Sokoban Game User Guide

Number of Players: 1+

Software Requirement: CPUlator

October 16, 2024

Contents

Introduction

Sokoban is a classic puzzle game originally designed by Hiroyuki Imabayashi in 1981 and released in December 1982. The game challenges players to push boxes around a confined area, aiming to place them on designated target locations. Success requires strategic planning and precise moves, as a single misstep—like pushing a box into a corner or blocking the path for other boxes—can make the puzzle unsolvable, forcing players to backtrack or restart. Careful consideration of each move's consequences and the puzzle's overall layout is essential to avoid deadlocks and solve the challenge.

This version of Sokoban offers a flexible and customizable gameplay experience, allowing multiple players to participate. Players can adjust the board size, number of players, and the quantity of boxes for a tailored puzzle-solving adventure.

Game Setup

Running the Program

First, open [CPUlator RISC-V RV32 System Simulator (01xz.net)] in your browser, click **File** > **Open**, or use the hotkey **Ctrl+O**. A pop-up window will appear, allowing you to navigate to the *sokoban.s* file on your computer. Open it in CPUlator.

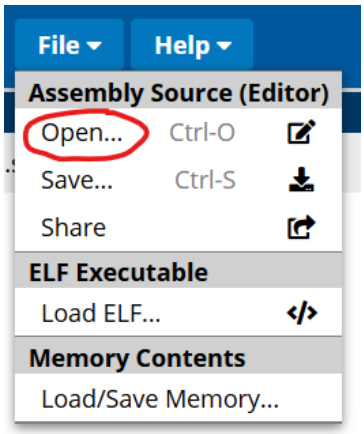

Figure 1 The button to open a file

If you successfully open the file, your editor should display the following screen.

