




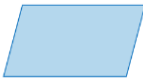

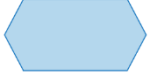







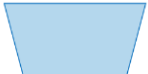
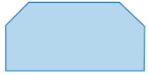


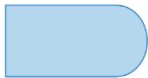
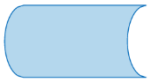


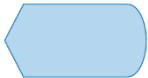

FLOW CHARTS

A flow chart, or flow diagram, is a graphical representation of a process or system that details the sequencing of steps required to create output. A typical flow chart uses a set of basic symbols to represent various functions, and shows the sequence and interconnection of functions with lines and arrows. Flow charts can be used to document virtually any type of business system, from the movement of materials through machinery in a manufacturing operation to the flow of applicant information through the hiring process in a human resources department. (Encyclopedia, 2019)

According to SmartDraw, flowcharts consist of a few common geometric shapes representing steps. The most common shape is a rectangle used to show a single action or operation is the following:

 Start/End Symbol	The terminator symbol marks the starting or ending point of the system. It usually contains the word "Start" or "End."
 Action or Process Symbol	A box can represent a single step ("add two cups of flour"), or an entire sub-process ("make bread") within a larger process.
 Document Symbol	A printed document or report.
 Multiple Documents Symbol	Represents multiple documents in the process.
 Decision Symbol	A decision or branching point. Lines representing different decisions emerge from different points of the diamond.
 Input/output Symbol	Represents material or information entering or leaving the system, such as customer order (input) or a product (output).
 Manual Input Symbol	Represents a step where a user is prompted to enter information manually.

 Preparation Symbol	Represents a set-up to another step in the process.
 Connector Symbol	Indicates that the flow continues where a matching symbol (containing the same letter) has been placed.
 Or Symbol	Indicates that the process flow continues in more than two branches.
 Summoning Junction Symbol	Indicates a point in the flowchart where multiple branches converge back into a single process.
 Merge Symbol	Indicates a step where two or more sub-lists or sub-processes become one.
 Collate Symbol	Indicates a step that orders information into a standard format.
 Sort Symbol	Indicates a step that organizes a list of items into a sequence or sets based on some pre-determined criteria.
 Subroutine Symbol	Indicates a sequence of actions that perform a specific task embedded within a larger process. This sequence of actions could be described in more detail on a separate flowchart.
 Manual Loop Symbol	Indicates a sequence of commands that will continue to repeat until stopped manually.
 Loop Limit Symbol	Indicates the point at which a loop should stop.

 Delay Symbol	Indicates a delay in the process.
 Data Storage or Stored Data Symbol	Indicates a step where data gets stored.
 Database Symbol	Indicates a list of information with a standard structure that allows for searching and sorting.
 Internal Storage Symbol	Indicates that information was stored in memory during a program, used in software design flowcharts.
 Display Symbol	Indicates a step that displays information.
 Off Page	Indicates that the process continues off page.

Flow charts are an important tool for the improvement of processes. By providing a graphical representation, they help project teams to identify the different elements of a process and understand the interrelationships among the various steps. Flow charts may also be used to gather information and data about a process as an aid to decision making or performance evaluation. For example, the owner of a small advertising agency who hopes to reduce the time involved in creating a print ad might be able to use a flow chart of the process to identify and eliminate unnecessary steps. Though flow charts are relatively old design tools, they remain popular among computer programmers working on systems analysis and design. In recent years, many software programs have been developed to assist business people in creating flow charts. (Encyclopedia, 2019)

PSEUDOCODES

According to RICE Office of Information Technology, Pseudocode is a method of describing computer algorithms using a combination of natural language and programming language. It is essentially an intermittent step towards the development of the actual code. It allows the programmer to formulate their thoughts on the organization and sequence of a computer algorithm without the need for actually following the exact coding syntax. Although pseudocode is frequently used there are no set of rules for its exact implementation. In general, here are some rules that are frequently followed when writing pseudocode:

- The usual Fortran symbols are used for arithmetic operations (+, -, *, /, **).
- Symbolic names are used to indicate the quantities being processed.
- Certain Fortran keywords can be used, such as PRINT, WRITE, READ, etc.
- Indentation should be used to indicate branches and loops of instruction.

