July 4, 2015

Launchpad

Lecture - 1

Basics of Problem Solving

Aman Bahl

CODING
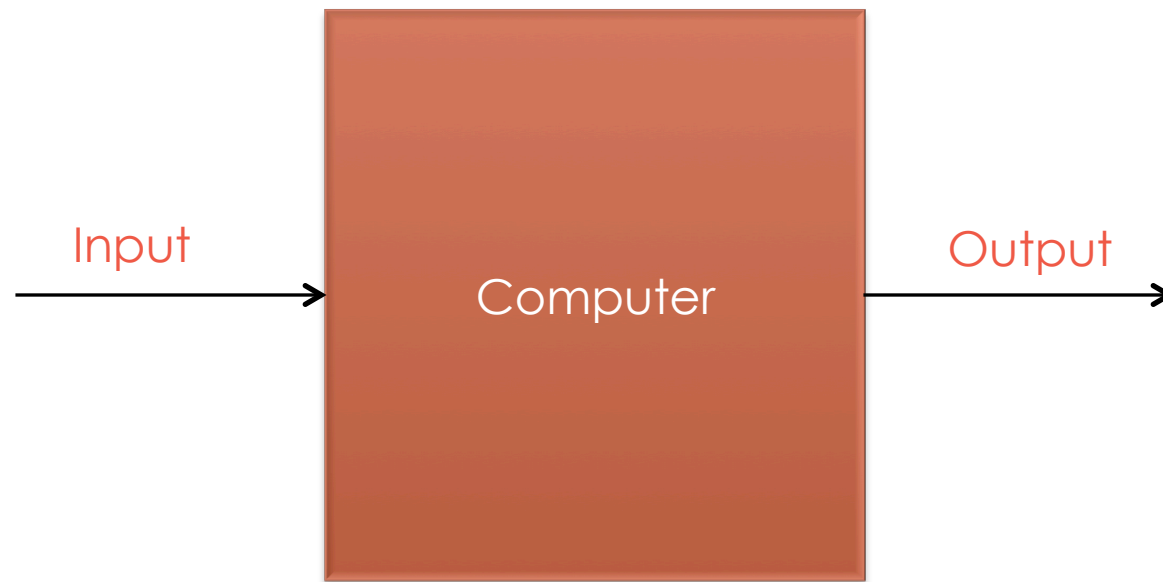BLOCKS

Course Structure

I.   Basics of Problem Solving

II. Programming Fundamentals

III. Object Oriented Programming

IV. Data Structures

CODING
BLOCKS

Course Administration

I.   Facebook Group

II. Regular Assignments

III. Laptops

IV. Doubt Sessions

CODING
BLOCKS

What does a computer do?

Input → Computer → Output

What is programming?

- Programming is:
    - Telling your machine what to do and how to do

- If you don't program your computer
    - You know just what and not how
    - You are using it just as any other machine

CODING
BLOCKS

It's a machine!

I. Computers are a machine, and at the most basic level, they are collection of switches – where **1** represents "on" and 0 represents "off".

