CS6102– Computational Thinking

Week -7

28 – Dec-2022

Object Description Abstraction, Modelling

Algorithmic Decomposition and Flowchart

Object Description - Abstraction and Modeling

Describe an object that is used every day. Imagine that the object has j**ust been invented** and has to describe the object.

1. Think about and list the attributes of the object that are needed to describe and define the object
2. List the behaviors of the object.
    1. The functions / uses of the object
    2. What are the needs fulfilled by the object?
    3. The physical attributes and characteristics of the object (components or parts, shape or materials, general dimensions, connections between parts
3. There are some specifications to describe all of the attributes and functions of the object:
    1. Use clear, non-technical language, to describe the object's function, the need it fulfills and its attributes.
    2. Your description must be specific enough so that someone who has never seen the object could visualize it, understand how it works, and appreciate the benefits it provides.
    3. Describe the object using at least 150 words and listing a minimum of 6 attributes. Keep in mind that attributes should involve all of your senses. (e.g. Is it smooth? Does it make a noise? Does it have an odour? etc)

Objects that can be considered:

- ➢ **Scissors**
- ➢ **Measuring tape**
- ➢ **Stapler**
- ➢ **Umbrella**
- ➢ **Scale**
- ➢ **Key**
- ➢ **Notebook**
- ➢ **Television**
- ➢ **Mobile phone**
- ➢ **Knife**
- ➢ **Spoon**
- ➢ **Tumbler**
- ➢ **Pen**
- ➢ **Printer**

Reading and Understanding:

Mapping to Computer Science (*for better understanding of the concepts*):

Q1. Consider your object as if you were a computer program. Let's draw a diagram that shows all of its functions as boxes, and for each function, its inputs (i.e. what is required to use the object in this way?) and outputs (i.e. what is produced when the object is used in this way?). Now draw the diagram of the object. Ask, Are there inputs and outputs that repeat for different functions?

Q2. Are there functions that are similar and can be combined so that the object can be represented with a more concise program (i.e. fewer steps or boxes)?

Q3. Think about the physical attributes and characteristics of your object. Organize these so that each is declared as a variable with its proper type (e.g. 'color,' 'material type,' 'height,' 'weight')**. Can some of these attributes and characteristics be arranged into a hierarchy of related attributes and characteristics** (e.g. 'Material Type' can indicate weight or color, but weight and color do not indicate material type)**?**

Q4. How does abstraction in Computer Science relate to the process of identifying the functions and characteristics as you have done in this exercise?

SOME MORE NOTES FOR REFERENCE:

Patterns are things that are the same within a problem and between problems.

- Identifying patterns means that there is probably an existing solution already out there.
- Pattern recognition is based on the 5 key steps of:
  - Identifying common elements in problems or systems
  - Identifying and Interpreting common differences in problems or systems
  - Identifying individual elements within problems
  - Describing patterns that have been identified
  - Making predictions based on identified patterns.
- Pattern abstraction is hiding the complexities of one pattern from another.
- Pattern generalisation is spotting things that are common between patterns.
- We can represent parts of a system in general terms, including Variables, Constants, Key Processes, repeated Processes, Inputs and Outputs.

Algorithmic Decomposition and Flowchart

Notes:

Keywords: Iteration (repetition), Variables, Filtering, Flowchart, Pseudocode, Procedures and parameters

To visualize the activities of task decomposition we use:

Sequence of steps, **Flowchart, Pseudocode, Procedures and parameters**

Sequence of steps:

Ex: Count the number of items in a shopping cart (Maintain two piles, uncounted pile – pile 1, counted pile – pile 2)

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Step 0: Start

Step 1: Initialize *count* to 0

Step 2: Check items in pile 1

Step 3: if no more items, go to step 8

Step 4: pick an item **x** from pile 1

Step 5: move item **x** to pile 2

Step 6: increment *count*

Step 7: Go back to step 2

Step 8: End

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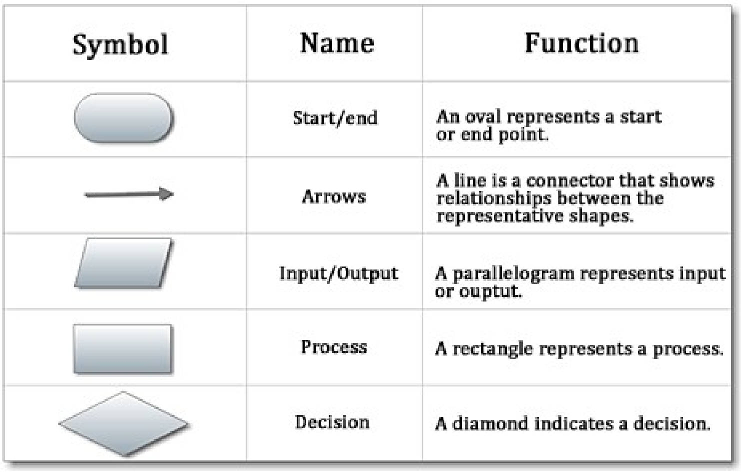
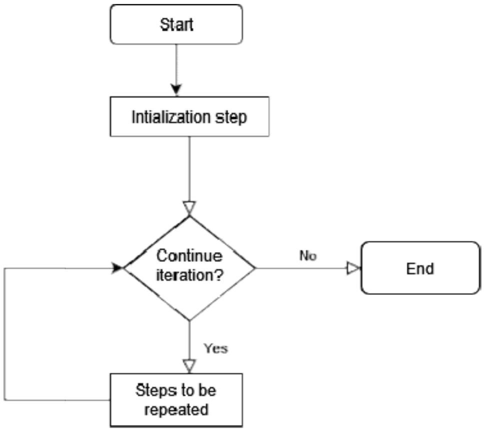
Flowchart

What are the five basic flowchart symbols? The **oval, parallelogram, rectangle, diamond, and arrow** are the basics.



