

# Outcome 3

# Report

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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.

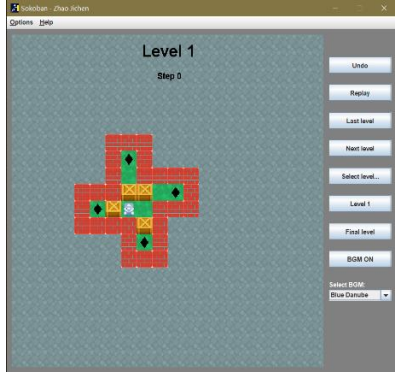
## 1.3. Logs

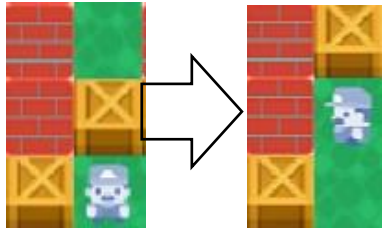
As the tester, the entire testing process is recorded in the following logs.

### 1.3.1. Test Log 1

Program name: Sokoban

Version: 1.0

Action	Expected	Actual	Result
Start the program.	<ul style="list-style-type: none"> <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>	<p>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 1.3.1 – 1.</p>  <p>Picture 1.3.1 – 1</p>	Pass
Move the tiny man.	<ul style="list-style-type: none"> <li>The tiny man moves horizontally or vertically onto empty squares (never through walls or crates) according to the</li> </ul>	<p>The tiny man does not move as expected. Picture 1.3.1 – 2 shows one example when the player presses the LEFT key.</p>	Fail

	<p>key that the player presses (UP, DOWN, LEFT, or RIGHT).</p> <ul style="list-style-type: none"> <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>	 <p>Picture 1.3.1 - 2</p>	
Undo steps.	<ul style="list-style-type: none"> <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 style="list-style-type: none"> <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 style="list-style-type: none"> <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 style="list-style-type: none"> <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 style="list-style-type: none"> <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 style="list-style-type: none"> <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 style="list-style-type: none"> <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.	BGM will not be changed unless the player changes it.	Owing to the failure of last action, this action cannot continue.	-
Click on the menu item “Help Contents” in the menu Help.	A frame containing help contents is displayed.	Owing to the failure of last action, this action cannot continue.	-
Click on the menu item “About Sokoban” in the menu Help.	A frame containing some basic info of the program is displayed.	Owing to the failure of last action, this action cannot continue.	-
Exit the program.	A notice is displayed to ask for confirmation.	Owing to the failure of last 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 abnormality of the function of moving the tiny man.

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

```
for (int i = 0; i < 20; i++)
    for (int j = 0; j < 20; j++)
        g.drawImage(mapElements[mapData[i][j]], i * 30, j * 30, this);
```

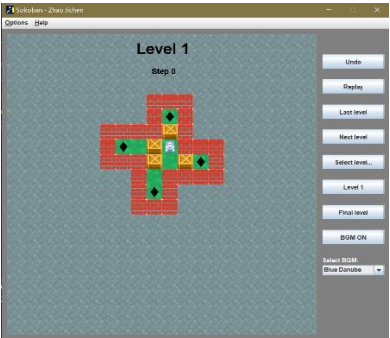
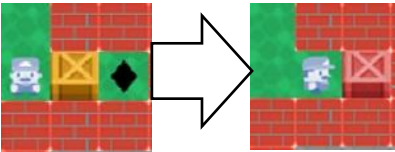
To fix the bug, code should be changed to:

```
for (int i = 0; i < 20; i++)
    for (int j = 0; j < 20; j++)
        g.drawImage(mapElements[mapData[j][i]], i * 30, j * 30, this);
```


### 1.3.2. Test Log 2

Program name: Sokoban

Version: 2.0

Action	Expected	Actual	Result
Start the program.	<ul style="list-style-type: none"> <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>	<p>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.</p>  <p>Picture 1.3.2 – 1</p>	Pass
Move the tiny man.	<ul style="list-style-type: none"> <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>	<p>All have been executed as expected. Picture 1.3.2 – 2 indicates one example.</p>  <p>Picture 1.3.2 – 2</p>	Pass
Undo steps.	<ul style="list-style-type: none"> <li>No matter the player presses Ctrl + Z, or clicks on the menu item "Undo"</li> </ul>	<p>Most are as expected. However, regulations are broken when the player tries to</p>	Fail