II. Everything that a computer does is implemented in this most basic of all numbering systems – binary

III. So if you want to communicate directly we need to talk to in binary

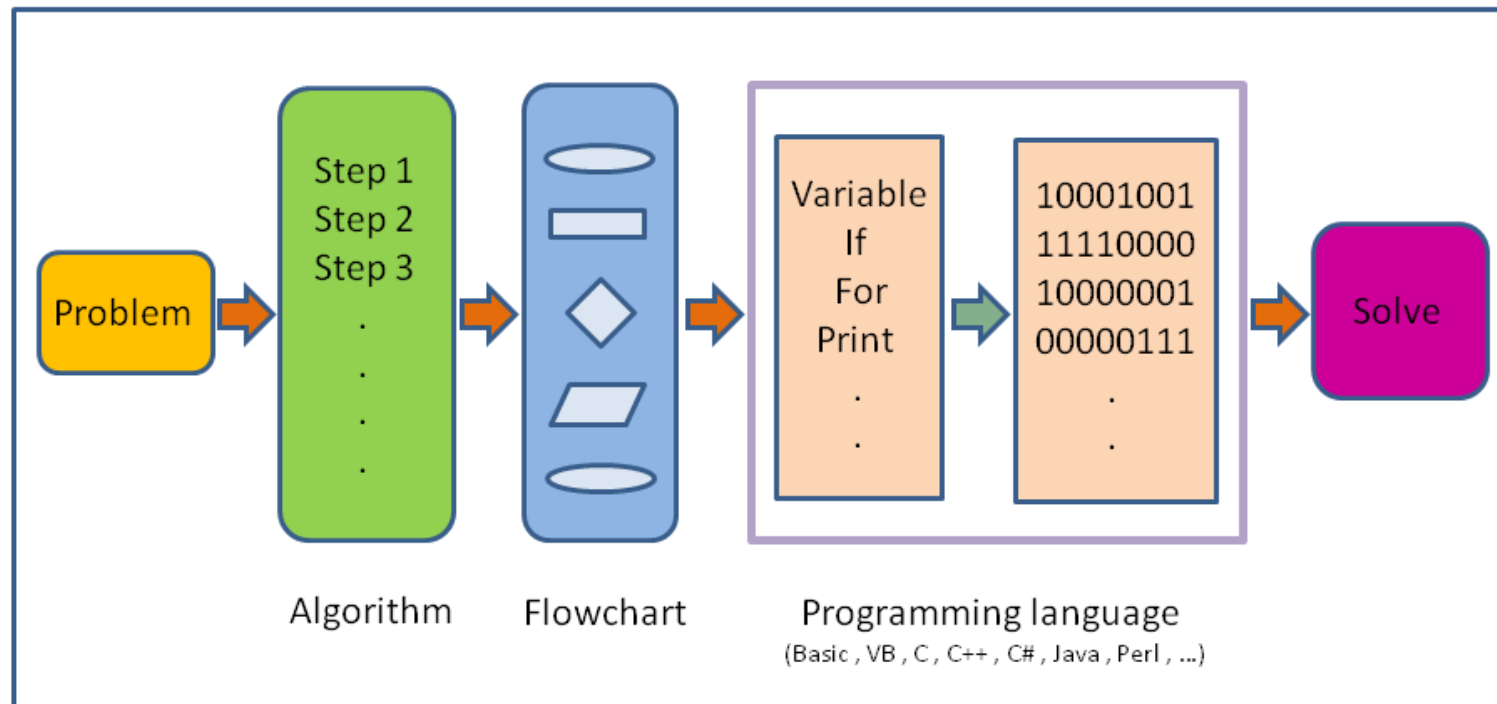CODING BLOCKS

Programming language
(Basic , VB , C , C++ , C# , Java , Perl , ...)
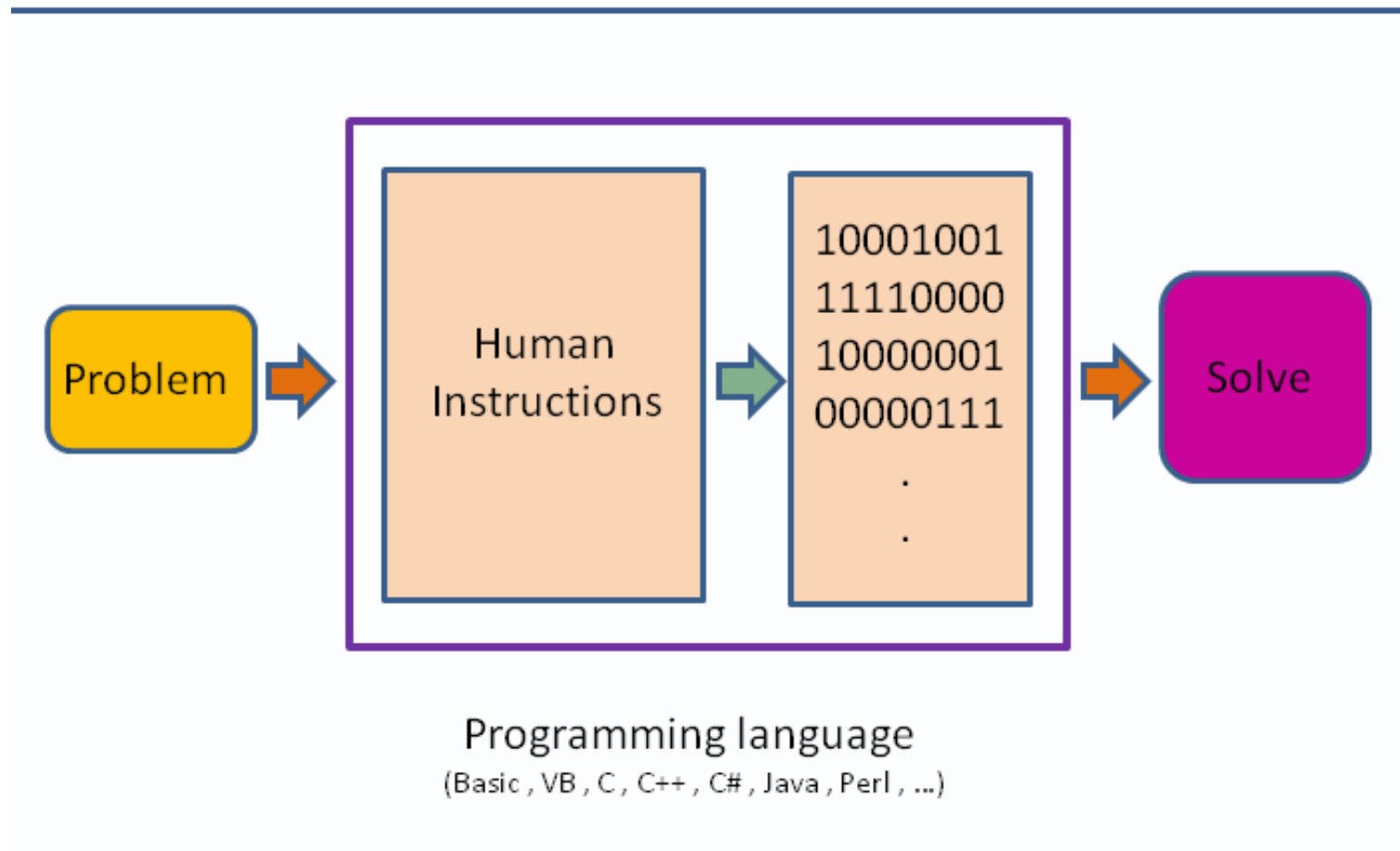
Its nearly impossible to write in Binary!

CODING BLOCKS

So we use programming language
with Flowcharts & Algorithms for
solving a Problem

CODING
BLOCKS

Algorithm   Flowchart   Programming language
(Basic , VB , C , C++ , C# , Java , Perl , …)

What is programming language?

