

## Session 6: Input – Process – Output Chart

### 6.1 Introduction

In Session 3, we defined six steps used the problem solving process; and went ahead to discuss the first step in this session we will describe how the computer solution is specified using an algorithm and further complete Input – Process – Output chart. We will also discuss the concept of algorithm in brief.

### 6.2 Plan an Algorithm

We define the term algorithm as an ordered set of unambiguous steps that produces a result and terminates in a finite time. In simple terms an algorithm is a well-defined, ordered set of instructions. After going through the all instructions in an algorithm we expect a result from the algorithm. It is also important to note that an algorithm must terminate.

1. Calculate the amount of tip to be paid.
2. Display the amount of tip to be paid.
3. Subtract liquor charge from total bill to get the amount to be charged tip (call this amount as 'tip amount bill').
4. Calculate the tip amount as a percentage of tip amount bill.

Figure 3-3: Initial attempt on Requirements Specification for Mahir Athman problem

*(Brought here for reference purposes only, it was discussed in Session 3 earlier)*

We have a starting point to write the algorithm for the Mahir Athman problem. As we can see in Figure 3-3 above, in general there are two tasks defined in requirements 1 and 2 respectively; however, if we follow that list of requirements as an algorithm, it will not suffice – reason, we cannot display the value of the tip in requirement 2 while we have not computed the value in requirement 4. Therefore, there is need to rearrange the requirements, to make all the requirements logically flow as they are executed; this will result into our initial algorithm to solve the Mahir Athman problem as shown in Figure 6-1 below:

1. Calculate the amount of tip to be paid.
2. Subtract liquor charge from total bill to get the amount to be charged tip (call this amount as 'tip amount bill').
3. Calculate the tip amount as a percentage of tip amount bill.
4. Display the amount of tip to be paid.

Figure 6-1: Initial Algorithm for Mahir Athman problem

Remember, we had an assumption for the input data items; again from Figure 3-3, input to this program is not stated as a step in the algorithm; thus, we also need to add at the beginning an input step for the input data items. Again, from Figure 6-1, it is evident that step 1 can actually be

achieved through step 2 and 3; hence no need to have step 1. This modification realizes the algorithm in Figure 6-2 as follows:

- |  |
|--|
| <ol style="list-style-type: none"><li>1. Enter total bill, liquor charge and tip percentage.</li><li>2. Subtract liquor charge from total bill to get the amount to be charged tip (call this amount as 'tip amount bill').</li><li>3. Calculate the tip amount as a percentage of tip amount bill.</li><li>4. Display the amount of tip to be paid.</li></ol> |
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Figure 6-2: The Algorithm for Mahir Athman problem

From Figure 6-2, you realize that each step in the algorithm describe an action that the computer needs to take. Therefore, each step starts with a verb. In most cases, algorithms begin with a step to enter input data items into the computer. The steps that follow, usually record how the input data items are processed to achieve the problem's output. The processing involves performing one or more calculations using the input data items. Most algorithms end with a step to display, print or store the output items.

Now, that we have an algorithm that define the steps to solve the problem; it is imperative to complete, the Input, Processing and Output chart (**IPO Chart**)- which is used to organize and summarize the analysis step. You record the input items in the Input column of the IPO chart, record the processing items in the Processing column and record the output items in the Output column. You also record algorithm in the Processing column of IPO chart. Figure 6-3 shows the IPO chart for the Mahir Athman problem.

Input	Processing	Output
total bill liquor charge tip percentage	tip amount bill tip  <b>Algorithm</b> 1. Enter total bill, liquor charge and tip percentage. 2. Subtract liquor charge from total bill to get the amount to be charged tip (call this amount as 'tip amount bill'). 3. Calculate the tip amount as a percentage of tip amount bill. 4. Display the amount of tip to be paid.	tip

Figure 6-3: The IPO chart for the Mahir Athman problem.

### 6.3 Algorithm Representation

Algorithms can be represented in many ways; however, there are formal tools that have been designed for this purpose. In this unit, we will only deal with two of the tools, namely; pseudocode and flowchart. This session will only introduce the pseudocode tool and explore the tool further in the next session.

#### Pseudocode

Pseudocode is an English-like representation of an algorithm. There is no standard for pseudocode; some people use a lot of details, and others use less – however, you find similarities among various versions. Programmers use pseudocode to help them while planning an algorithm. It allows them to write down their ideas using human-readable language without having to worry about the syntax of a programming language. Pseudocode is used as a guide by the programmer when coding the algorithm.

In Figure 6-4, we presented the algorithm in pseudocode form, we will go into more details of the same in Session 7 as we will look to introduce the various control structures used in programming.

#### Exercises

Draw the IPO chart for each of the following problem specifications:

- a) The computation for payment of part-time teaching at the Technical University of Mombasa is based on the number of hours a lecturer has taught and rate per hour. The gross pay is computed as a product of number of hours worked per semester and rate per hour, withholding tax is computed as 30% of the gross pay and the net pay is computed as a difference of the withholding tax from gross pay.

The administrator wants you to write a program that computes the gross pay, withholding tax and net pay. The program should also display the hours worked, rate per hour, gross pay, withholding tax and net pay.

- b) James Njuguna is interested with a program that computes the corresponding Value Added Tax (VAT) of a product given the product price. Then the program should also compute the selling product price after tax and display the product price, selling price after tax, and its corresponding VAT. Assume a 16% VAT rate.