	<p>in the menu Options, or clicks on the button “Undo”, the tiny man undoes a step, and the info of steps changes.</p> <ul style="list-style-type: none"> <li>● If no step can be undone, display a notice.</li> </ul>	<p>undo steps after going to next level. Picture 1.3.2 – 3 displays one example.</p>  <p>Picture 1.3.2 – 3</p>	
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 style="list-style-type: none"> <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 style="list-style-type: none"> <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 style="list-style-type: none"> <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	<ul style="list-style-type: none"> <li>● Originally, it is selected because BGM Blue Danube will be played as</li> </ul>	Owing to the failure of last action, this action cannot continue.	-

“Play BGM” in the menu Options.	<p>soon as the program is started. After clicking, it is not selected.</p> <ul style="list-style-type: none"> <li>● The text of the button controlling playing or stopping BGM is “BGM OFF”.</li> <li>● BGM is stopped.</li> </ul>		
Click on the button “BGM OFF” in the option area.	<ul style="list-style-type: none"> <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 style="list-style-type: none"> <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.	BGM will not be changed unless the player changes it.	Owing to the failure of last action, this action cannot continue.	-
Click on the menu item “Help Contents”	A frame containing help contents is displayed.	Owing to the failure of last action, this action cannot continue.	-

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

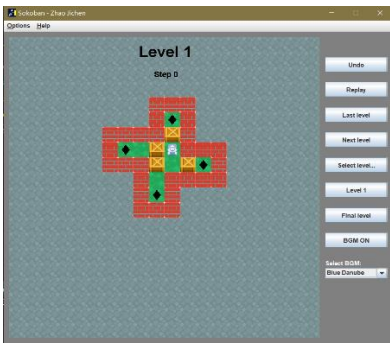
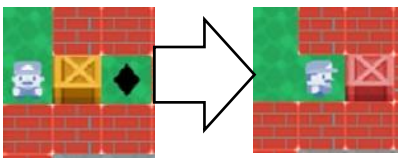
```
repaint();
```

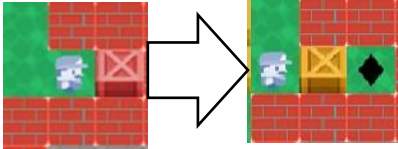
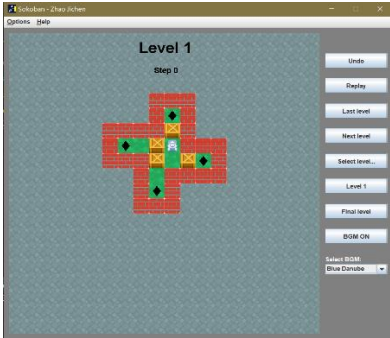
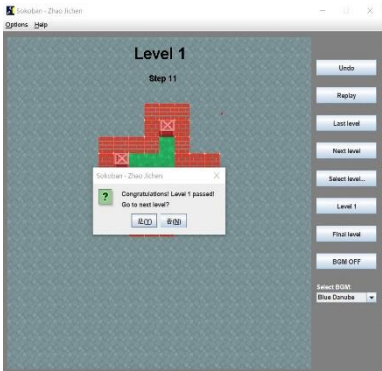
```
clearUndoingRecord(); // call the specified method to clear undoing records
```

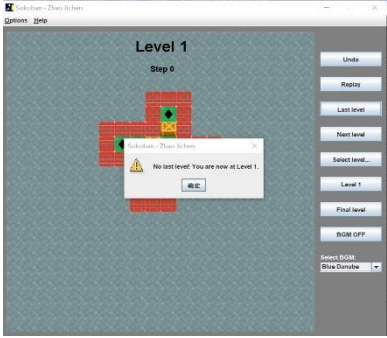
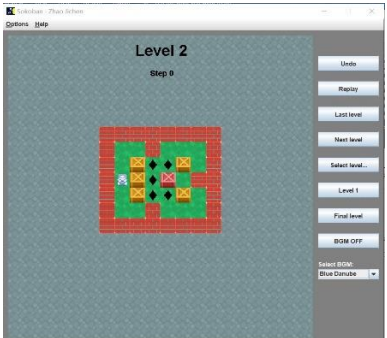
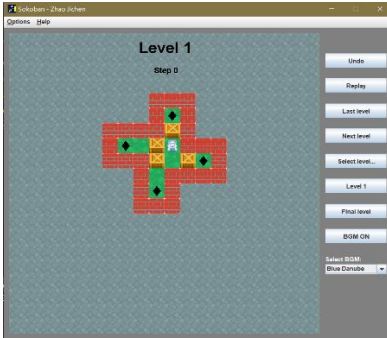
### 1.3.3. Test Log 3