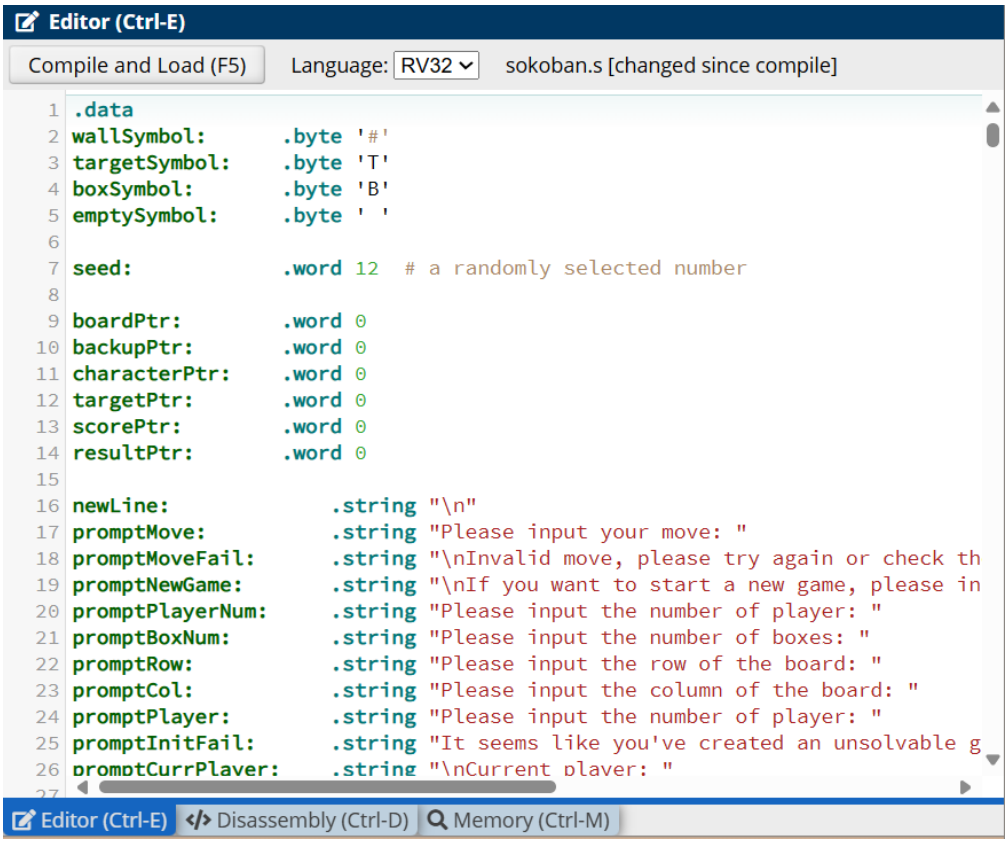

Figure 2 Screen displayed after opening the sokoban.s file

Then, click the "**Compile and Load (F5)**" button on the top of the editor window, or press "**F5**" on your keyboard. If you cannot find the button, try to click on the "**Editor(Ctrl+E)**" button at the button of your screen or use the hotkey **Ctrl+E** to switch to the editor window.

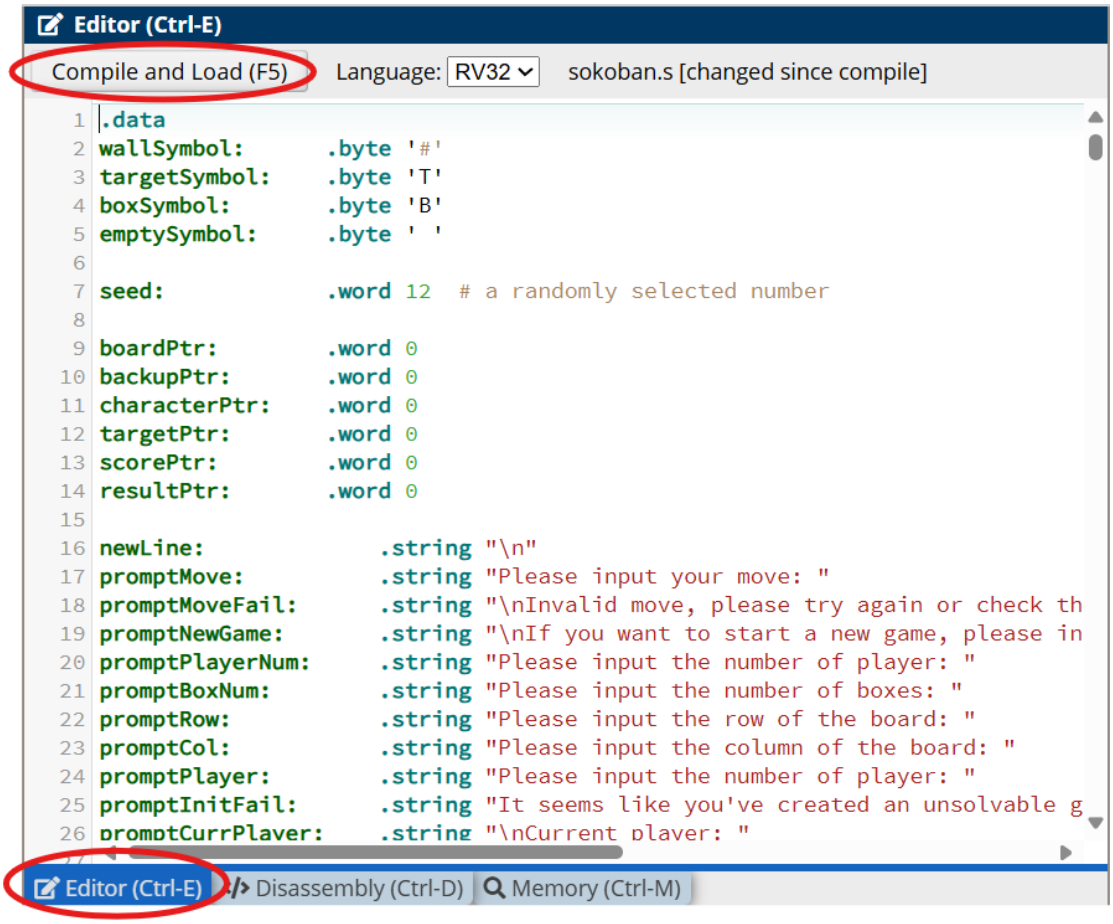

Figure 3 Buttons for compiling and loading the game

If the compile and load process is successful, you will see this message pop up in the Messages window.

