#Final Project

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1. 簡介

Minesweeper(踩地雷)，遊戲版面為二維陣列 M*N 的方格組成，玩家可根據難易度(陣列大小、地雷數量多寡)不同選擇破關的關卡，關卡難度分為簡單(地雷佔比 12.3%)、中等(15.6%)、難(20.6%)，以及可自行輸入想挑戰的陣列大小及地雷數量，遊玩遊戲的同時亦有時間限制。

輸入任一格之列與行數值即可開始遊戲，同時開始倒數計時。如果玩家選擇沒有地雷的方格，則會顯現一個數字在方格內(若周圍無地雷則顯示’B’)，其表示該方格之九宮格範圍內(不包含自己那格)的地雷數量，玩家以此判斷地雷所在位置，於遊戲規定時間內破關則完成該關卡，若時間內尚未選出所有非地雷之方格或踩到地雷，則該關卡挑戰失敗。

~資料結構~

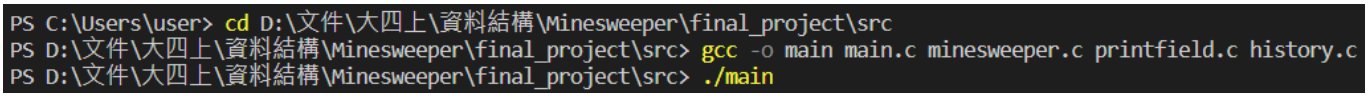
enum、switch case：判斷遊戲難易度的選擇

陣列：遊戲版面呈現及方格資料儲存。

遞迴：玩家透過輸入行與列的數值選擇猜測為非地雷的方格，利用遞迴函式讓玩家再遊戲結束前可不斷輸入行與列的數值，並判斷遊戲是否繼續執行或已破解成功/失敗。

linked-list、struct：記錄遊戲歷史資料(玩家輸入的行列數值)。

2. 編譯結果



```
PS C:\Users\user> cd D:\文件\大四上\資料結構\Minesweeper\final_project\src
PS D:\文件\大四上\資料結構\Minesweeper\final_project\src> gcc -o main main.c minesweeper.c printfield.c history.c
PS D:\文件\大四上\資料結構\Minesweeper\final_project\src> ./main
```

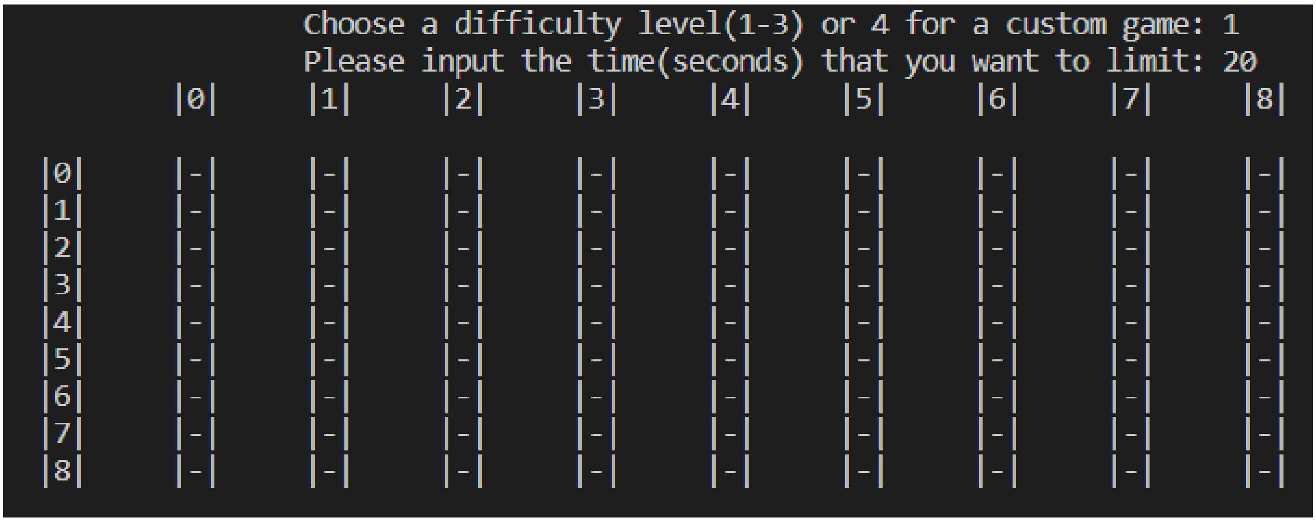
3. 執行結果

Test_1

輸入難度為 1(簡單)：9*9 的方格，有 10 顆地雷

輸入限制時間(單位：秒)

