UTM
UNIVERSITI TEKNOLOGI MALAYSIA

FACULTY OF COMPUTING
UTM Johor Bahru

SESSION 2023/2024 SEMESTER 1

SECJ - DATA STRUCTURE AND ALGORITHMS

Project

Group Name: Center Point

Topics: Inventory Management System

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1. Objective

In our data structure and algorithm project, the main objectives of developing the Inventory management system are :

- Develop an Inventory Management System using queue
- Manage inventory in a warehouse by features
    1. Add Inventory
    2. Delete Inventory
    3. Sort Inventory
    4. Find Inventory
    5. Display Inventory (based on category or display all)
    6. Update current inventory information
    7. Check low stock inventory

2. Synopsis

The inventory management system is essential for one business or organization to track or manage its warehouse. Our inventory management system is designed to organize the inventory. User can organize the inventory by adding the inventory, deleting the inventory, sorting the inventory by it's ID in ascending order, and finding the inventory by item or by its category. Since we are using a queue data structure implementation concept, user can only add the inventory at the last position in the list, and delete the first element in the inventory. In addition, user can choose to display the inventory list whether by its category or display full inventory list. Then, we also implement extra features such as updating inventory and checking stock item. User can update the inventory information by entering the item code, then choosing the part they would like to update such as name, type, quantity, or price. Then, the low-stock inventory feature helps the user to check and analyze all the low-stock items and display as a list. The item which has a quantity of less than 10 will be counted as low-stock inventory.

3. Problem Analysis

Regarding warehouse management, the current manual inventory system often causes issues related to efficiency and accuracy. This mode of operation is not automated to achieve maximum resource optimization, and it may often cause errors and inefficiencies. To overcome these challenges, our Inventory Management System aims at using a queue data structure for an organized and automated solution.

This system simplifies the warehousing process through the ability to add and delete inventory items by the FIFO (First In First Out) rule. It also aims to improve the organization by implementing a sorting feature to allow quick searches and offering a user-friendly interface to view and edit inventory data. The real-time updates and a low-stock alert function, it enable timely actions to avoid shortages. Through these goals and characteristics, the Inventory Management System will provide efficiency and accuracy for every warehouse management.

4. System Design

4.1. Pseudocode

4.1.1. Add Inventory

```
1. Start
2. Get inventory code
   2.1 check code format
      2.1.1 if code length >4
         2.1.1.1 set codeformat== false
      2.1.2 if first character is not 'I'
         2.1.2.1 set codeformat== false
   2.2 check duplicate code
      2.2.1 if code is empty
         2.2.1.1 set duplicateCode ==false
      2.2.2  Set temp=head
      2.2.3 Do
         2.2.3.1 {if (temp->getCode() == code)
            2.2.3.1.1 set duplicateCode ==true
            2.2.3.1.2 temp = temp->next;
            2.2.3.1.3 } while (temp != back->next);
      2.2.4 set duplicateCode ==false
   2.3 If (codeformat is true AND duplicateCode is false)
      2.3.1 go to step 2.5
   2.4 Else
      2.4.1 if (codeformat==false)
         2.4.1.1 cout << " Re-enter your code (IXXX) where X
                 should be a digit."
         2.4.1.2 go to step 2
      2.4.2 else if (duplicateCode==true)
         2.4.2.1 cout << " The code already exists."
         2.4.2.2 go to step 2
   2.5 Change code to upper case
3. Get inventory name
   3.1 check duplicate name
      3.1.1  if (isEmpty())
         3.1.1.1 set duplicateName== false;
      3.1.2 Do
         3.1.2.1 if (temp->getName() == name)
            3.1.2.1.1 set duplicateName== true
            3.1.2.1.2  temp = temp->next
            3.1.2.1.3 } while (temp != back->next);
```

```
        3.1.3  set duplicateName== false;
    3.2 If duplicateName==false
        3.2.1 Go to step 4
    3.3 Else
        3.3.1 cout << "Invalid name! The name already exists.
              Re-enter."
        3.3.2 Go to step 3
4.  Get inventory type
    4.1 change inventory type to upper case
5.  Get inventory quantity
    5.1 while quantity<0
        5.1.1 cout << "Invalid quantity! Reenter! "
        5.1.2 go to step 5
6.  Get inventory price
7.  Set *newInventory = new Inventory(code, name, type, quantity,
    price)
8.  if list is empty
    8.1 Set back = newInventory
    8.2 Set newInventory->next = back
9.  Else
    9.1 Set newInventory->next = back->next
    9.2 Set back->next = newInventory
    9.3 Set back = newInventory
10. Display congrats message
11. End
```

4.1.2. Delete Inventory

```
1.  Start
2.  If list is empty
    2.1 cout << "No nodes left!!"
3.  Else
    3.1 Set Inventory *temp = back->next;
    3.2  if (back->next != back)
        3.2.1 Set back->next = temp->next
    3.3 else
        3.3.1 Set back = NULL;
    3.4  Set temp->next =NULL
    3.5 delete temp;
4.  Display congrats message
5.  End
```

4.1.3. Sort the Inventory

```
1. Start
2. If queue is empty
    2.1. Print “The queue is empty”
3. Else
    3.1. Set *first=back->next
    3.2. Set *curr=back->next
    3.3. Set *sBack=new Inventory("", "", "", 0, 0)
    3.4. Set sBack->next = sBack
    3.5. Do
        3.5.1. Set *Next = curr->next
        3.5.2. if (curr->getCode() < sBack->next->getCode())
            3.5.2.1. curr->next = sBack->next
            3.5.2.2. sBack->next = curr
        3.5.3. Else
            3.5.3.1. Set *temp = sBack->next->next
            3.5.3.2. Set *prev = sBack->next
            3.5.3.3. while (temp != sBack->next &&
                     curr->getCode() > temp->getCode())
                3.5.3.3.1. prev = temp
                3.5.3.3.2. temp = temp->next
            3.5.3.4. if (temp == sBack->next)
                3.5.3.4.1. curr->next = sBack->next
                3.5.3.4.2. sBack->next = curr
                3.5.3.4.3. sBack = curr
            3.5.3.5. Else
                3.5.3.5.1. prev->next = curr
                3.5.3.5.2. curr->next = temp
        3.5.4. curr=Next
        3.5.5. while (curr != first)
    3.6. sBack->next = sBack->next->next
    3.7. back = sBack
4. Print "Inventory List is sorted by Inventory Code in Ascending\n"
5. Print queue
6. End
```

4.1.4. Find an Inventory

```
1.  Start
2.  Set *temp = back->next
3.  Set found = 0
4.  Print find menu
5.  Get find choice
6.  if (fChoice == 1)
    6.1. Get search key
    6.2. Do
         6.2.1. if (temp->getCode() == sKey)
                6.2.1.1. found=true
                6.2.1.2. Print the inventory detail
         6.2.2. tem=temp->next
    6.3. while (temp != back->next && found == false)
7.  else if (fChoice == 2)
    7.1. Get search key
    7.2. Do
         7.2.1. if (temp->getCode() == sKey)
                7.2.1.1. found=true
                7.2.1.2. Print the inventory detail
         7.2.2. tem=temp->next
    7.3. while (temp != back->next && found == false)
8.  Else
    8.1. Go to step 10
9.  If(found==false)
    9.1. Print “The entered value is invalid”
10. End
```

4.1.5. Display Inventory List based on Category

```
1.  Start
2.  Get category
3.  Set found=false
4.  Set *temp=back->next
5.  Do
    5.1.  if (temp->getType() == cat)
          5.1.1.  Show temp->getCode, temp->getName,
                  temp->getType, temp->getQuantity, temp->getPrice
          5.1.2.  found=true
    5.2.  temp = temp->next
6.  while (temp != back->next)
7.  if (!found)
    7.1.  Print "There is no such category in inventory list. Pls try
          again”
8.  End
```

4.1.6. Display Full Inventory List

```
1. Start
2. Set *temp = back->next
3. Do
   3.1 Display temp->getCode()
   3.2 Display temp->getName()
   3.3 Display temp->getType()
   3.4 Display temp->getQuantity()
   3.5 Display temp->getPrice()
   3.6 Set temp = temp->next;
   3.6 while (temp != back->next)
4. End
```

