I did not take pictures of all the screens - please look at the Powerpoint.

Bubble sort - PASS #1

Original numbers:

5 6 2 3 4

SUB1 1

SUB2 2

HOLD

END PT 5

FLIP CT 0

Compare 5 which is what SUB1 is pointing to and 6 which is what SUB2 is pointing to.
In this instance, 5 < 6 so nothing is done.

After numbers:

5 6 2 3 4
Bubble sort - PASS #1

Before numbers:

- SUB1: 5 6 2 3 4
- SUB2: 1 2
- HOLD: 6
- END PT: 5
- FLIP CT: 0 1

Three steps in flip:
1) Number SUB1 is pointing to is moved to HOLD
2) Number SUB2 is pointing to is moved to END PT
3) Number FLIP CT is incremented

Compare 6 which is what SUB1 is pointing to and 6 which is what SUB2 is pointing to.
In this instance, 6 > 2 so flip and add one to the flip-ct.

After numbers:

- 5 2 6 3 4
At this point we notice that 6 has to flip to the bottom.

Before numbers:

```
5 2 3 4
```

After numbers:

```
2 3 4 5
```

Compare 6, which is what SUB1 is pointing to and 4 which is what SUB2 is pointing to. In this instance 6 > 4 so flip and add one to the flip counter.
**Bubble sort - PASS #3**

**Before numbers:**
- 2
- 3
- 4
- 5
- 6

**SUB1**
- 1
- 2
- 3

**SUB2**
- 2
- 3
- 4

**HOLD**

**END PT**
- 3

**FLIP CT**
- 0

END-PT signals the end of the pass. We can test either by using SUB2 > END-PT or SUB1 = END-PT.

At this point SUB2 is greater than END-PT so the pass is complete. AND since there were no flips the sort is complete.

**After numbers:**
- 2
- 3
- 4
- 5
- 6

The sort is complete because there has been a pass with no flips or because there have been the right number of passes (with 5 elements, the right number of passes would be 4). Note that this can be measured against END-PT.
The code starts sub1 and sub2 at 0 while the logic code in the powerpoint starts at 1.
Three steps in flip:
1) Number and name SUB1 is pointing to is moved to hold
2) Number and name SUB2 is pointing to is moved to the spot where SUB1 is pointing
3) Number and from HOLD is moved to spot where SUB2 is pointing

Topdown logic - again please see the Powerpoint.
Back to the bubble. The topdown is the one you need to write for homework.
MOD 11 Check Digit

A check digit is a number that is used to validate a series of numbers whose accuracy you want to ensure. Frequently the last digit of a number using such as identification number is a check digit. Let's say the identification number starts out at 6 digits. A calculation is done using the six digits and a seventh digit is produced as a result of the calculation. This number is the check digit. There are many calculations that can be used - this example illustrates the logic of the MOD 11 check digit.

Steps to calculate the MOD11 check digit for a number such as an ID #:
- Assign weights to each digit of the ID #. The weights in MOD11 are from 2 through a maximum of 10 beginning with the low order position at the field.
- Each digit in the ID # is multiplied by its weight
- The results of the multiplication are added together
- This product is divided by the modulus number 11
- The remainder is subtracted from the modulus number 11 giving the check digit

Example: find the check digit for the number 036532

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>2</th>
<th>6</th>
<th>5</th>
<th>3</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>x7</td>
<td></td>
<td>x6</td>
<td>x5</td>
<td>x4</td>
<td>x3</td>
<td>x2</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>18</td>
<td>30</td>
<td>20</td>
<td>9</td>
<td>4</td>
</tr>
</tbody>
</table>

\[0 + 18 + 30 + 20 + 9 + 4 = 81\]

\[81/11 = 7\text{ remainder }4\]

\[11 - 4 = 7\]

6 is therefore the check digit.

PROBLEMS: If the remainder from the division is 0 or 1, then the subtraction will yield a two digit number of either 10 or 17. This won't work, so if the check digit is 10, then X is frequently used as the check digit and if the check digit is 11 then 0 is used as the check digit. If X is used, then the field for the check digit has to be defined as character extending or there will be a numeric problem.

Steps to verify if the check digit is included as part of the number:
- The entire number is multiplied by the same weights that were used to calculate and the check digit itself is multiplied by 1.
- The results of the multiplication are added together.
- The sum is divided by 11 and if the remainder is 0, the number is correct.

PROBLEM: Note that if the check digit is X then 10 is used in the multiplication. Code for this occurrence must be included.

