# Outcome 3 Report

Class: 16SD

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## 1. Testing

### 1.1. Strategies

For the entire testing process, strategies used are unit testing, integration testing, white-box testing, and black-box testing.

As short code fragments created by programmers or occasionally by white box testers during the development process, unit testing is a software testing method by which individual units of source code, sets of one or more computer program modules together with associated control data, usage procedures, and operating procedures, are tested to determine whether they are fit for use.

White-box testing is another software testing method that tests internal structures or workings of an application. In white-box testing, an internal perspective of the system, as well as programming skills, are used to design test cases. It is a method at the level of the source code. These test cases are derived through the use of the design techniques mentioned above: control flow testing, data flow testing, branch testing, path testing, statement coverage and decision coverage as well as modified condition / decision coverage. White-box testing is the use of these techniques as guidelines to create an error-free environment by examining any fragile code. These white-box testing techniques are the building blocks of white-box testing, whose essence is the careful testing of the application at the source code level to prevent any hidden errors later on. These different techniques exercise every visible path of the source code to minimise errors and create an error-free environment. The whole point of white-box testing is the ability to know which line of the code is being executed and being able to identify what the correct output should be.

Black-box testing is a software testing method that examines the functionality of an application without peering into its internal structures or workings. Specific knowledge of the application's code, internal structure and programming knowledge in general is not required. The tester is aware of what the software is supposed to do but is not aware of how it does it. For instance, the tester is aware that a particular input returns a certain, invariable output but is not aware of how the software produces the output in the first place.

#### **1.2. Plans**

For unit testing, the tester will test each unit right after finishing developing a unit during the development process. For instance, whether the main frame is generated will

be tested just after coding the relevant unit.

For white-box testing, the tester will test each logic and function according to code. Testing items include loading the main frame with a game area, moving the tiny man, undoing a step, playing or stopping BGM, going to a specified level, and so on.

For black-box testing, a user will act as a tester and play the game Sokoban developed himself / herself to try to find any bug or bad using experience. The user is not familiar with code. He / she will test the program according to previous experience and functional requirements.

## **1.3.** Logs

As the tester, the entire testing process is recorded in the following logs.

#### 1.3.1. Test Log 1

Program name: Sokoban

onto

empty

(never through walls or

crates) according to the

Result Action **Expected** Actual Start the The main frame with a All have been executed as Pass menu bar, the game area, expected. The main frame, the program. the option game area, the option area and displays, and the window with the button "BGM ON" maximise has been shown in Picture cannot restore down. 1.3.1 - 1.The map of Level 1 is loaded in the game area with the info of "Level 1: Step 0". Default **BGM** Blue Danube starts to play. The text of the button controlling playing stopping BGM is "BGM ON", and the menu item Picture 1.3.1 - 1"Play BGM" in the menu Options is selected. Move the The tiny man moves The tiny man does not move as Fail tiny man. horizontally or vertically expected. Picture 1.3.1 – 2

Version: 1.0

squares

shows one example when the

player presses the LEFT key.

	<ul> <li>key that the player presses (UP, DOWN, LEFT, or RIGHT).</li> <li>The tiny man can also move into a crate, which pushes it into the square beyond.</li> <li>Crates may not be pushed into other crates or walls, and they cannot be pulled.</li> <li>The info of steps changes.</li> </ul>	Picture 1.3.1 - 2	
Undo steps.	<ul> <li>No matter the player presses Ctrl + Z, or clicks on the menu item "Undo" in the menu Options, or clicks on the button "Undo", the tiny man undoes a step, and the info of steps changes.</li> <li>If no step can be undone, display a notice.</li> </ul>	Owing to the failure of last action, this action cannot continue.	-
Replay the current level.	Reload the map of the current level.	Owing to the failure of last action, this action cannot continue.	-
Pass a level.	The puzzle is solved when all crates are at diamonds. A notice should be displayed for the player to choose whether to go to next level or not.	Owing to the failure of last action, this action cannot continue.	-
Go to last level.	<ul> <li>Load the map of last level.</li> <li>If the player is on Level 1, display an error message.</li> </ul>	Owing to the failure of last action, this action cannot continue.	-
Go to next level.	<ul> <li>Load the map of next level.</li> <li>If the player is on the final level, display an error message.</li> </ul>	Owing to the failure of last action, this action cannot continue.	-
Go to Level 1.	Load the map of Level 1.	Owing to the failure of last action, this action cannot continue.	-
Go to the final level.	Load the map of the final level.	Owing to the failure of last action, this action cannot continue.	-