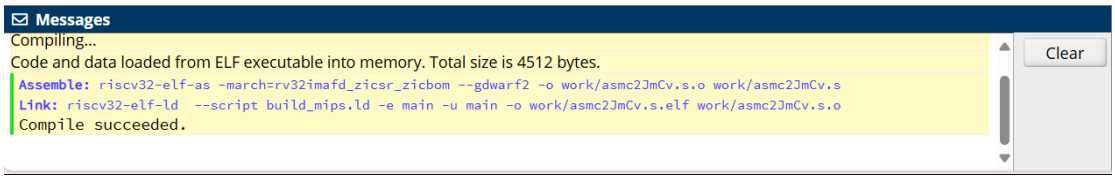

Figure 4 Message indicating successful compilation

Note that if you receive an error message stating "Compile failed", click **Stop (F4)** > **Restart (Ctrl+R)** > **Reload (Ctrl+Shift+L)**, then click on "**Compile and Load (F5)**" again.

After successfully compiling and loading the program, click the “Continue” button at the top of your screen, or press “**F3**” on your keyboard to start the game.

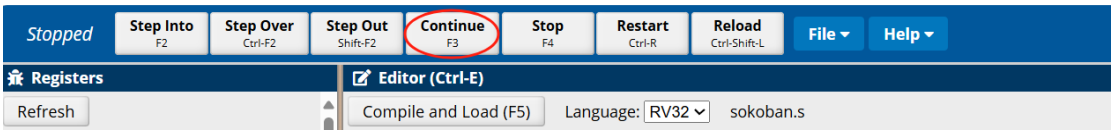

Figure 5 Continue button to start the game

On the right side of your screen, you should be able to find a **Terminal** window. Upon clicking the “**Continue (F3)**” button, the program will start running. Once the game starts running, CPUlator will switch to the **Disassembly** window. The tool bar at the top of your screen will change to green and will display “**Running**” in the upper left corner. If you see a prompt in the **Terminal** saying “Please input the row of the board: ” as shown below, you are now ready to play Sokoban.