Program name: Sokoban

Version: 3.0

Action	Expected	Actual	Result
Start the program.	<ul style="list-style-type: none"> <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>	<p>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.</p>  <p>Picture 1.3.3 – 1</p>	Pass
Move the tiny man.	<ul style="list-style-type: none"> <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>	<p>All have been executed as expected. Picture 1.3.3 – 2 indicates one example.</p>  <p>Picture 1.3.3 – 2</p>	Pass

	<p>pulled.</p> <ul style="list-style-type: none"> <li>● The info of steps changes.</li> </ul>		
Undo steps.	<ul style="list-style-type: none"> <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>	<p>All have been executed as expected. Picture 1.3.3 – 3 shows one example.</p>  <p>Picture 1.3.3 – 3</p>	Pass
Replay the current level.	<p>Reload the map of the current level.</p>	<p>All have been executed as expected (Picture 1.3.3 – 4).</p>  <p>Picture 1.3.3 – 4</p>	Pass
Pass a level.	<p>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.</p>	<p>All have been executed as expected (Picture 1.3.3 – 5).</p>  <p>Picture 1.3.3 – 5</p>	Pass
Go to last level.	<ul style="list-style-type: none"> <li>● Load the map of last level.</li> <li>● If the player is on Level 1, display an error message.</li> </ul>	<p>All have been executed as expected (Picture 1.3.3 – 6).</p>	Pass

		 <p>Picture 1.3.3 – 6</p>	
Go to next level.	<ul style="list-style-type: none"> <li>● Load the map of next level.</li> <li>● If the player is on the final level, display an error message.</li> </ul>	<p>All have been executed as expected (Picture 1.3.3 – 7).</p>  <p>Picture 1.3.3 – 7</p>	Pass
Go to Level 1.	Load the map of Level 1.	<p>All have been executed as expected (Picture 1.3.3 – 8).</p>  <p>Picture 1.3.3 – 8</p>	Pass
Go to the final level.	Load the map of the final level.	<p>All have been executed as expected (Picture 1.3.3 – 9).</p>	Pass



the option area.	Options is selected, and BGM is played.		
Click on the button “BGM ON” in the option area.	<ul style="list-style-type: none"> <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.	BGM will not be changed unless the player changes it.	Owing to the failure of last action, this action cannot continue.	-
Click on the menu item “Help Contents” in the menu Help.	A frame containing help contents is displayed.	Owing to the failure of last action, this action cannot continue.	-
Click on the menu item “About Sokoban” in the menu Help.	A frame containing some basic info of the program is displayed.	Owing to the failure of last action, this action cannot continue.	-
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			

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 abnormality 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
to select (1 - " + finalLevel + "):", "Sokoban - Zhao Jichen",
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
to " + 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
from 1 to " + 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
}
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();