Go to a level selected.	<ul> <li>Load the map of the level selected.</li> <li>An error message should be displayed for any invalid input.</li> </ul>	Owing to the failure of last action, this action cannot continue.	-
Click on the menu item "Play BGM" in the menu Options.	<ul> <li>Originally, it is selected because BGM Blue Danube will be played as soon as the program is started. After clicking, it is not selected.</li> <li>The text of the button controlling playing or stopping BGM is "BGM OFF".</li> <li>BGM is stopped.</li> </ul>	Owing to the failure of last action, this action cannot continue.	
Click on the button "BGM OFF" in the option area.	<ul> <li>The text of it is "BGM ON".</li> <li>The menu item "Play BGM" in the menu Options is selected, and BGM is played.</li> </ul>	Owing to the failure of last action, this action cannot continue.	-
Click on the button "BGM ON" in the option area.	<ul> <li>The text of it is "BGM OFF".</li> <li>The menu item "Play BGM" in the menu Options is not selected, and BGM is stopped.</li> </ul>	Owing to the failure of last action, this action cannot continue.	-
Select BGM Courage.	BGM Courage is played.	Owing to the failure of last action, this action cannot continue.	-
Select BGM Luster.	BGM Luster is played.	Owing to the failure of last action, this action cannot continue.	-
Select BGM Ten Years.	BGM Ten Years is played.	Owing to the failure of last action, this action cannot continue.	_
Select BGM Titanic.	BGM Titanic is played.	Owing to the failure of last action, this action cannot continue.	-
Select BGM Blue Danube.	BGM Blue Danube is played.	Owing to the failure of last action, this action cannot continue.	-

Listen to	BGM will not be changed	Owing to the failure of last -
BGM.	unless the player changes it.	action, this action cannot
		continue.
Click on	A frame containing help	Owing to the failure of last -
the menu	contents is displayed.	action, this action cannot
item		continue.
"Help		
Contents"		
in the		
menu		
Help.		
Click on	A frame containing some	Owing to the failure of last -
the menu	basic info of the program is	action, this action cannot
item	displayed.	continue.
"About		
Sokoban"		
in the		
menu		
Help.		
Exit the	A notice is displayed to ask for	Owing to the failure of last -
program.	confirmation.	action, this action cannot
		continue.
		Final result: Fail

After carefully debugging, it is found that wrong match between "i", "j" and "x", "y" appears in "GameArea.java". This causes that the map shown is rotated, while the tiny man tries to move on the correct map, which leads to the abnormity of the function of moving the tiny man.

The original relevant code in method paint() of "GameArea.java" is:

```
\begin{split} &\text{for (int } i=0; \ i<20; \ i++) \\ &\text{for (int } j=0; \ j<20; \ j++) \\ &\text{g.drawImage(mapElements[mapData[i][j]], } i * 30, \ j * 30, \ this); \end{split}
```

To fix the bug, code should be changed to:

```
\begin{split} &\text{for (int } i=0; \ i<20; \ i++) \\ &\text{for (int } j=0; \ j<20; \ j++) \\ &\text{g.drawImage(mapElements[mapData[j][i]], } i * 30, \ j * 30, \ this); \end{split}
```