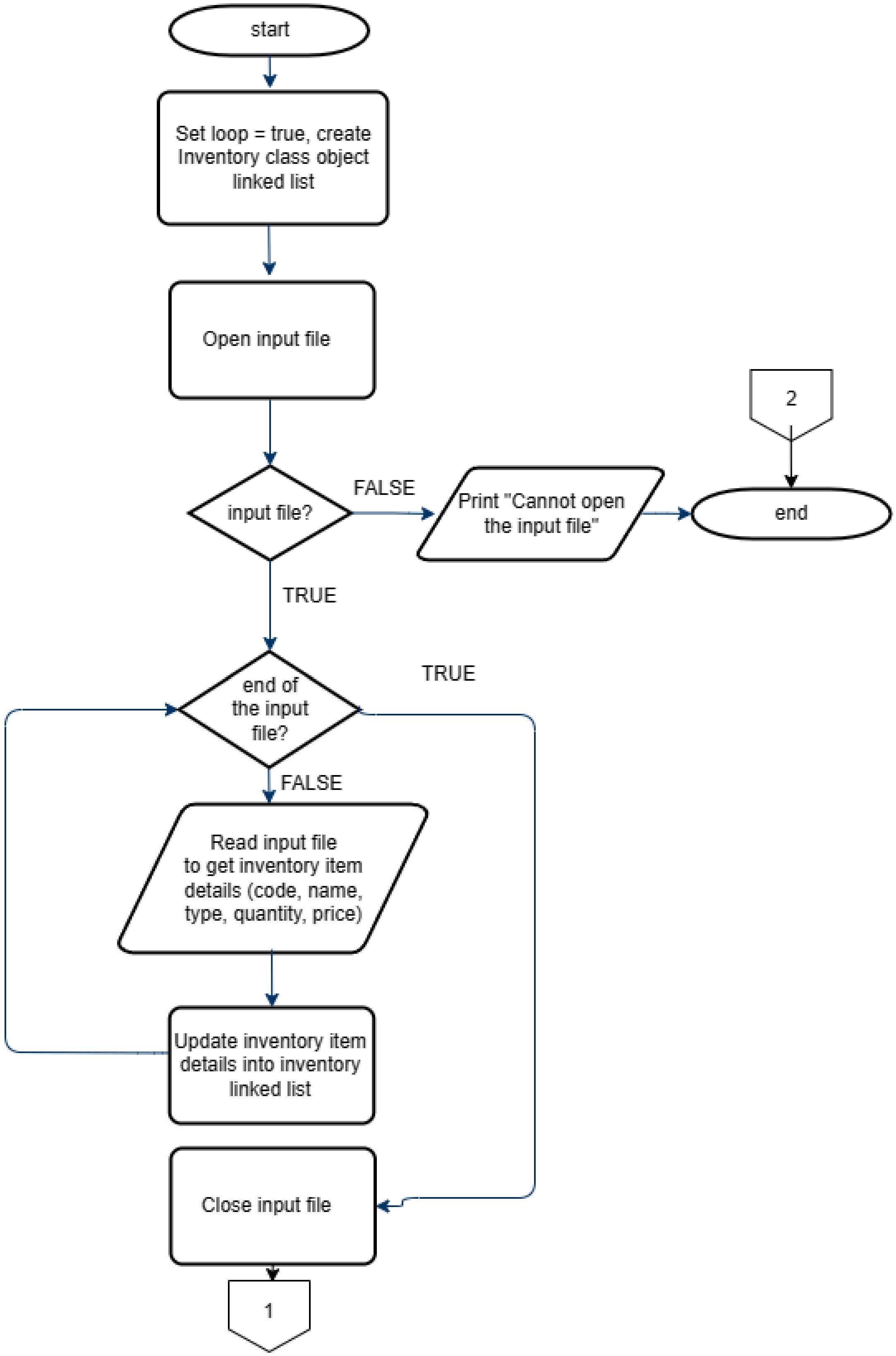
4.1.7. Update an Inventory

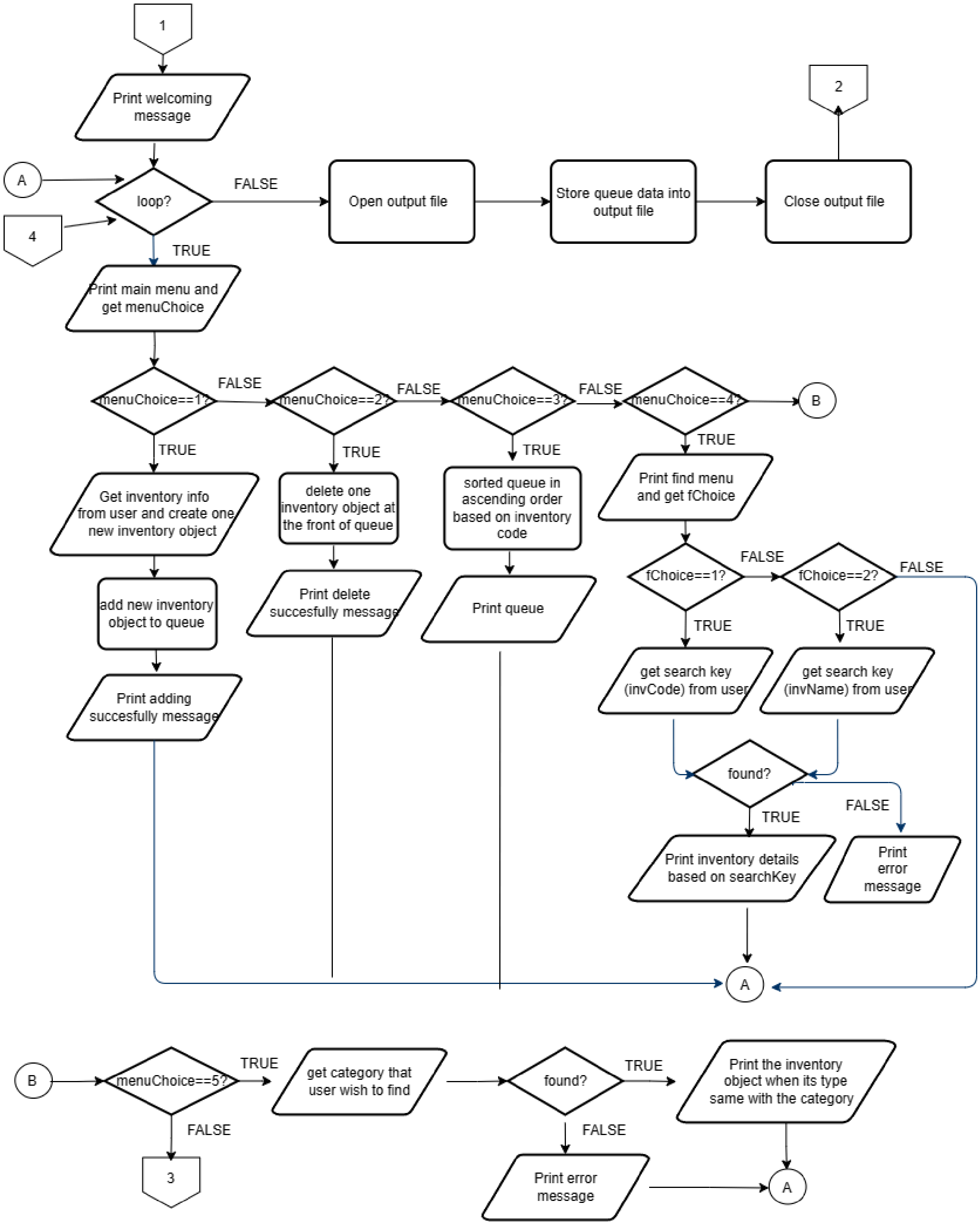
```
1.  Start
2.  Get iCode, iName, iType, choice, iQuantity, iPrice
3.  Set temp = back->next
4.  Set found = false
5.  Do
    5.1.  If ( temp->getCode == iCode)
          5.1.1.  found = true
          5.1.2.  printDetail(temp)
          5.1.3.  Break
    5.2.  temp = temp->next
6.  While (temp != back->next)
7.  If (!found)
    7.1.  Show "The entered inventory code is invalid!"
    7.2.  return
8.  Set choice = updateMenu()
9.  If (choice == 1)
    9.1.  Get iName
    9.2.  iName = changeToUpper(iName)
    9.3.  Set dup = false
    9.4.  Set findDup = back->next
    9.5.  Do
          9.5.1.  If (iName == findDup->getName())
                  9.5.1.1.  dup = true
                  9.5.1.2.  break
          9.5.2.  findDup = findDup->next
    9.6.  While ( findDup != back->next)
    9.7.  If (dup)
          9.7.1.  Show “The entered inventory name is duplicate!"
                   "Unsuccessfully update!"
    9.8.  Else
          9.8.1.  temp->putName(iName)
          9.8.2.  Show "The inventory with code [" + iCode + "] is
                  updated!"
          9.8.3.  printDetail(temp)
    9.9.  Break
10. Else if (choice == 2)
    10.1.  Get iType
    10.2.  iType = changeToUpper(iType)
    10.3.  Set temp->putType(iType)
    10.4.   display "The inventory with code [" + iCode + "] is
            updated!"
    10.5.    printDetail(temp)
    10.6.     break
11.   Else if (choice == 3)
    11.1.   Get iQuantity
    11.2.   If (chekcQuantity(iQuantity)
        11.2.1.   temp->putQuantity(iQuantity)
        11.2.2.   Show "The inventory with code [" + iCode + "] is
                  updated!"
        11.2.3.    printDetail(temp)
    11.3.   Else
        11.3.1.   Show "The entered quantity is negative value!"
                  "Unsuccessfully update!"
    11.4.   break
12.   Else if (choice == 4)
    12.1.   Get iPrice
    12.2.   temp->putPrice(iPrice)
    12.3.   Show "The inventory with code [" + iCode + "] is
            updated!"
    12.4.    printDetail(temp)
    12.5.   Break
13.   Else
    13.1.   return
14.   End
```