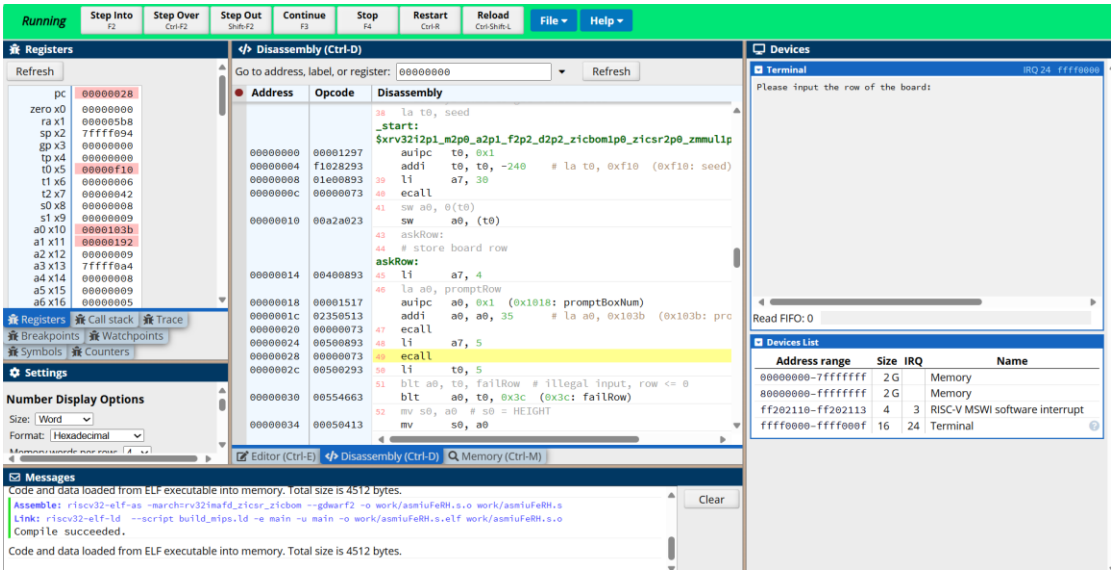

Figure 6 Screen displayed when the game starts running

Continue reading to learn more about the details of how to configure the game once the program begins running. If you encounter any problems, please refer to the **Troubleshooting** section at the end of the user guide to search for solutions.

Setting up the Game Board

To complete all settings, simply follow the instructions prompted in the **Terminal** to input all the information. After each input, make sure to press **Enter** on your keyboard to finish input. For example, the inputs **8** > **Enter** > **9** > **Enter** > **2** > **Enter** > **3** > **Enter** will create an 8×8 game board with 3 pairs of boxes and targets, playable by 2 players.

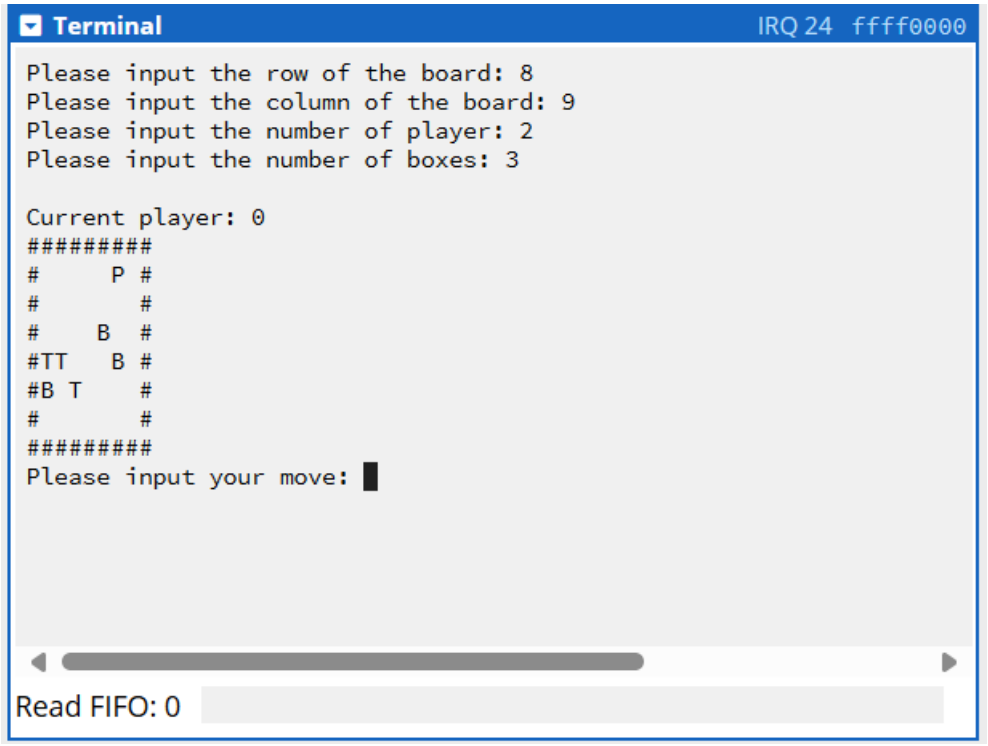

Figure 7 Example of custom game setup

If you would like to play alone, simply type **1** when the **Terminal** prompting "Please input the number of player: ", and press the **Enter**.