# 1.3.2. Test Log 2

Program nar	ne: Sokoban	Ver	rsion: 2.0
Action	Expected	Actual	Result
Start the program.	<ul> <li>The main frame with a menu bar, the game area, and the option area displays, and the window cannot maximise or restore down.</li> <li>The map of Level 1 is loaded in the game area with the info of "Level 1; Step 0".</li> <li>Default BGM Blue Danube starts to play. The text of the button controlling playing or stopping BGM is "BGM ON", and the menu item "Play BGM" in the menu</li> </ul>	All have been executed as expected. The main frame, the game area, the option area with the button "BGM ON" has been shown in Picture 1.3.2 – 1.	Pass
Move the tiny man.	<ul> <li>Options is selected.</li> <li>The tiny man moves horizontally or vertically onto empty squares (never through walls or crates) according to the key that the player presses (UP, DOWN, LEFT, or RIGHT).</li> <li>The tiny man can also move into a crate, which pushes it into the square beyond.</li> <li>Crates may not be pushed into other crates or walls, and they cannot be pulled.</li> <li>The info of steps changes.</li> </ul>	All have been executed as expected. Picture 1.3.2 – 2 indicates one example.  Picture 1.3.2 – 2	Pass
Undo steps.	No matter the player presses Ctrl + Z, or clicks on the menu item "Undo"	Most are as expected. However, regulations are broken when the player tries to	Fail

	in the menu Options, or	undo steps after going to next	
	clicks on the button	level. Picture 1.3.2 – 3 displays	
	"Undo", the tiny man	one example.	
	<ul> <li>undoes a step, and the info of steps changes.</li> <li>If no step can be undone, display a notice.</li> </ul>		
		Picture 1.3.2 – 3	
Replay	Reload the map of the current	Owing to the failure of last -	•
the	level.	action, this action cannot	
current		continue.	
level.			
Pass a	The puzzle is solved when all	Owing to the failure of last -	-
level.	crates are at diamonds. A	action, this action cannot	
	notice should be displayed for	continue.	
	the player to choose whether		
C + 1 +	to go to next level or not.		
Go to last	• Load the map of last	Owing to the failure of last -	•
level.	level.	action, this action cannot	
	• If the player is on Level	continue.	
	1, display an error		
Go to	<ul><li>message.</li><li>Load the map of next</li></ul>	Owing to the failure of last -	
next	level.	action, this action cannot	
level.	• If the player is on the	continue.	
10 ( 01.	final level, display an	Continue.	
	error message.		
Go to		Owing to the failure of last -	
Level 1.	•	action, this action cannot	
		continue.	
Go to the	Load the map of the final	Owing to the failure of last -	-
final	level.	action, this action cannot	
level.		continue.	
Go to a	• Load the map of the level	Owing to the failure of last -	-
level	selected.	action, this action cannot	
selected.	• An error message should	continue.	
	be displayed for any		
	invalid input.		
Click on	• Originally, it is selected	Owing to the failure of last -	-
the menu	because BGM Blue	action, this action cannot	
item	Danube will be played as	continue.	

"Play	soon as the program is		
BGM" in	started. After clicking, it		
the menu	is not selected.		
Options.	• The text of the button		
	controlling playing or		
	stopping BGM is "BGM		
	OFF".		
	• BGM is stopped.		
Click on	• The text of it is "BGM	Owing to the failure of last	-
the button	ON".	action, this action cannot	
"BGM	• The menu item "Play	continue.	
OFF" in	BGM" in the menu		
the option	Options is selected, and		
area.	BGM is played.		
Click on	• The text of it is "BGM	Owing to the failure of last	-
the button	OFF".	action, this action cannot	
"BGM	• The menu item "Play	continue.	
ON" in	BGM" in the menu		
the option	Options is not selected,		
area.	and BGM is stopped.		
Select	BGM Courage is played.	Owing to the failure of last	-
BGM		action, this action cannot	
Courage.		continue.	
Select	BGM Luster is played.	Owing to the failure of last	-
BGM		action, this action cannot	
Luster.		continue.	
Select	BGM Ten Years is played.	Owing to the failure of last	-
BGM Ten		action, this action cannot	
Years.		continue.	
Select	BGM Titanic is played.	Owing to the failure of last	-
BGM		action, this action cannot	
Titanic.		continue.	
Select	BGM Blue Danube is played.	Owing to the failure of last	-
BGM		action, this action cannot	
Blue		continue.	
Danube.			
Listen to	BGM will not be changed	Owing to the failure of last	-
BGM.	unless the player changes it.	action, this action cannot continue.	
Click on	A frame containing help	Owing to the failure of last	
the menu	contents is displayed.	action, this action cannot	-
item	contents is displayed.	continue.	
		Continue.	
"Help			
Contents"			