Here is an example problem, including a flowchart, pseudocode, and the final Fortran 90 program. This problem and solution are from RICE Office of Information Technology, nd.

For a given value, Limit, what is the smallest positive integer Number for which the sum

$$\text{Sum} = 1 + 2 + \dots + \text{Number}$$

is greater than Limit. What is the value for this Sum?

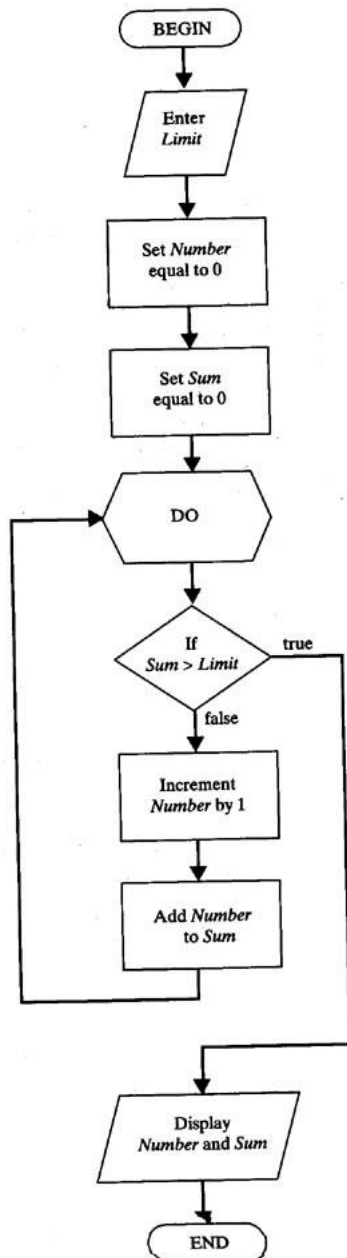
Pseudocode:

Input: An integer Limit

Output: Two integers: Number and Sum

1. Enter Limit
2. Set Number = 0.
3. Set Sum = 0.
4. Repeat the following:
 - a. If Sum > Limit, terminate the repetition, otherwise.
 - b. Increment Number by one.
 - c. Add Number to Sum and set equal to Sum.
5. Print Number and Sum.

Flowchart:



Fortran 90 code:

```
PROGRAM Summation

! Program to find the smallest positive integer Number
! For which Sum = 1 + 2 + ... + Number
! is greater than a user input value Limit.
IMPLICIT NONE

! Declare variable names and types
INTEGER :: Number, Sum, Limit

! Initialize Sum and Number
Number = 0
Sum = 0

! Ask the user to input Limit
PRINT *, "Enter the value for which the sum is to exceed:"
READ *, Limit

! Create loop that repeats until the smallest value for Number is found.
DO
    IF (Sum > Limit) EXIT ! Terminate repetition once Number is found
    ! otherwise increment number by one
    Number = Number + 1
    Sum = Sum + 1
END DO

! Print the results
PRINT *, "1 + ... + ", Number, "=", Sum, ">", Limit

END PROGRAM
```

REFERENCES

2019, September 30. Flow Charts – Encyclopedia – Business Terms. Retrieved from <https://www.inc.com/encyclopedia/flow-charts.html>

2019. Flowchart Symbols – SmartDraw. Retrieved from <https://www.smartdraw.com/flowchart/flowchart-symbols.htm>

RICE 1 Office of Information Technology. N.D. Pseudocode and Flowcharts. Retrieved from http://www.owl.net.rice.edu/~ceng303/manuals/fortran/FOR3_3.html