Symbol	Name	Function
⬭	Start/end	An oval represents a start or end point.
→	Arrows	A line is a connector that shows relationships between the representative shapes.
▱	Input/Output	A parallelogram represents input or ouptut.
▭	Process	A rectangle represents a process.
◇	Decision	A diamond indicates a decision.

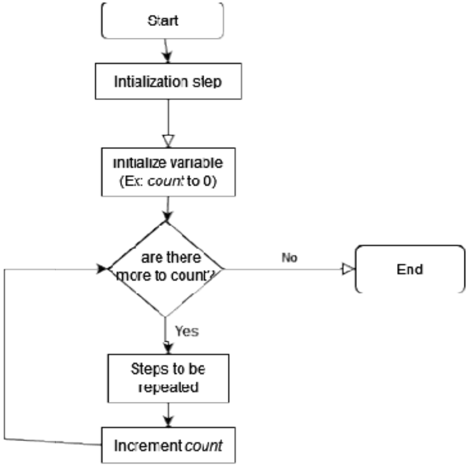
i) A simple generic iterator flowchart:



Using Iterator flowchart, identify the activities (initialization, repetition, decision step) to be done for each of the following tasks:

T1: Locating a specific house in a street.
T2: Making a list of all the buses that stop at a given bus-stop

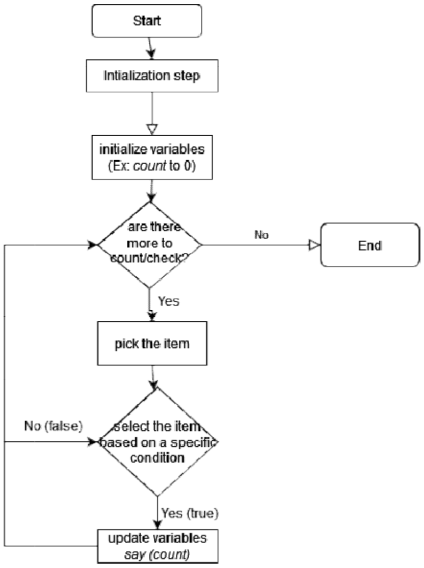
ii) A generic flowchart for iterator with variables:



T3: Sum the values of items in a shopping cart
T4: Compute average value of the items in the shopping cart

ii) A generic flowchart for iterator with filtering:

When we need to perform some operation on a subset of the data items by selection, we use filtering


Start
Intialization step
initialize variables (Ex: count to 0)
are there more to count/check?
No
End
Yes
pick the item
No (false)
select the item based on a specific condition
Yes (true)
update variables say (count)

T5: Collecting and counting all heights in a class of students between 160 and 180 cms
T6: No. of words starting with letter ‘p’ in a paragraph of text.
T7: group the words (3 groups) in a paragraph according to the lengths of the words.
T8: search for a specific city in a list of cities

Pseudocode:

Simple counting:

```
****************************************
      Start
      Count = 0
      While (pile 1 has more items) {
      Pick an item x from pile 1
      Move x to pile 2
      Increment count
      }
      End
****************************************
```

Simple sum:

```
****************************************
      Start
      Sum = 0
      While (pile 1 has more items) {
      Pick an item x from pile 1
      Move x to pile 2
      Add value of x to sum
      }
      End
****************************************
```

Procedure:

Procedure for item with max price

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```
Procedure findMax(items)
        max = 0
While (pile 1 has more items) {
Pick an item x from pile 1
Move x to pile 2
        If (x.price>max){
        max = x.price
        }
}
return (max)
End findMax
```

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EXERCISES

Note:

1. for all questions start with *simple sequence of steps* (described above) and draw flowcharts (described above)
2. Refer to the word **algorithm** as “sequence of steps” and “flowchart” to visualize

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1. Answer the questions from T1 to T8 from the description above under each category.
2. Write an *algorithm* to read two numbers from user, add and print the result.
3. Write an *algorithm* to print your address in the following format:

   Name,
   Register number,
   Department,
   University,
   Place – pin code.
4. Write an *algorithm* to find average age of students of a class.
5. Design an *algorithm* and draw a *flowchart* to convert a decimal number, n, to binary format.
6. Write an *algorithm* to swap two numbers and draw the flow chart for the same.
7. Write an algorithm and draw a *flowchart* to find the sum of first 100 natural numbers.
8. Write an algorithm and draw a *flowchart* which generates first 50 items of the Fibonacci series: 1, 1, 2, 3, 5, 8,…?
9. Write an *algorithm* to read a character in upper case and then print it in lower case.
10. Write an *algorithm* to read numbers from the user until -1 is encountered. Count the number of Positive, negative and zero entered by the user.

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