in the		
menu		
Help.		
Click on	A frame containing some	Owing to the failure of last -
the menu	basic info of the program is	action, this action cannot
item	displayed.	continue.
"About		
Sokoban"		
in the		
menu		
Help.		
Exit the	A notice is displayed to ask	Owing to the failure of last -
program.	for confirmation.	action, this action cannot
		continue.
		Final result: Fail

Debugging results show that the program has failed to call a specified method to clear undoing records. The mistake is located in "GameArea.java". This causes that there are still undoing records of last level after loading and painting the map of the current level, which leads to the abnormity of the function of undoing steps after going to next level.

The original relevant code in method loadGameArea() of "GameArea.java" is:

```
map = new MapLoader(level);
tempMap = new MapLoader(level);
```

mapData = map.getMap(); // call the specified method in class MapLoader to get the map of a specified level

manX = map.getManX(); // call the specified method in class MapLoader to get X of the tiny man in the map

manY = map.getManY(); // call the specified method in class MapLoader to get Y of the tiny man in the map

tempMapData = tempMap.getMap(); // call the specified method in class MapLoader to get the map of a specified level repaint();

To fix the bug, code should be changed to:

```
map = new MapLoader(level);
```

tempMap = new MapLoader(level);

mapData = map.getMap(); // call the specified method in class MapLoader to get the map of a specified level

manX = map.getManX(); // call the specified method in class MapLoader to get X of the tiny man in the map

manY = map.getManY(); // call the specified method in class MapLoader to get Y of

the tiny man in the map

tempMapData = tempMap.getMap(); // call the specified method in class MapLoader
to get the map of a specified level
repaint();

clearUndoingRecord(); // call the specified method to clear undoing records

## 1.3.3. Test Log 3

Action	ne: Sokoban <b>Expected</b>	Actual	rsion: 3.0  Result
Start the program.	<ul> <li>The main frame with a menu bar, the game area, and the option area displays, and the window cannot maximise or restore down.</li> <li>The map of Level 1 is loaded in the game area with the info of "Level 1; Step 0".</li> <li>Default BGM Blue Danube starts to play. The text of the button controlling playing or stopping BGM is "BGM ON", and the menu item "Play BGM" in the menu Options is selected.</li> </ul>	All have been executed as expected. The main frame, the game area, the option area with the button "BGM ON" has been shown in Picture 1.3.3 – 1.	Pass
Move the tiny man.	<ul> <li>The tiny man moves horizontally or vertically onto empty squares (never through walls or crates) according to the key that the player presses (UP, DOWN, LEFT, or RIGHT).</li> <li>The tiny man can also move into a crate, which pushes it into the square beyond.</li> <li>Crates may not be pushed into other crates or walls, and they cannot be</li> </ul>	All have been executed as expected. Picture 1.3.3 – 2 indicates one example.  Picture 1.3.3 – 2	Pass