I.   A programming language is a set of rules that provides a way of telling a computer what operations to perform

II. It provides a linguistic framework for describing computations.

III. A programming language also has words, symbols and rules of grammar.

IV. The grammatical rules are called syntax
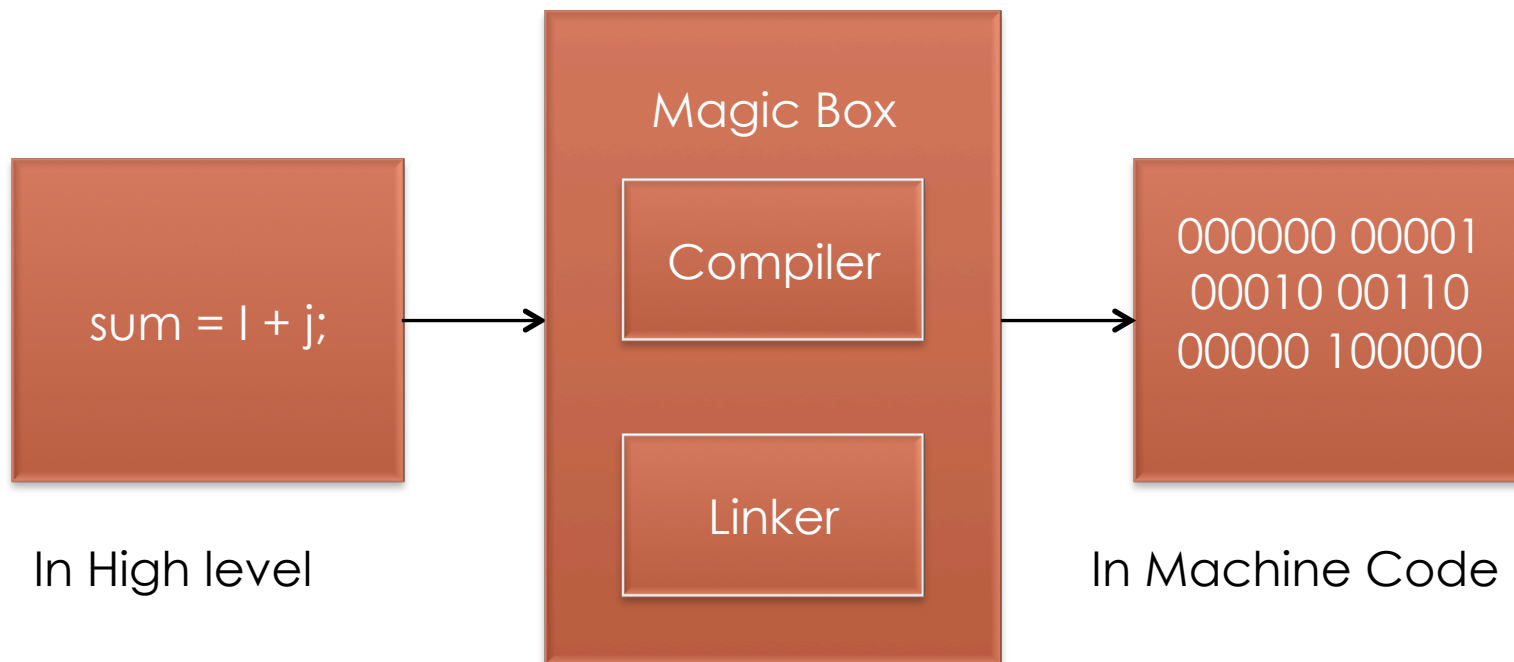
High/Low Level Languages!

C++/ Java/ Python

Assembly language

Machine Code

ARM/MIPS/IBM

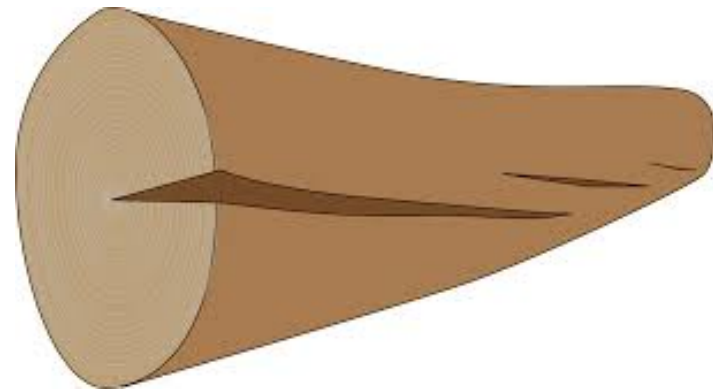CODING BLOCKS

How do we work with High Level?

In High level

Magic Box

Compiler

Linker

In Machine Code

sum = I + j;

