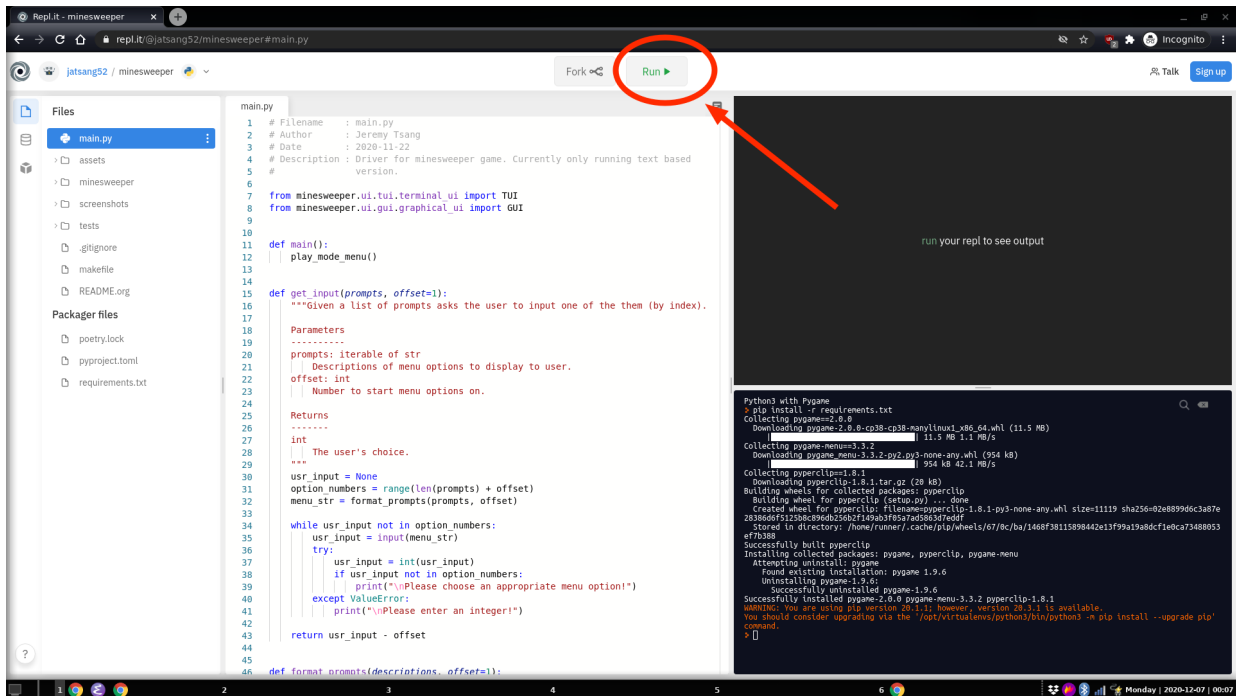- Follow instructions on terminal to choose TUI or GUI mode.