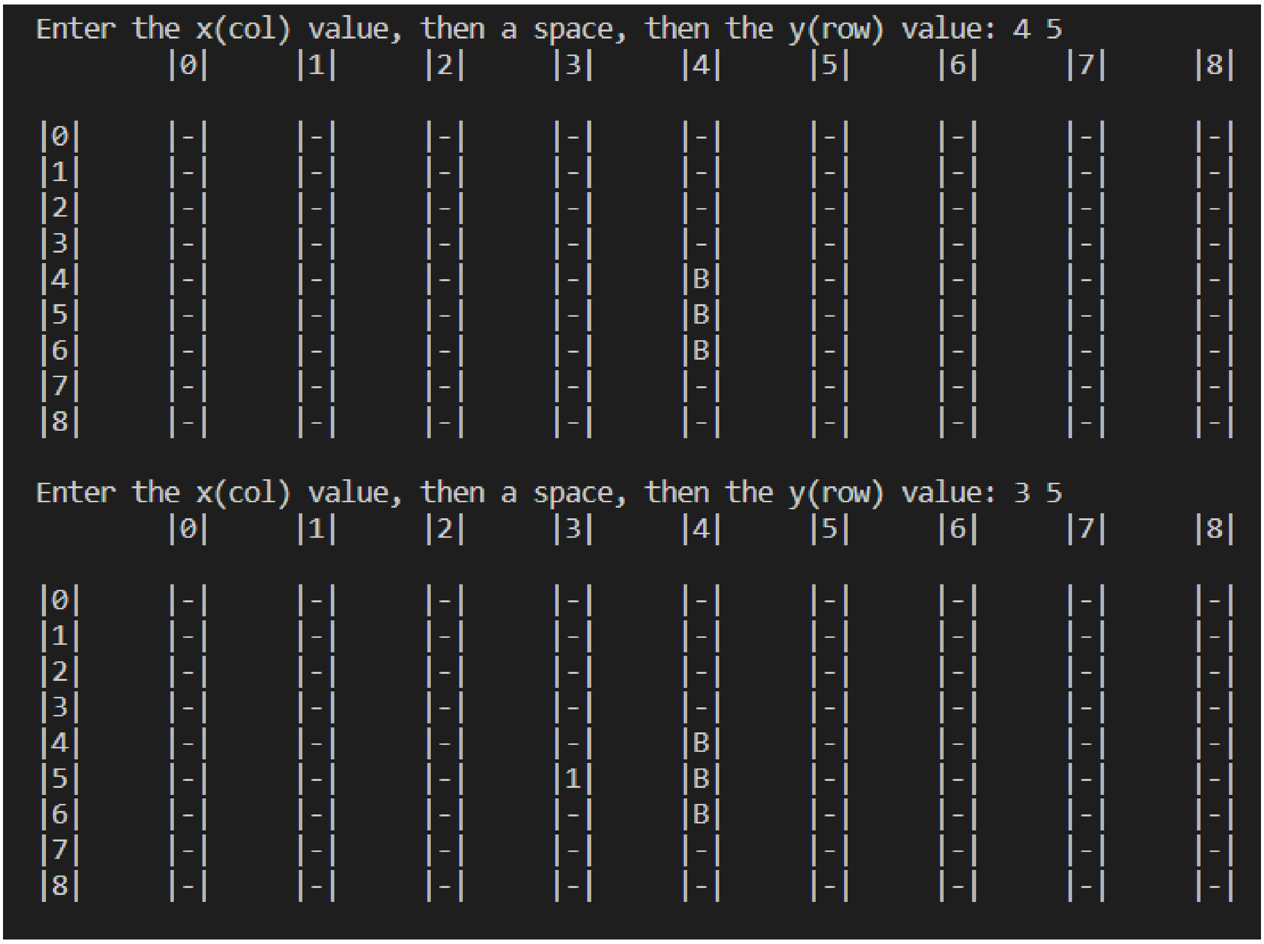
輸出初始狀態的方格



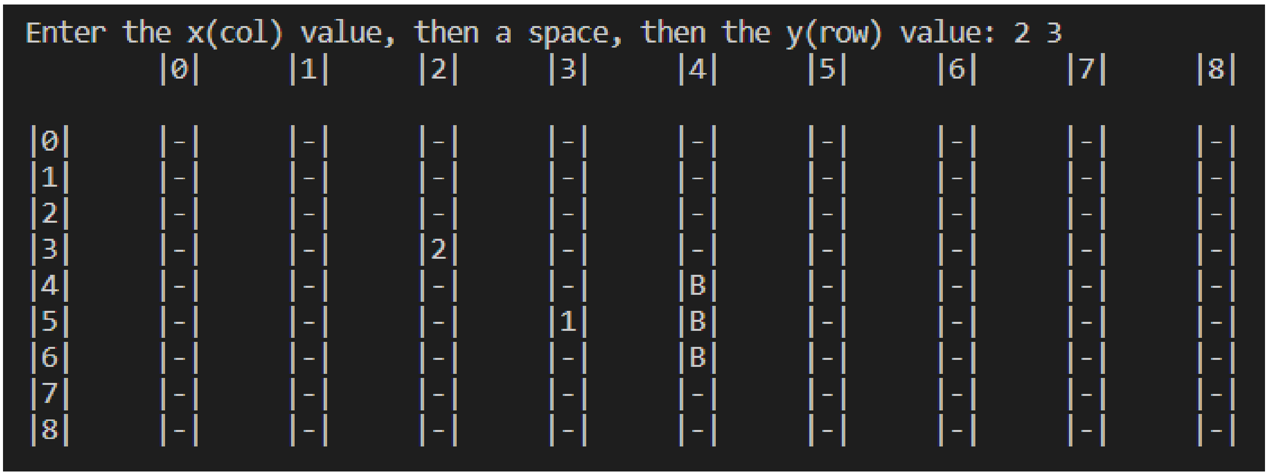
```
                Choose a difficulty level(1-3) or 4 for a custom game: 1
                Please input the time(seconds) that you want to limit: 20
         |0|      |1|      |2|      |3|      |4|      |5|      |6|      |7|      |8|

  |0|    |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|
  |1|    |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|
  |2|    |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|
  |3|    |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|
  |4|    |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|
  |5|    |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|
  |6|    |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|
  |7|    |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|
  |8|    |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|      |-|
```

不斷輸入行與列的數值

亦不斷輸出最新的方格狀態



```
Enter the x(col) value, then a space, then the y(row) value: 4 5
        |0|     |1|     |2|     |3|     |4|     |5|     |6|     |7|     |8|

|0|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|1|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|2|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|3|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|4|     |-|     |-|     |-|     |-|     |B|     |-|     |-|     |-|     |-|
|5|     |-|     |-|     |-|     |-|     |B|     |-|     |-|     |-|     |-|
|6|     |-|     |-|     |-|     |-|     |B|     |-|     |-|     |-|     |-|
|7|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|8|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|

Enter the x(col) value, then a space, then the y(row) value: 3 5
        |0|     |1|     |2|     |3|     |4|     |5|     |6|     |7|     |8|

|0|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|1|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|2|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|3|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|4|     |-|     |-|     |-|     |-|     |B|     |-|     |-|     |-|     |-|
|5|     |-|     |-|     |-|     |1|     |B|     |-|     |-|     |-|     |-|
|6|     |-|     |-|     |-|     |-|     |B|     |-|     |-|     |-|     |-|
|7|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|8|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
```



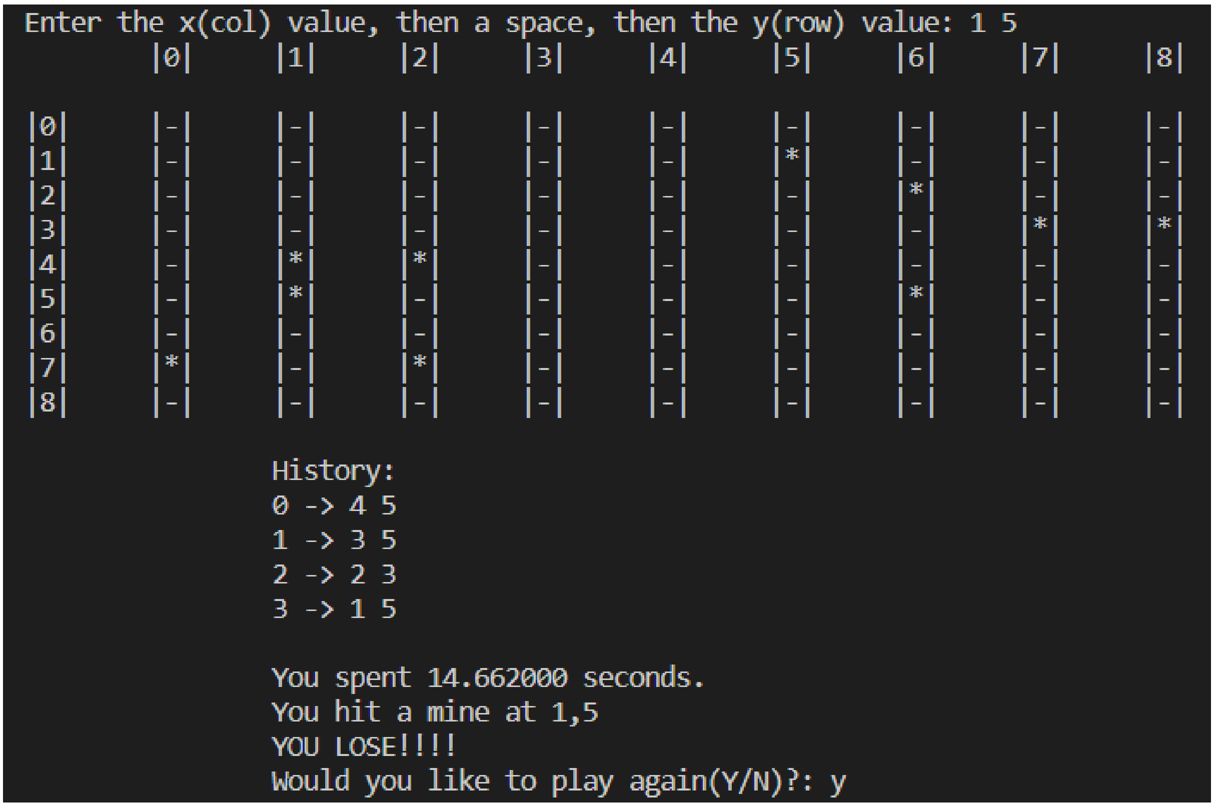
```
Enter the x(col) value, then a space, then the y(row) value: 2 3
        |0|     |1|     |2|     |3|     |4|     |5|     |6|     |7|     |8|

|0|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|1|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|2|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|3|     |-|     |-|     |2|     |-|     |-|     |-|     |-|     |-|     |-|
|4|     |-|     |-|     |-|     |-|     |B|     |-|     |-|     |-|     |-|
|5|     |-|     |-|     |-|     |1|     |B|     |-|     |-|     |-|     |-|
|6|     |-|     |-|     |-|     |-|     |B|     |-|     |-|     |-|     |-|
|7|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|8|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
```