000000 00001
00010 00110
00000 100000
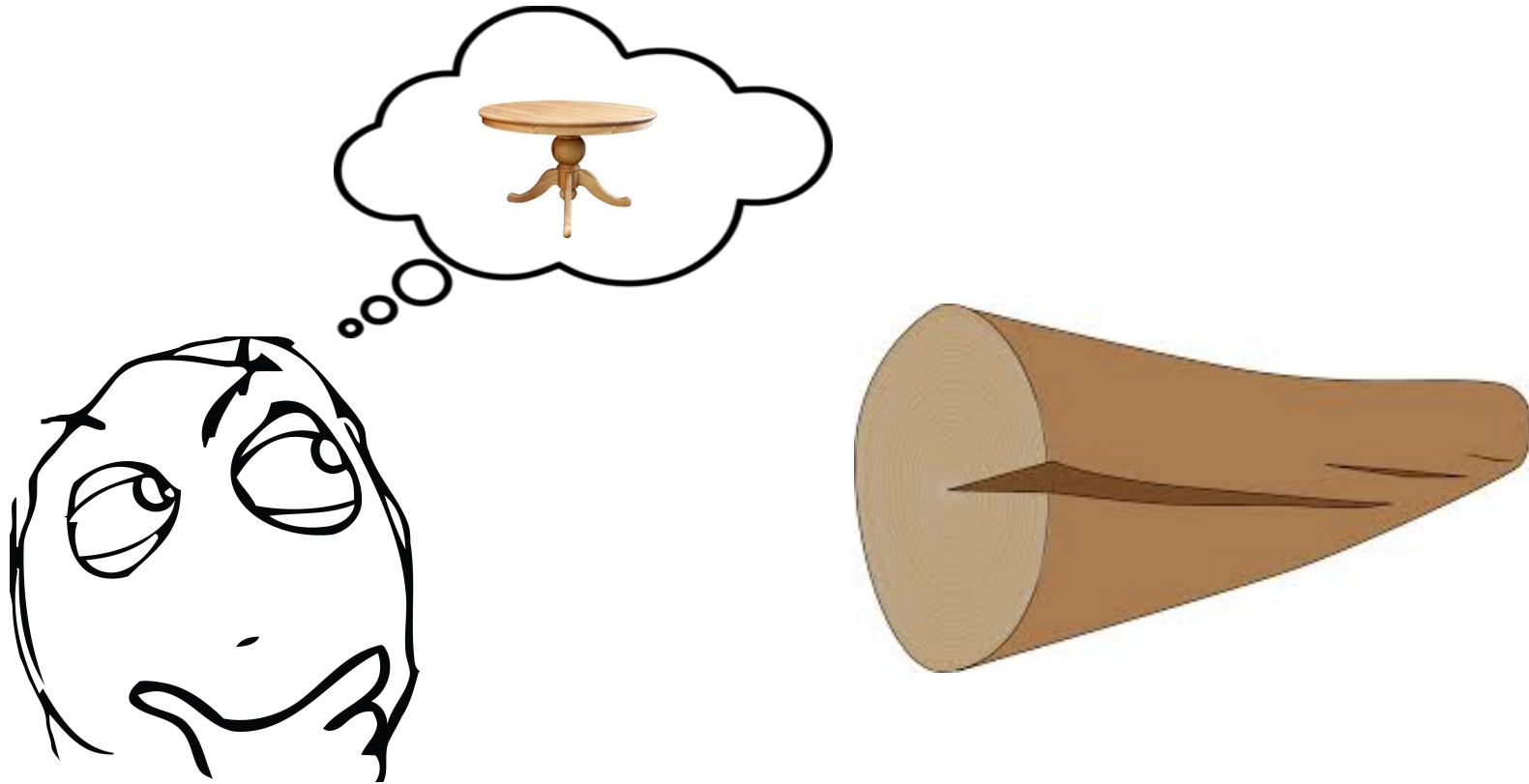
Programming is like carpentry
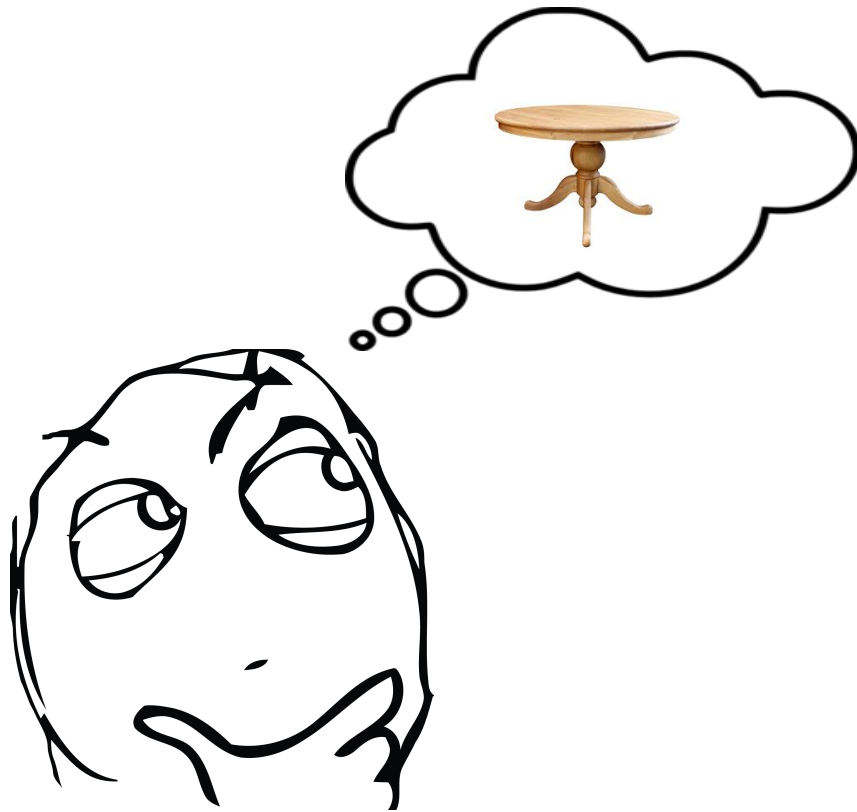
Programming is like carpentry

What does he need?

Before he starts cutting wood he needs **"A clear idea of what he wants to build and how is he going to build"**

CODING BLOCKS

Before we write a program for a solution we need an **Algorithm.**

CODING
BLOCKS

So what is an algorithm?

I. An algorithm is a self-contained step by step set of operations to be performed in order to solve a problem.

II. Its an effective method that can be expressed within a finite amount of space and time and in well-defined formal language for solving a problem.

III. Another way to describe an algorithm is a sequence of unambiguous instructions.

CODING
BLOCKS

Expressing Algorithms?

I.   Algorithms can be expressed in many kind of notations, including natural languages, pseudocode, flowcharts, etc.

II. Natural Language expressions of algorithms tend to be verbose and ambiguous, and are rarely used for complex or technical algorithms.

III. Programming languages are primarily intended for expressing algorithms in a form that can be executed by a computer.

CODING BLOCKS

Two basic aspects of programming

I. Data

II. Instructions

CODING
BLOCKS

To understand data we need to understand **Variables**!

CODING BLOCKS

What are Variables?

I. Variables in a computer program are analogous to Buckets or Envelopes where information can be maintained and referenced.

II. On the outside of the bucket is a name.

III. When referring to the bucket, we use the name of the bucket, not the data stored in the bucket.

CODING BLOCKS

Variable Actions!

I. **Create** one (with a nice name). A variable should be named to represent all possible values that it might contain. Some examples are: midterm_score, midterm_scores, data_points, course_name, etc.

II. **Put** some information into it (destroying whatever was there before). We "put" information into a variable using the assignment operator, e.g., midterm_score = 93;

III. **Get** a copy of the information out of it (leaving a copy inside). We "get" the information out by simply writing the name of the variable, the computer does the rest for us, e.g., average = (grade_1 + grade_2) / 2.

CODING BLOCKS

Now lets talk about Instructions!

CODING
BLOCKS

What are instructions?

I.   Its an order given to computer.

II.   At lowest level each of these is a sequence of 0s and 1s.

III. In assembly language, each statement is one instruction but in high level each statement can be further broken into multiple steps.

CODING
BLOCKS

Six basic computer instructions

I. Reading/Receiving some information

II. Outputting/Printing some information

III. Performing arithmetic operation

IV. Assigning a value to a variable or memory location

V. Conditional Execution

VI. Repeat a group of actions

CODING BLOCKS

Time for Flowcharts!

What is a flowchart?

