June 10, 2015

Crux
Lecture -1

Basics of Problem Solving
Flowcharts & Pseudocode

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Course Content

- Basics of Problem Solving
- Programming Fundamentals
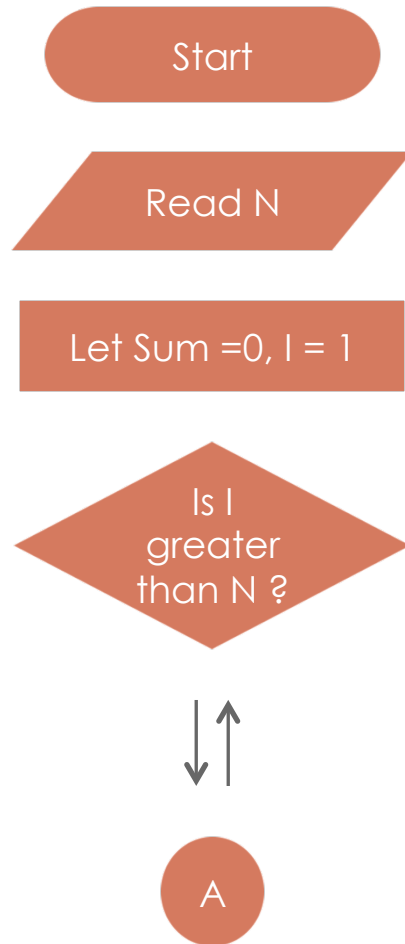- Object Oriented Programming
- Data Structures

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Logistics

- Facebook Group
  - https://www.facebook.com/groups/cruxjune2015/
- Laptops
- Assignments

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What is a flowchart?

- Diagrammatic representation illustrating a solution to a given problem.

- Allows you to break down any process into smaller steps and display them in a visually pleasing way.
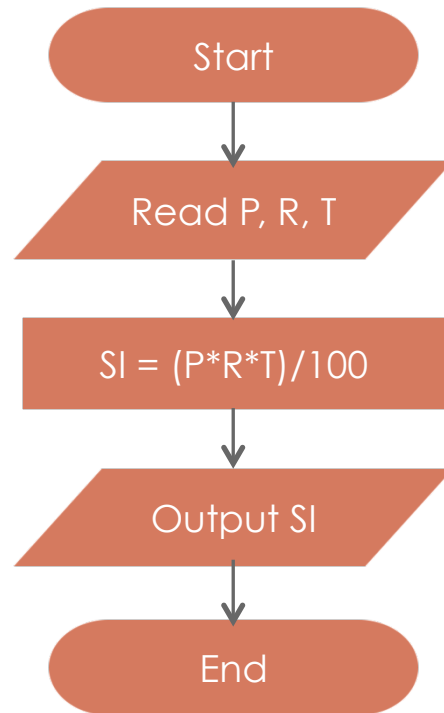
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Flowchart Components