5.2 Option 2: `repl.it`

1. Navigate to the following link: `https://repl.it/@jatsang52/minesweeper#main.py`
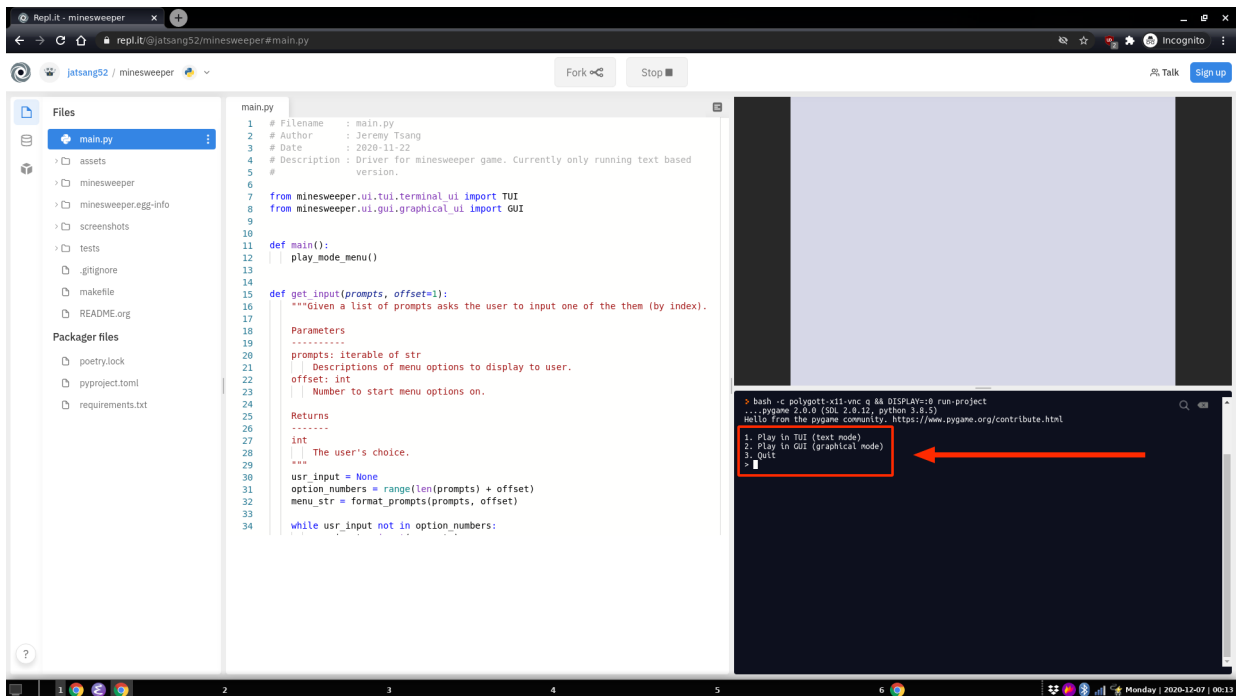

2. In the repl.it terminal, install dependencies with `pip install -r requirements.txt`
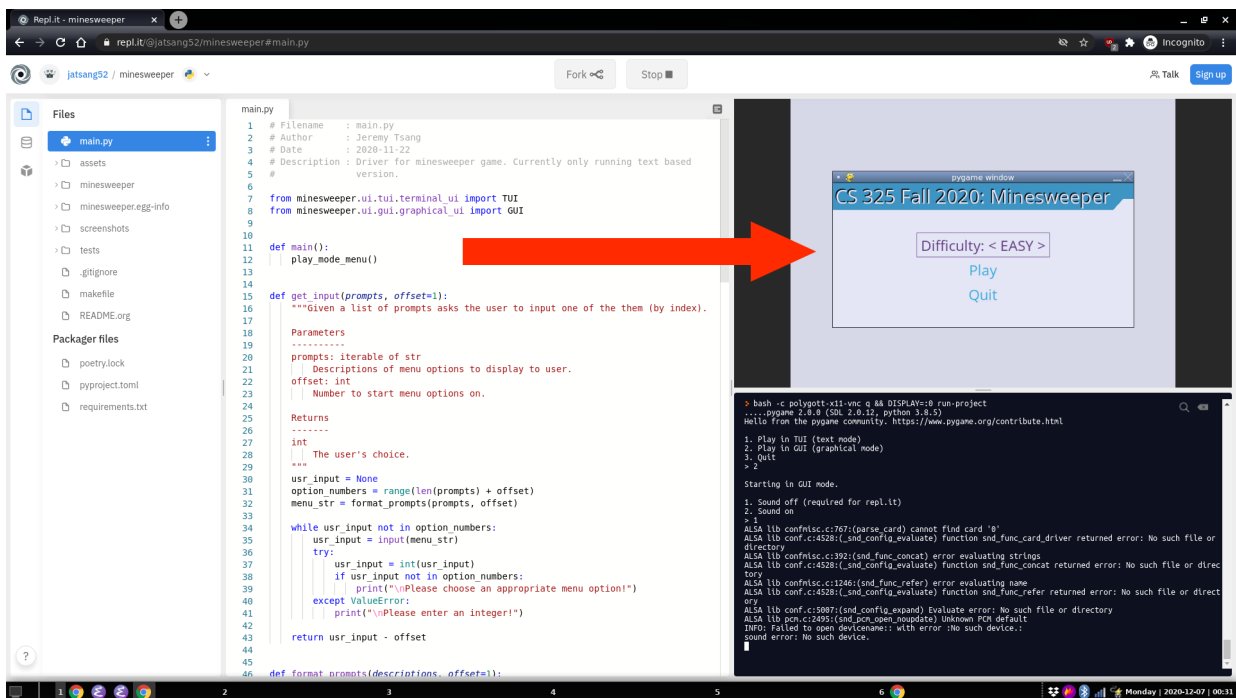