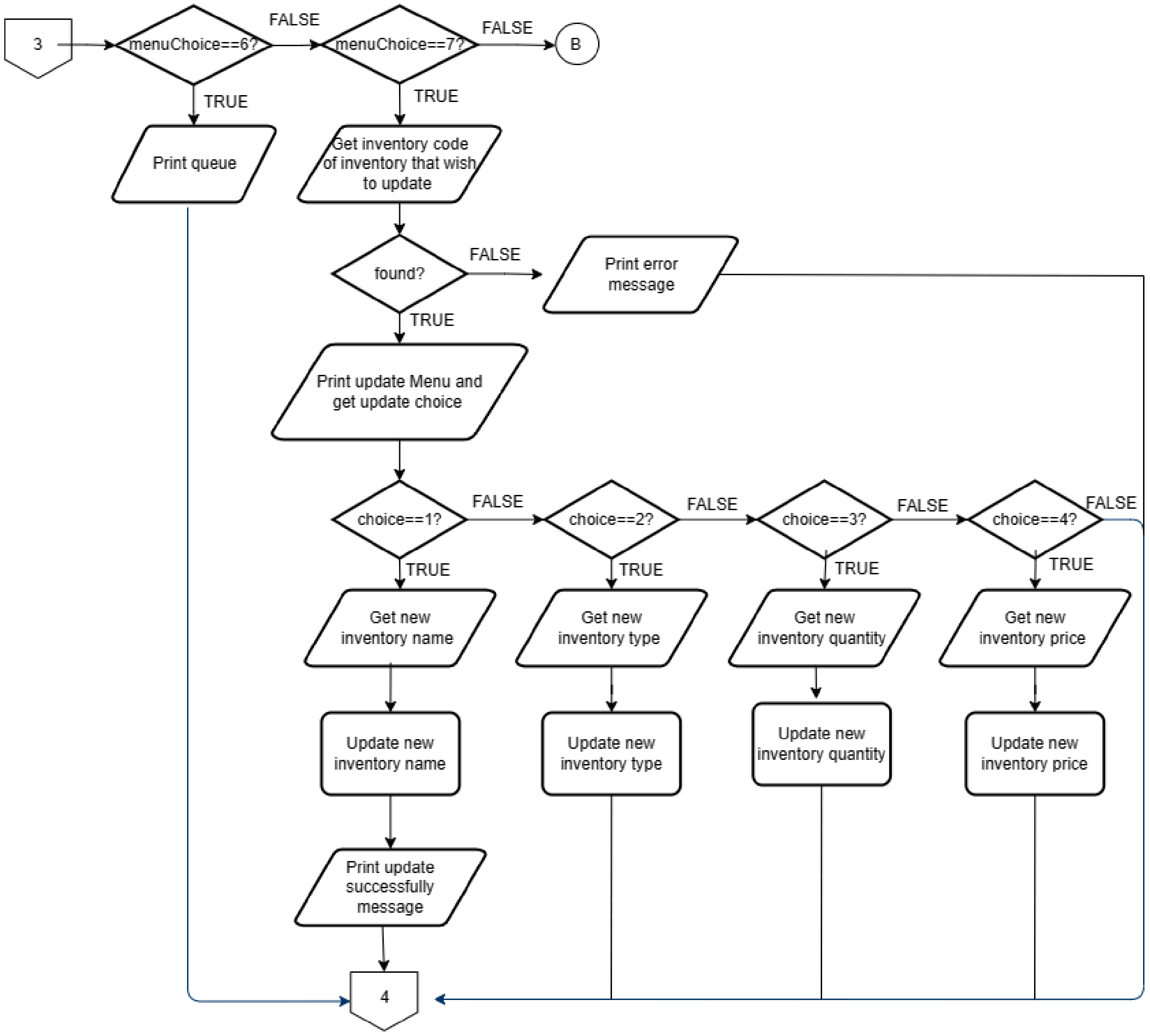
4.1.8. Check Low Stock Inventory

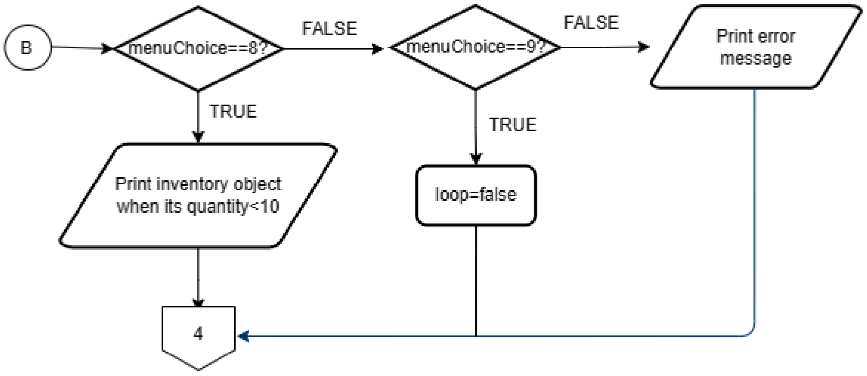
```
1. Start
2. Set min = 10
3. Set temp = back->next
4. Show Low Stock Inventory interface
5. Do
   5.1. If (temp->getQuantity < min)
        5.1.1. Show temp->getCode, temp->getName,
               temp->getType, temp->getQuantity,
               temp->getPrice
   5.2. temp = temp->next
6. While (temp != back->next)
7. End
```

