SOKOBAN – WAREHOUSE KEEPER

A User Guide to a Sokoban Implementation

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Welcome

Welcome to your new favorite game! You are a warehouse keeper hard at work!

How To Start

You will be playing this game in a RISC-V simulator. Open a web browser of your choice and visit the link provided for the RISC-V simulator. Additionally, you will need to download the separate file provided, ‘Sokoban Implementation.s’. Ensure you are able to navigate to this file after downloading for the next steps.

Once you have completed the steps above, click on the ‘File’ button located in the top bar. Navigate and click on the ‘Open…’ option in the dropdown under the ‘File’ button (Figure 1). Clicking on ‘Open…’ will launch your File Explorer. Navigate to the ‘Sokoban Implementation.s’ file you previously downloaded, and open the file.

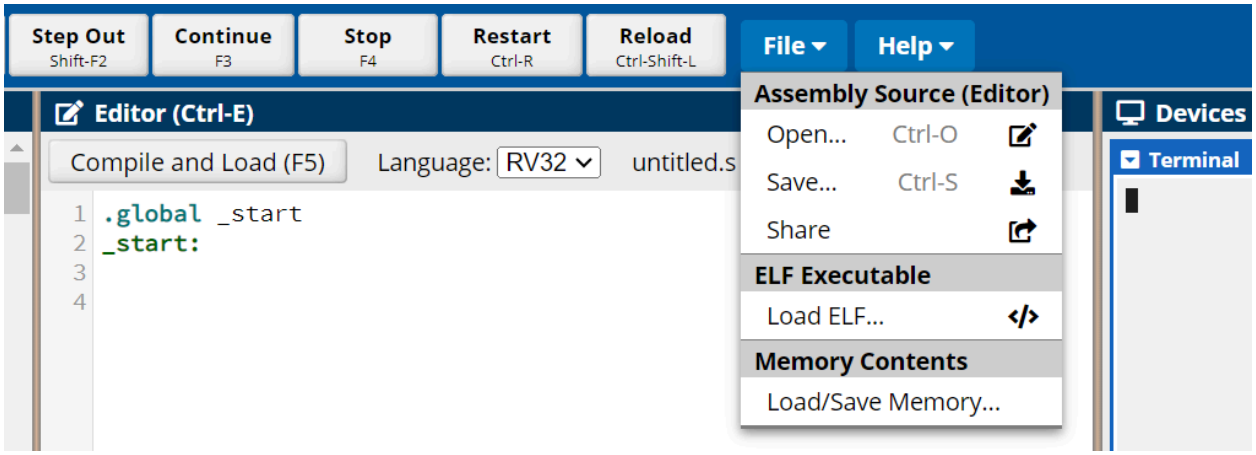

Figure 1. Navigating to the ‘File’ and ‘Open’ Menu to open Sokoban on the Simulator

Now, you will have the Sokoban implementation open on the RISC-V simulator. The next step is to click on the ‘Compile and Load’ button (Figure 2). The function of this button is

to take the written code and translate it into a language that the computer is able to understand in order for the Sokoban game to run. Finally, to finish setting up your Sokoban game, click on the 'Continue' button shown below.