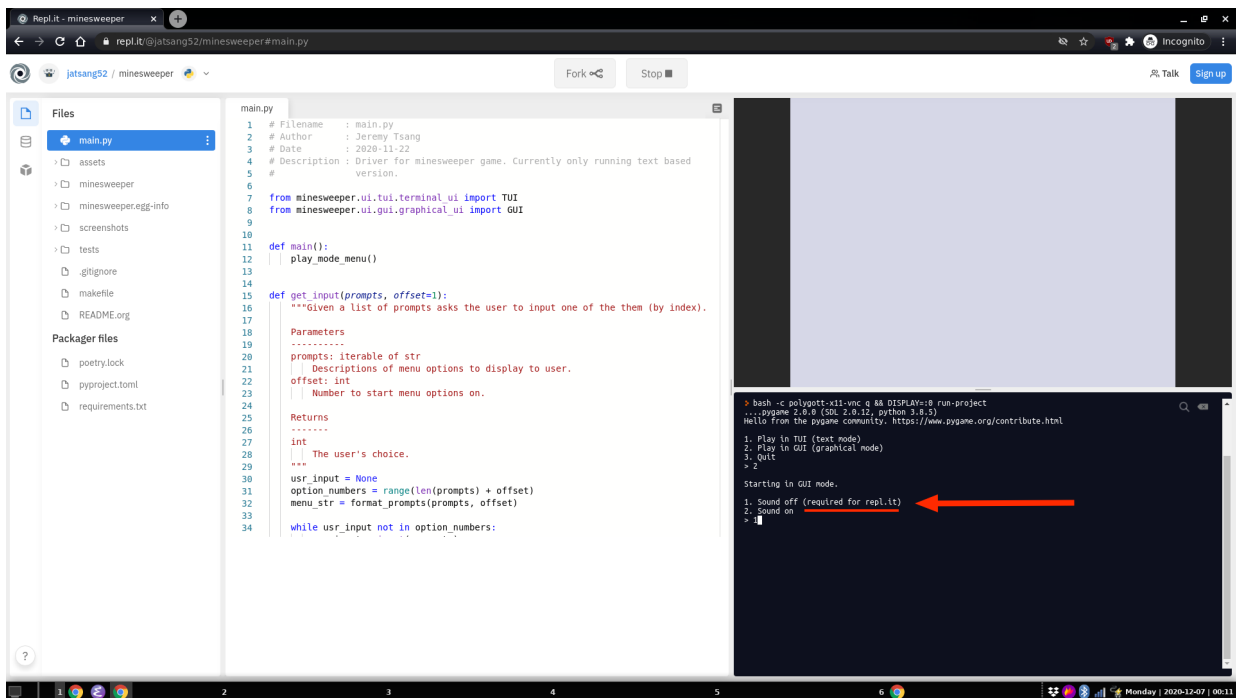3. After the installation completes press the `Run` button.

