

1. Test Cases

Setting	User input	Expected result	Actual Result
Enter a number of rows: Enter a number of columns:	1 3	The Chronicle of the Narnia The grapes of Wrath Harry Potter Total value of 3 items: \$870. Choose 1)show 2)sell 3)buy 4)quit:	The Chronicle of the Narnia The grapes of Wrath Harry Potter Total value of 3 items: \$870. Your bank account: \$0 Choose 1)Show 2)Sell 3)Buy 4)Recite 5)Quit:
The Chronicle of the Narnia The grapes of Wrath Harry Potter Total value of 3 items: \$870. Choose 1)show 2)sell 3)buy 4)quit:	1	Enter row: Enter column:	Row: Column:
Enter row: Enter column:	1 3	Book: title: Harry Potter, author: J.K. Rowling, value: \$223, publication year: 1997 Choose 1)show 2)sell 3)buy 4)quit:	Book: [Title: Harry Potter], [Author: J.K. Rowling], [Value: \$223], [Publication year: 1997]
Book: title: Harry Potter, author: J.K. Rowling, value: \$223, publication year: 1997 Choose 1)show 2)sell 3)buy 4)quit:	3	Enter row: Enter column:	Row: Column:
Enter row: Enter column:	1 3	The showcase is totally full. Please try again:	The location is full! Please try again! The Chronicle of the Narnia The grapes of Wrath Harry Potter Total value of 3 items: \$870. Your bank account: \$0 Choose 1)Show 2)Sell 3)Buy 4)Recite 5)Quit:
The showcase is totally filled. Please try again:	2	Enter row: Enter column:	Row: Column:

Enter row: Enter column:	1 3	You sell Harry Potter for \$223. Your bank account: \$223 Choose 1)show 2)sell 3)buy 4)quit:	You sell Harry Potter for \$223. Total value of 2 items: \$647. Your bank account: \$223 Choose 1)Show 2)Sell 3)Buy 4)Recite 5)Quit:
You sell Harry Potter for \$223.Your bank account: \$223 Choose 1)show 2)sell 3)buy 4)quit:	4	The program is ended.	The program is ended.

2. The actual time that I spent to finish the implementation was about 6 hours. Before the implementation in design document, I estimated that it will take about 3 hours, but actually it only took twice of the estimated time.

3. The output obtained from running valgrind

```
==15794== Memcheck, a memory error detector
```

```
==15794== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
```

```
==15794== Using Valgrind-3.14.0 and LibVEX; rerun with -h for copyright info
```

```
==15794== Command: assign5_showcase
```

```
==15794==
```

```
Enter Rows: 4
```

```
Enter Columns: 4
```

```
Guns, Germs, and Steel  The Lord of the Rings  The Old Man and the Sea Capitalism,
Socialism, and Democracy
```

```
Bridge to Terabithia    Logisch-Philosophische  Capitalism, Socialism, and Democracy
The grapes of Wrath
```

```
Critik der reinen Vemunft      Cosmos  Kritik der reinen Vemunft      Logisch-
Philosophische
```

```
The Lord of the Rings  Harry Potter    Kritik der reinen Vemunft      Capitalism,
Socialism, and Democracy
```

```
Your total value of 16books: $6724 Your bank account: $0
```

```
1) Show 2)Sell 3)Buy 4)Recite 5)Quit: 1
```

```
Row: 1
```

```
Column: 1
```

```
Book: |Title: Guns, Germs, and Steel|Author: Jared Diamond|Value: $480|Publication year:
1997|
```

```
Guns, Germs, and Steel  The Lord of the Rings  The Old Man and the Sea Capitalism,
Socialism, and Democracy
```

```
Bridge to Terabithia    Logisch-Philosophische  Capitalism, Socialism, and Democracy
```

The grapes of Wrath

Critik der reinen Vernunft Cosmos Kritik der reinen Vernunft Logisch-Philosophische

The Lord of the Rings Harry Potter Kritik der reinen Vernunft Capitalism, Socialism, and Democracy

Your total value of 16books: \$6724 Your bank account: \$0

1) Show 2)Sell 3)Buy 4)Recite 5)Quit: 5

==15794==

==15794== HEAP SUMMARY:

==15794== in use at exit: 0 bytes in 0 blocks

==15794== total heap usage: 37 allocs, 37 frees, 1,781 bytes allocated

==15794==

==15794== All heap blocks were freed -- no leaks are possible

==15794==

==15794== For counts of detected and suppressed errors, rerun with: -v

==15794== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)

flip3 ~/assignments/assign5_showcase 1002\$ vim assign5_showcase.cpp

flip3 ~/assignments/assign5_showcase 1003\$ g++ assign5_showcase.cpp -o assign5_showcase

flip3 ~/assignments/assign5_showcase 1004\$ valgrind assign5_showcase

==21543== Memcheck, a memory error detector

==21543== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.