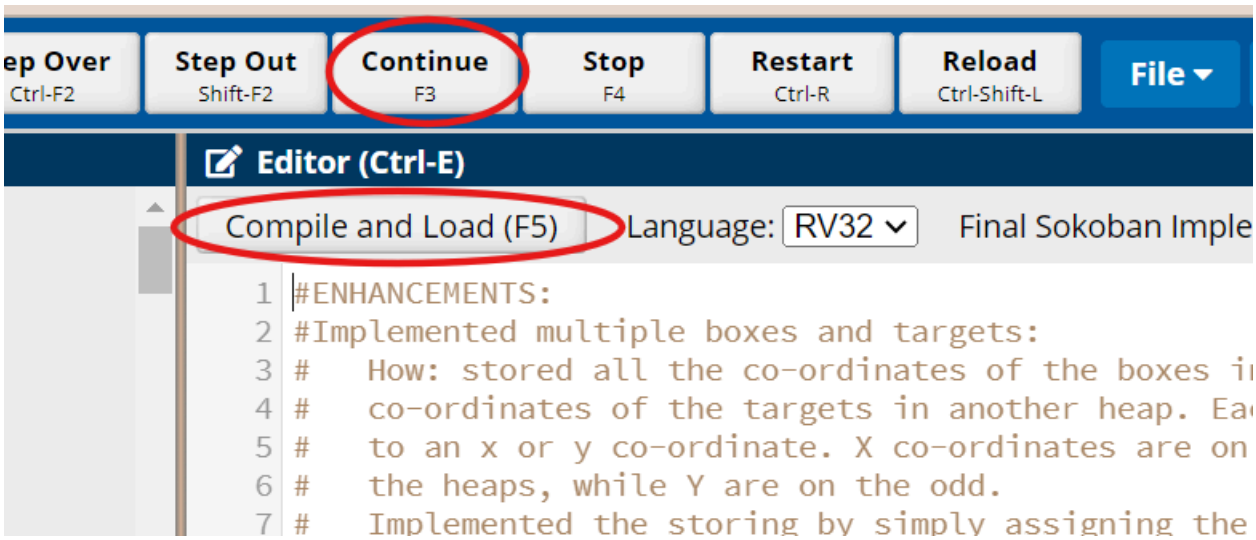

Figure 2. Click (1) 'Compile and Load' before clicking (2) 'Continue' button.

On the right hand side of your screen is a terminal. This is where you will be playing your Sokoban game. In order to engage with your game, ensure that you click on the Terminal box and a cursor is **blinking** (Figure 3). After clicking the 'Continue' button, the terminal will prompt you with the following question; "Would you like to change the number of boxes and targets (y/n)?".

The original implementation of Sokoban has the number of boxes set as 1. However, you are able to change this amount by clicking the letter 'y' on your keyboard. Clicking the letter 'y' will cause another prompt to appear on the terminal, "Please state how many boxes you would like:". Type the number of boxes you would like to appear on your game board and click the return key on your keyboard. The maximum number of boxes that are allowed in this Sokoban implementation is 255.

WARNING: Even after staying under the maximum, if the number of boxes is too large to produce a solvable Sokoban board, the game may not work. Please navigate to the Common Issues section to solve this issue.

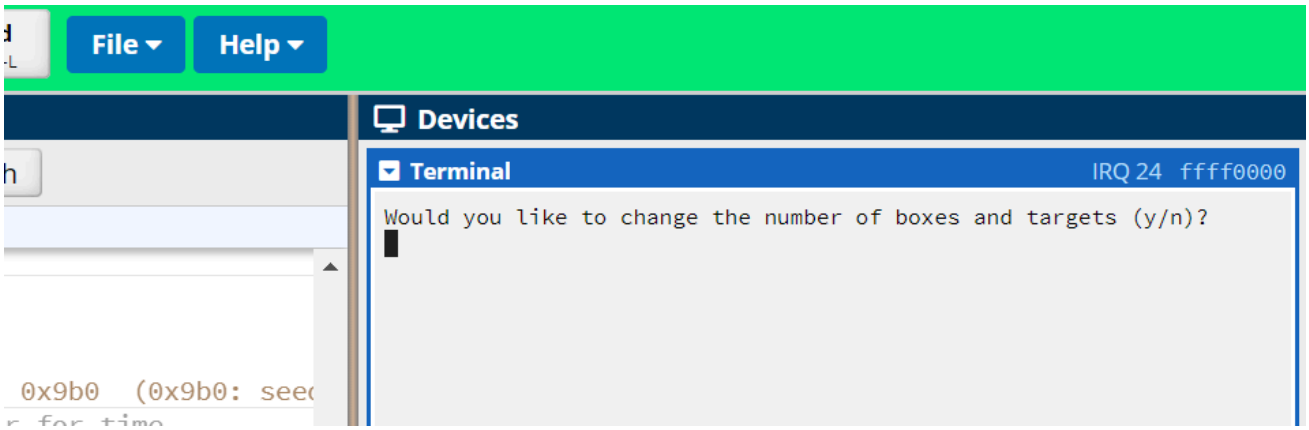

Figure 3. Demonstrating how the Terminal looks after the user sets it up, along with the starting prompt and cursor.