Note that the program will only accept positive whole number inputs (*excluding* 0). The *minimum* board size is 5×5; otherwise, the game will not be playable. Therefore, you should enter whole numbers that are greater than or equal to 5 for both the rows and columns of the board. It is recommended to use a larger game board (e.g., 8×8) to allow for more boxes and targets. If you input any other values, the **Terminal** will display an error message, and you can follow the instructions to input the correct information.

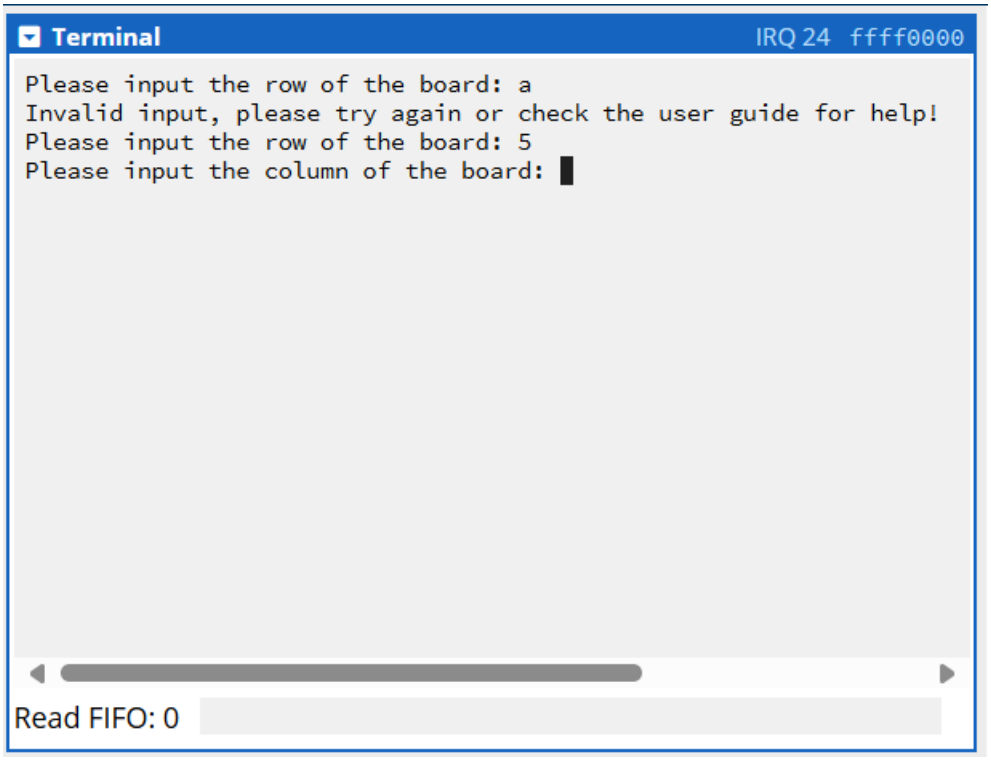

Figure 8 Example of inputting setup information

If you create an unsolvable game, the Terminal may freeze temporarily and prompt a message indicating that the game is not solvable. For instance, if you create a 5×5 board with 2 players and 13 boxes, but the board cannot accommodate that many boxes and targets, the game will automatically restart, and you will need to enter the information again as described above.