I.   Diagrammatic representation illustrating a solution to a given problem.

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

III. It shows steps as boxes of various kinds, and their order by connecting them with arrows.

IV. It helps your audience to see the logical flow and relationship between steps.

CODING
BLOCKS

Flowchart components

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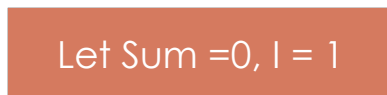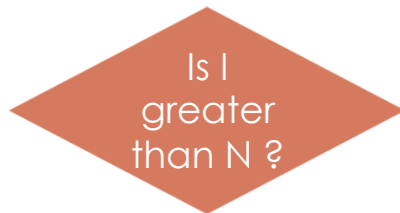
CODING BLOCKS

Lets look at few problems and their flowcharts!

CODING
BLOCKS

Read Principal, Rate & Time and Print SI
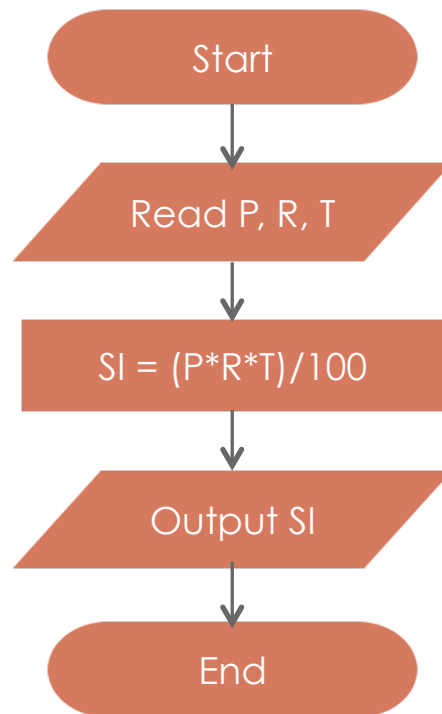
Find largest of three numbers

```
                    ┌─────────────────┐
                    │      Start      │
                    └─────────────────┘
                             │
                             ▼
                    ╱─────────────────╲
                    │   Read A,B,C     │
                    ╲─────────────────╱
                             │
                             ▼
                    ╱╲
                   ╱  ╲
                  ╱Is A > B╲      Yes    ╱─────────────────╲
                 ╱   and    ╲──────────▶ │     Print A      │────┐
                 ╲  A > C   ╱            ╲─────────────────╱     │
                  ╲        ╱                                      │
                   ╲╱                                             │
                    │ No                                          │
                    ▼                                             │
                   ╱╲                                             │
                  ╱  ╲                                            │
                 ╱Is B > A╲       Yes    ╱─────────────────╲      │
                ╱  and B   ╲───────────▶ │     Print B      │     │
                ╲   > C    ╱             ╲─────────────────╱      │
                 ╲        ╱                       │               │
                  ╲╱                              │               │
                    │ No                          ▼               │
                    ▼                                             │
           ╱─────────────────╲          ┌─────────────────┐      │
           │     Print C      │─────────▶│      End        │◀─────┘
           ╲─────────────────╱          └─────────────────┘
```

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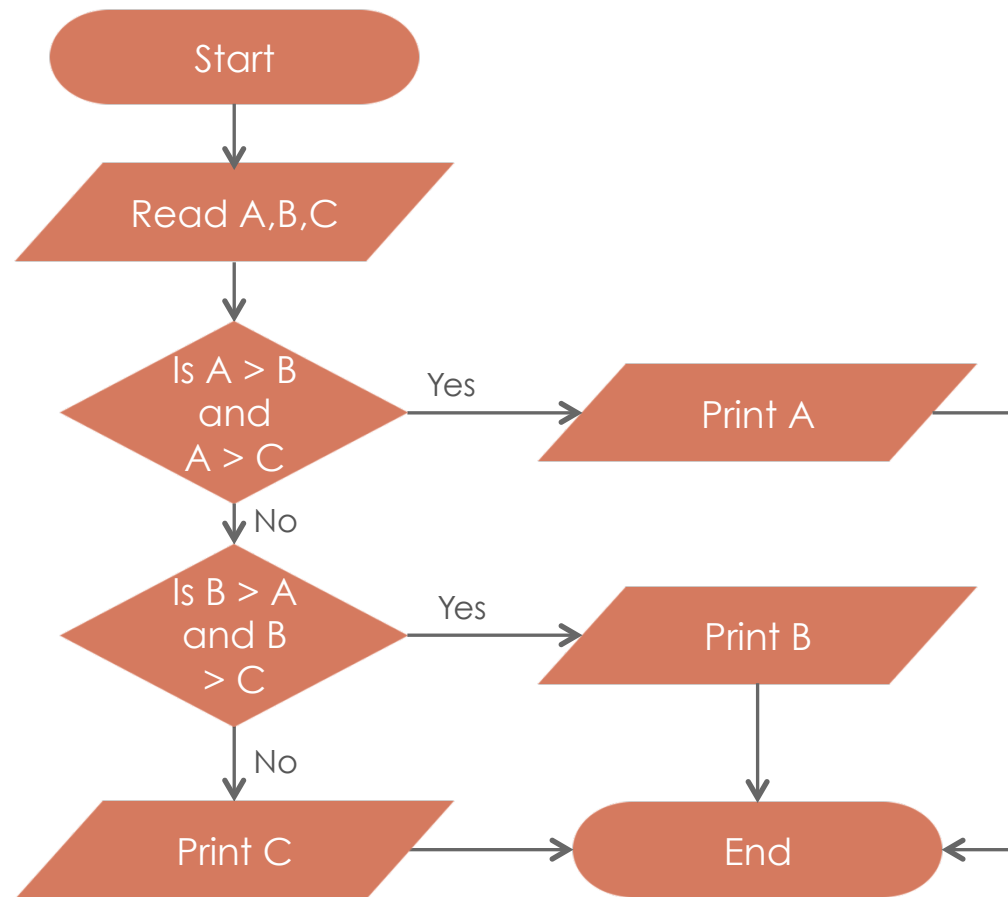
Read a & d, print 10 numbers of form a+d, a+2d, a+3d…