Note, the original implementation of Sokoban also has the board size set as default 8 x 8 (width x length) which does not include the walls. You can change the default width and length by navigating to the “gridsize” value on line 21 in the code, as shown below. Follow the modifications to grid size by clicking the ‘Compile and Load’ button, followed by the ‘Continue’ button (Figure 2). Please note, the maximum width or length of the grid size is 255.

```
14 #    in heap.
15
16
17
18
19 .data
20 seed:          .word 0x12345678
21 gridsize:      .byte 8,8
22 character:     .byte 0,0
23 box:           .byte 0,0
24 target:        .byte 0,0
```

Figure 4. Navigate to ‘gridsize’ to change the size of the Sokoban board. Grid size is in format width, length

Alternatively, you can play with the original Sokoban implementation without any modifications. To do so, simply click the ‘n’ key on your keyboard when prompted with the question “Would you like to change the number of boxes and targets (y/n)?” in the beginning.

You have now set the Sokoban board size and number of boxes and targets to your preference (See Figure 5. for an example of your Terminal view). The Sokoban implementation will now generate a solvable game with random initial locations for the character, boxes and targets. You are ready to play the game!

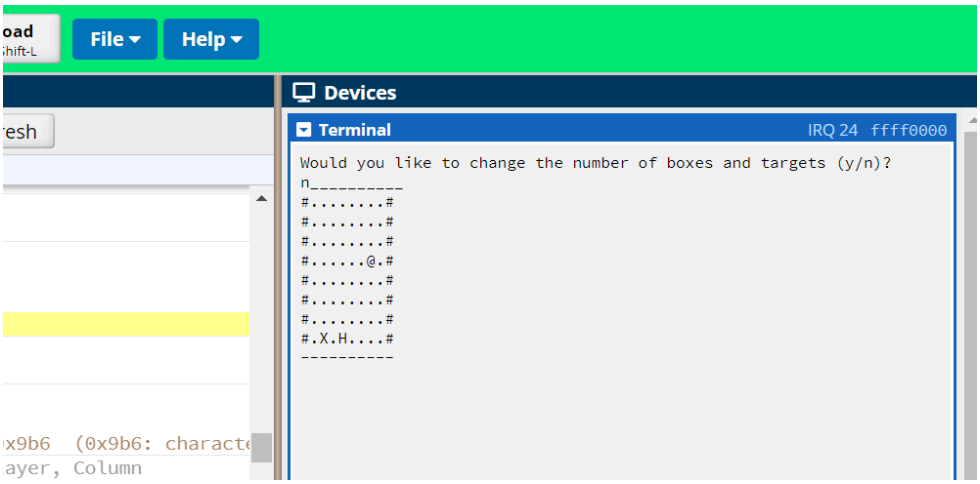

Figure 5. If the ‘n’ key is pressed on the keyboard for modifying the number of boxes, the above is an example of what your board might look like. Note: All Sokoban board’s have randomized locations for character, boxes and targets.

Gameplay

Understanding the Sokoban Board

Once you have configured your board, it will be displayed on the terminal (Figure 5 above). The symbols on the Sokoban board represent the following:

- The symbol, '**@**' is your character (Figure 6).
- The empty spaces on the Sokoban board are represented by the symbol '**.**'.
- 'H' represents the boxes that your character is able to push
- 'X' represents the target spaces that must be filled by all the boxes in order to win the game.
- Lastly, the two symbols '-' and '#' represent the walls of your Sokoban board. Both your character and the boxes cannot move beyond these walls, ensuring that all actions remain within the confines of the board

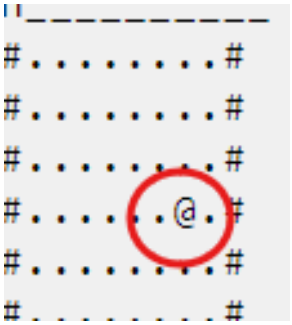

Figure 6. The symbol that represents the user on the board, with walls as the outline of the game board.