4. In the repl.it terminal choose TUI or GUI mode.

5. In the repl.it terminal if you choose GUI mode make sure to choose option 1 to disable sound (repl.it doesn't play nicely with pygame apps with sound)

6   Modes

6.1   Graphical User Interface (GUI)

6.1.1   Controls

- After pressing `Play` left click anywhere to start the game.

- Mouse controls

control	action
left click	open cell
right click	toggle flag
middle click	chord cell

- Keyboard controls

key	action
q	Quit to main menu

6.1.2 Screenshots
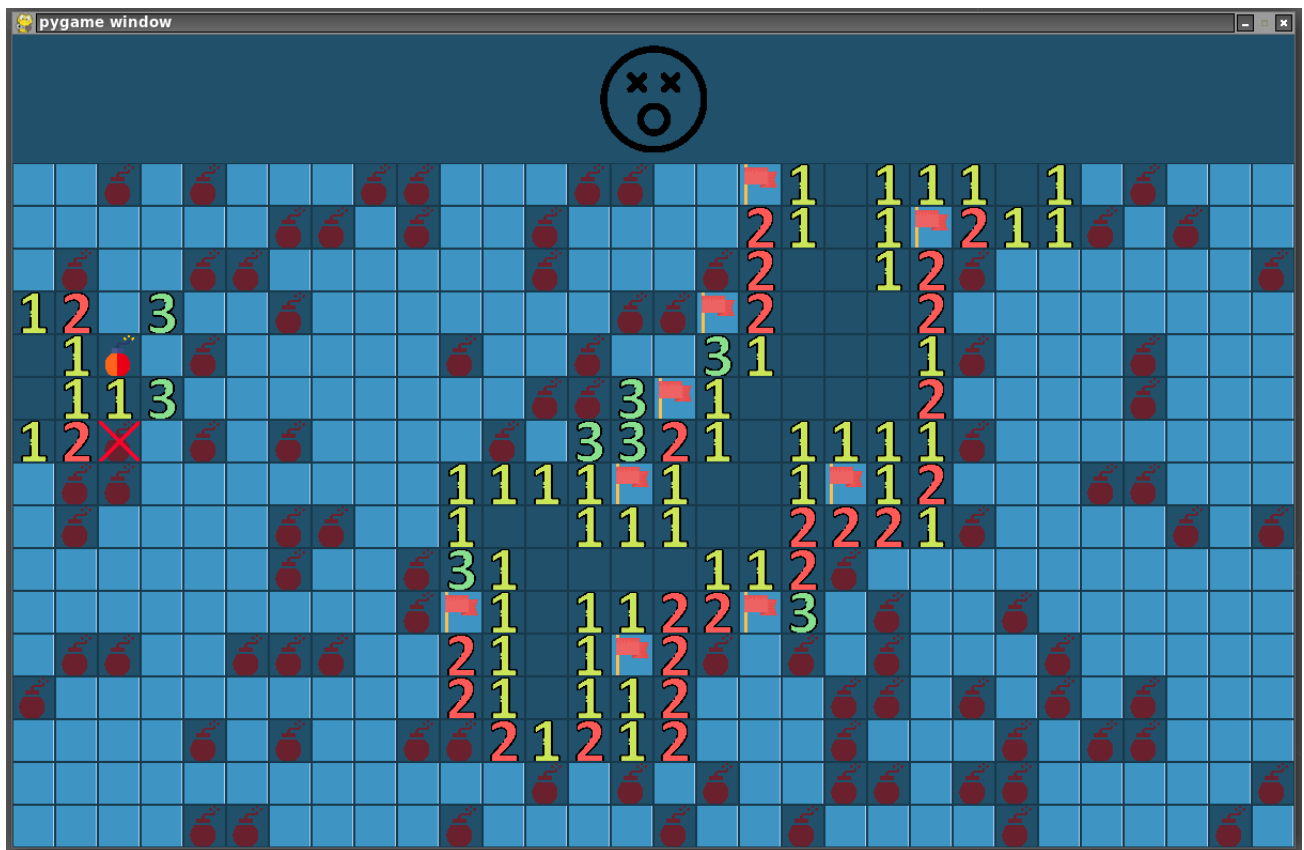
6.1.3 Video

Youtube: Minesweeper GUI Demo

6.2 Terminal User Interface (TUI)

6.2.1 Controls

- Follow menu directions on screen.