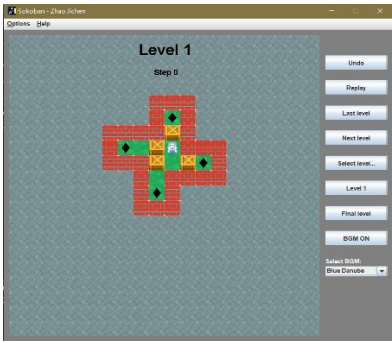
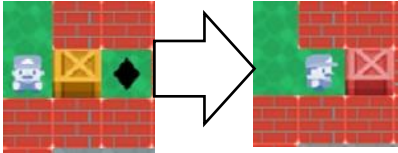
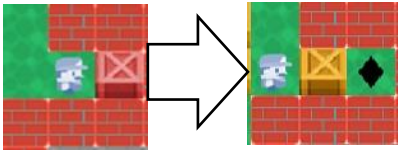
```

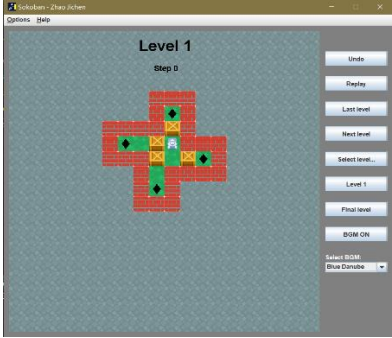
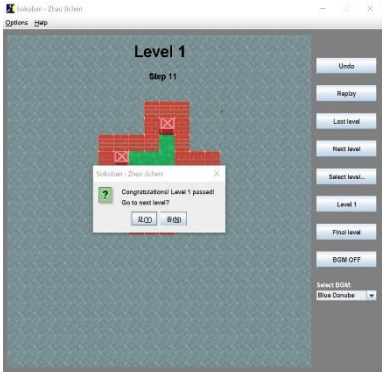
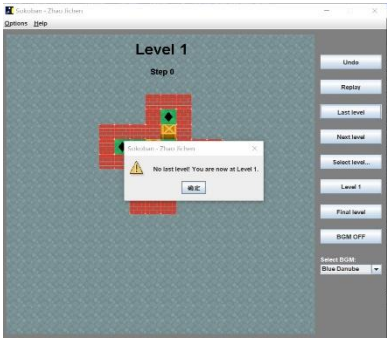
#### 1.3.4. Test Log 4


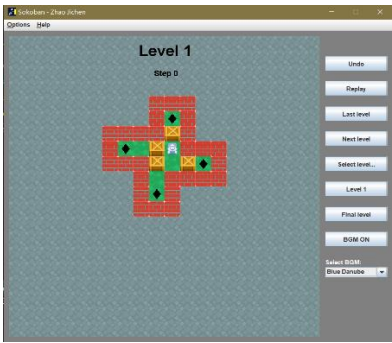
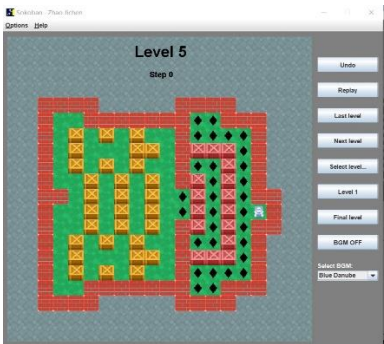
Program name: Sokoban

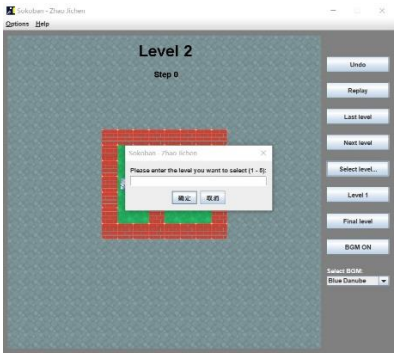
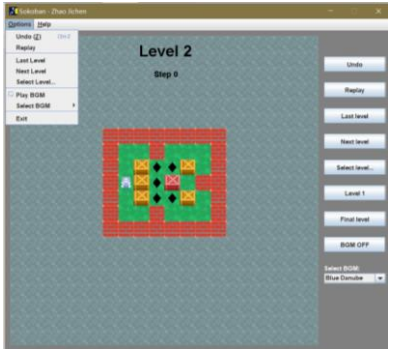
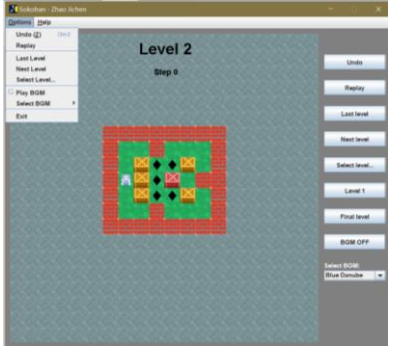
Version: 4.0

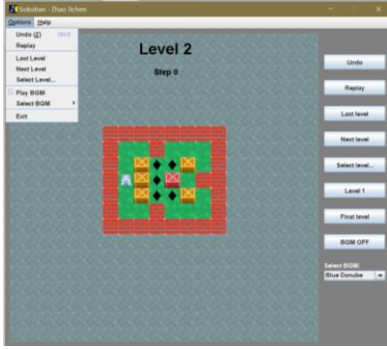




Action	Expected	Actual	Result
Start the program.	<ul style="list-style-type: none"> <li>● The main frame with a menu bar, the game area, and the option area displays, and the window cannot maximise or restore down.</li> <li>● The map of Level 1 is loaded in the game area</li> </ul>	All have been executed as expected. The main frame, the game area, the option area with the button “BGM ON” has been shown in Picture 1.3.4 – 1.	Pass





	<p>with the info of “Level 1; Step 0”.</p> <ul style="list-style-type: none"> <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>	 <p>Picture 1.3.4 – 1</p>	
Move the tiny man.	<ul style="list-style-type: none"> <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>	<p>All have been executed as expected. Picture 1.3.4 – 2 indicates one example.</p>  <p>Picture 1.3.4 – 2</p>	Pass
Undo steps.	<ul style="list-style-type: none"> <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>	<p>All have been executed as expected. Picture 1.3.4 – 3 shows one example.</p>  <p>Picture 1.3.4 – 3</p>	Pass
Replay the current level.	Reload the map of the current level.	All have been executed as expected (Picture 1.3.4 – 4).	Pass

		 <p>Picture 1.3.4 – 4</p>	
Pass level.	a	<p>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.</p> <p>All have been executed as expected (Picture 1.3.4 – 5).</p>  <p>Picture 1.3.4 – 5</p>	Pass
Go to last level.	<ul style="list-style-type: none"> <li>● Load the map of last level.</li> <li>● If the player is on Level 1, display an error message.</li> </ul>	<p>All have been executed as expected (Picture 1.3.4 – 6).</p>  <p>Picture 1.3.4 – 6</p>	Pass
Go to next level.	<ul style="list-style-type: none"> <li>● Load the map of next level.</li> <li>● If the player is on the final level, display an error message.</li> </ul>	<p>All have been executed as expected (Picture 1.3.4 – 7).</p>	Pass

		 <p>Picture 1.3.4 – 7</p>	
Go to Level 1.	Load the map of Level 1.	<p>All have been executed as expected (Picture 1.3.4 – 8).</p>  <p>Picture 1.3.4 – 8</p>	Pass
Go to the final level.	Load the map of the final level.	<p>All have been executed as expected (Picture 1.3.4 – 9).</p>  <p>Picture 1.3.4 – 9</p>	Pass