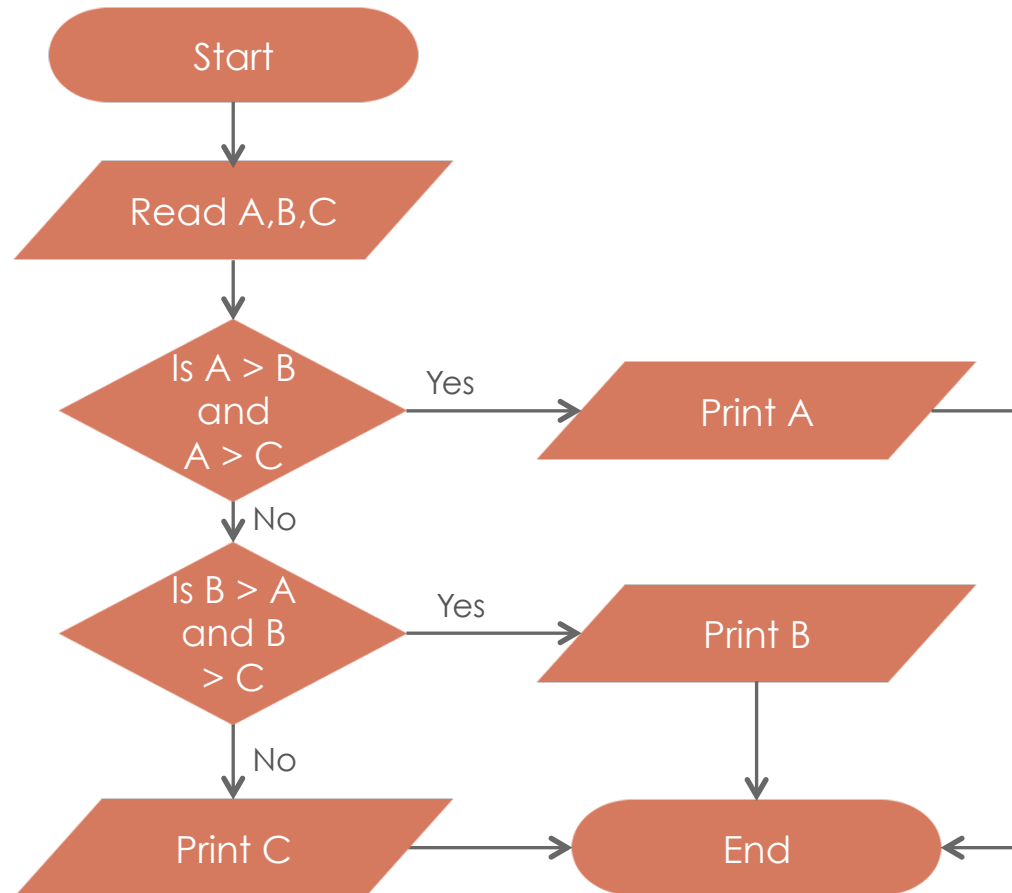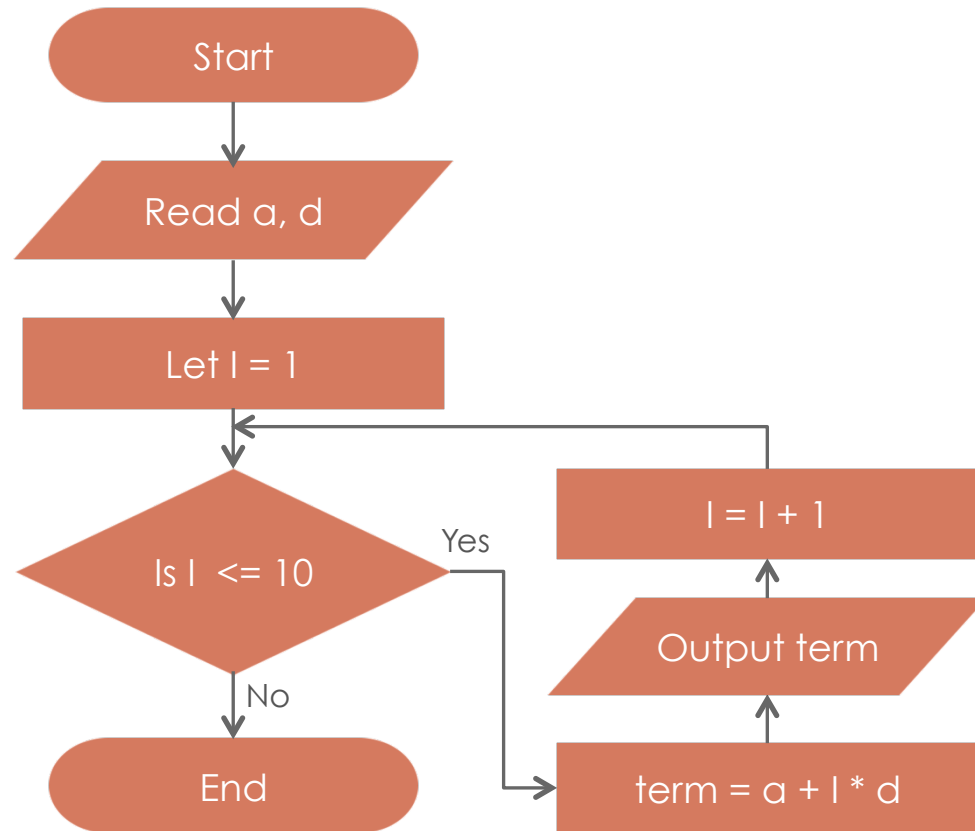|	
Start	Terminator
Read N	Input / Output
Let Sum =0, I = 1	Process
Is I greater than N ?	Decision
↓↑	Arrow
A	Connector

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Read Principal, Rate & Time and Print SI