4.2. Flow Chart

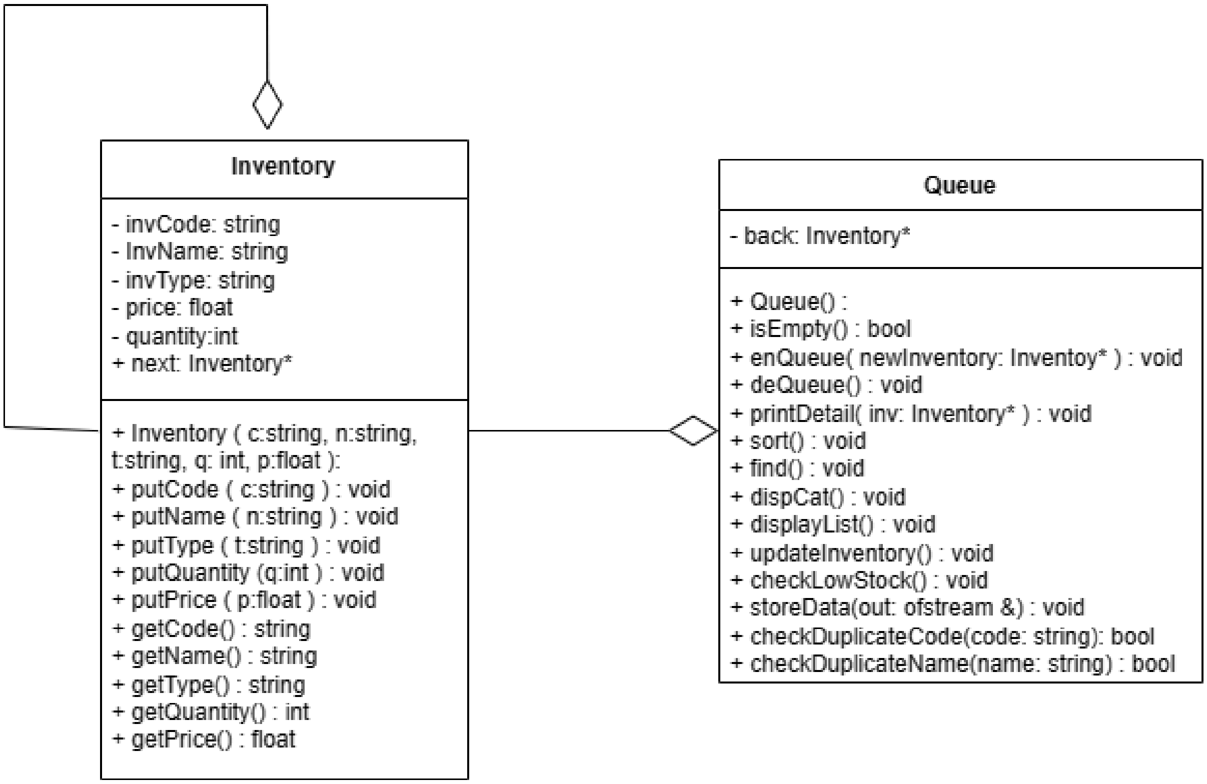

start
Set loop = true, create Inventory class object linked list
Open input file
input file?
FALSE
Print "Cannot open the input file"
end
2
TRUE
end of the input file?
TRUE
FALSE
Read input file to get inventory item details (code, name, type, quantity, price)
Update inventory item details into inventory linked list
Close input file
1


1
Print welcoming message
A
loop?
4
FALSE
Open output file
Store queue data into output file
Close output file
2
TRUE
Print main menu and get menuChoice
menuChoice==1?
FALSE
menuChoice==2?
FALSE
menuChoice==3?
FALSE
menuChoice==4?
B
TRUE
Get inventory info from user and create one new inventory object
add new inventory object to queue
Print adding succesfully message
TRUE
delete one inventory object at the front of queue
Print delete succesfully message
TRUE
sorted queue in ascending order based on inventory code
Print queue
TRUE
Print find menu and get fChoice
fChoice==1?
FALSE
fChoice==2?
FALSE
TRUE
get search key (invCode) from user
TRUE
get search key (invName) from user
found?
TRUE
FALSE
Print inventory details based on searchKey
Print error message
A
B
menuChoice==5?
TRUE
get category that user wish to find
found?
TRUE
Print the inventory object when its type same with the category
FALSE
3
FALSE
Print error message
A


3
menuChoice==6?
FALSE
menuChoice==7?
FALSE
B
TRUE
Print queue
TRUE
Get inventory code of inventory that wish to update
found?
FALSE
Print error message
TRUE
Print update Menu and get update choice
choice==1?
FALSE
choice==2?
FALSE
choice==3?
FALSE
choice==4?
FALSE
TRUE
Get new inventory name
Update new inventory name
Print update successfully message
TRUE
Get new inventory type
Update new inventory type
TRUE
Get new inventory quantity
Update new inventory quantity
TRUE
Get new inventory price
Update new inventory price
4


B
menuChoice==8?
FALSE
menuChoice==9?
FALSE
Print error message
TRUE
Print inventory object when its quantity<10
TRUE
loop=false
4

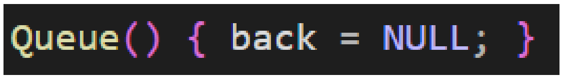
4.3. Class Diagram


Inventory
- invCode: string
- InvName: string
- invType: string
- price: float
- quantity:int
+ next: Inventory*
+ Inventory (c:string, n:string, t:string, q: int, p:float):
+ putCode (c:string) : void
+ putName (n:string) : void
+ putType (t:string) : void
+ putQuantity (q:int) : void
+ putPrice (p:float) : void
+ getCode() : string
+ getName() : string
+ getType() : string
+ getQuantity() : int
+ getPrice() : float
Queue
- back: Inventory*
+ Queue() :
+ isEmpty() : bool
+ enQueue(newInventory: Inventoy*) : void
+ deQueue() : void
+ printDetail(inv: Inventory*) : void
+ sort() : void
+ find() : void
+ dispCat() : void
+ displayList() : void
+ updateInventory() : void
+ checkLowStock() : void
+ storeData(out: ofstream &) : void
+ checkDuplicateCode(code: string): bool
+ checkDuplicateName(name: string) : bool

5. Data Structure Concept Implementation

The data structure that is implemented in this program is Queue. Queue has First-in, first-out (FIFO) property where the first item inserted into a queue will be the first item to leave the queue and at the same time the middle elements are logically inaccessible. Here, we apply the circular linked list to represent the queue. This type of linked list can provide flexible size and do not have rightward-drifting problems.

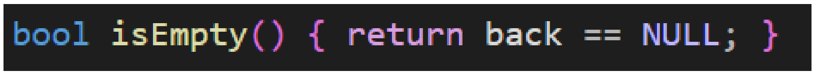
- Initial the queue by setting back = NULL



```
Queue() { back = NULL; }
```

- bool isEmpty()

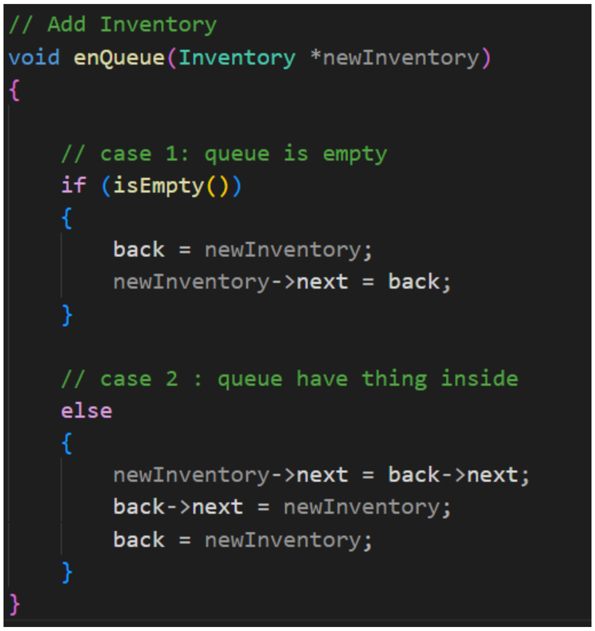
  Return true when back is equal to NULL



```
bool isEmpty() { return back == NULL; }
```

- void enQueue(Inventory *newInventory)

  Add an new inventory to the back of the queue

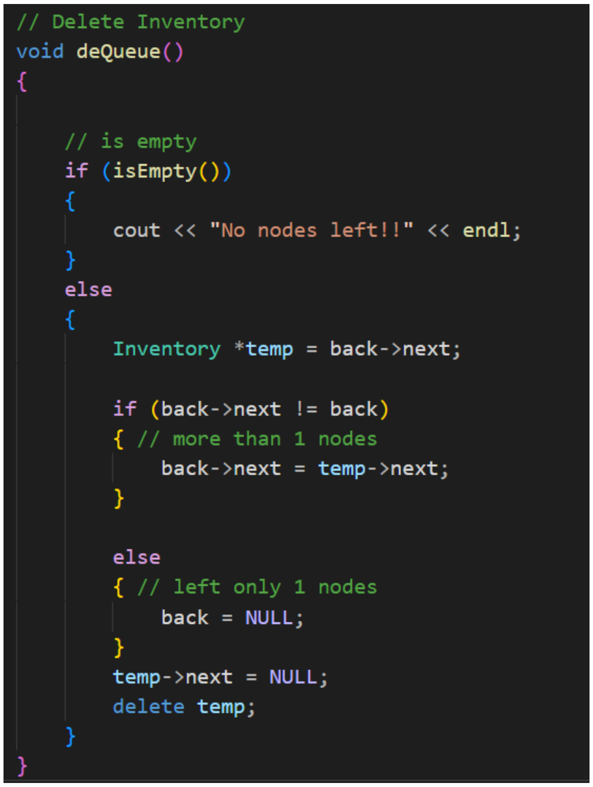


```
// Add Inventory
void enQueue(Inventory *newInventory)
{

    // case 1: queue is empty
    if (isEmpty())
    {
        back = newInventory;
        newInventory->next = back;
    }

    // case 2 : queue have thing inside
    else
    {
        newInventory->next = back->next;
        back->next = newInventory;
        back = newInventory;
    }
}
```

  - If the queue is empty, set back = newInventory, newInventory->next = back;
  - Else, newInventory->next = back->next (first element in queue), add a new element at the back of queue and set back = newInventory

- void deQueue()