	pulled.		
	• The info of steps		
	changes.		
Undo steps.	<ul> <li>No matter the player presses Ctrl + Z, or clicks on the menu item "Undo" in the menu Options, or clicks on the button "Undo", the tiny man undoes a step, and the info of steps changes.</li> <li>If no step can be undone, display a notice.</li> </ul>	All have been executed as expected. Picture 1.3.3 – 3 shows one example.  Picture 1.3.3 – 3	Pass
Replay	Reload the map of the current	All have been executed as	Pass
the	level.	expected (Picture $1.3.3 - 4$ ).	
current level.		Control Help  Level 1  Comp D  Comp D	
		Picture 1.3.3 – 4	
Pass a level.	The puzzle is solved when all crates are at diamonds. A notice should be displayed for the player to choose whether to go to next level or not.	All have been executed as expected (Picture 1.3.3 – 5).  Level 1  Computational Law 1 passed to the	Pass
Go to last	• Load the map of last	All have been executed as	Pass
level.	level.	expected (Picture $1.3.3 - 6$ ).	
	• If the player is on Level 1, display an error message.		

		Level 1 Step 0  Restree  No last feet Very are now at Level 1  Restree  Res	
Go to next level.	<ul> <li>Load the map of next level.</li> <li>If the player is on the final level, display an error message.</li> </ul>	All have been executed as expected (Picture 1.3.3 – 7).  **Control Bulgo  **Level 2**  **Level 2	Pass
Go to Level 1.	Load the map of Level 1.	All have been executed as expected (Picture 1.3.3 – 8).  **Biochim 2019 Nove   September	Pass
Go to the final level.	Load the map of the final level.	All have been executed as expected (Picture 1.3.3 – 9).	Pass

		Control pice  Level 5  Level 5  Region  Figure  Level 5  Region  Figure  Figur	
Go to a level selected.	<ul> <li>Load the map of the level selected.</li> <li>An error message should be displayed for any invalid input.</li> </ul>	Most are as expected. If the player enters an integer from 1 to 5, the map of the level selected will be loaded. If the player enters an invalid integer, a notice will be displayed. However, exception will be thrown (Picture 1.3.3 – 10) and the game area may lose focus if the content is nothing or only spaces or invalid input.	Fail
Click on the menu item "Play BGM" in the menu Options.	<ul> <li>Originally, it is selected because BGM Blue Danube will be played as soon as the program is started. After clicking, it is not selected.</li> <li>The text of the button controlling playing or stopping BGM is "BGM OFF".</li> <li>BGM is stopped.</li> </ul>	Picture 1.3.3 – 10  Owing to the failure of last action, this action cannot continue.	-
Click on the button "BGM OFF" in	<ul> <li>The text of it is "BGM ON".</li> <li>The menu item "Play BGM" in the menu</li> </ul>	Owing to the failure of last action, this action cannot continue.	-

41 41	0-4:	
the option	Options is selected, and	
area.	BGM is played.	0 : 4 (1 (1 (1 (1 (1 (1 (1 (1 (1 (1 (1 (1 (1
Click on	• The text of it is "BGM	Owing to the failure of last -
the button	OFF".	action, this action cannot
"BGM	• The menu item "Play	continue.
ON" in	BGM" in the menu	
the option	Options is not selected,	
area.	and BGM is stopped.	
Select	BGM Courage is played.	Owing to the failure of last -
BGM		action, this action cannot
Courage.		continue.
Select	BGM Luster is played.	Owing to the failure of last -
BGM		action, this action cannot
Luster.		continue.
Select	BGM Ten Years is played.	Owing to the failure of last -
BGM Ten		action, this action cannot
Years.		continue.
Select	BGM Titanic is played.	Owing to the failure of last -
BGM		action, this action cannot
Titanic.		continue.
Select	BGM Blue Danube is played.	Owing to the failure of last -
BGM		action, this action cannot
Blue		continue.
Danube.		
Listen to	BGM will not be changed	Owing to the failure of last -
BGM.	unless the player changes it.	action, this action cannot
		continue.
Click on	A frame containing help	Owing to the failure of last -
the menu	contents is displayed.	action, this action cannot
item		continue.
"Help		
Contents"		
in the		
menu		
Help.		
Click on	A frame containing some	Owing to the failure of last -
the menu	basic info of the program is	action, this action cannot
item	displayed.	continue.
"About	<del>-</del> -	
Sokoban"		
in the		
menu		
Help.		
Exit the	A notice is displayed to ask	Owing to the failure of last -
2/110 0110	12 hours is displayed to disk	5 Ing to the latter of last