==21543== Using Valgrind-3.14.0 and LibVEX; rerun with -h for copyright info

==21543== Command: assign5_showcase

==21543==

Enter Rows: 1

Enter Columns: 4

The Lord of the Rings The grapes of Wrath The Lord of the Rings Kritik der reinen
Vemunft

Your total value of 4books: \$2166 Your bank account: \$0

1) Show 2)Sell 3)Buy 4)Recite 5)Quit: 1

Row: 1

Column: 1

Book: |Title: The Lord of the Rings|Author: J.R.R. Tolken|Value: \$423|Publication year: 1954|

The Lord of the Rings The grapes of Wrath The Lord of the Rings Kritik der reinen
Vemunft

Your total value of 4books: \$2166 Your bank account: \$0

1) Show 2)Sell 3)Buy 4)Recite 5)Quit: 5

==21543==

==21543== HEAP SUMMARY:

==21543== in use at exit: 0 bytes in 0 blocks

==21543== total heap usage: 34 allocs, 34 frees, 1,445 bytes allocated

==21543==

==21543== All heap blocks were freed -- no leaks are possible

==2,1543==

==21543== For counts of detected and suppressed errors, rerun with: -v

==21543== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)

4. Introducing a Bug

A. <Bug Introduction>

```
172 }
173 }
174
175 void delete_array(books** arr, int a){
176     for(int i = 0; i < a; i++){
177         delete [] arr[i];
178     }
179     delete [] arr;
180 }
181
182 void asking_location(int& a, int& b, int c, int d){
183     cout << "Row: ";
184     cin >> a;
185     invalid_row(a,c);
186     cout << "Column: ";
187     cin >> b;
188     invalid_column(b,d);
189 }
190
191 void print_program(books** arr, int a, int b, int c, int d, string arr1[],
192                  string arr2[], int arr3[], int arr4[], int& e, int& s, int f){
193     while(true){
194         cout << "Your total value of " << count_items(arr,a,b) << "books: $"
195         << s << " Your bank account: $" << e << endl;
196         cout << "1) Show 2) Sell 3) Buy 4) Recite 5) Quit: ";
197         cin >> f;
198         invalid_choice(f);
199         if(f == 5) break;
200         asking_location(c,d,a,b);
201         show_item(arr,c,d,f);
202         sell_item(arr,c,d,f,arr1,arr2,arr3,arr4,e,s);
203         buy_item(arr,c,d,f,arr1,arr2,arr3,arr4,e,s);
204         recite_item(arr,c,d,f,e);
205         print_showcase(arr,a,b);
206         delete_array(arr,a);
207     }
208     // delete_array(arr,a);
209 }
210
211 void asking_size(int& a, int& b){
212     cout << "Enter Rows: ";
213     cin >> a;
214     invalid_rows(a);
215     cout << "Enter Columns: ";
216     cin >> b;
217     invalid_columns(b);
218 }
219
220 int main(){
221     string titles[] = {"The Chronicles of Narnia", "Harry Potter", "The Lord of the Rings", "Critik der reinen Vernunft",
222                      "The Razor's Blade", "Bridge to Terabithia", "The Old Man and the Sea", "1984",
223                      "Logisch-Philosophische", "The grapes of Wrath", "Surveiller et punir", "Sein und Zeit", "Capitalism, Socialism, and Democracy",
224                      "Cosmos", "Guns, Germs, and Steel", "Revolutionary Wealth"};
225     string authors[] = {"C.S. Lewis", "J.K. Rowling", "J.R.R. Tolkien", "Immanuel Kant",
226                       "assign5_showcase.cpp" 253L, 6578C written
227 }
228
229 }
```

where
bug is
introduced.

Fun1 = count_items(arr,a,b)

Fun2 = show_item(arr,c,d,f)

Fun3 = sell_item(arr,a)

Fun4 = buy_item(arr,c,d,f,arr1,arr2,arr3,arr4,e,s)

Fun5 = recite_item(arr,c,d,f,e)

Fun6 = print_showcase(arr,a,b)

Fun7 = delete_array(arr,a)