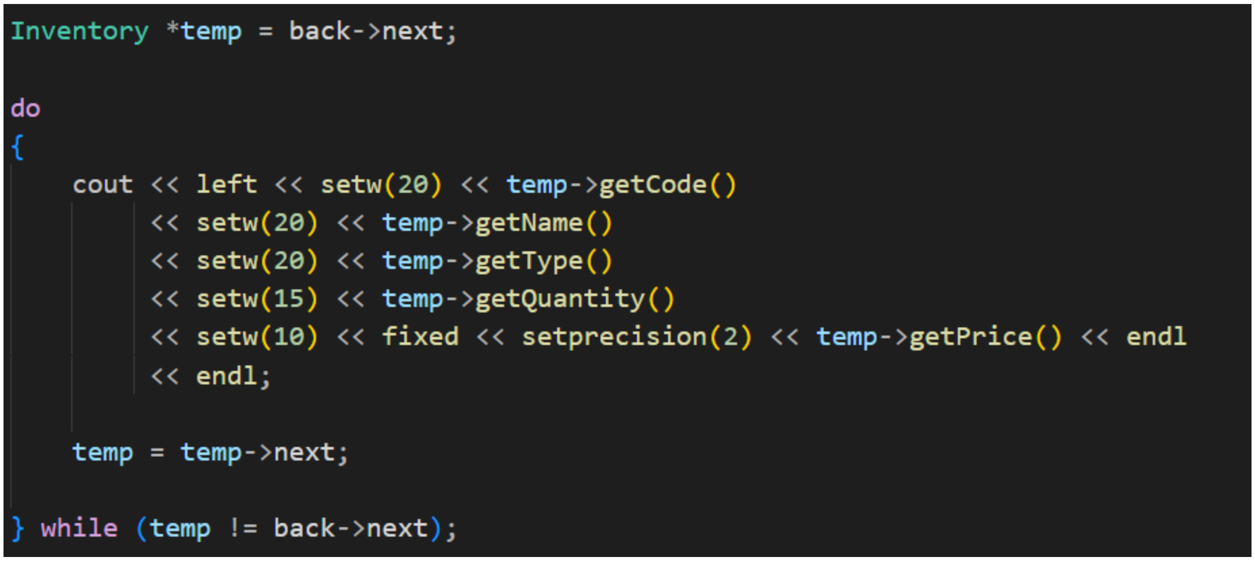
  Delete the first element in the queue



```
// Delete Inventory
void deQueue()
{

    // is empty
    if (isEmpty())
    {
        cout << "No nodes left!!" << endl;
    }
    else
    {
        Inventory *temp = back->next;

        if (back->next != back)
        { // more than 1 nodes
            back->next = temp->next;
        }

        else
        { // left only 1 nodes
            back = NULL;
        }
        temp->next = NULL;
        delete temp;
    }
}
```

- If the queue is empty, then pop out the "No nodes left" message.
- Else, set temp = back->next (first element in the queue)
  - If there is more than 1 node in the queue, link the last node the the second node in the queue
  - Else, there is only 1 node left in the queue, directly set back as NULL
- Set temp->next as NULL and delete temp

- void displayList()

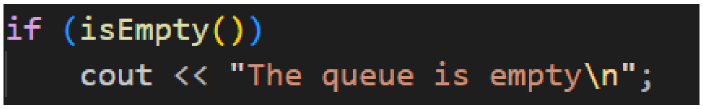


```
Inventory *temp = back->next;

do
{
    cout << left << setw(20) << temp->getCode()
         << setw(20) << temp->getName()
         << setw(20) << temp->getType()
         << setw(15) << temp->getQuantity()
         << setw(10) << fixed << setprecision(2) << temp->getPrice() << endl
         << endl;

    temp = temp->next;

} while (temp != back->next);
```

  - Set temp = back->next (first element in the queue)
  - Start looping to display the detail of temp by calling the accessors
  - Set temp = temp->next
  - End the loopint when temp == back->next (first element in the queue)

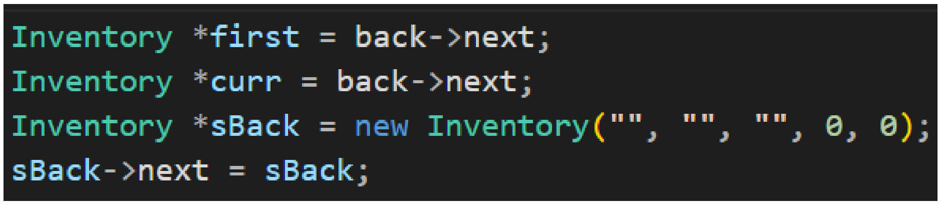
- void sort()

If the queue is empty, display “The queue is empty” message



```
if (isEmpty())
    cout << "The queue is empty\n";
```

Else, set node *first* and *curr* which point to the first node of current linked list
Also create a new circular linked list named *sBack* which the first node is a empty node

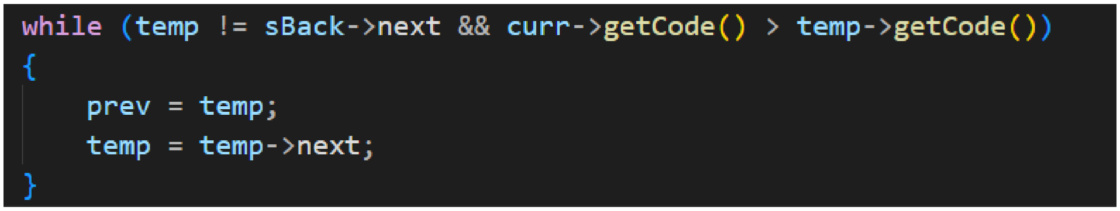


```
Inventory *first = back->next;
Inventory *curr = back->next;
Inventory *sBack = new Inventory("", "", "", 0, 0);
sBack->next = sBack;
```

Start looping and stop until *curr* == *first*

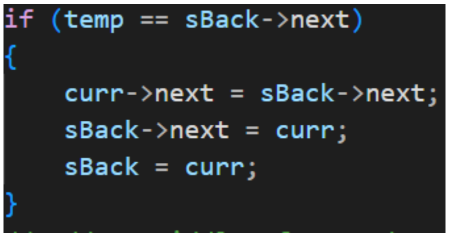
In the looping, set a new pointer *Next* which is the second node of the current linked list.

- If the *curr* node code value is smaller than the first node in the *sBack,* add the curr node before the sBack first node
- Else, do another looping to find the position where to put the current node of current linked list to *sBack* and add it into the *sBack*.



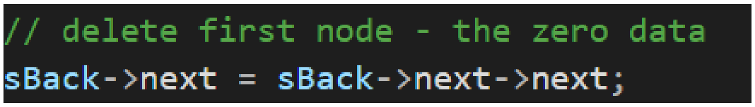
```
while (temp != sBack->next && curr->getCode() > temp->getCode())
{
    prev = temp;
    temp = temp->next;
}
```

- At the meantime, if already achieved the last node of the *sBackl*, directly insert the node at the end of the *sBack*.



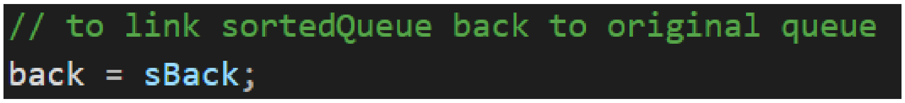
```
if (temp == sBack->next)
{
    curr->next = sBack->next;
    sBack->next = curr;
    sBack = curr;
}
```

- Delete the first empty node of the *sBack*.



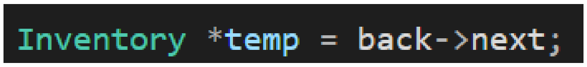
```
// delete first node - the zero data
sBack->next = sBack->next->next;
```

- Replace the original list with sorted list



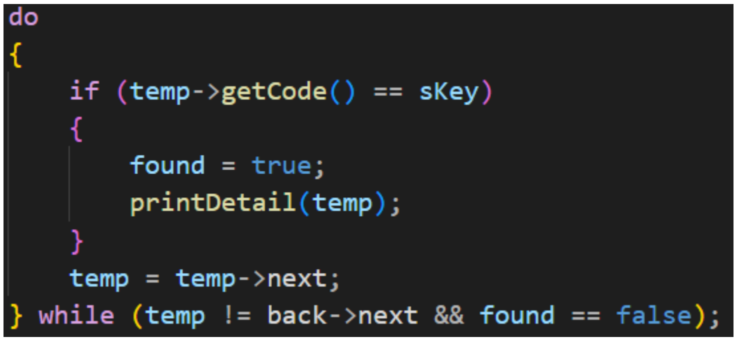
```
// to link sortedQueue back to original queue
back = sBack;
```

- void find()
    - Set a *temp* node where point to the first node of the list

      ```
      Inventory *temp = back->next;
      ```

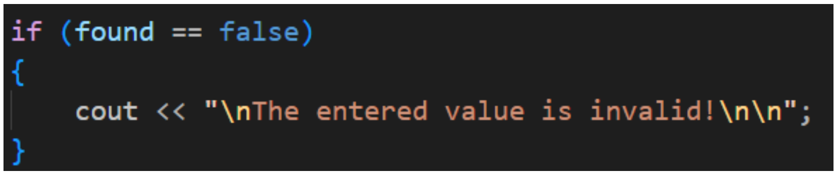
      [Example: Find an inventory by using inventory code]
    - Do the looping to compare the user input code with the code of *temp*, stop the loop when it is found or temp is the first node of the list.