Find largest of three numbers

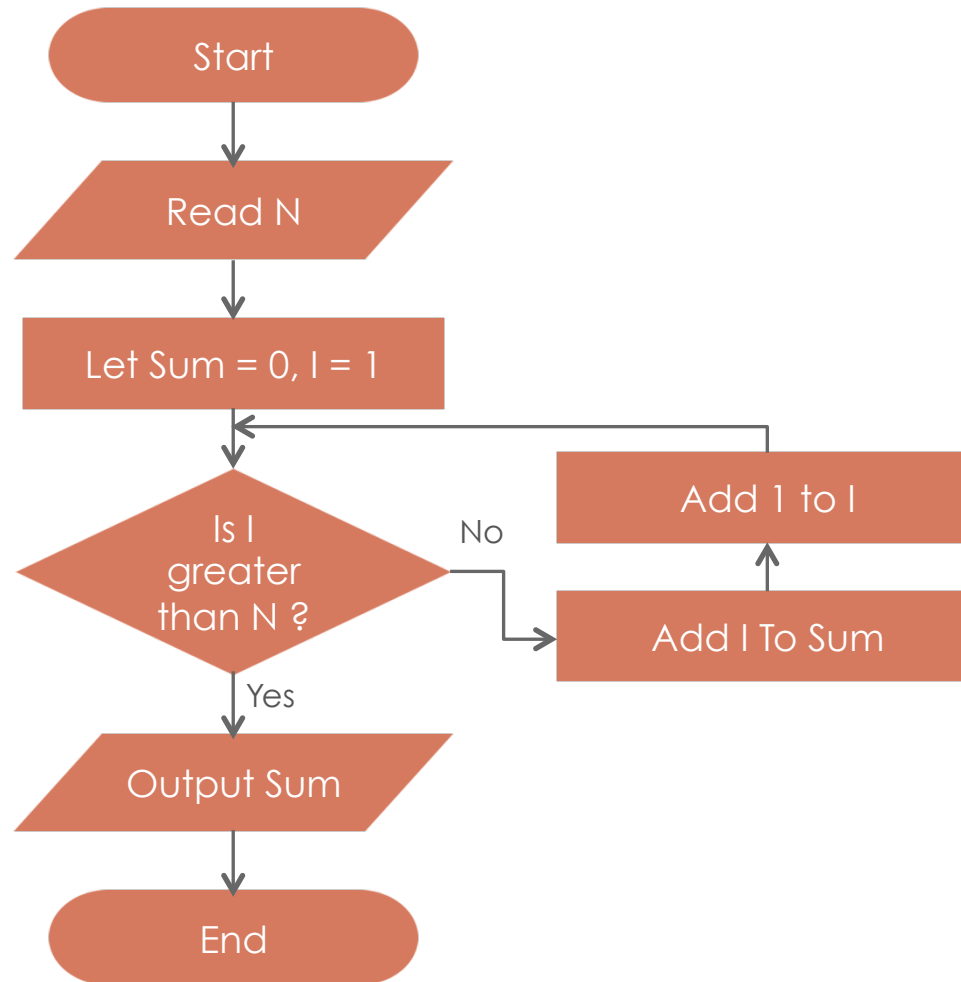# Read a & d, print 10 numbers of form a+d, a+2d, a+3d…

Find Sum of numbers from 1 to N

Time to Try?

- Read five numbers and print their average
- Given N, find sum of even numbers from 1 to N
- Given N, check if its prime or not

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Check if a number Is Prime?
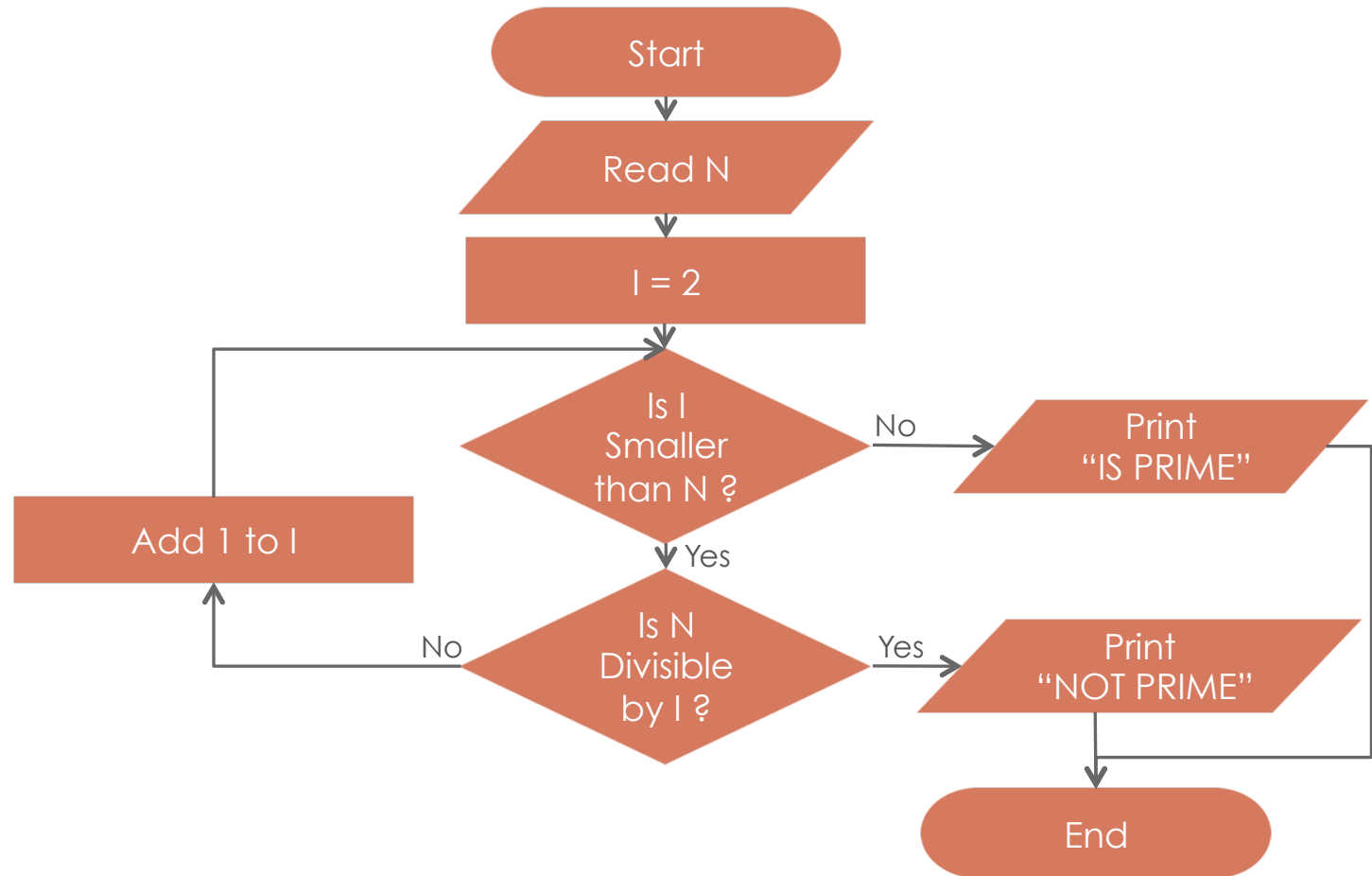
Some more examples!