Example of verifying the number 0365317 where 7 is the calculated MOD11 check digit

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>5</th>
<th>3</th>
<th>2</th>
<th>7</th>
</tr>
</thead>
</table>
Example: find the check digit for the number 036532.

\[
\begin{array}{cccccc}
0 & 3 & 6 & 5 & 3 & 2 \\
18 & 0 & 0 & 0 & 0 & 0 \\
\end{array}
\]

\[0 + 18 + 30 + 20 + 9 + 4 = 81\]

\[81 \div 11 = 7 \text{ remainder } 4\]

\[11 - 4 = 7\]

Therefore the check digit is 7.

**Problems:** If the remainder from the division is 0 or 1, then the subtraction will yield a two-digit number of either 10 or 11. This won't work, so if the check digit is 10, then X is frequently used as the check digit and if the check digit is 11 then 0 is used as the check digit. If X is used, then the field for the check digit has to be defined as character testing or there will be a numeric problem.

Steps to verify if the check digit is included as part of the number:

1. The entire number is multiplied by the same weights that were used to calculate and the check digit itself is multiplied by 1.
2. The results of the multiplication are added together.
3. The sum is divided by 11 and if the remainder is 0, the number is correct.

**Problem:** Note that if the check digit is X then 10 is used in the multiplication. Code for this occurrence must be included.

Example of verifying the number 0365327 where 7 is the calculated MOD11 check digit:

\[
\begin{array}{ccccccc}
0 & 3 & 6 & 5 & 3 & 2 & 7 \\
18 & 0 & 0 & 0 & 0 & 0 & 0 \\
\end{array}
\]

\[0 + 18 + 30 + 20 + 9 + 4 + 7 = 88\]

\[88 \div 11 = 8 \text{ remainder } 0\]

Since the remainder from this calculation is 0, the check digit 7 is valid.
Example: find the check digit for the number 036532

\[
\begin{array}{cccccc}
0 & 3 & 6 & 5 & 3 & 2 \\
\times 7 & \times 6 & \times 5 & \times 4 & \times 3 & \times 2 \\
0 & 21 & 30 & 20 & 9 & 4 \\
\end{array}
\]

\[0 + 21 + 30 + 20 + 9 + 4 = 81\]

\[81/11 = 7 \text{ remainder } 4\]

\[11 - 4 = 7\]

Therefore the check digit is 7.

**PROBLEMS:** If the remainder from the division is 0 or 1, then the subtraction will yield a two-digit number of either 10 or 11. This won’t work, so if the check digit is 10, then a is frequently used as the check digit and if the check digit is 11 then 0 is used as the check digit. If a is used, then the field for the check digit has to be defined as character text editing or there will be a numeric problem.

Steps to verify if the check digit is included as part of the number:

- The same number is multiplied by the same weights that were used to calculate and the check digit itself is multiplied by 1.
- The results of the multiplication are added together.
- The sum is divided by 11 and if the remainder is 0, the number is correct.

**PROBLEM:** Note that if the check digit is 0 then 10 is used in the multiplication. Code for this occurrence must be included.

Example: verifying the number 0365327 where 7 is the calculated \( \text{MOD}11 \) check digit

\[
\begin{array}{cccccc}
0 & 3 & 6 & 5 & 3 & 2 & 7 \\
\times 7 & \times 6 & \times 5 & \times 4 & \times 3 & \times 2 & \times 1 \\
0 & 21 & 30 & 20 & 9 & 4 & 7 \\
\end{array}
\]

\[0 + 21 + 30 + 20 + 9 + 4 + 7 = 88\]

\[88/11 = 8 \text{ remainder } 0\]

Since the remainder from this calculation is 0, the check digit 7 is valid.
Example find the check digit for the number 036532

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0 + 18 + 30 + 20 + 9 + 4 = 81
81/11 = 7 remainder 4
11 - 4 = 7

Therefore the check digit is 7.

PROBLEMS: If the remainder from the division is 0 or 1, then the subtraction will yield a two-digit number of either 10 or 11. This won't work, so if the check digit is 10, then X is frequently used as the check digit and if the check digit is 11 then 0 is used as the check digit. If X is used, then the field for the check digit has to be defined as character text string or there will be a numeric problem.

Steps to verify if the check digit is included as part of the number:
- The entire number is multiplied by the same weights that were used to calculate and the check digit itself is multiplied by 1.
- The results of the multiplication are added together.
- The sum is divided by 11 and if the remainder is 0, the number is correct.

Example of verifying the number 0365327 where 7 is the calculated MOD11 check digit:

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</tr>
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</table>

0 + 18 + 30 + 20 + 9 + 4 + 7 = 88
88/11 is 8 remainder 0

Since the remainder from this calculation is 0, the check digit 7 is valid.
I am setting up a structure called itemInfo which is made up of itemNo and itemName.