直到踩到地雷

輸出歷史記錄(玩家遊玩時輸入的行列數值)、玩家遊玩花費了多少時間(秒)及踩到哪顆地雷

挑戰失敗

輸入是否想繼續遊玩(Y or y => 繼續遊玩)



```
Enter the x(col) value, then a space, then the y(row) value: 1 5
        |0|     |1|     |2|     |3|     |4|     |5|     |6|     |7|     |8|

|0|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|1|     |-|     |-|     |-|     |-|     |-|     |*|     |-|     |-|     |-|
|2|     |-|     |-|     |-|     |-|     |-|     |-|     |*|     |-|     |-|
|3|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |*|     |*|
|4|     |-|     |*|     |*|     |-|     |-|     |-|     |-|     |-|     |-|
|5|     |-|     |*|     |-|     |-|     |-|     |-|     |*|     |-|     |-|
|6|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|7|     |*|     |-|     |*|     |-|     |-|     |-|     |-|     |-|     |-|
|8|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|

                History:
                0 -> 4 5
                1 -> 3 5
                2 -> 2 3
                3 -> 1 5

                You spent 14.662000 seconds.
                You hit a mine at 1,5
                YOU LOSE!!!!
                Would you like to play again(Y/N)?: y
```

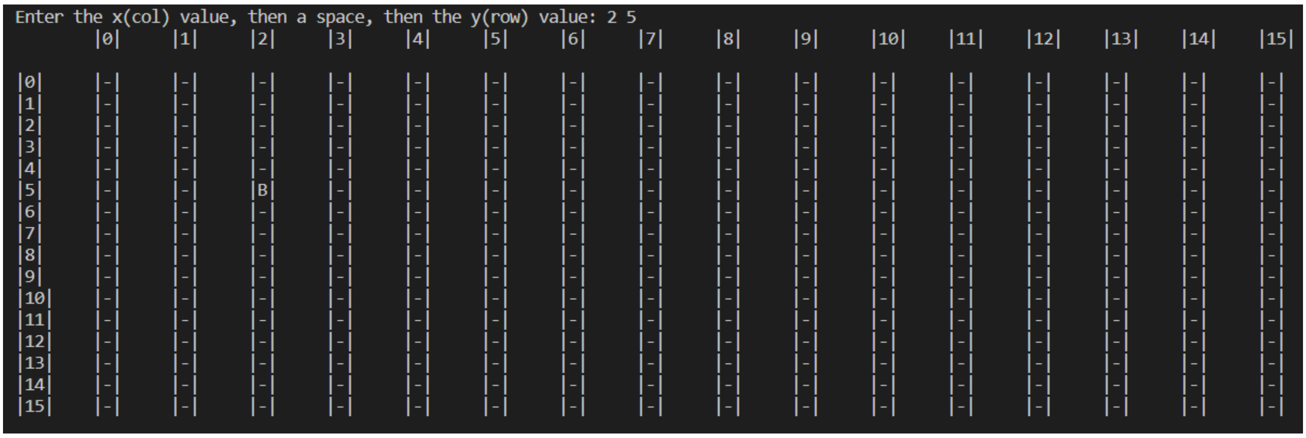
Test_2

繼續挑戰

輸入難度為 2(中等):16*16 的方格，有 40 顆地雷

輸入限制時間(單位：秒)

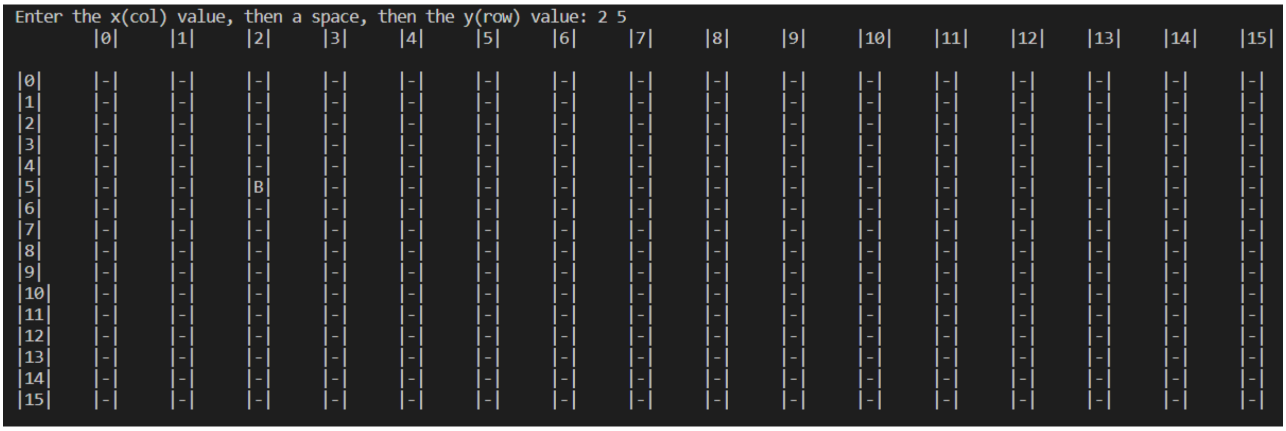
輸出初始狀態的方格



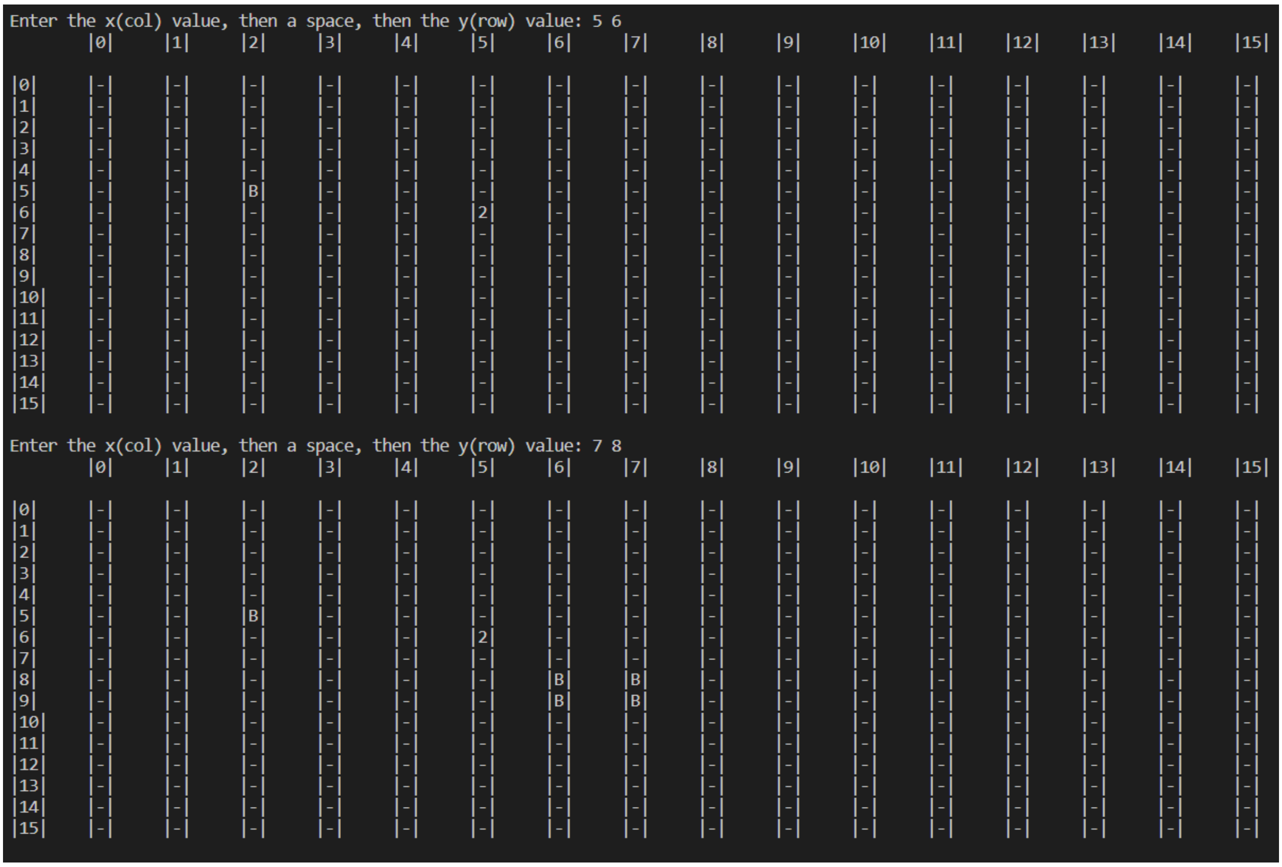
```
Enter the x(col) value, then a space, then the y(row) value: 2 5
        |0|     |1|     |2|     |3|     |4|     |5|     |6|     |7|     |8|     |9|     |10|    |11|    |12|    |13|    |14|    |15|

|0|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|1|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|2|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|3|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|4|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|5|     |-|     |-|     |B|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|6|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|7|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|8|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|9|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|10|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|11|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|12|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|13|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|14|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|15|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
```