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Find largest of N numbers
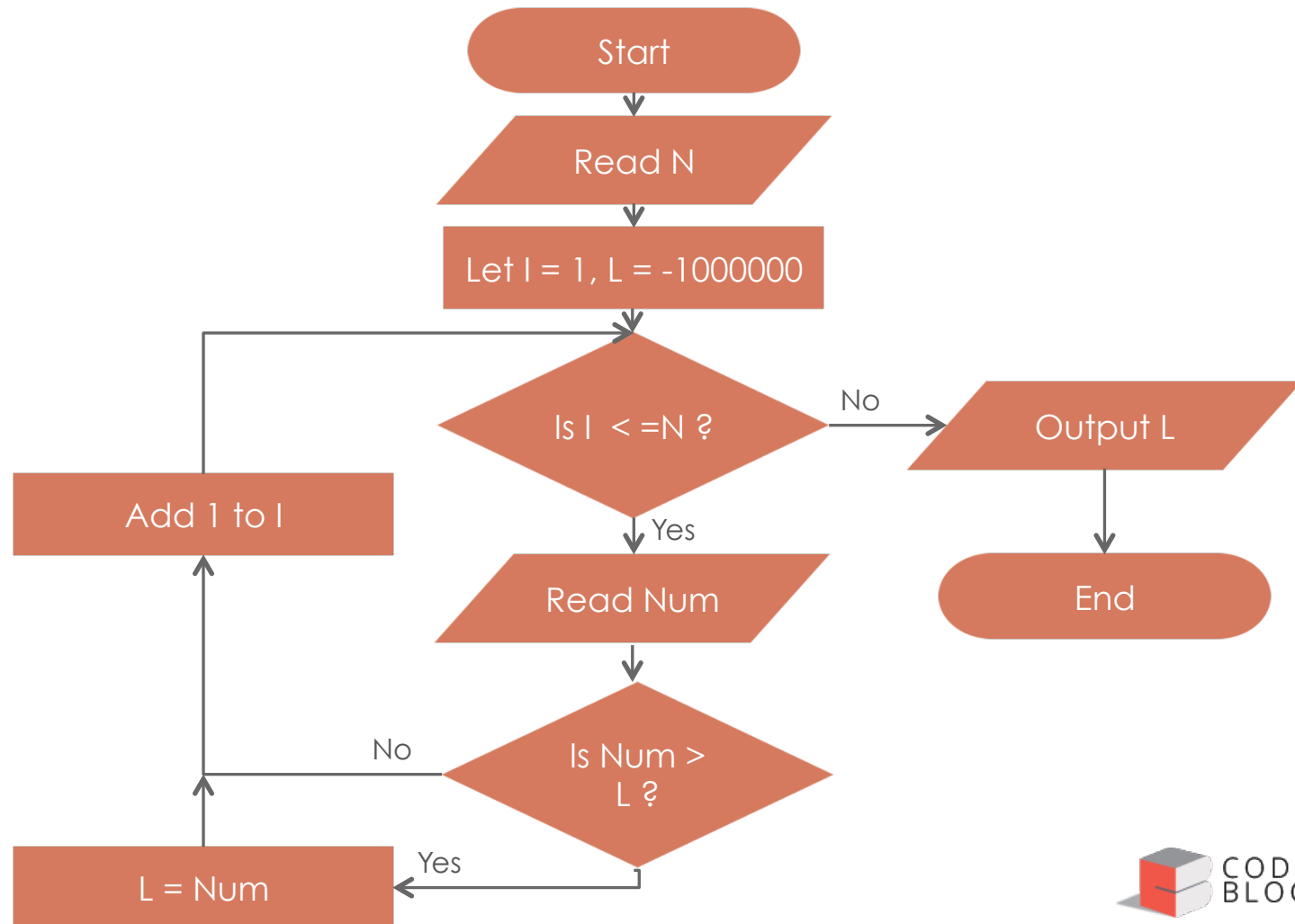
Print the below pattern

```
*
**
***
****
*****
```
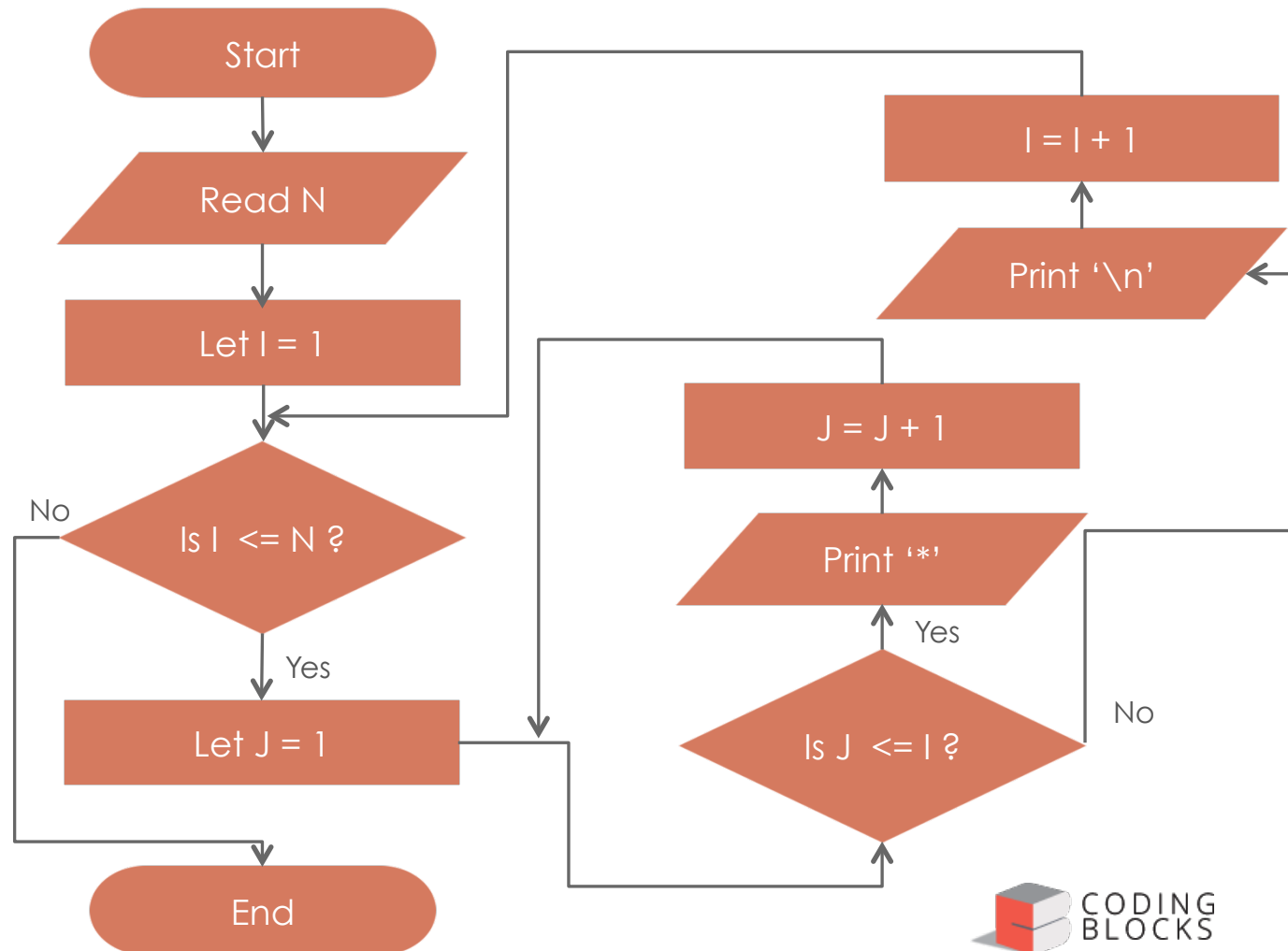
Time to try?