How to Play

In order to play the game, you can move in only four directions: left, right, up, and down. To make a valid move with your character, click the following keys on your keyboard:

- '**w**': Moves the character up within the bounds of the board walls. If there is a single box directly above the character, pressing 'w' will cause the character to push the box up within the bounds of the board as well.
- '**a**': Moves the character left within the bounds of the board walls. If there is a single box directly to the left of the character, pressing 'a' will cause the character to push the box left within the bounds of the board as well.
- '**s**': Moves the character down within the bounds of the board walls. If there is a single box directly below the character, pressing 's' will cause the character to push the box down within the bounds of the board as well.
- '**d**': Moves the character to the right within the bounds of the board walls. If there is a single box directly to the right of the character, pressing 'd' will cause the character to push the box right within the bounds of the board as well.

While your character can push boxes, certain limitations apply, You cannot pull boxes, and you are only able to push one box at a time. Furthermore, boxes cannot be pushed outside the boundaries defined by the walls of the Sokoban board. If you do attempt to make any of these moves, the terminal will not create any changes to your Sokoban board. Instead, the terminal will wait for you to make any one of the valid moves in order to make changes to the board.

If you wish to restart the game, click on the 'r' key on your keyboard. Alternatively, you can click the 'Restart' button on the RISC-V simulator, followed by the 'Continue' button (Figure 7).

Regardless of what method you use to restart, the terminal will prompt you to configure the number of boxes if you wish, and display a newly randomized Sokoban board.

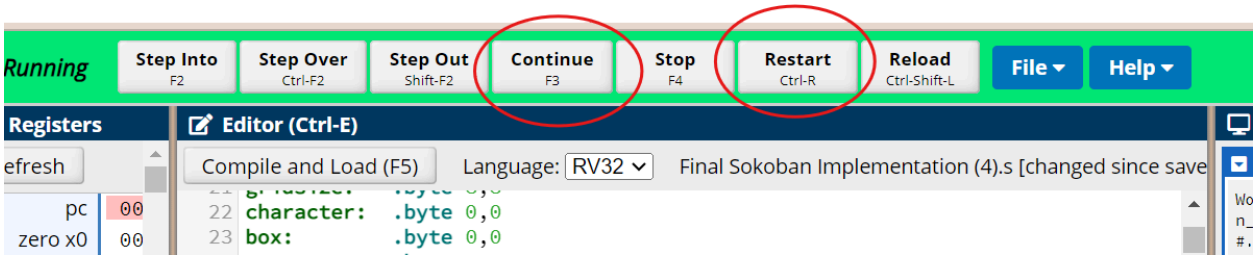

Figure 7. Demonstrates the 'Restart' and 'Continue' buttons that must be clicked to restart the Sokoban game.

If you wish to completely exit the game before you finish the puzzle, press the 'e' key on your keyboard. Note: In order to restart after exiting, please click the 'Restart' button, followed by the 'Continue' button. The 'r' key will no longer function as a restart button once you exit or complete the puzzle.

Completing the Puzzle

In order to complete the puzzle, you must push the boxes on the Sokoban board onto the target spots marked with 'X', until there are no targets remaining.

Meet Chibi! Look out for Chibi to know whether you have completed your puzzle (Figure 8). If you solve the Sokoban puzzle, Chibi will appear on your terminal and the game will stop.

Figure 8. Your Sokoban buddy, Chibi. Chibi appears when you complete a Sokoban puzzle.

Reminder: Once completing the puzzle, the ‘r’ key will not function as a reset button. In order to reset the Sokoban board to a new randomized board and modify configurations, please click the ‘Restart’ button followed by the ‘Continue’ button as shown previously in Figure 7.