      ```
      do
      {
          if (temp->getCode() == sKey)
          {
              found = true;
              printDetail(temp);
          }
          temp = temp->next;
      } while (temp != back->next && found == false);
      ```

        - If the code is the same with the entered code, set found = true and print the details of inventory.
        - Else, continue to compare the code of the next node with the entered code.

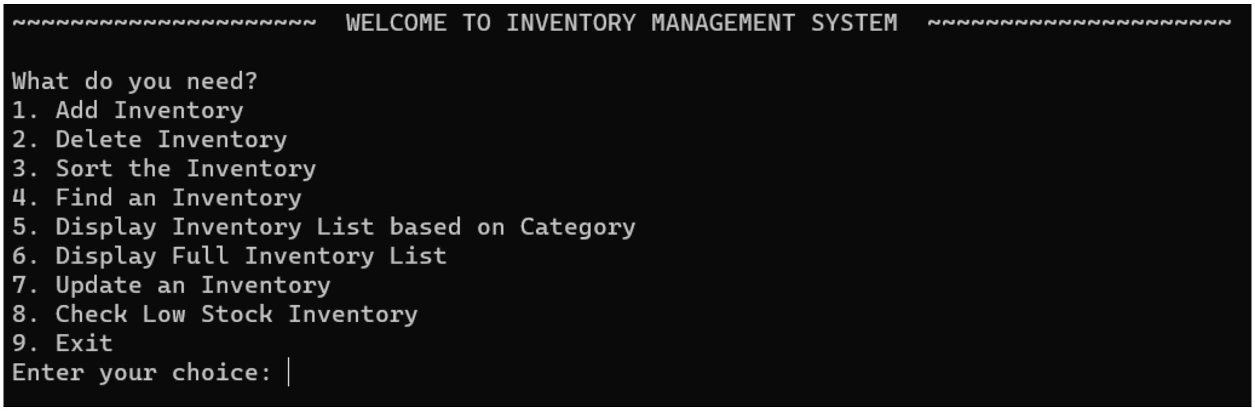
    - If it already break the loop, still cannot find the node that has the same value as the entered code, pop out a message that shows unsuccessfully finding the inventory.

      ```
      if (found == false)
      {
          cout << "\nThe entered value is invalid!\n\n";
      }
      ```

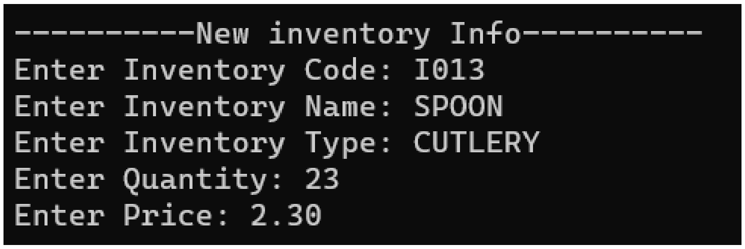
6. User Manual/Guide

Main Menu



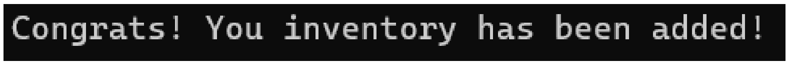
```
~~~~~~~~~~~~~~~~~~~~~  WELCOME TO INVENTORY MANAGEMENT SYSTEM  ~~~~~~~~~~~~~~~~~~~~~

What do you need?
1. Add Inventory
2. Delete Inventory
3. Sort the Inventory
4. Find an Inventory
5. Display Inventory List based on Category
6. Display Full Inventory List
7. Update an Inventory
8. Check Low Stock Inventory
9. Exit
Enter your choice: |
```

1. Add Inventory
   Enter the information of an inventory which includes inventory code, inventory name, inventory type, quantity and price.



```
----------New inventory Info----------
Enter Inventory Code: I013
Enter Inventory Name: SPOON
Enter Inventory Type: CUTLERY
Enter Quantity: 23
Enter Price: 2.30
```

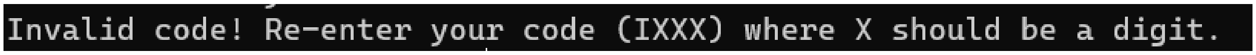
The new inventory will automatically insert at the back of the list and a success message will pop out.



```
Congrats! You inventory has been added!
```

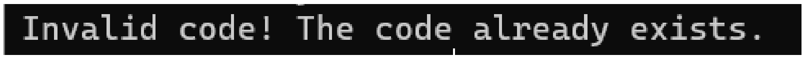
<u>Constraints</u>

**The inventory code is restricted to format "IXXX" where X should be a digit.



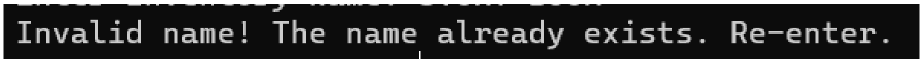
```
Invalid code! Re-enter your code (IXXX) where X should be a digit.
```

**The inventory code cannot be duplicated



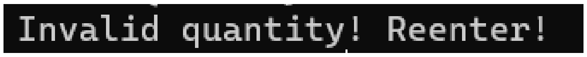
```
Invalid code! The code already exists.
```

**The inventory name cannot be duplicated



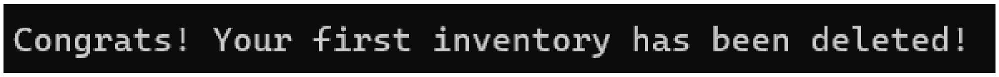
```
Invalid name! The name already exists. Re-enter.
```

**The quantity cannot in negative value



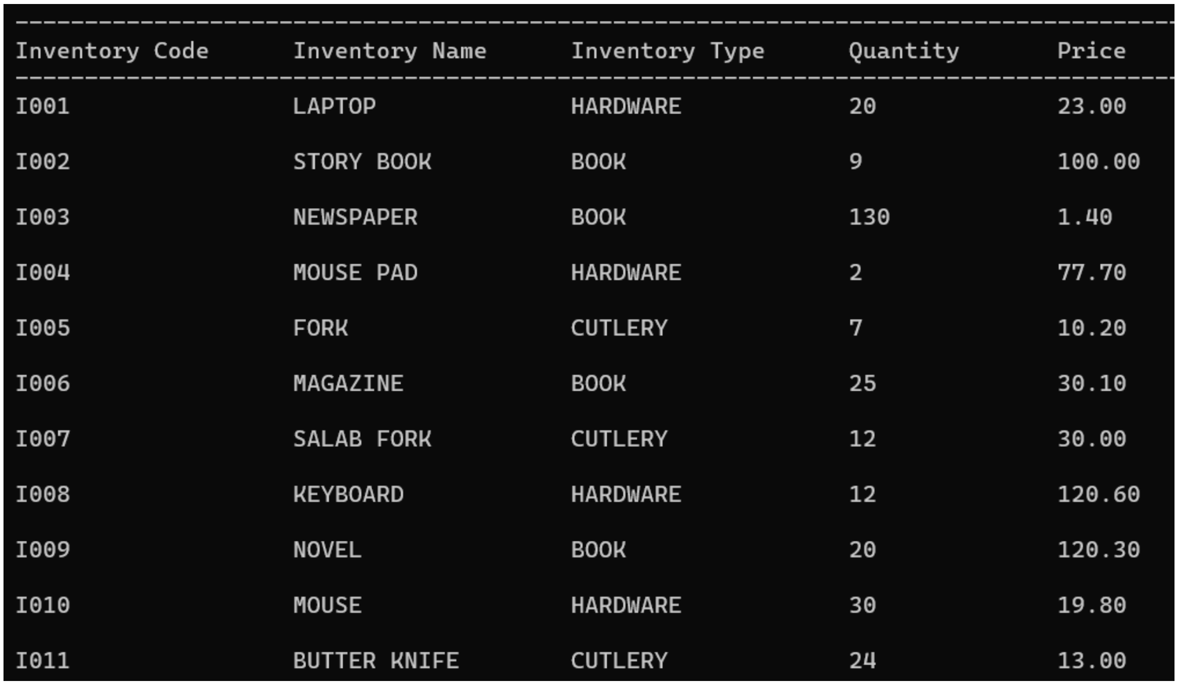
```
Invalid quantity! Reenter!
```

2. Delete Inventory
   The first inventory of the list will be deleted.