program.	for confirmation.	action,	action	cannot	
				Final res	ult: Fail

With the help of exception information, it is found that bad logic of input processing in "MainFrame.java" is responsible for the failure action. This causes that the map shown is rotated, while the tiny man tries to move on the correct map, which leads to the abnormity of the function of moving the tiny man.

The original relevant code in method actionPerformed() of "MainFrame.java" is:

```
String selection = JOptionPane.showInputDialog(this, "Please enter the level you want
    select (1 - " + finalLevel +
                                           "):", "Sokoban
                                                                   Zhao
JOptionPane.PLAIN MESSAGE);
if (selection != null)
    int levelSelected = Integer.parseInt(selection.trim());
    if (levelSelected > finalLevel || levelSelected < 1)
        JOptionPane.showMessageDialog(this, "No such level! Not an integer from 1
                 finalLevel
                                      "?",
                                              "Sokoban
                                                                 Zhao
                                                                           Jichen",
JOptionPane.WARNING MESSAGE);
        game.requestFocus();
    }
    else
    {
        game.setLevel(levelSelected); // call the specified method in class GameArea
to set the current level
        game.loadGameArea(); // call the specified method in class GameArea to load
the game area
        game.requestFocus();
    } // end if...else
} // end if
```

To fix the bug, code should be changed to:

String selection = JOptionPane.showInputDialog(this, "Please enter the level you want to select (1 - " + finalLevel + "):", "Sokoban - Zhao Jichen", JOptionPane.PLAIN MESSAGE);

```
if (selection != null)
{
```

```
try
        int levelSelected = Integer.parseInt(selection.trim());
        if (levelSelected > finalLevel || levelSelected < 1)
            JOptionPane.showMessageDialog(this, "No such level! Not an integer
                          finalLevel
                                           "?",
from
                                                  "Sokoban
                                                                   Zhao
                                                                           Jichen",
JOptionPane.WARNING MESSAGE);
            game.requestFocus();
        else
            game.setLevel(levelSelected); // call the specified method in class
GameArea to set the current level
            game.loadGameArea(); // call the specified method in class GameArea to
load the game area
            game.requestFocus();
        } // end if...else
    catch (NumberFormatException exception)
        JOptionPane.showMessageDialog(this, "Illegal input! Please enter an integer
from 1 to " + finalLevel + ".\n(" + exception.toString() + ")", "Sokoban - Zhao Jichen",
JOptionPane.ERROR MESSAGE);
        game.requestFocus();
    } // end try...catch
}
else
    game.requestFocus();
```

## 1.3.4. Test Log 4

Program name: Sokoban

Version:	4.0	)
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1 Togram nar	110.	ookooun	101	131011. 7.0
Action		Expected	Actual	Result
Start the	•	The main frame with a	All have been executed as	Pass
program.		menu bar, the game area,	expected. The main frame, the	
		and the option area	game area, the option area with	
		displays, and the window	the button "BGM ON" has	
		cannot maximise or	been shown in Picture 1.3.4 –	
		restore down.	1.	
	•	The map of Level 1 is		
		loaded in the game area		