6.2.2 Screenshots

- Starting an **EASY** difficulty game.

```
(minesweeper) jt ~/hw/minesweeper $ python main.py
pygame 2.0.0 (SDL 2.0.12, python 3.8.5)
Hello from the pygame community. https://www.pygame.org/contribute.html

1. Play in TUI (text mode)
2. Play in GUI (graphical mode)
3. Quit
> 1

Starting in TUI mode.

1. New game
2. Quit
> 1

1. Easy
2. Medium
3. Hard
4. Custom
> 1

Starting EASY game!
height: 10
 width: 10
 bombs: 10

(Legal) Turns taken: 0
|---+---+---+---+---+---+---+---+---+---+---|
|   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---+---+---+---+---+---+---+---+---+---+---|
| 0 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---|
| 1 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---|
| 2 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---|
| 3 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---|
| 4 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---|
| 5 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---|
| 6 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---|
| 7 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---|
| 8 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---|
| 9 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---|

1. Open cell
2. Quit
> 1
```

```
Which row?
> 0
```

- Starting an **CUSTOM** difficulty game.

```
(minesweeper) jt ~/hw/minesweeper $ python main.py
pygame 2.0.0 (SDL 2.0.12, python 3.8.5)
Hello from the pygame community. https://www.pygame.org/contribute.html

1. Play in TUI (text mode)
2. Play in GUI (graphical mode)
3. Quit
> 1

Starting in TUI mode.

1. New game
2. Quit
> 1

1. Easy
2. Medium
3. Hard
4. Custom
> 4

How many rows?
> 18

How many cols?
> 12

How many bombs? (must be in the range [1 (inclusive) ... 216 (exclusive)])
> 45

Starting CUSTOM game!
height: 18
 width: 12
 bombs: 45

(Legal) Turns taken: 0
|---+---+---+---+---+---+---+---+---+---+---+---+---|
|   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10| 11|
|---+---+---+---+---+---+---+---+---+---+---+---+---|
| 0 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---+---+---|
| 1 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---+---+---|
| 2 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---+---+---|
| 3 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---+---+---|
| 4 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---+---+---|
| 5 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---+---+---|
| 6 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---+---+---|
| 7 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---+---+---|
| 8 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---+---+---|
| 9 | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---+---+---|
| 10| ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---+---+---|
| 11| ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
|---+---+---+---+---+---+---+---+---+---+---+---+---|
```

6.2.3 Video

Youtube: Minesweeper TUI Demo

7 Credits

7.1 Icons

7.1.1 Numbers

Number icons made by Freepik from www.flaticon.com

7.1.2 Bombs

Bomb Icons made by Freepik from www.flaticon.com

7.1.3 Flags

Flag Icons made by Vectors Market from www.flaticon.com

7.1.4 Squares

Square Icons made by Freepik from www.flaticon.com

7.1.5 Emoticons

Emoticon Icons made by Pixel perfect from www.flaticon.com

- `https://www.flaticon.com/free-icon/dead_589932`

- `https://www.flaticon.com/free-icon/confused_589927`

- `https://www.flaticon.com/free-icon/smile_590000`

- `https://www.flaticon.com/free-icon/smiling_590002`

7.2 Sounds

7.2.1 End Game

- Explosion sound made by Michel Baradari

- Win Sound made by Listener