```
Congrats! Your first inventory has been deleted!
```

3. Sort the Inventory
   Sort the inventory by inventory code in ascending order.

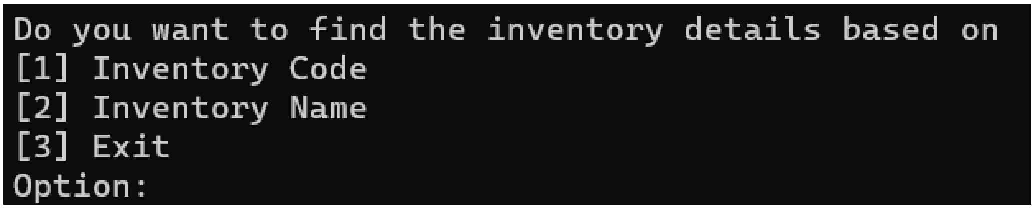


```
------------------------------------------------------------------------------------
Inventory Code      Inventory Name      Inventory Type      Quantity       Price
------------------------------------------------------------------------------------
I001                LAPTOP              HARDWARE            20             23.00

I002                STORY BOOK          BOOK                9              100.00

I003                NEWSPAPER           BOOK                130            1.40

I004                MOUSE PAD           HARDWARE            2              77.70

I005                FORK                CUTLERY             7              10.20

I006                MAGAZINE            BOOK                25             30.10

I007                SALAB FORK          CUTLERY             12             30.00

I008                KEYBOARD            HARDWARE            12             120.60

I009                NOVEL               BOOK                20             120.30

I010                MOUSE               HARDWARE            30             19.80

I011                BUTTER KNIFE        CUTLERY             24             13.00
```

4. Find an Inventory

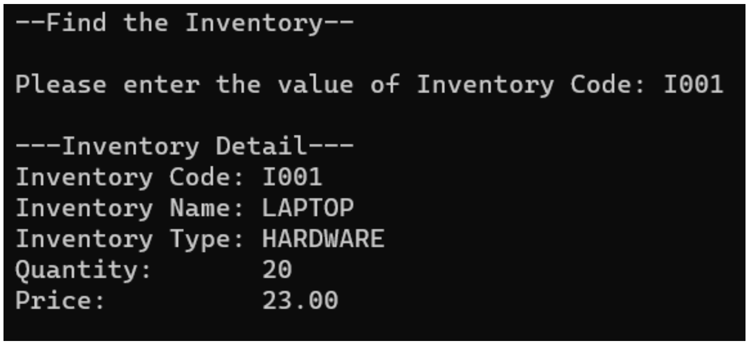
   Find the inventory details based on inventory code or inventory name.

   First, select either want to find an inventory based on inventory code or inventory name



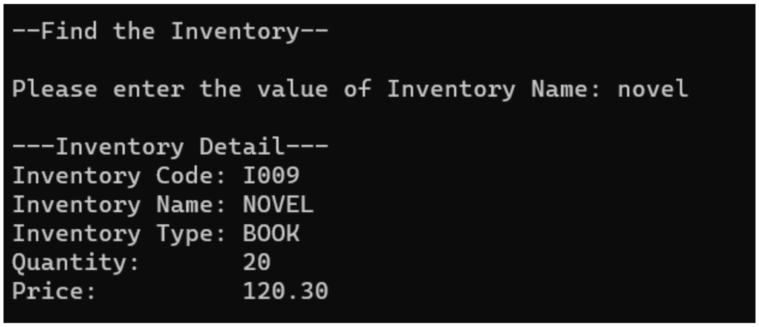
```
Do you want to find the inventory details based on
[1] Inventory Code
[2] Inventory Name
[3] Exit
Option:
```

   If choose to find an inventory based on inventory code [example: I001]



```
--Find the Inventory--

Please enter the value of Inventory Code: I001

---Inventory Detail---
Inventory Code: I001
Inventory Name: LAPTOP
Inventory Type: HARDWARE
Quantity:       20
Price:          23.00
```

   If choose to find an inventory based on inventory name [example: novel]

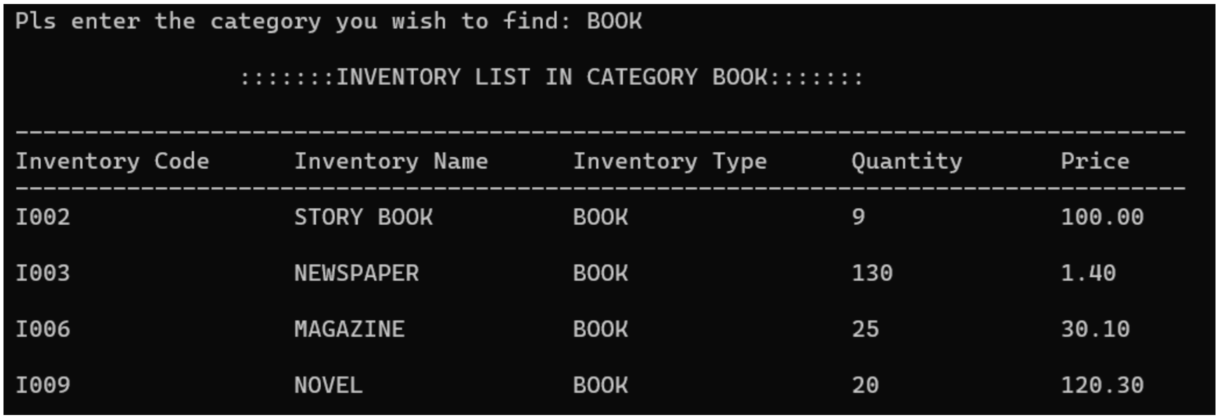


```
--Find the Inventory--

Please enter the value of Inventory Name: novel

---Inventory Detail---
Inventory Code: I009
Inventory Name: NOVEL
Inventory Type: BOOK
Quantity:       20
Price:          120.30
```

5. Display Inventory List based on Category
   Find the inventories that have the same category.

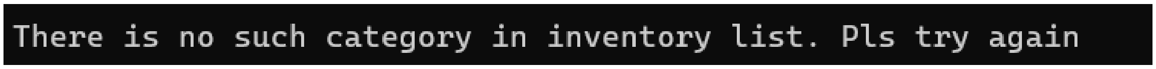
   Enter the inventory type and the list of that type will be displayed.

   Example value entered: BOOK



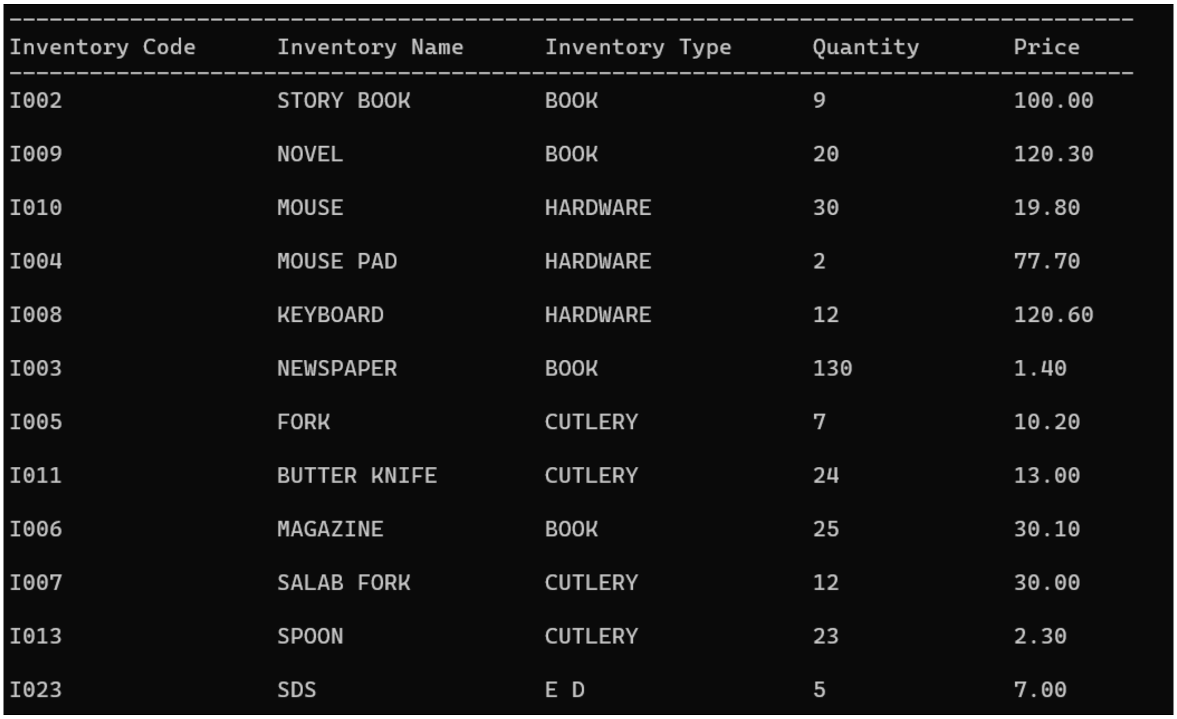
```
Pls enter the category you wish to find: BOOK