Start

Read a, d

Let I = 1

Is I <= 10

Yes

No

I = I + 1
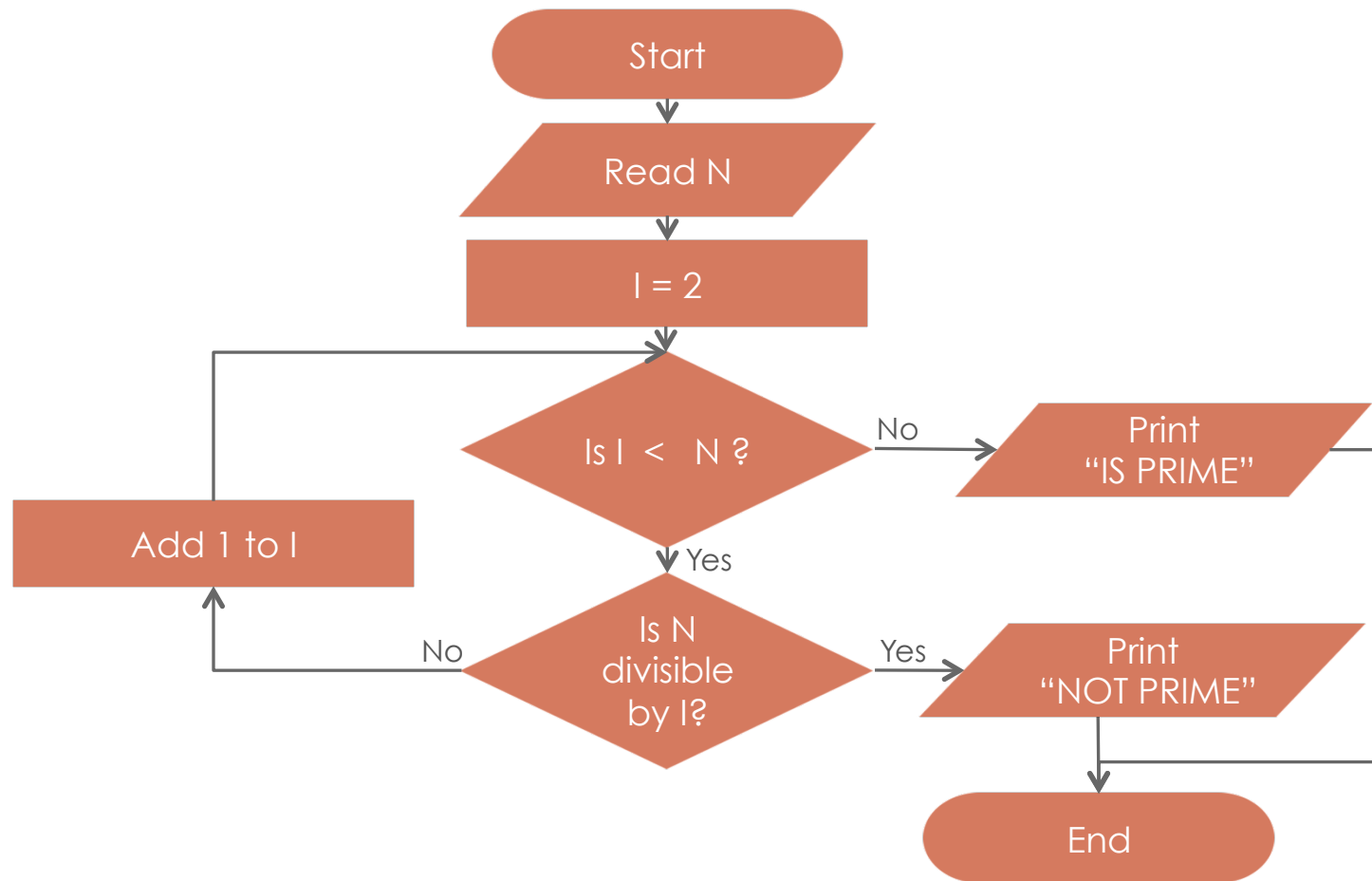
Output term

End

term = a + I * d