B.<The output of gdb>

```
2 CS161 5 CS161 x
? DISPLAY : ✓ (automatically set on remote server)
▶ For more info, ctrl+click on help or visit our website

Success. Logging you in...
Last login: Mon Jun 1 15:30:36 2020 from 10.248.241.43
=====
Beginning Friday 12 July 2019 at 500pm, two-factor Duo authentication
will be required on the following College of Engineering linux SSH servers:

    access.engr.oregonstate.edu
    flip.engr.oregonstate.edu
    nome.eecs.oregonstate.edu

Students can sign up for two-factor Duo at:
https://beav.es/duo

-----
If you have any problems with this machine, please mail support@engr.orst.edu
=====

flip3 ~ 999$ cd assignments/assign5_showcase
flip3 ~/assignments/assign5_showcase 1000$ g++ assign5_showcase.cpp -g -o assign5_showcase
flip3 ~/assignments/assign5_showcase 1001$ gdb ./assign5_showcase
GNU gdb (GDB) Red Hat Enterprise Linux 7.6.1-115.el7
Copyright (C) 2013 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software; you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law. Type "show copying"
and "show warranty" for details.
This GDB was configured as "x86_64-redhat-linux-gnu".
For bug reporting instructions, please see:
<http://www.gnu.org/software/gdb/bugs/>...
Reading symbols from /nfs/stak/users/kimh6/assignments/assign5_showcase/assign5_showcase...done.
(gdb) run
Starting program: /nfs/stak/users/kimh6/assignments/assign5_showcase/./assign5_showcase
Enter Rows: 2
Enter Columns: 2
The Lord of the Rings    Cosmos
Critik der reinen Vernunft    The Lord of the Rings
Your total value of 4books: $2067 Your bank account: $0
1) Show 2)Sell 3)Buy 4)Recite 5)Quit: 1
Row: 1
Column: 1
Book: |Title: The Lord of the Rings|Author: J.R.R. Tolkien|Value: $423|Publication year: 1954|
The Lord of the Rings    Cosmos
Critik der reinen Vernunft    The Lord of the Rings

Program received signal SIGSEGV, Segmentation fault.
0x0000000004011a6 in count_items (arr=0x605740, x=2, y=2) at assign5_showcase.cpp:50
50      if(arr[i][j].value != 0)
(gdb) where
#0  0x0000000004011a6 in count_items (arr=0x605740, x=2, y=2) at assign5_showcase.cpp:50
#1  0x000000000401d8c in print_program (arr=0x605740, a=2, b=2, c=@0x7fffffffda7c: 1, d=@0x7fffffffda78: 1, arr1=0x7fffffffda970, arr2=0x7fffffffda9f0, arr3=0x7fffffffda8f0, arr4=0x7fffffffda930,
    e=@0x7fffffffda84: 0, s=@0x7fffffffda80: 2067, f=1) at assign5_showcase.cpp:196
#2  0x00000000040285e in main () at assign5_showcase.cpp:249
(gdb) █
```

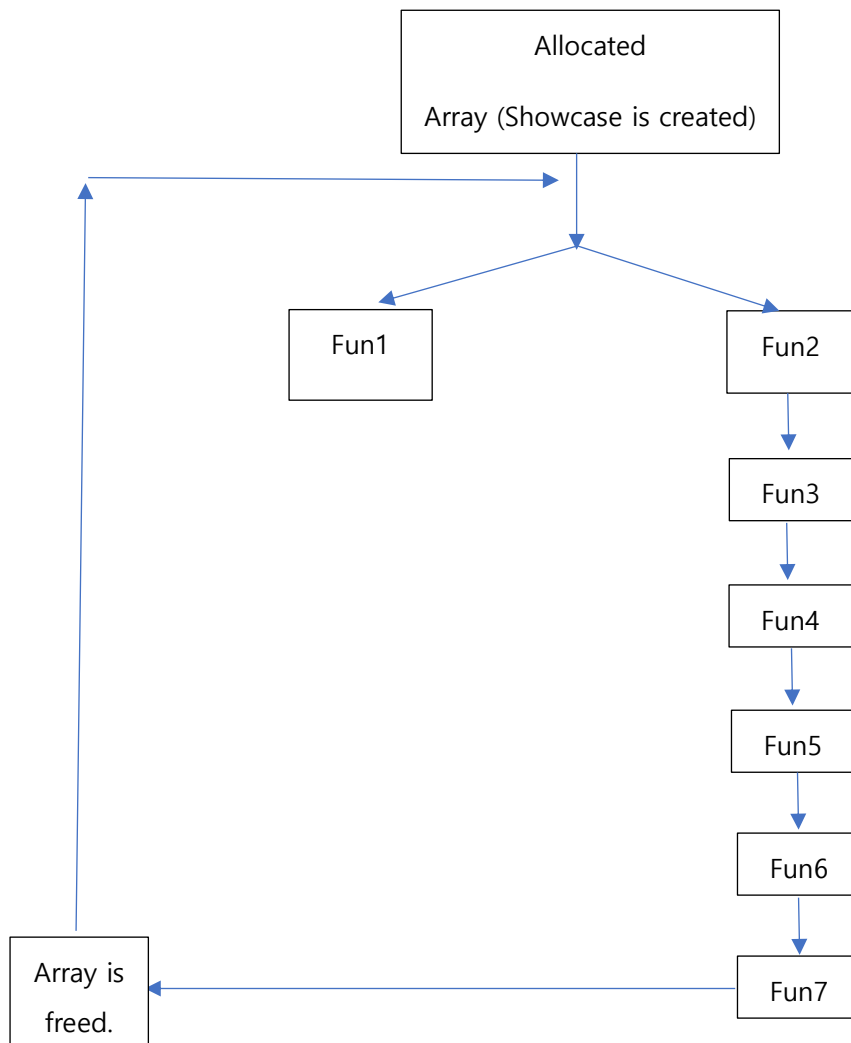
libxterm by subscribing to the professional edition here: <https://mobaxterm.mobatek.net>