                :::::::INVENTORY LIST IN CATEGORY BOOK:::::::

------------------------------------------------------------------------------------
Inventory Code      Inventory Name      Inventory Type      Quantity       Price
------------------------------------------------------------------------------------
I002                STORY BOOK          BOOK                9              100.00

I003                NEWSPAPER           BOOK                130            1.40

I006                MAGAZINE            BOOK                25             30.10

I009                NOVEL               BOOK                20             120.30
```

   Error message if the category entered is invalid:



```
There is no such category in inventory list. Pls try again
```

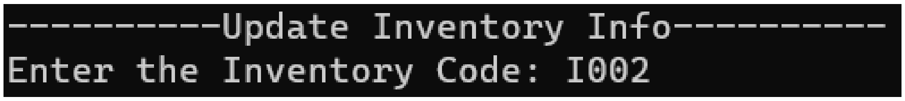
6. Display Full Inventory List
   Display of the information in the Inventory Management System



```
------------------------------------------------------------------------------------
Inventory Code      Inventory Name      Inventory Type      Quantity       Price
------------------------------------------------------------------------------------
I002                STORY BOOK          BOOK                9              100.00

I009                NOVEL               BOOK                20             120.30

I010                MOUSE               HARDWARE            30             19.80

I004                MOUSE PAD           HARDWARE            2              77.70

I008                KEYBOARD            HARDWARE            12             120.60

I003                NEWSPAPER           BOOK                130            1.40

I005                FORK                CUTLERY             7              10.20

I011                BUTTER KNIFE        CUTLERY             24             13.00

I006                MAGAZINE            BOOK                25             30.10

I007                SALAB FORK          CUTLERY             12             30.00

I013                SPOON               CUTLERY             23             2.30

I023                SDS                 E D                 5              7.00
```

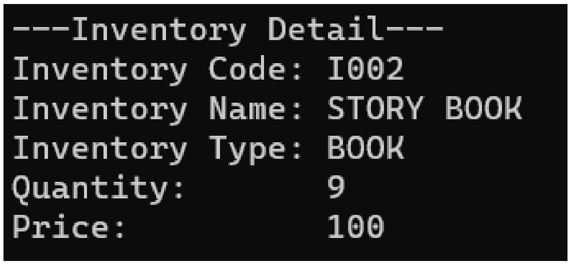
7. Update an Inventory
   Update the part of inventory either inventory name, inventory type, quantity or price by using their inventory code to define them.

   Enter the inventory code of the inventory that desired to update



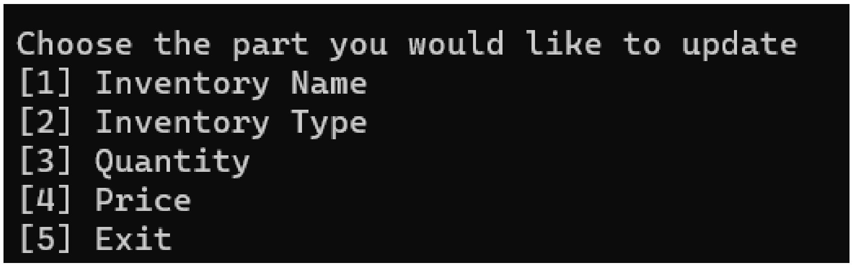
```
----------Update Inventory Info----------
Enter the Inventory Code: I002
```

   The details of the inventory will be displayed. Check it.



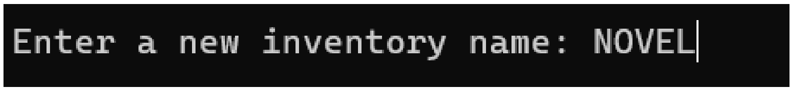
```
---Inventory Detail---
Inventory Code: I002
Inventory Name: STORY BOOK
Inventory Type: BOOK
Quantity:       9
Price:          100
```

   Select the part that would like to update



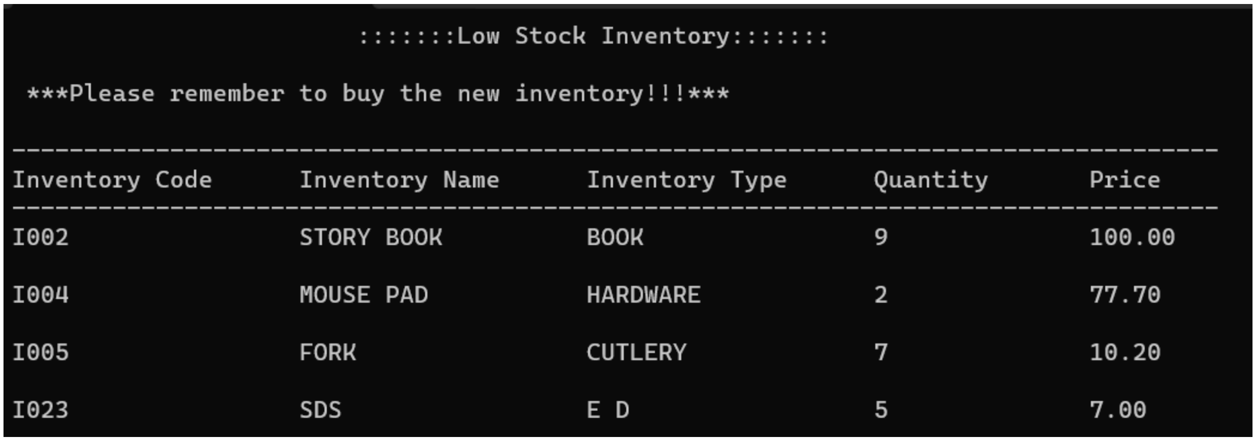
```
Choose the part you would like to update
[1] Inventory Name
[2] Inventory Type
[3] Quantity
[4] Price
[5] Exit
```

   Enter a new value for the part (example: [1] Inventory Name)



```
Enter a new inventory name: NOVEL
```

8. Check Low Stock Inventory
   Display the information of the inventory with quantity less than 10.



```
                        ::::::Low Stock Inventory::::::

 ***Please remember to buy the new inventory!!!***

-----------------------------------------------------------------------------------
Inventory Code      Inventory Name      Inventory Type      Quantity       Price
-----------------------------------------------------------------------------------
I002                STORY BOOK          BOOK                9              100.00

I004                MOUSE PAD           HARDWARE            2              77.70

I005                FORK                CUTLERY             7              10.20

I023                SDS                 E D                 5              7.00
```

9. Exit
   Exit and terminate the program.

7. Conclusion

To sum up, a queue which implements a circular linked list is a robust and efficient solution for inventory management systems as there are no size restrictions for pointer-based implementations. Also, the queue has restricted the position to the front and back, only the end position can be accessed. This makes the insertion, deletion operation more efficient.

Compared to our assignment 2 system, we have added more features for our system. Firstly, this system enables users to get the list of inventory by category. Secondly, we also provide a function to update the inventory details so that the workers can update the inventory details such as price and quantity when they change. Thirdly, this system allows workers to check the low stock too. If the stock of inventory is less than 10, it will be displayed. Lastly, we also add more constraints to ensure our data integrity and consistency such as restricting duplication of name, code, quantity cannot be less than 0 and code format must be in IXXX where X should be digit.

It is possible to conclude that this program is more complete, integrity and efficient than the previous program in Assignment 2.