不斷輸入行與列的數值

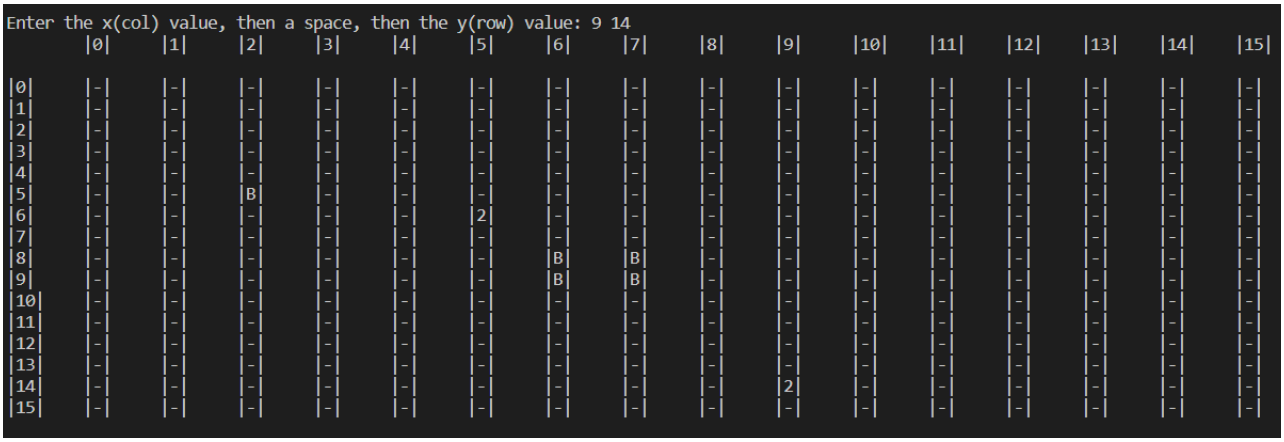
亦不斷輸出最新的方格狀態



```
Enter the x(col) value, then a space, then the y(row) value: 2 5
        |0|     |1|     |2|     |3|     |4|     |5|     |6|     |7|     |8|     |9|     |10|    |11|    |12|    |13|    |14|    |15|

|0|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|1|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|2|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|3|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|4|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|5|     |-|     |-|     |B|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|6|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|7|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|8|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|9|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|10|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|11|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|12|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|13|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|14|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|15|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
```



```
Enter the x(col) value, then a space, then the y(row) value: 5 6
        |0|     |1|     |2|     |3|     |4|     |5|     |6|     |7|     |8|     |9|     |10|    |11|    |12|    |13|    |14|    |15|

|0|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|1|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|2|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|3|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|4|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|5|     |-|     |-|     |B|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|6|     |-|     |-|     |-|     |-|     |-|     |2|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|7|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|8|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|9|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|10|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|11|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|12|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|13|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|14|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|15|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
Enter the x(col) value, then a space, then the y(row) value: 7 8
        |0|     |1|     |2|     |3|     |4|     |5|     |6|     |7|     |8|     |9|     |10|    |11|    |12|    |13|    |14|    |15|

|0|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|1|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|2|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|3|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|4|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|5|     |-|     |-|     |B|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|6|     |-|     |-|     |-|     |-|     |-|     |2|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|7|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|8|     |-|     |-|     |-|     |-|     |-|     |-|     |B|     |B|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|9|     |-|     |-|     |-|     |-|     |-|     |-|     |B|     |B|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|10|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|11|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|12|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|13|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|14|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|15|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
```



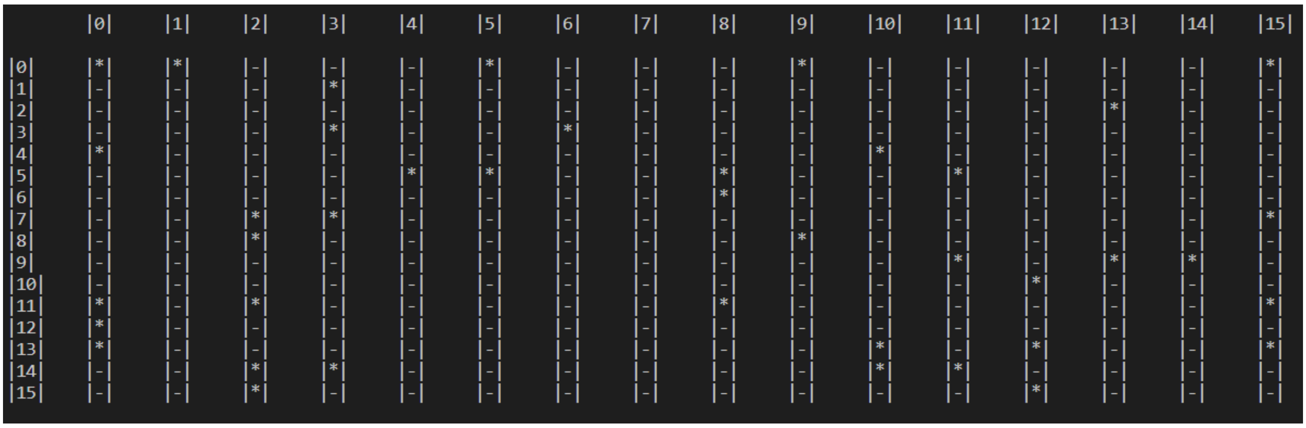
```
Enter the x(col) value, then a space, then the y(row) value: 9 14
        |0|     |1|     |2|     |3|     |4|     |5|     |6|     |7|     |8|     |9|     |10|    |11|    |12|    |13|    |14|    |15|

|0|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|1|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|2|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|3|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|4|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|5|     |-|     |-|     |B|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|6|     |-|     |-|     |-|     |-|     |-|     |2|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|7|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|8|     |-|     |-|     |-|     |-|     |-|     |-|     |B|     |B|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|9|     |-|     |-|     |-|     |-|     |-|     |-|     |B|     |B|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|10|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|11|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|12|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|13|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|14|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |2|     |-|     |-|     |-|     |-|     |-|     |-|
|15|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
```