- Given a list of N integers, find mean, maximum and minimum value. You would be given first N, and then N integers of the list.

- Given a number check if it is a member of Fibonacci sequence or not

- Read N, and print the following pattern

  1
  2 3
  4 5 6
  7 8 9 10
  11 12 13 14 15

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Time for Brain Teasers!

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BT - 1: Hour Glasses

You have two hourglasses: a 7 minute one and a 11 minute one. Using just two hourglass, **accurately time 15 minutes**.

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BT – 2: Apples and Oranges

There are three closed and opaque cardboard boxes. One is labeled "APPLES", another is labeled "ORANGES", and the last is labeled "APPLES AND ORANGES". You know that the labels are currently misarranged, such that no box is correctly labeled. You would like to correctly rearrange these labels. To accomplish this, you may draw only one fruit from one of the boxes. **Which box do you choose, and how do you then proceed to rearrange the labels?**

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BT – 3: Average Salary

Three coworkers would like to know their average salary. However, they are self-conscious and don't want to tell each other their own salaries, for fear of either being ridiculed or getting their houses robbed**. How can they find their average salary, without disclosing their own salaries?**

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What is a Pseudocode?

Human readable informal description of a algorithm/program

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Why Learn It?

- Language Independent.
- Structure your code before writing it.
- Fastest way to verify.