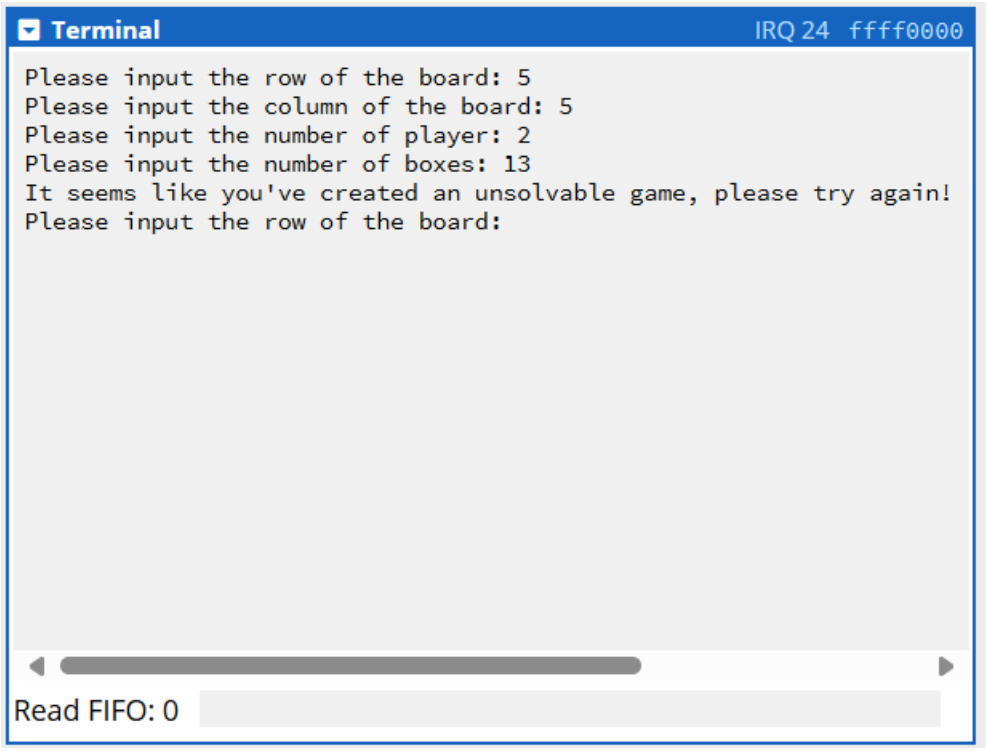

Figure 9 Example of invalid setup information

Once you have entered all the information, you are ready to play. The game will then generate a randomized puzzle, placing all the players, boxes, and targets on the game board. Note that this process may take some time if the boxes occupy a large portion of the board. You will see a square wrapped in "#" with some letters and numbers displayed in the Terminal. The meanings of these symbols will be explained in the **How to Play** section, so it is recommended to read through all sections of this user guide before starting the game. Read the next section to learn how to play simply with only five buttons.

How to Play

Game Key

The square area enclosed by the symbol "#" defines the game board. The meanings of the symbols are outlined in the table below. In this table, "#" signifies a wall, indicating a position that cannot be accessed. Within the game area, different letters denote various elements: "B" represents boxes, and "T" stands for targets. The symbol "P" represents a player, regardless of whether they are the first player, second player, or any other player. The remaining empty spaces are playable positions where players can move freely.

SYMBOL	REPRESENTATION
#	Wall
B	Box
T	Target
P	Player
<space>	Free position

Table 1 Description of each symbol's meaning

It is important to note that throughout the game, the target, box, and player can only occupy one free position at a time. For instance, a player can stand on a target at certain moments during the game. In this case, both the player and the target share the same position, causing the player's symbol "**P**" to temporarily cover the target's symbol "**T**." Once the player moves away, meaning they are no longer in the same position as the target, the symbol "**T**" will reappear in its original position. A similar scenario occurs when a box is pushed onto a target. However, the player will not cover the display of the box, and the target will not obscure the player or the box.

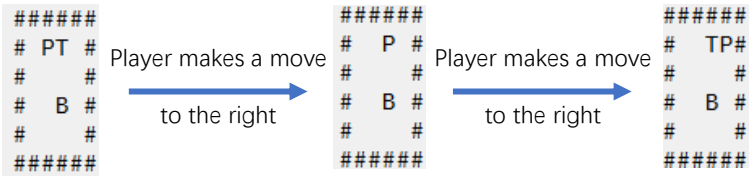

Figure 10 Example of a player covering a target

Making a Move

A "**move**" is when a player shifts from one free position to another, the player will be located on the next free position after the move is made. A move may only be by moving up, down, left, or right to an adjacent position of the player's current position (represented by the symbol "**P**"); diagonal movements are not permitted. These moves are executed by pressing the "**w**", "**a**", "**s**" or "**d**" keys on the keyboard, where "**w**" corresponds to moving up, "**a**" corresponds to moving left, "**s**" corresponds to moving down, and "**d**" corresponds to moving right..