	with the info of "Level 1; Step 0".  Default BGM Blue Danube starts to play. The text of the button controlling playing or stopping BGM is "BGM ON", and the menu item "Play BGM" in the menu Options is selected.	Control Steps  Level 1  Beep 1  Beep 2  Last twell  Last twell  Last twell  Section twell  Dod CN  Section twell	
Move the tiny man.	<ul> <li>The tiny man moves horizontally or vertically onto empty squares (never through walls or crates) according to the key that the player presses (UP, DOWN, LEFT, or RIGHT).</li> <li>The tiny man can also move into a crate, which pushes it into the square beyond.</li> <li>Crates may not be pushed into other crates or walls, and they cannot be pulled.</li> <li>The info of steps changes.</li> </ul>	All have been executed as expected. Picture 1.3.4 – 2 indicates one example.  Picture 1.3.4 – 2	Pass
Undo steps.	<ul> <li>No matter the player presses Ctrl + Z, or clicks on the menu item "Undo" in the menu Options, or clicks on the button "Undo", the tiny man undoes a step, and the info of steps changes.</li> <li>If no step can be undone, display a notice.</li> </ul>	All have been executed as expected. Picture 1.3.4 – 3 shows one example.  Picture 1.3.4 – 3	Pass
Replay the current level.	Reload the map of the current level.	All have been executed as expected (Picture 1.3.4 – 4).	Pass

		Level 1  Bags D  Gradus  Level 1  Bags D  Gradus  Level 1  Base D  B	
Pass a level.	The puzzle is solved when all crates are at diamonds. A notice should be displayed for the player to choose whether to go to next level or not.	All have been executed as expected (Picture 1.3.4 – 5).  Level 1  Level 1  Registration  Registration  Registration  Registration  Produce 1000  Produce 1000  Produce 1000  Produce 1000  Produce 1.3.4 – 5	Pass
Go to last level.	<ul> <li>Load the map of last level.</li> <li>If the player is on Level 1, display an error message.</li> </ul>	All have been executed as expected (Picture 1.3.4 – 6).  Level 1  Step 0  Restrict Front Front Restrict Front R	Pass
Go to next level.	<ul> <li>Load the map of next level.</li> <li>If the player is on the final level, display an error message.</li> </ul>	All have been executed as expected (Picture 1.3.4 – 7).	Pass

	1	T T	
		Level 2  step b  these figure  Level 1  step b  figure  Teat tool  Level 1  Foot tool  Bots core  Concentration  Teat tool  Description  Teat tool  Teat t	
Go to	Load the map of Level 1.	All have been executed as	Pass
Level 1.		expected (Picture 1.3.4 – 8).  Michigan Van John Contract Halp  Level 1  Rep D  Grant Halp  Level 1  Rep To the Heat Invent  Select Level 1  Final word  Bold Contract  Final word  Final	
		Picture 1.3.4 – 8	
Go to the final level.	Load the map of the final level.	All have been executed as expected (Picture 1.3.4 – 9).  Level 5	Pass
Go to a level selected.	<ul> <li>Load the map of the level selected.</li> <li>An error message should be displayed for any invalid input.</li> </ul>	All have been executed as expected (Picture 1.3.4 – 10).	Pass

		Level 2  Step 0  Undo  Reging  Last basel  Rect word  R	
Click on the menu item "Play BGM" in the menu Options.	<ul> <li>Originally, it is selected because BGM Blue Danube will be played as soon as the program is started. After clicking, it is not selected.</li> <li>The text of the button controlling playing or stopping BGM is "BGM OFF".</li> <li>BGM is stopped.</li> </ul>	All have been executed as expected (Picture 1.3.4 – 11).    Company   Compan	Pass
Click on the button "BGM OFF" in the option area.	<ul> <li>The text of it is "BGM ON".</li> <li>The menu item "Play BGM" in the menu Options is selected, and BGM is played.</li> </ul>	All have been executed as expected (Picture 1.3.4 – 12).    Company   Decided   Decide	Pass
Click on the button "BGM ON" in the option area.	<ul> <li>The text of it is "BGM OFF".</li> <li>The menu item "Play BGM" in the menu Options is not selected, and BGM is stopped.</li> </ul>	All have been executed as expected (Picture 1.3.4 – 13).	Pass