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Lets define our own Pseudocode language

- Input [read N]
- Assignment [Sum ← 0]
- Output [print Sum]
- If Else [if I < N then … end else then … end]
- While Loop [while I < N do … end]
- Exit [exit]

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Check if a number is Prime?

```
read N
divisor ← 2
while divisor < N do
        if N is divisible by divisor then
                print "NOT PRIME"
                exit
        end
        divisor ← divisor + 1
end
print "IS PRIME"
exit
```

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Find largest of N numbers

```
                    ┌──────────────┐
                    │    Start     │
                    └──────┬───────┘
                           ▼
                    ╱─────────────╱
                   ╱   Read N     ╱
                  ╱──────┬────────╱
                         ▼
              ┌─────────────────────┐
              │ Let I = 1, L = -1000000 │
              └──────────┬──────────┘
                         ▼
                    ◇─────────◇
                   ╱           ╲        No
                  ◇  Is I < N ? ◇──────────►  ╱─────────╱
                   ╲           ╱              ╱ Output L ╱
                    ◇─────────◇              ╱──────────╱
                         │ Yes                    │
                         ▼                        ▼
                  ╱─────────────╱           ┌──────────┐
                 ╱  Read Num    ╱           │   End    │
                ╱──────┬───────╱            └──────────┘
                       ▼
                  ◇─────────◇
        No       ╱           ╲
  ◄─────────────◇  Is Num >  ◇
                 ╲    L ?    ╱
                  ◇─────────◇
                       │ Yes
                       ▼
              ┌──────────────┐
              │   L = Num    │
              └──────────────┘
```

Add 1 to I
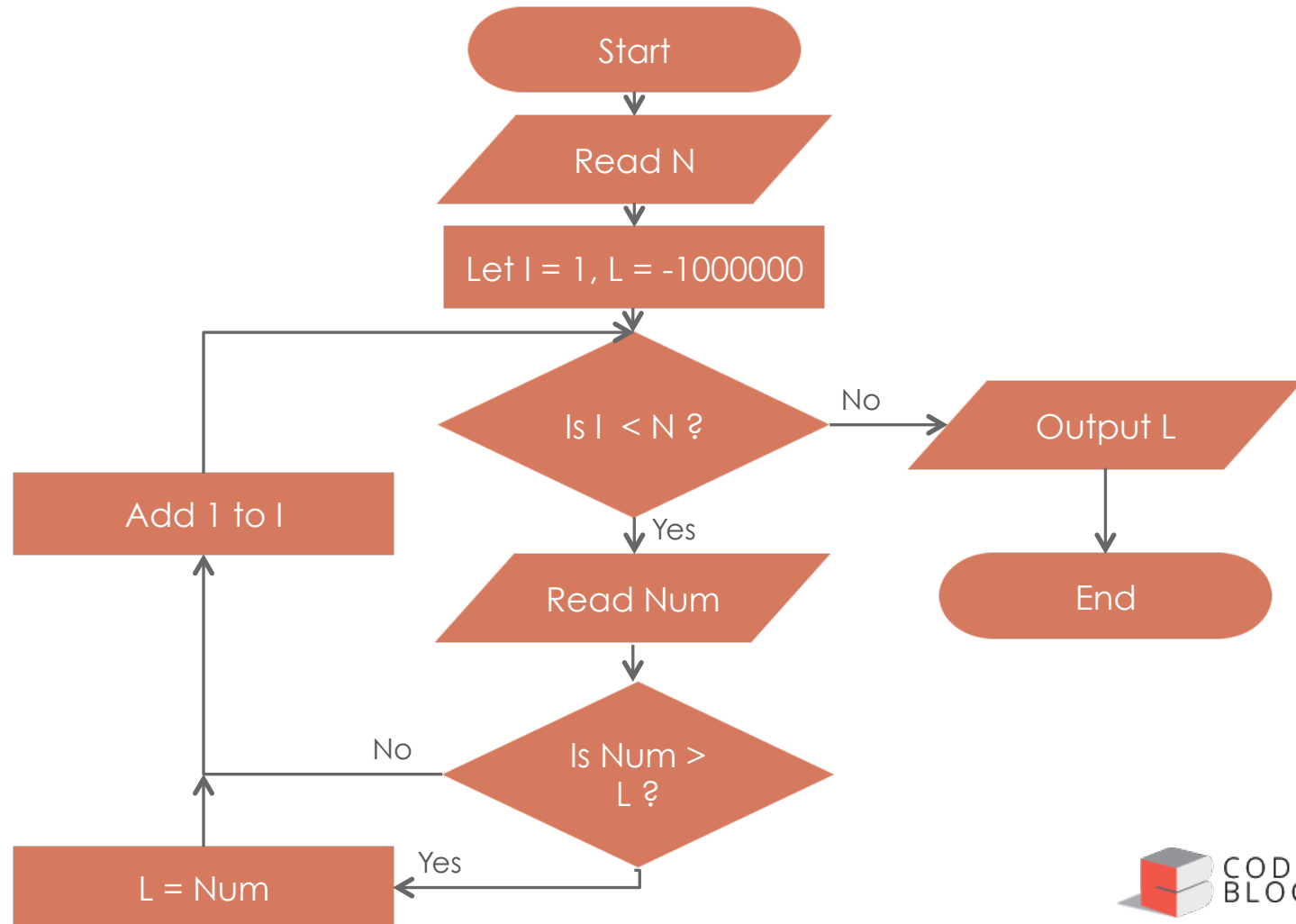
Pseudocode –Largest of N numbers

```
read N
I ← 1, L ← -100000
while I <= N do
        read num
        if num > L then
                L ← num
        endif
        I ← I + 1
end
print L
exit
```