Common Issues

1. The number of boxes the user decided to display is too large, causing the game to keep running. The Sokoban board will not display on the terminal. See Figure 9 for an example.

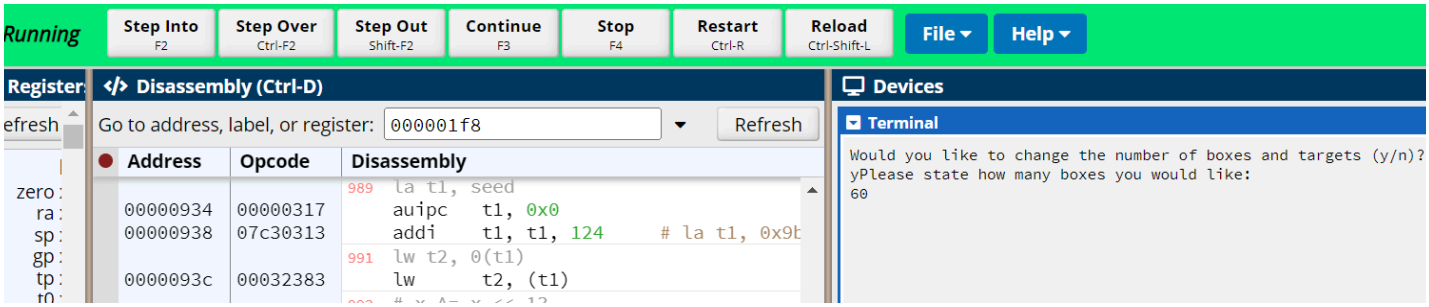

Figure 9. This example asks for 60 boxes on an 8x8 board game size.

In order to solve this issue, follow these steps in the order they are listed (see Figure 10 for reference):

a. Click on the ‘Stop’ button located at the top of the screen
b. Click on the ‘Restart’ button located at the top of the screen
c. Click on the ‘Continue’ button located at the top of the screen

Once you have followed the steps listed above, the terminal will display the question “Would you like to change the number of boxes and targets (y/n)?” once more. Please choose your modifications wisely.

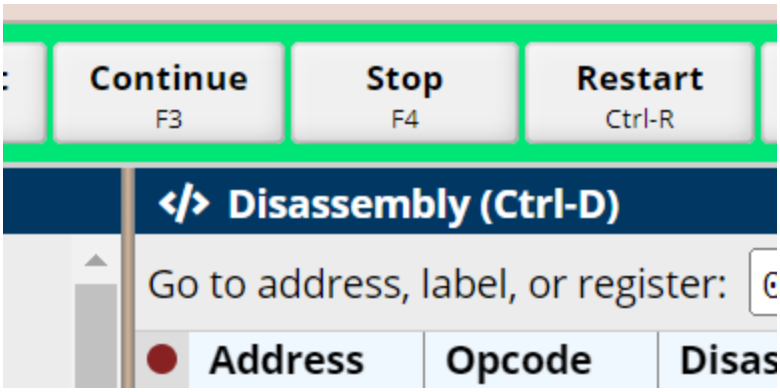

Figure 10. Click on the Stop, Restart and Continue buttons in the same order respectively.

2. The terminal is not responding to any valid key the user is pressing on the keyboard.

Solution: Ensure that you are able to see a cursor blinking on the terminal. If you do not see a cursor, tap on the terminal screen with your mouse or trackpad.

3. The terminal is displaying the wrong number of boxes or targets / The terminal is not displaying correctly.

Solution: Please follow the same steps that are outlined under the solution to the first issue in this section.

4. The board is being displayed on the terminal at a slow pace.

Solution: The cause of the issue is often that the user modified the board size to be too large. Unfortunately, there is no solution to this issue. If you would like the board to display faster, decreasing the board size is the only viable option. Remember to click the 'Compile and Load' button followed by the 'Continue' button every time you modify the board size.