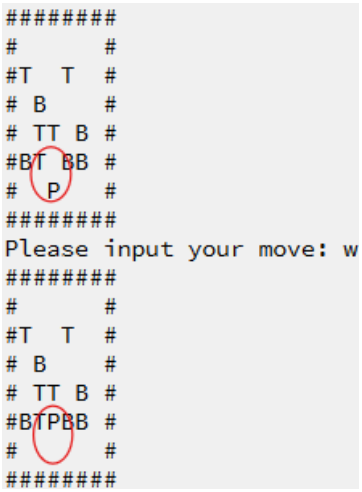

Figure 12 Example of player moving upwards

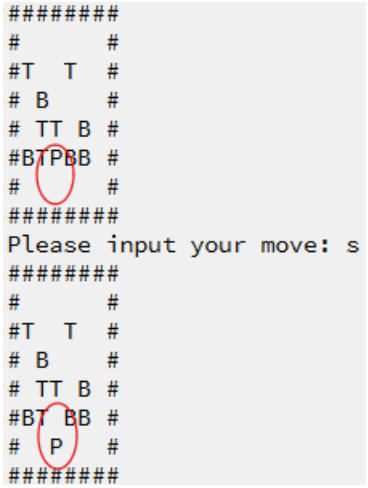

Figure 11 Exampe of player moving downwards

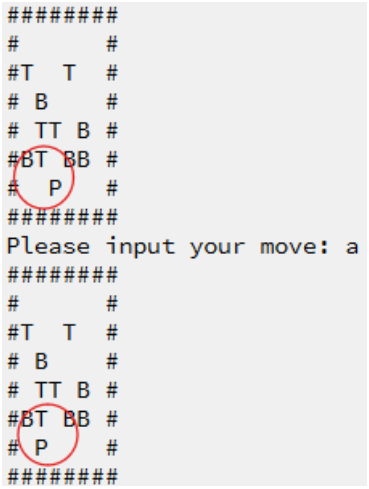

Figure 14 Example of player moving left

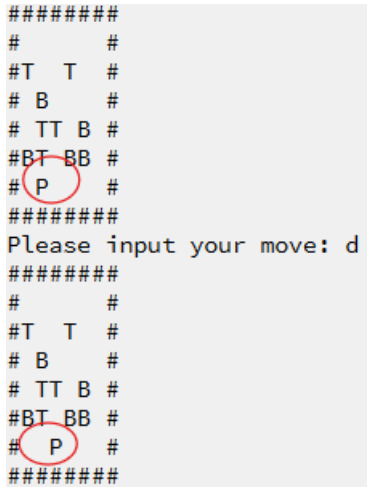

Figure 13 Example of player moving right

Note that only the four letters "**w**", "**a**", "**s**" and "**d**" are accepted. The move is identified as invalid when a player is moved to a wall or a box is pushed to an adjacent box or a wall. When a player makes an invalid move or invalid input, the **Terminal** will show a prompt as below. In this situation, simply enter a valid move to continue playing.

```
Please input your move: s
Invalid move, please try again or check the user guide for help!
Please input your move: x
Invalid move, please try again or check the user guide for help!
Please input your move:
```

Figure 15 Example of invalid move

Pushing the Box

A player may "**push**" a box simply by moving toward it. For example, if a box is positioned directly to the left of the player, the player can push the box one position to the right by making a move to the left. As a result, the player will then occupy the position that the box occupied before it was pushed, as demonstrated below.

```
########
#      #
#T  T  #
# B    #
# TT BP#
#BT BB #
#      #
########
Please input your move: a
########
#      #
#T  T  #
# B    #
# TTBP #
#BT BB #
#      #
########
```

Figure 16 Example of player pushing a box

Multiplayer Mode

You may choose to play the game with several of your friends in a competitive mode. Each of you, as a player, will solve the same puzzle separately. Each player has a unique number, starting with 0.