Your Turn

Write psuedocode to print following pattern!
1
2 3
4 5 6
7 8 9 10

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Pseudocode

```
read N
Row ← 1
Value ← 1
while Row <= N do
        Col ← 1
        while Col <= Row do
                print Value
                Value ← Value + 1
                Col ← Col + 1
        end
        print "\n"
        Row ← Row + 1
end
exit
```

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Lets try one more pattern!

```
        1
       123
      12345
     1234567
    123456789
```

```
read N
i ← 1
while i <= N do
        j ← 1
        while j <= n-i do
                print ' '
                j ← j + 1
        end
        j ← 1, value ← 1
        while j <= 2*I - 1 do
                print value
                j ← j + 1
                value ← value + 1
        end
        print '\n'
        i ← i + 1
end
```

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Time to try?

- Convert your flowcharts into pseudocode
- Read N and print the below pattern

```
    1
   232
  34543
 4567654
567898765
```

III. Given a number N, find sum of its digits

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BT-4: Criminal Cupbearers

An evil king has 1000 bottles of wine. A neighboring queen plots to kill the bad king, and sends a servant to poison the wine. The king's guards catch the servant after he has only poisoned one bottle. The guards don't know which bottle was poisoned, but they do know that the poison is so potent that even if it was diluted 1,000,000 times, it would still be fatal. Furthermore, the effects of the poison take one month to surface. The king decides he will get some of his prisoners in his vast dungeons to drink the wine. **Rather than using 1000 prisoners each assigned to a particular bottle, this king knows that he needs to murder no more than 10 prisoners to figure out what bottle is poisoned, and will still be able to drink the rest of the wine in 5 weeks time. How does he pull this off**?

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Why binary number system?

- We humans use a decimal, or base-10, numbering system, presumably because people have 10 fingers

- Early computers were designed around the decimal numbering system. This approach made the creation of computer logic capabilities unnecessarily complex and did not make efficient use of resources. (For example, 10 vacuum tubes were needed to represent one decimal digit.)

- To deal with the basic electronic states of on and off, Von Neumann suggested using the binary numbering system

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What is binary number system

- The binary, or base-2, numbering system is based on the same principles as the decimal, or base-10, numbering system, with which we are already familiar

- Bit(Binary Digit) is the basic unit. It can have only one of two values (0 or 1), and may therefore be physically implemented with a two-state device.

- Bits are commonly stored and manipulated in groups generally referred as Byte (group of 8 bits)

- Number of bits effect accuracy of result and also limits the size of numbers manipulated by computer.
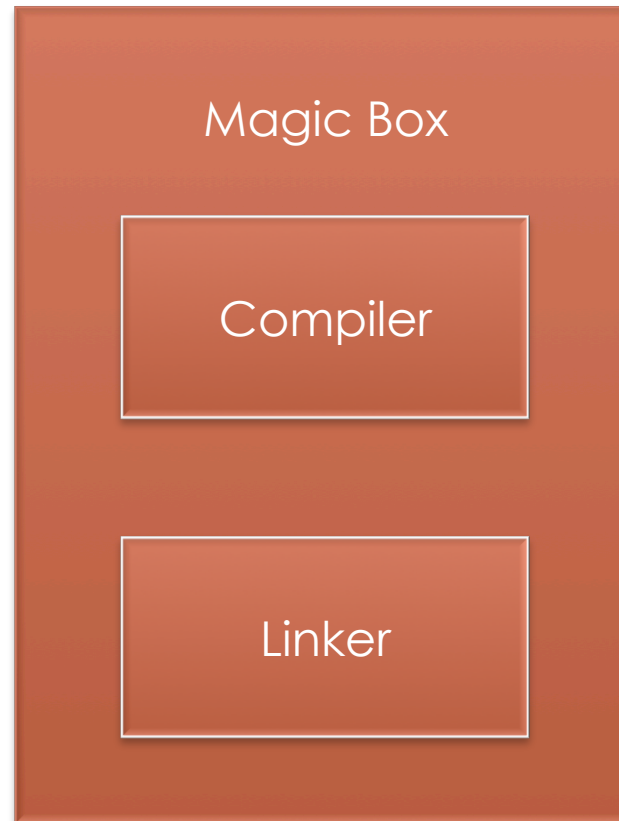
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Other Number Systems

- Hexadecimal Number System (base 16)
- Octal Number System (base 8)

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How do we work with High Level?