直到超過限制的時間

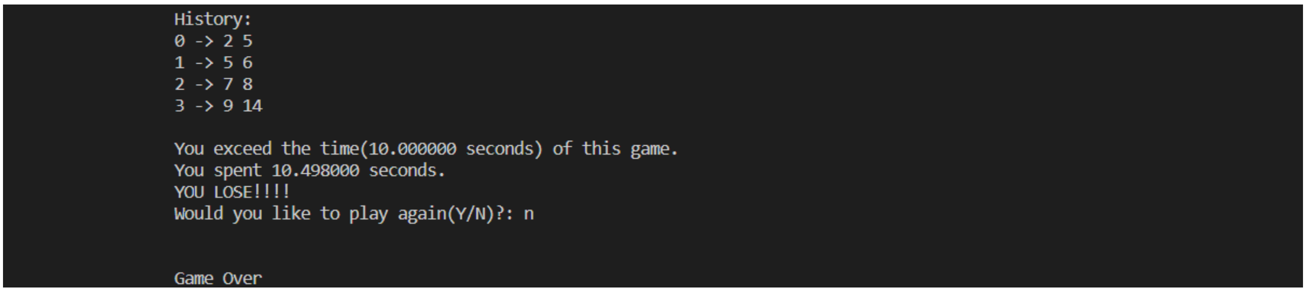
輸出歷史記錄(玩家遊玩時輸入的行列數值)及玩家遊玩花費了多少時間(秒)

挑戰失敗

輸入是否想繼續遊玩(N or n => 離開)



```
        |0|     |1|     |2|     |3|     |4|     |5|     |6|     |7|     |8|     |9|     |10|    |11|    |12|    |13|    |14|    |15|

|0|     |*|     |*|     |-|     |-|     |-|     |*|     |-|     |-|     |-|     |*|     |-|     |-|     |-|     |-|     |-|     |*|
|1|     |-|     |-|     |-|     |*|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|2|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |*|     |-|     |-|
|3|     |-|     |-|     |-|     |*|     |-|     |-|     |*|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|4|     |*|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |*|     |-|     |-|     |-|     |-|     |-|
|5|     |-|     |-|     |-|     |-|     |*|     |*|     |-|     |-|     |*|     |-|     |-|     |*|     |-|     |-|     |-|     |-|
|6|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |*|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|7|     |-|     |-|     |*|     |*|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |*|
|8|     |-|     |-|     |*|     |-|     |-|     |-|     |-|     |-|     |-|     |*|     |-|     |-|     |-|     |-|     |-|     |-|
|9|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |*|     |-|     |*|     |*|     |-|
|10|    |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |*|     |-|     |-|     |-|
|11|    |*|     |-|     |*|     |-|     |-|     |-|     |-|     |-|     |*|     |-|     |-|     |-|     |-|     |-|     |-|     |*|
|12|    |*|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|
|13|    |*|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |*|     |-|     |*|     |-|     |-|     |*|
|14|    |-|     |-|     |*|     |*|     |-|     |-|     |-|     |-|     |-|     |-|     |*|     |*|     |-|     |-|     |-|     |-|
|15|    |-|     |-|     |*|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |-|     |*|     |-|     |-|     |-|
```



```
                History:
                0 -> 2 5
                1 -> 5 6
                2 -> 7 8
                3 -> 9 14

                You exceed the time(10.000000 seconds) of this game.
                You spent 10.498000 seconds.
                YOU LOSE!!!!
                Would you like to play again(Y/N)?: n


                Game Over
```

Test_3

輸入難度為 4(可自行設定方格行列數及地雷數量)

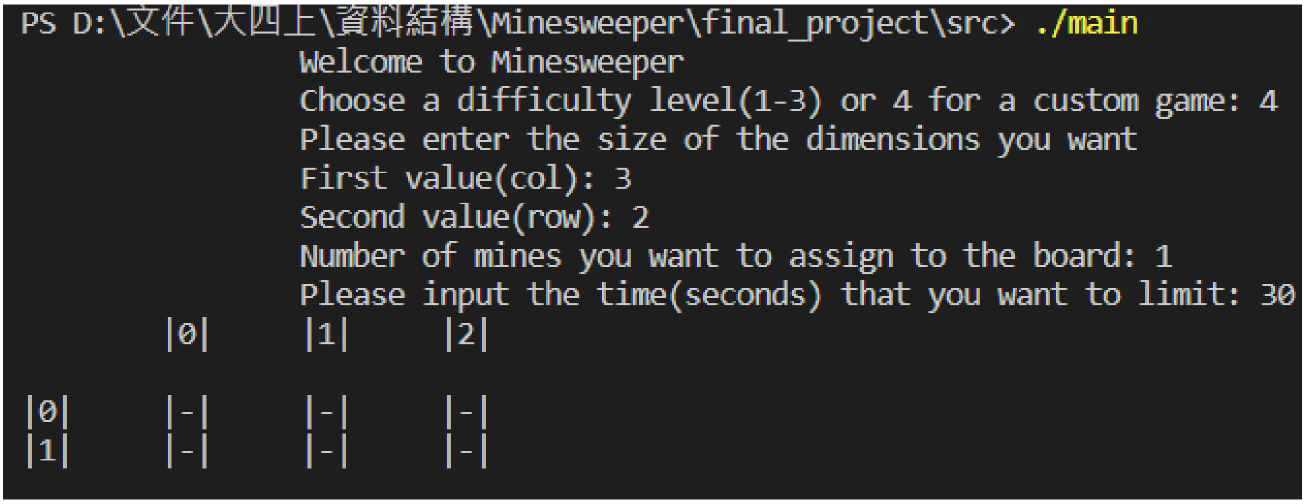
輸入方格行數

輸入方格列數

輸入地雷數量

輸入限制時間(單位：秒)