CODING BLOCKS
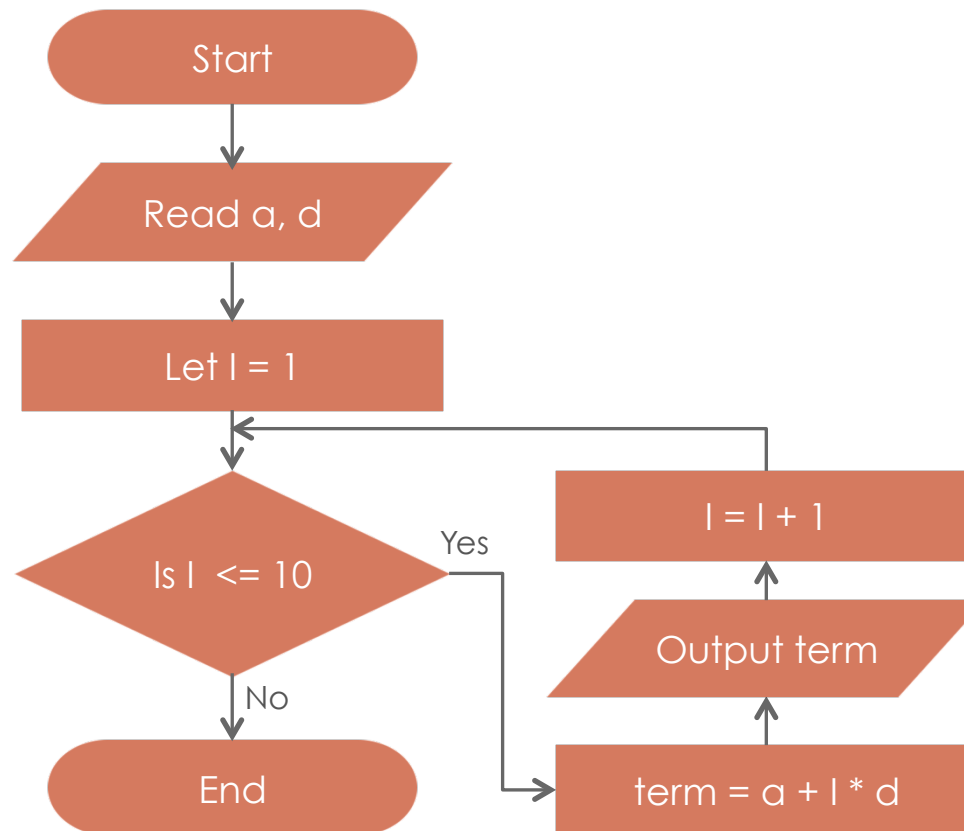
Given N, print all numbers from 1 to N
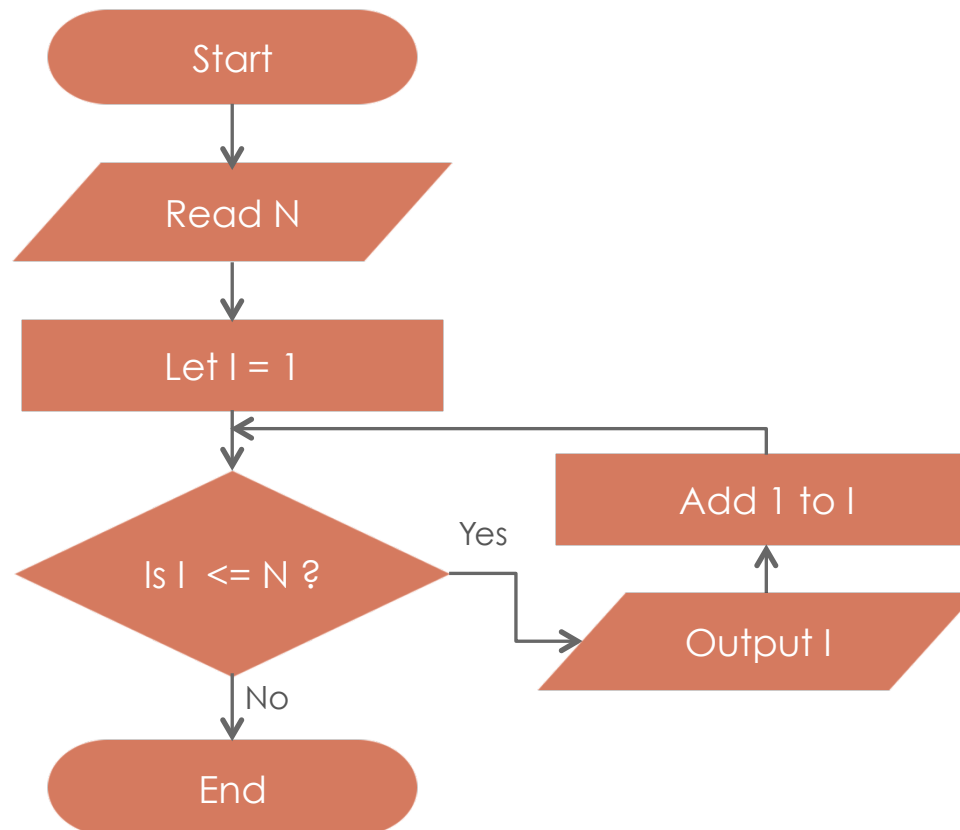
Time to try?