sum = I + j; → Magic Box → 000000 00001 00010 00110 00000 100000
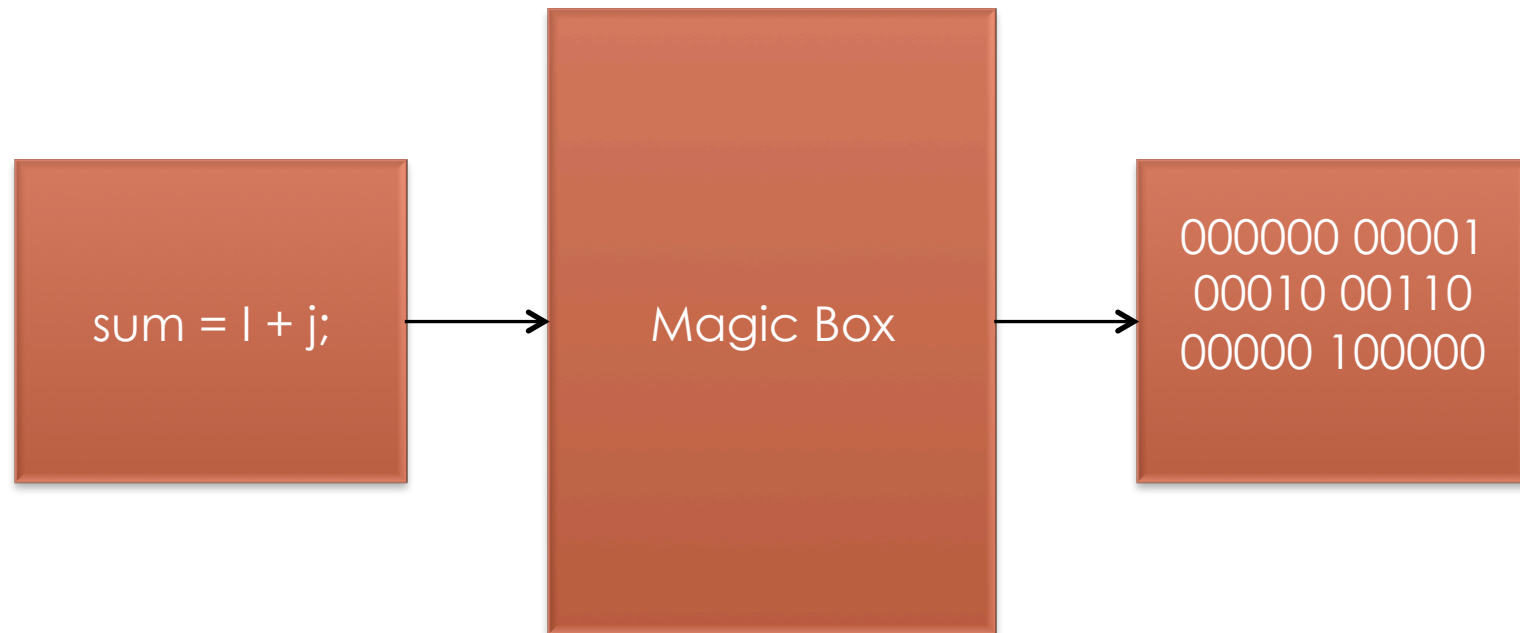
Components of the Magic Box

Magic Box

Compiler

Linker

Java Virtual Machine

Time to talk about IDE.

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Time for more Brain Teasers!

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BT – 5: Circular Jail Cell

There is a circular jail with 100 cells numbered 1-100. Each cell has an inmate and the door is locked. One night the jailor gets drunk and starts running around the jail in circles. In his first round he opens each door. In his second round he visits every 2nd door (2,4,6---) and shuts the door. In the 3rd round he visits every 3rd door (3,6,9---) and if the door is shut he opens it, if it is open he shuts it. This continues for 100 rounds (i.e. 4,8,12 ---; 5,10,15 ---; ---; 49,98 etc.) and exhausted the jailor falls down. **How many prisoners found their doors open after 100 rounds**?

BT – 6: Greedy Pirates

A pirate ship captures a treasure of 1000 golden coins. The treasure has to be split among the 5 pirates: 1, 2, 3, 4, and 5 in order of rank. The pirates have the following important characteristics: infinitely smart, bloodthirsty, greedy. Starting with pirate 5 they can make a proposal how to split up the treasure. This proposal can either be accepted or the pirate is thrown overboard. A proposal is accepted if and only if a majority of the pirates agrees on it. **What proposal should pirate 5 make?**

BT – 7: Infinite Quarter Sequence

You are wearing a blindfold and thick gloves. An infinite number of quarters are laid out before you on a table of infinite area. Someone tells you that 20 of these quarters are tails and the rest are heads. He says that if you can split the quarters into 2 piles where the number of tails quarters is the same in both piles, then you win all of the quarters. You are allowed to move the quarters and to flip them over, but you can never tell what state a quarter is currently in (the blindfold prevents you from seeing, and the gloves prevent you from feeling which side is heads or tails). **How do you partition the quarters so that you can win them all?**

What is Next Class about?

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Programming Fundamentals - 1

- Constants, Variables & Datatypes
- Operands & Operator
- Conditional Statement
- Loops

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Thank You!

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