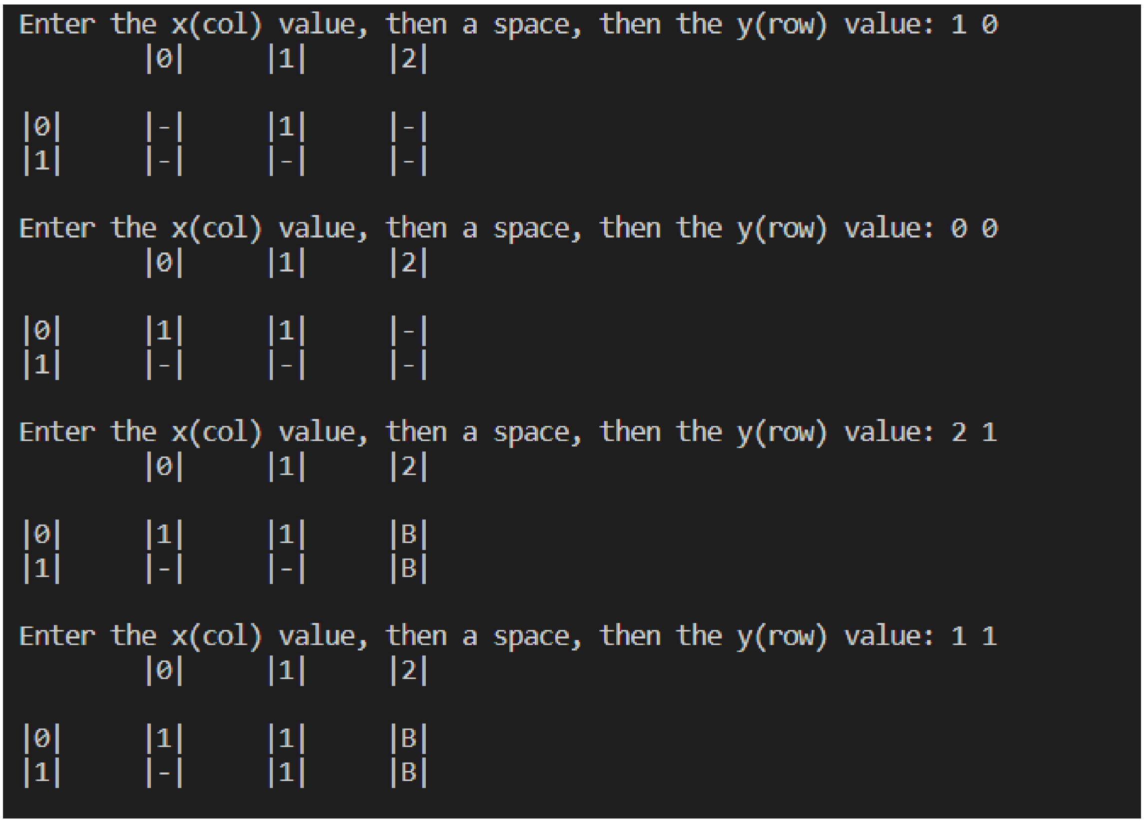
輸出初始狀態的方格



```
PS D:\文件\大四上\資料結構\Minesweeper\final_project\src> ./main
                    Welcome to Minesweeper
                    Choose a difficulty level(1-3) or 4 for a custom game: 4
                    Please enter the size of the dimensions you want
                    First value(col): 3
                    Second value(row): 2
                    Number of mines you want to assign to the board: 1
                    Please input the time(seconds) that you want to limit: 30
          |0|       |1|       |2|

|0|       |-|       |-|       |-|
|1|       |-|       |-|       |-|
```

不斷輸入行與列的數值

亦不斷輸出最新的方格狀態

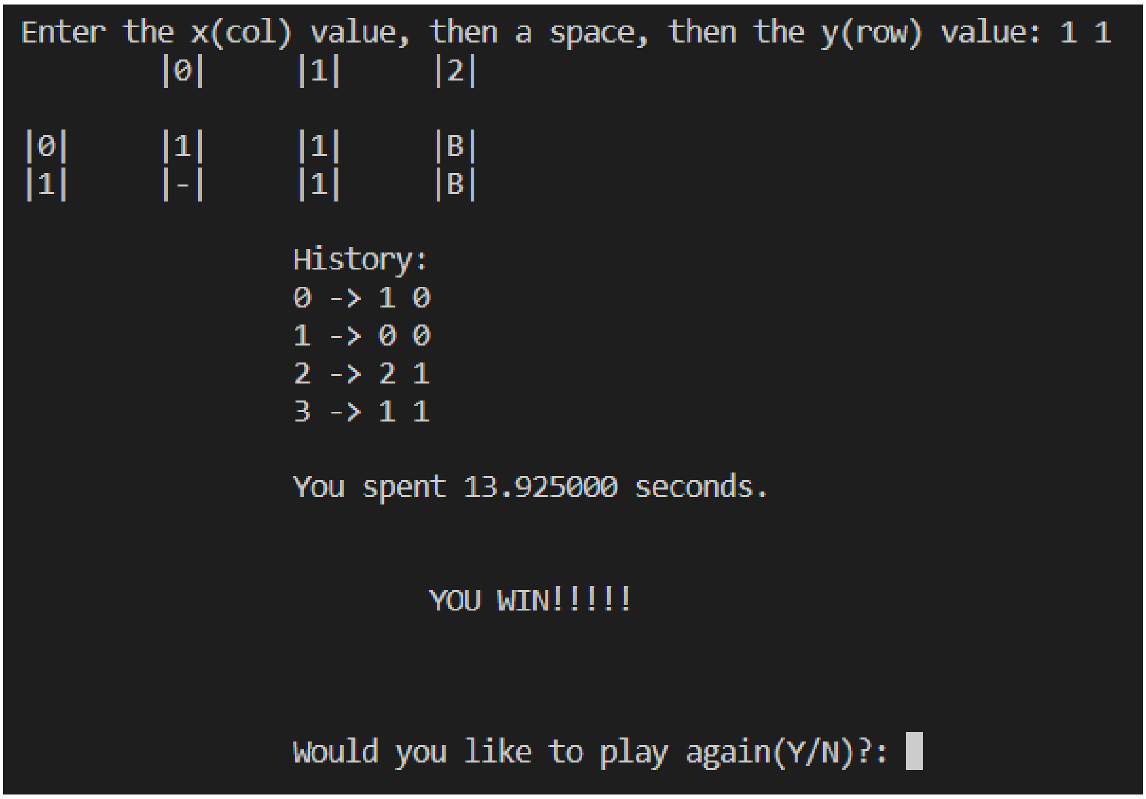


```
Enter the x(col) value, then a space, then the y(row) value: 1 0
        |0|     |1|     |2|

|0|     |-|     |1|     |-|
|1|     |-|     |-|     |-|

Enter the x(col) value, then a space, then the y(row) value: 0 0
        |0|     |1|     |2|

|0|     |1|     |1|     |-|
|1|     |-|     |-|     |-|

Enter the x(col) value, then a space, then the y(row) value: 2 1
        |0|     |1|     |2|

|0|     |1|     |1|     |B|
|1|     |-|     |-|     |B|

Enter the x(col) value, then a space, then the y(row) value: 1 1
        |0|     |1|     |2|

|0|     |1|     |1|     |B|
|1|     |-|     |1|     |B|
```

直到找出所有非地雷的方格

輸出歷史記錄(玩家遊玩時輸入的行列數值)及玩家遊玩花費了多少時間(秒)

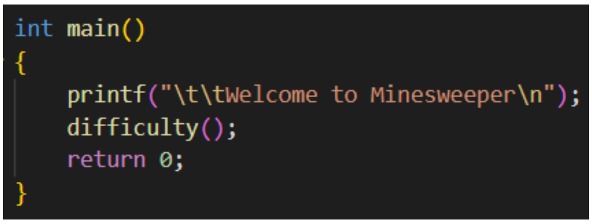
挑戰成功



```
Enter the x(col) value, then a space, then the y(row) value: 1 1
        |0|     |1|     |2|

|0|     |1|     |1|     |B|
|1|     |-|     |1|     |B|

                History:
                0 -> 1 0
                1 -> 0 0
                2 -> 2 1
                3 -> 1 1

                You spent 13.925000 seconds.


                        YOU WIN!!!!!



                Would you like to play again(Y/N)?: █
```