Go to a level selected.	<ul style="list-style-type: none"> <li>● Load the map of the level selected.</li> <li>● An error message should be displayed for any invalid input.</li> </ul>	<p>All have been executed as expected (Picture 1.3.4 – 10).</p>	Pass

		 <p>Picture 1.3.4 – 10</p>	
Click on the menu item “Play BGM” in the menu Options.	<ul style="list-style-type: none"> <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>	<p>All have been executed as expected (Picture 1.3.4 – 11).</p>  <p>Picture 1.3.4 – 11</p>	Pass
Click on the button “BGM OFF” in the option area.	<ul style="list-style-type: none"> <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>	<p>All have been executed as expected (Picture 1.3.4 – 12).</p>  <p>Picture 1.3.4 – 12</p>	Pass
Click on the button “BGM ON” in the option area.	<ul style="list-style-type: none"> <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>	<p>All have been executed as expected (Picture 1.3.4 – 13).</p>	Pass

		 <p>Picture 1.3.4 – 13</p>	
Select BGM Courage.	BGM Courage is played.	<p>All have been executed as expected (Picture 1.3.4 – 14).</p>  <p>Picture 1.3.4 – 14</p>	Pass
Select BGM Luster.	BGM Luster is played.	<p>All have been executed as expected (Picture 1.3.4 – 15).</p>  <p>Picture 1.3.4 – 15</p>	Pass
Select BGM Ten Years.	BGM Ten Years is played.	<p>All have been executed as expected (Picture 1.3.4 – 16).</p>  <p>Picture 1.3.4 – 16</p>	Pass
Select BGM Titanic.	BGM Titanic is played.	<p>All have been executed as expected (Picture 1.3.4 – 17).</p>  <p>Picture 1.3.4 – 17</p>	Pass

Select BGM Blue Danube.	BGM Blue Danube is played.	All have been executed as expected (Picture 1.3.4 – 18).  Picture 1.3.4 – 18	Pass
Listen to BGM.	BGM will not be changed unless the player changes it.	All have been executed as expected.	Pass
Click on the menu item “Help Contents” in the menu Help.	A frame containing help contents is displayed.	All have been executed as expected (Picture 1.3.4 – 20).  Picture 1.3.4 – 20	Pass
Click on the menu item “About Sokoban” in the menu Help.	A frame containing some basic info of the program is displayed.	All have been executed as expected (Picture 1.3.4 – 21).  Picture 1.3.4 – 21	Pass
Exit the program.	A notice is displayed to ask for confirmation.	All have been executed as expected (Picture 1.3.4 – 22).  Picture 1.3.4 – 22	Pass
Final result: Pass			

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 abnormality 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 abnormality 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

[1] RUNOOB.COM, Introduction of Java Swing, 2 March 2017  
<http://www.runoob.com/w3cnote/java-swing-demo-intro.html>, 11 November 2018

[2] CSDN, Playing MIDI files with Java, 18 June 2009  
<https://yoyo08.iteye.com/blog/410508>, 14 November 2018

[3] Wikipedia, Sokoban, 9 December 2011  
<https://en.wikipedia.org/wiki/Sokoban>, 19 November 2018

[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