Programming Fundamentals:

Introduction

Binary Code

Binary numbering is a numbering system with base 2, Computers run on 0s and 1s. These codes represent different numbers, characters and functions.
We can find the decimal number with base 10 by the formula $\mathbf{(d0 \times 2^0) + (d1 \times 2^1) + ... + (dn \times 2^n)}$

For example **1101**
$(1 \times 2^0) + (0 \times 2^1) + (1 \times 2^2) + (1 \times 2^3) = 1 + 0 + 4 + 8 = 13$
The decimal value of **1101** is **13**

We can divide a decimal by 2 until we reach 0 and keep the record of reminders from last to first.

For example **12**
12/2 = 5, 6/2 = 2, 3/2 = 1, 1/2 = 0
0 0 1 1
The binary of **12** is **1100**

Decimal Number	Binary Number	4 Bit Expression (8421)
0	0	0000
1	1	0001
2	10	0010
3	11	0011
4	100	0100
5	101	0101
6	110	0110
7	111	0111
8	1000	1000
9	1001	1001

Numbering Systems

There are 2 other numbering systems octal numbering system with base 8 and hexa decimal numbering system with base 16

Hex base 16	Decimal base 10
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	A
11	B
12	C
13	D
14	E
15	F

Octalbase 10	Decimalbase 10
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	10
9	11

Unit of Data

Bit: The smallest unit of data in computing, it has only two states 1 or 0. A combination of 8 bits is usually called one **Byte**. The table of unites of computational data is bellow.

Unit	**Bytes**	
1 Kilobyte (KB)	1024 Bytes	10^3 Bytes
1 Megabyte (MB)	1024 Kilobytes	10^6 Bytes
1 Gigabyte (GB)	1024 Megabytes	10^9 Bytes
1 Terabyte (TB)	1024 Gigabytes	10^{12} Bytes
1 Petabyte (PB)	1024 Terabytes	10^{15} Bytes
1 Exabyte (EB)	1024 Petabytes	10^{18} Bytes
1 Zettabyte (ZB)	1024 Exabytes	10^{21} Bytes

Languages

Computer languages are categorized into three types

- Machine Language
- Assembly Language
- High-level Language

Machine Language: It is a low-level computer language that is directly understandable by computer hardware.

Machine Instruction	Machine Operation
00000000	Stop Program
00000001	Turn bulb fully on
00000010	Turn bulb fully off
00000100	Dim bulb by 10%
00001000	Brighten bulb by 10%
00010000	If bulb is fully on, skip over next instruction
00100000	If bulb is fully off, skip over next instruction
01000000	Go to start of program (address 0)

Languages

Assembly Language: It is a low-level computer language that is comprised of some symbolic operators and symbolic names.

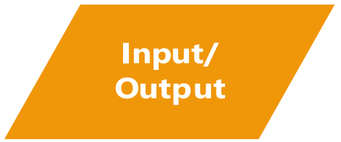
```
load num1
add num2
store sum
```

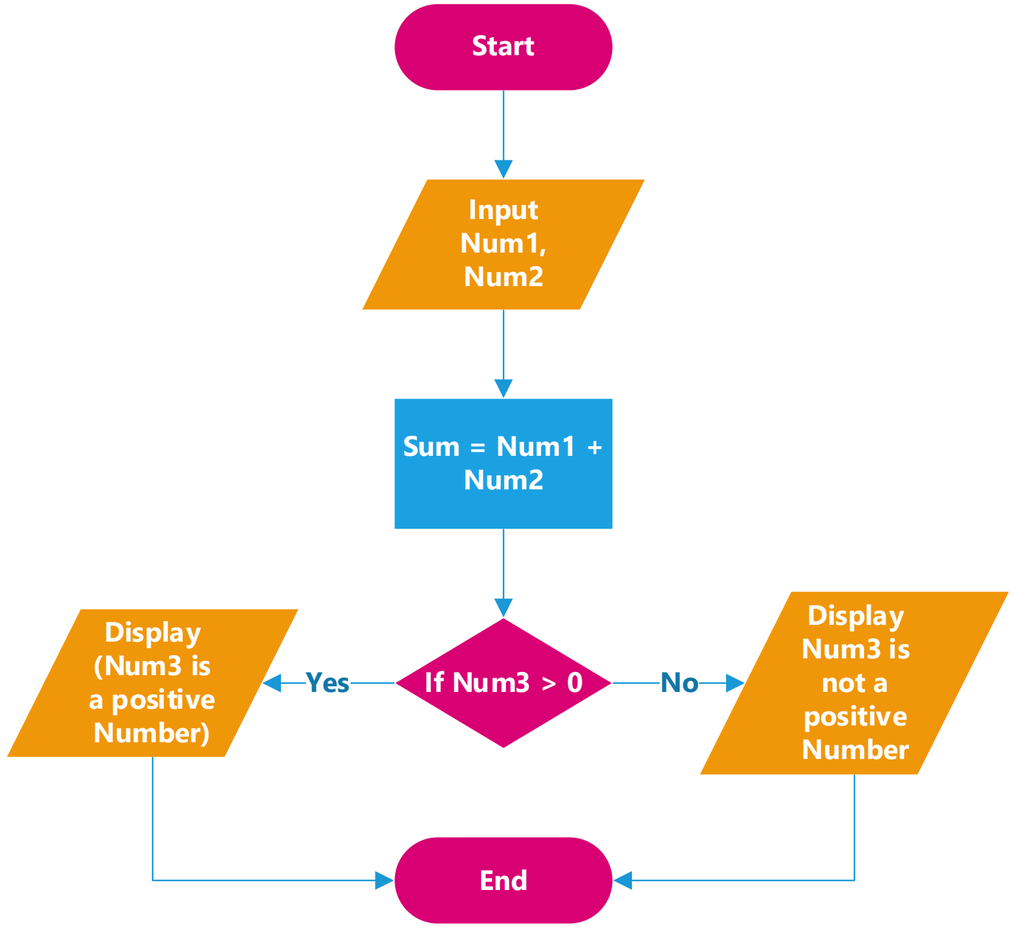
High-level Language: More human-friendly and easier language and help in developing complex computer algorithms.

```
Sum = num1 + num2
```

Flow Chart

The flowchart is a graphical representation of an algorithm. There are some basic symbols that help to determine the processing of algorithm





Algorithm

An algorithm is simply a set of steps used to complete a specific task. For the addition of two numbers, the example algorithm is

Step 1: Start
Step 2: Declare three variables num1, num2 and sum.
Step 3: Read variables num1 and num2 from the user.
Step 4: Add num1 and num2 and save the calculation in sum.
Step 5: Display the sum.
Step 6: Stop.

Pseudo Code

expression in a formally-styled natural language rather than in a programming language but in the form of logical notation.

For example (Checking which number is big)

```
Input num1 and num2
if num1 is greater than num2
    print num1 is greater.
if num2 is greater than num1
    print num2 is greater.
else
    print Both are the same.
```

Pseudo Code

```
input limit
initialize counter to Zero
while counter is less than limit
    print counter
    add 1 to counter
end while
```

Exercise

Write a Pseudo Code to print the biggest number in a list of 3 numbers.

Write the Pseudo Code of the prime numbers between 0 to 15.