4. 分析

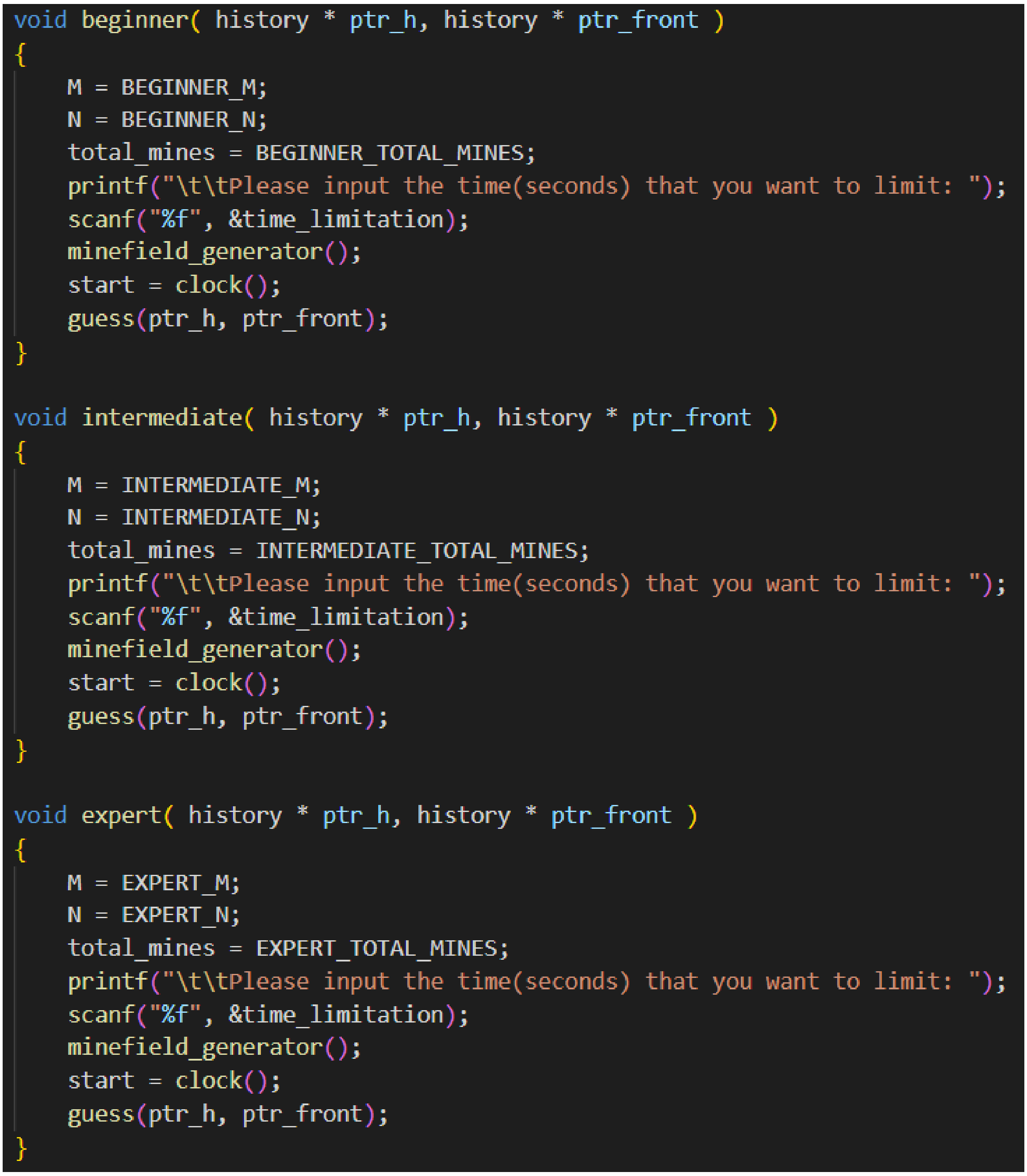
進入主程式後直接進行難易度的選擇



```
int main()
{
    printf("\t\tWelcome to Minesweeper\n");
    difficulty();
    return 0;
}
```

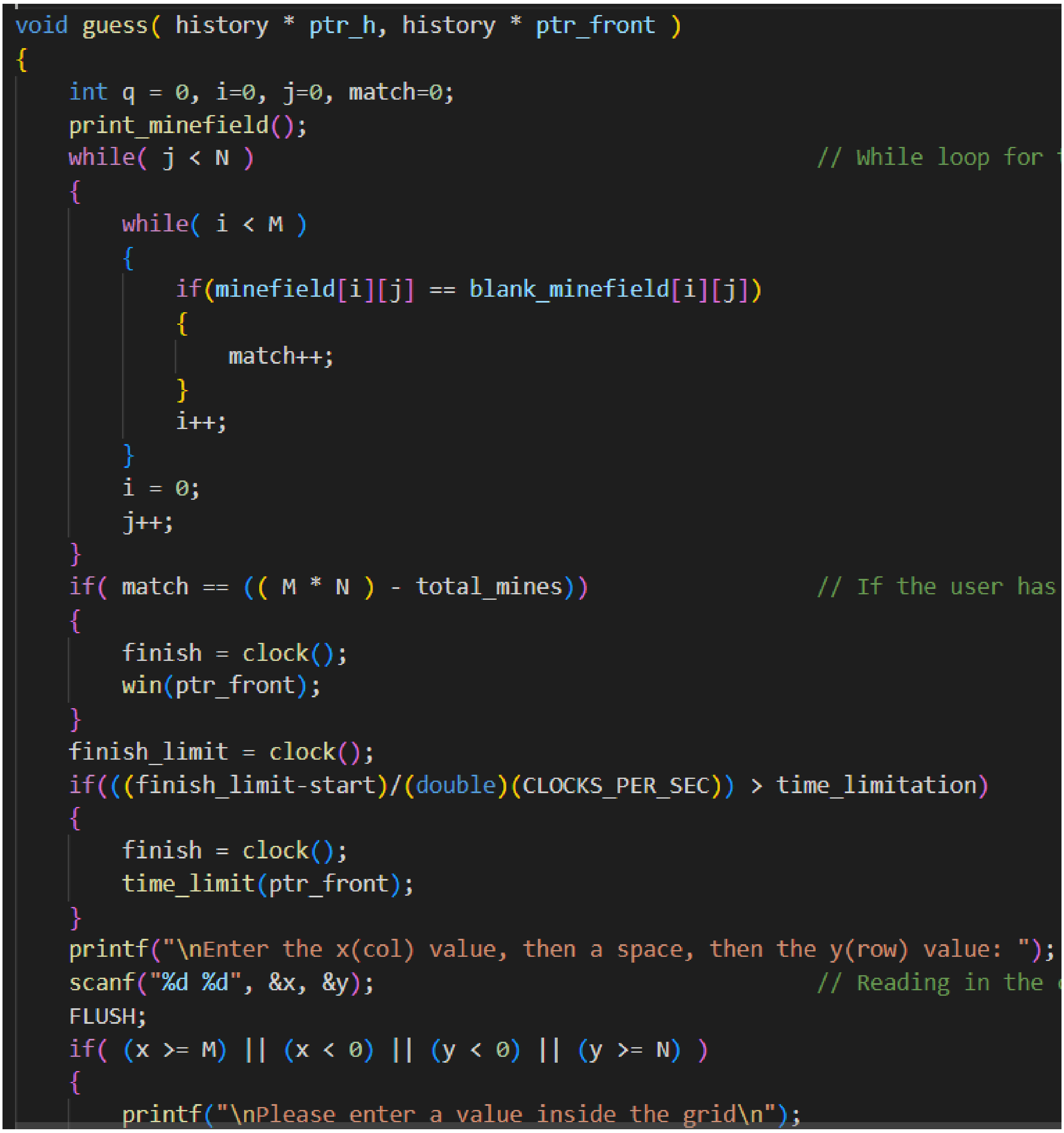
分別設定不同難易度的方格行列參數及地雷數量，並透過 minefield_generator 隨機在方格內產生地雷，將僅有地雷的陣列儲存於 final_minefield[][]陣列中，以及計算每個方格周圍的地雷數量，將其儲存至 minefield[][]陣列中