		Control Contro	
Select	BGM Courage is played.	Picture 1.3.4 – 13 All have been executed as	Pass
BGM Courage.		expected (Picture 1.3.4 – 14).  BGM ON	
		Select BGM: Courage  Picture 1.3.4 – 14	
Select BGM Luster.	BGM Luster is played.	All have been executed as expected (Picture 1.3.4 – 15).  BGM ON  Select BGM:  Luster  Picture 1.3.4 – 15	Pass
Select BGM Ten Years.	BGM Ten Years is played.	All have been executed as expected (Picture 1.3.4 – 16).  BGM ON  Select BGM: Ten Years  Picture 1.3.4 – 16	Pass
Select BGM Titanic.	BGM Titanic is played.	All have been executed as expected (Picture 1.3.4 – 17).  BGM ON  Select BGM: Titanic  Picture 1.3.4 – 17	Pass

G 1	DOLON D. 1 : 1 1		
Select	BGM Blue Danube is played.	All have been executed as	Pass
BGM		expected (Picture 1.3.4 – 18).	
Blue		BGM ON	
Danube.			
		Select BGM:	
		Blue Danube ▼	
		Picture 1.3.4 – 18	
Listen to	DCM will not be abanced		Daga
BGM.	BGM will not be changed		Pass
Click on	unless the player changes it.	expected.  All have been executed as	Pass
	A frame containing help		Pass
the menu item	contents is displayed.	expected (Picture 1.3.4 – 20).	
"Help		Help Contents X	
Contents"		A menu bar and the option area are provided for you to undo a step, replay the current level, go to last level, go	
in the		to next level, select a level, go to Level 1, go to the final level, play or stop BGM, and select BGM.	
menu		<ol> <li>Press T / 1 / ← / → to move the tiny man.</li> <li>To expand the menu Options conveniently, press Alt + O.</li> </ol>	
Help.		To expand the menu Help conveniently, press Alt + H.  To undo a step conveniently, press Ctrl + Z.	
Ticip.		确定	
		Picture 1.3.4 – 20	
Click on	A frame containing some	All have been executed as	Pass
the menu	basic info of the program is	expected (Picture 1.3.4 – 21).	
item	displayed.	About Sokoban ×	
"About		Sokoban	
Sokoban"		Version: 4.0	
in the		Author: Zhao Jichen (SCN: 187115469)	
menu		Copyright © Retro Games 2018	
Help.		确定	
		Picture 1.3.4 – 21	
Exit the	A notice is displayed to ask	All have been executed as	Pass
program.	for confirmation.	expected (Picture $1.3.4 - 22$ ).	
		Sokoban - Zhao Jichen X	
		? Are you sure to stop playing Sokoban?	
		,	
		是(Y) 否(N)	
		Picture 1.3.4 – 22	
		Final resu	lt. Pacc

No bug found via the test log. The reliability of the program has been proved to be brilliant.

# 2. History Versions

### 2.1. Source Code

Version	Description
1.0	Original version which can run successfully.
2.0	In the game area, fixed a bug which may cause the abnormity of the
	function of moving the tiny man. (Wrong match between "i", "j" and "x",
	"y")
3.0	In the game area, fixed a bug which may cause the abnormity of the
	function of undoing steps after going to next level. (Failed to call a
	specified method to clear undoing records)
4.0	In the main frame, fixed a bug which the game area may lose focus if the
	content in the text box of the function of selecting a level is nothing or only
	spaces or invalid input. (Bad logic of input processing)

## 2.2. Reports

Version	Description
1.0	Original version.
2.0	Correct wrong UML.
3.0	Add relevant screenshots of map files into UI Introduction.

## 3. References

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[4] Oracle, Java SE API, 19 May 2017 https://www.oracle.com/technetwork/cn/java/javase/documentation/api-jsp-136079-zhs.html, 21 December 2018