Player's Turns

A "**turn**" of the game is when one player attempts to solve a puzzle. Each player gets exactly one turn per game, each turn supports an unlimited number of moves to solve that turn's puzzle.

For instance, in a game of two players, there will be exactly two turns in a game. Player 0 plays their turn first, followed by Player 1 working on the same puzzle to finish their turn. There will be a prompt to indicating when a player's turn is end and when a player's turn starts.

```
######
#    #
#P   #
#B   #
#    #
######
Congratulation! You have finished the puzzle!


Current player: 1
######
#    #
# B  #
#T   #
# P  #
######
Please input your move:
```

Figure 17 Message indicating the switch to the next player

A player's turn ends when they solve the puzzle. A game is end after all of the player have finished their turns. The **Terminal** will prompt "Congratulation! You have solved the puzzle!" when a turn is end.

If the game is being played in a single player, a turn and a game will begin and end at the same time as there is only one player playing the game.

Solving the Puzzle

A player may take as much time as needed and make an unlimited number of moves to solve the puzzle. A puzzle is considered solved when all the boxes have been pushed onto the designated targets, meaning every target is covered by a box. In other words, each box must be positioned so that it occupies the same playable area as a target to complete the puzzle. Boxes can be pushed onto targets from any direction. The figure below visually illustrates the various methods by which a puzzle can be solved.

Starting Over

A player may choose to replay the puzzle at any time by pressing "**r**" before making a move. For instance, if a player accidentally pushes a box into a corner, rendering it immovable and not positioned on a target, the game will become stuck, making it impossible to complete. In this situation, the player has effectively failed the puzzle, but they may choose to reset the game by pressing "**r**" to replay the puzzle.

```
Please input your move: w
######
#B   #
#P   #
#T   #
#    #
######
Please input your move: w
Invalid move, please try again or check the user guide for help!
Please input your move: r
Current player: 1
######
#    #
# B  #
#T   #
# P  #
######
Please input your move:
```

Figure 18 Example of restarting the current puzzle

Keeping Score

The game will track how many moves each player makes to solve the puzzle. The **cumulative standing** indicates sum of *all* moves (excluding the invalid moves) a player has made in their turn. After a game had end, there will be a **scoreboard** displaying the cumulative standings of each player in an increasing order.

```
----------Score Board----------
Player 1: 6
Player 0: 10
```

Figure 19 Example of a scoreboard

Winning the Game

The game is over when the final player completes their turn. A player wins if they have made the *fewest* moves compared to the other players. The player with the second-fewest moves will take second place, followed by the player with the third-fewest moves in third place, and so forth.

In a single-player game, there are no competitors, so the focus is solely on the player striving to achieve the lowest number of moves possible.

Restarting the Game

When a game is end, a prompt is shown as below. Players may choose to start a new game by pressing "**r**" on the keyboard or quit the game by pressing any key other than "**r**".

```
If you want to start a new game, please input 'r';
if you want to quit, please input any other letter:
```

Figure 20 Example of starting a new game

To restart after you quit the game, simply click **Stop (F4)** > **Restart (Ctrl+R)** > **Reload (Ctrl+Shift+L)** > **Continue (F3)**.

Figure 21 Steps to restart the game after quitting

Troubleshooting

If the game stops running or there is an issue at any point, simply click **Stop (F4)** > **Restart (Ctrl+R)** > **Reload (Ctrl+Shift+L)** > **Continue (F3)**. Note that this brief process will also need to be done to restart the game once it is complete.

Figure 22 Steps to resolve unexpected game behaviour

Otherwise, if the above set of buttons does not work, click "**Compile and Load (F5)**" and then try **Stop (F4)** > **Restart (Ctrl+R)** > **Reload (Ctrl+Shift+L)** > **Continue (F3)** again.

Figure 23 Another method to resolve unexpected game behaviour

You may also try reopening the file and following the steps in the Game Setup section.