進入 guess 函式前，記錄開始時間 start

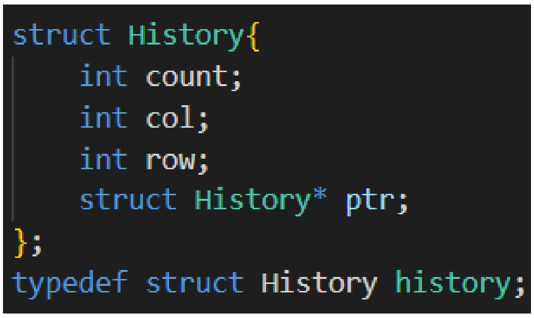


```
void beginner( history * ptr_h, history * ptr_front )
{
    M = BEGINNER_M;
    N = BEGINNER_N;
    total_mines = BEGINNER_TOTAL_MINES;
    printf("\t\tPlease input the time(seconds) that you want to limit: ");
    scanf("%f", &time_limitation);
    minefield_generator();
    start = clock();
    guess(ptr_h, ptr_front);
}

void intermediate( history * ptr_h, history * ptr_front )
{
    M = INTERMEDIATE_M;
    N = INTERMEDIATE_N;
    total_mines = INTERMEDIATE_TOTAL_MINES;
    printf("\t\tPlease input the time(seconds) that you want to limit: ");
    scanf("%f", &time_limitation);
    minefield_generator();
    start = clock();
    guess(ptr_h, ptr_front);
}

void expert( history * ptr_h, history * ptr_front )
{
    M = EXPERT_M;
    N = EXPERT_N;
    total_mines = EXPERT_TOTAL_MINES;
    printf("\t\tPlease input the time(seconds) that you want to limit: ");
    scanf("%f", &time_limitation);
    minefield_generator();
    start = clock();
    guess(ptr_h, ptr_front);
}
```

猜測非地雷的方格時，不斷更新 blank_minefield[][]陣列，以儲存玩家遊玩時的最新方格狀態
當行列值輸入正確時，將其儲存於 history.h 的 History struct 中，便於建立歷史記錄的 linked-list
遊戲結束時記錄結束時間 finish

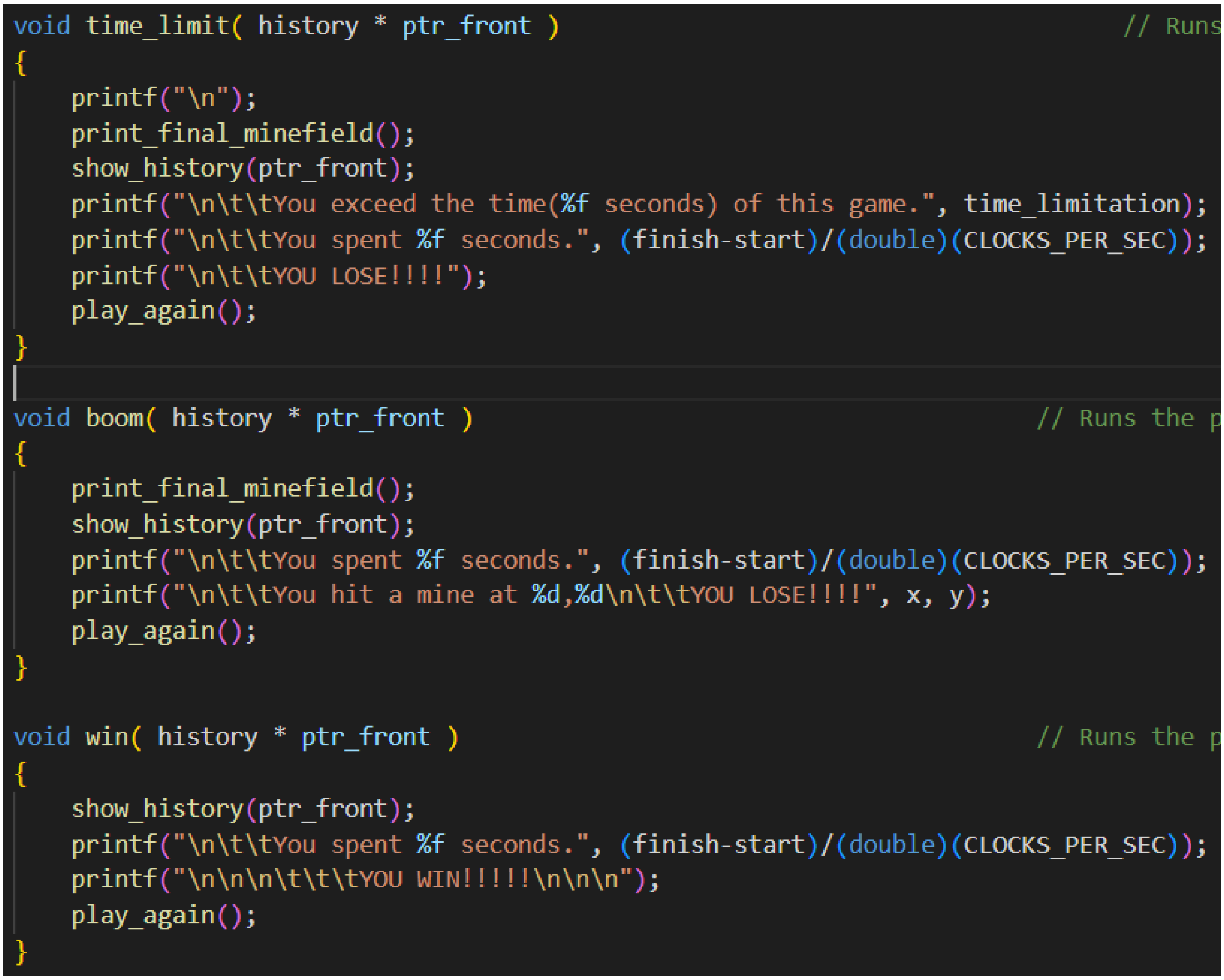


```
void guess( history * ptr_h, history * ptr_front )
{
    int q = 0, i=0, j=0, match=0;
    print_minefield();
    while( j < N )                                    // While loop for
    {
        while( i < M )
        {
            if(minefield[i][j] == blank_minefield[i][j])
            {
                match++;
            }
            i++;
        }
        i = 0;
        j++;
    }
    if( match == (( M * N ) - total_mines))           // If the user has
    {
        finish = clock();
        win(ptr_front);
    }
    finish_limit = clock();
    if(((finish_limit-start)/(double)(CLOCKS_PER_SEC)) > time_limitation)
    {
        finish = clock();
        time_limit(ptr_front);
    }
    printf("\nEnter the x(col) value, then a space, then the y(row) value: ");
    scanf("%d %d", &x, &y);                           // Reading in the
    FLUSH;
    if( (x >= M) || (x < 0) || (y < 0) || (y >= N) )
    {
        printf("\nPlease enter a value inside the grid\n");
```



```
struct History{
    int count;
    int col;
    int row;
    struct History* ptr;
};
typedef struct History history;
```

遊戲結束函式(超過破關時間、踩到地雷、破關成功)



```
void time_limit( history * ptr_front )                          // Runs
{
    printf("\n");
    print_final_minefield();
    show_history(ptr_front);
    printf("\n\t\tYou exceed the time(%f seconds) of this game.", time_limitation);
    printf("\n\t\tYou spent %f seconds.", (finish-start)/(double)(CLOCKS_PER_SEC));
    printf("\n\t\tYOU LOSE!!!!");
    play_again();
}

void boom( history * ptr_front )                          // Runs the p
{
    print_final_minefield();
    show_history(ptr_front);
    printf("\n\t\tYou spent %f seconds.", (finish-start)/(double)(CLOCKS_PER_SEC));
    printf("\n\t\tYou hit a mine at %d,%d\n\t\tYOU LOSE!!!!", x, y);
    play_again();
}

void win( history * ptr_front )                          // Runs the p
{
    show_history(ptr_front);
    printf("\n\t\tYou spent %f seconds.", (finish-start)/(double)(CLOCKS_PER_SEC));
    printf("\n\n\n\t\t\tYOU WIN!!!!!\n\n\n");
    play_again();
}
```

主要程式運行：