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# Introduction

This is a report relating to the Tool Library assignment and its functionalities. The project has been implemented fully and has full functionality although it sometimes lacks error checking and as a result will occasionally crash should an unexpected entry come its way. There were no changes made to the given interfaces other than the recommended change to make each of the return types from iTool to Tool etc. Some of the code is a little poorly written and is poorly commented.

This report will detail largely the algorithm used to display the top 3 most borrowed tools and an analysis of this algorithm. It will then contain examples of a test plan and what the program looks like when the program runs correctly.

## Algorithm design

```
//tools is a collation of 9 ToolCollection arrays

DisplayTopThree(tools[0..n-1])
  // Repeat until the array is sorted.
  Boolean: not_sorted = True

  While (not_sorted)
    // Assume we won't find a pair to swap.
    not_sorted = False

    // Search the array for adjacent items that are out of order.
    For i = 1 To <length of values>
      // See if items i and i - 1 are out of order.
      If (tools[i].NoBorrowings > values[i - 1].NoBorrowings) Then
        // Swap them.
        Tool temp = tools[i]
        tools[i] = tools[i - 1]
        tools[i - 1] = temp

        // The array isn't sorted after all.
        not_sorted = True
      End If
    Next i
  End While
End Bubblesort
```

Stephens, R. (2013). *Essential Algorithms*. Indianapolis: John Wiley & Sons, Inc.

# Algorithm analysis

To begin the algorithm, the tools from 9 ToolCollection arrays are collated into one List<Tool> for easier comparison.

It is then sorted in descending order utilising a bubblesort algorithm. This algorithm works by passing through the entire array, swapping items that are in the correct order until it no longer has to.

$$\begin{aligned}C(n) &= \sum_{i=0}^{n-2} \sum_{j=0}^{n-2-i} 1 = \sum_{i=0}^{n-2} [(n-2-i) - 0 + 1] \\&= \sum_{i=0}^{n-2} (n-1-i) = \frac{(n-1)n}{2} \in O(n^2)\end{aligned}$$

Referenced from the CAB301 lectures – Week 4

We can see that ultimately, the bubble sort algorithm that was implemented has a time complexity of  $O(n^2)$ .

The inner loop of this implementation of the bubble sort will occur equal to  $i$  to  $n$  times which is a time complexity of  $O(n)$ . Inside this loop contains several checks and assignments which are all  $O(1)$ . The outermost loop will occur as many times as necessary which equates to  $O(n)$ . Since the two loops are nested inside each other, the overall time complexity comes out to  $O(n^2)$ .

## Test plan and results

There is some error handling within the program but not everything is error handled, however some things will crash the program.

Examples of error handling include.

```
invalid choice, please choose again

Welcome to the Tool Library
=====Staff Menu=====
1. Add a new tool
2. Add new pieces of an existing tool
3. Remove some pieces of a tool
4. Register a new member
5. Remove a member
6. Find the contact number of a member
0. Return to main menu
=====

Please make a selection (1-6, or 0 to return to main menu): asdfasdf
```

Adding tool

```
What is the name of the tool: anything
1. Gardening Tools
2. Flooring Tools
3. Fencing Tools
4. Measuring Tools
5. Cleaning Tools
6. Painting Tools
7. Electronic Tools
8. Electricity Tools
9. Automotive Tools
Which category does this belong in (1-9): 1
1. Line Trimmer
2. Lawn Mower
3. Hand Tools
4. Wheelbarrows
5. Garden Power Tools
Which type does this belong to (1-5): 1
```

```
Added anything to Line Trimmer
```

Add quantity

```
1. Gardening Tools
2. Flooring Tools
3. Fencing Tools
4. Measuring Tools
5. Cleaning Tools
6. Painting Tools
7. Electronic Tools
8. Electricity Tools
9. Automotive Tools
Which category does this belong in (1-9): 1
1. Line Trimmer
2. Lawn Mower
3. Hand Tools
4. Wheelbarrows
5. Garden Power Tools
Which type does this belong to (1-5): 1
```

```
you are adding to: LineTrimmers anything
it currently has: 11
how many would you like to add: 100
successfully added: (100) to: LineTrimmers anything
```

Remove quantity

```
1. Gardening Tools
2. Flooring Tools
3. Fencing Tools
4. Measuring Tools
5. Cleaning Tools
6. Painting Tools
7. Electronic Tools
8. Electricity Tools
9. Automotive Tools
Which category does this belong in (1-9): 1
1. Line Trimmer
2. Lawn Mower
3. Hand Tools
4. Wheelbarrows
5. Garden Power Tools
Which type does this belong to (1-5): 1
```

```
you are removing from: LineTrimmers anything
it currently has: 111
how many would you like to remove: 50
successfully removed: (50) from: LineTrimmers anything
```

Register a member

```
What is the member's first name: sam
What is the member's second name: hutton
What is the member's phone number: 1111111
What is the member's pin: 1234
```

Remove a member

```
0. sam, hutton, 1111111, 1234
Which member do you wish to remove: 0
Press enter to continue....
```

Find contact number

```
=====Contact Number Lookup=====
Members first name: sam
Members second name: hutton
Members phone number is: 1111111
Press enter to continue...
```

Display all the tools of a type

```
1. Gardening Tools
2. Flooring Tools
3. Fencing Tools
4. Measuring Tools
5. Cleaning Tools
6. Painting Tools
7. Electronic Tools
8. Electricity Tools
9. Automotive Tools
Which category does this belong in (1-9): 1
1. Line Trimmer
2. Lawn Mower
3. Hand Tools
4. Wheelbarrows
5. Garden Power Tools
Which type does this belong to (1-5): 1
```

Name	Total Quantity	Available
1. LineTrimmers anything	61	61

press enter to continue....

Borrow a tool

```
1. Gardening Tools
2. Flooring Tools
3. Fencing Tools
4. Measuring Tools
5. Cleaning Tools
6. Painting Tools
7. Electronic Tools
8. Electricity Tools
9. Automotive Tools
Which category does this belong in (1-9): 1
1. Line Trimmer
2. Lawn Mower
3. Hand Tools
4. Wheelbarrows
5. Garden Power Tools
Which type does this belong to (1-5): 1
```

```
1. LineTrimmers anything
Please select corresponding number: 1
You are borrowing: LineTrimmers anything
press enter to continue....
```

Return a tool

```
0. LineTrimmers anything
Which do you wish to return or q to exit: 0
you are no longer borrowing: LineTrimmers anything
```

List tools I am renting

```
LineTrimmers anything
Press enter to continue.....
```

Display top three

```
1. LineTrimmers anything - 2
2. LawnMowers Mower - 0
Press enter to continue....
```