o Does gdb's output lead you to the right program line where you introduced the bug?

Yes. The output of gdb led me to the right program line where I introduced the bug.

o Write down the order of function calls that led to the place where the program crashed.

(e.g., func2 -> func2 -> func3 ...)



Result: Program Crashed!

<EXTRA CREDIT>

1) I asked my friend to use my program.

flip1 ~/assignments/assign5_showcase 1002\$./assign5_showcase

Enter Rows: 4

Enter Columns: 2

Guns, Germs, and Steel Cosmos

Critik der reinen Vemunft 1984

The Lord of the Rings The grapes of Wrath

Revolutionary Wealth Bridge to Terabithia

Your total value of 8books: \$3636 Your bank account: \$0

1) Show 2)Sell 3)Buy 4)Recite 5)Quit: 1

Row: 2

Column: 1

Book: |Title: Kritik der reinen Vemunft|Author: Immanuel Kant|Value: \$856|Publication year: 1781|

Guns, Germs, and Steel Cosmos

Critik der reinen Vemunft 1984

The Lord of the Rings The grapes of Wrath

Revolutionary Wealth Bridge to Terabithia

Your total value of 8books: \$3636 Your bank account: \$0

1) Show 2)Sell 3)Buy 4)Recite 5)Quit: 4

Row: 1

Column: 1

You recited |Guns, Germs, and Steel| for \$300.

Guns, Germs, and Steel Cosmos

Critik der reinen Vemunft 1984

The Lord of the Rings The grapes of Wrath

Revolutionary Wealth Bridge to Terabithia

Your total value of 8books: \$3636 Your bank account: \$300

1) Show 2)Sell 3)Buy 4)Recite 5)Quit: 5

```
flipl ~/assignments/assign5_showcase 1002$ ./assign5_showcase
Enter Rows: 4
Enter Columns: 2
Guns, Germs, and Steel  Cosmos
Kritik der reinen Vernunft  1984
The Lord of the Rings  The grapes of Wrath
Revolutionary Wealth  Bridge to Terabithia
Your total value of 8books: $3636 Your bank account: $0
1) Show 2)Sell 3)Buy 4)Recite 5)Quit: 1
Row: 2
Column: 1
Book: |Title: Kritik der reinen Vernunft|Author: Immanuel Kant|Value: $856|Publication year: 1781|
Guns, Germs, and Steel  Cosmos
Kritik der reinen Vernunft  1984
The Lord of the Rings  The grapes of Wrath
Revolutionary Wealth  Bridge to Terabithia
Your total value of 8books: $3636 Your bank account: $0
1) Show 2)Sell 3)Buy 4)Recite 5)Quit: 4
Row: 1
Column: 1
You recited |Guns, Germs, and Steel| for $300.
Guns, Germs, and Steel  Cosmos
Kritik der reinen Vernunft  1984
The Lord of the Rings  The grapes of Wrath
Revolutionary Wealth  Bridge to Terabithia
Your total value of 8books: $3636 Your bank account: $300
1) Show 2)Sell 3)Buy 4)Recite 5)Quit: 5
flipl ~/assignments/assign5_showcase 1002$ vim assign5_showcase.cpp
flipl ~/assignments/assign5_showcase 1003$ .assign5_showcase.cpp.swp
```

The program didn't crash or behave in a way I didn't expect. However, one surprising thing happened. Before my friend is going to start the program, he asked me whether my program is a game or not. I replied to him that my program is not a game, and it infinitely receives his input and prints out the changes which is depended on his input until he press the quit botton '5'.

- 2) One improvement that I would recommend to make my program more entertaining and readable is to use color codes. The reason is that the program asks the user to enter the row and the column when the user is going to determine the size of the showcase or the user is going to choose the options except quitting the program. These two cases have to be distinguished. Therefore, using color codes in order to distinguish them will make my program much more readable and entertaining.