I.   Read five numbers and print their average

II. Given N, find sum of even numbers from 1 to N
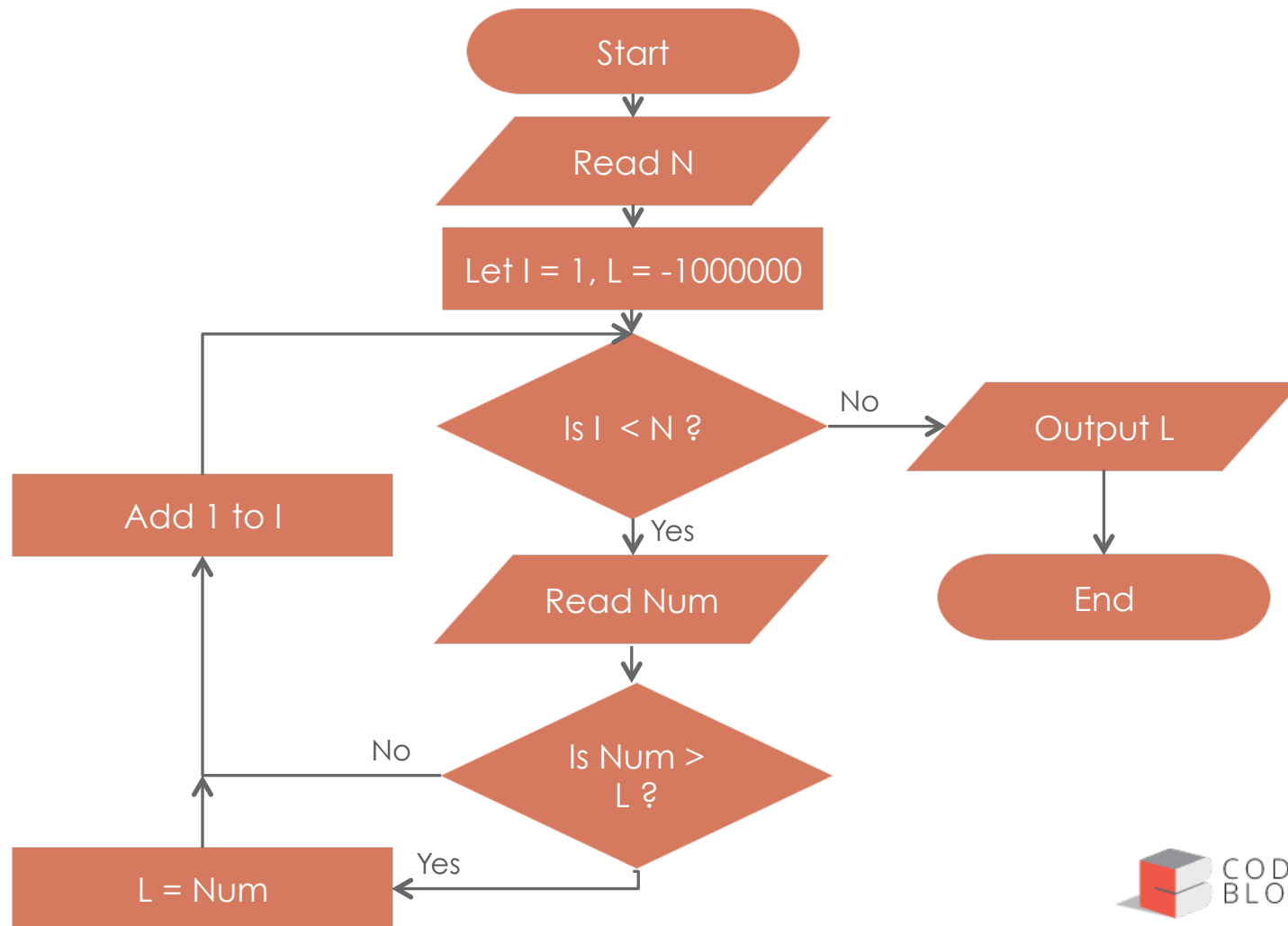
III. Given N, check if its prime or not
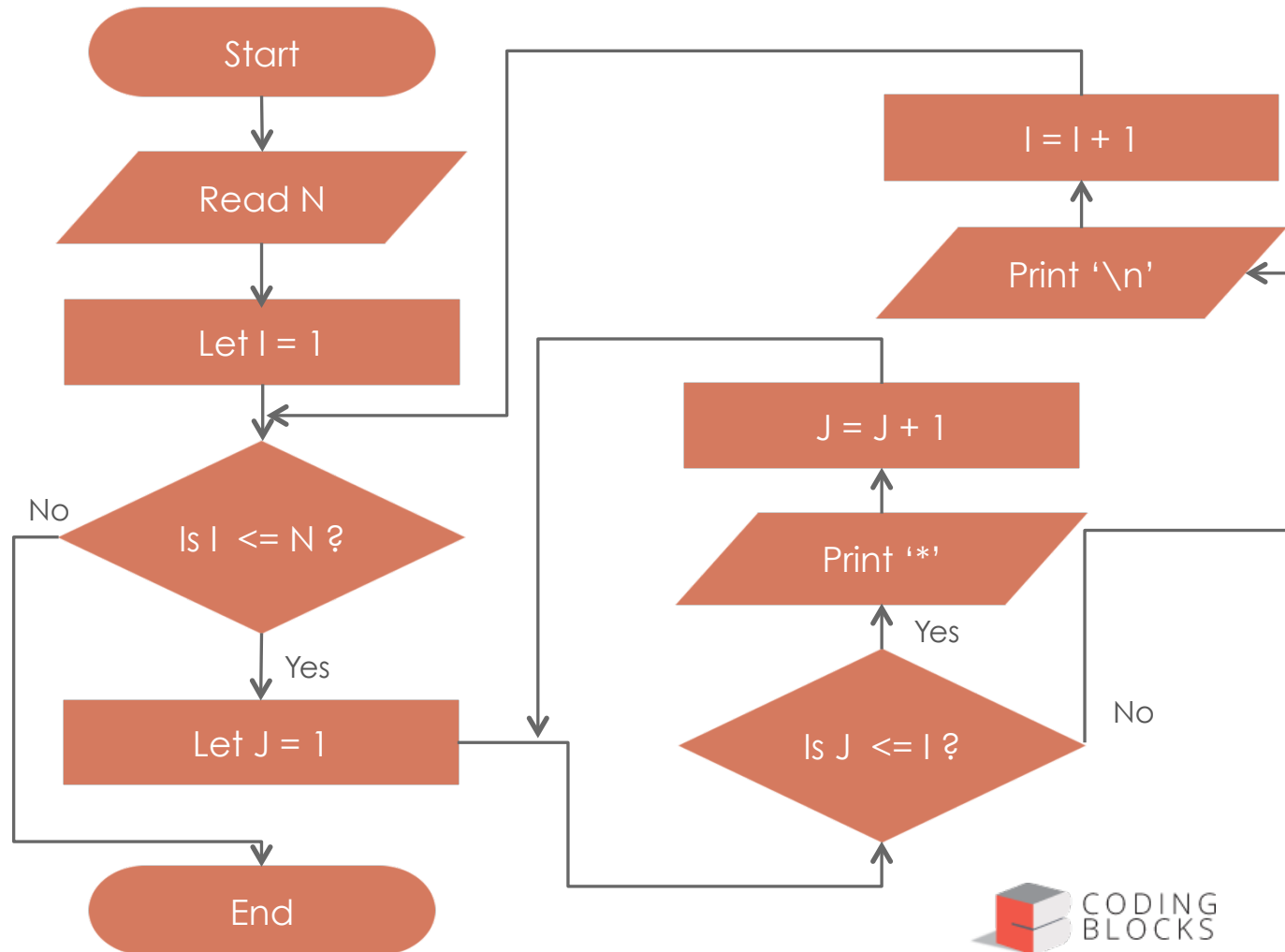
Check if a number is prime or not?

Some more examples!

CODING
BLOCKS

Find largest of N numbers

Print the below pattern

```
*
**
***
****
*****
```

Time to try?

I.   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.

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

III. Read N, and print the following pattern

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

Pseudocode!

What is pseudocode?

I. A notation resembling a simplified programming language, used in program design

II. It allows designers or lead programmers to express the design in great detail and provides programmers a detailed template for the next step of writing code in a specific programming language

CODING
BLOCKS

Notation for those basic six!

I. Reading/Receiving [read N]

II. Outputting/Printing [print Sum, print "Coding Blocks", print 1, print '\n']

III. Assignment [Sum ← 5]

IV. Arithmetic operators [a+b, a * 5, sum + i]

V. If Else [if I < N then ... end else then ... end]

VI. While Loop [while I < N do ... end]

CODING BLOCKS

Lets convert some flowcharts into pseudocode!

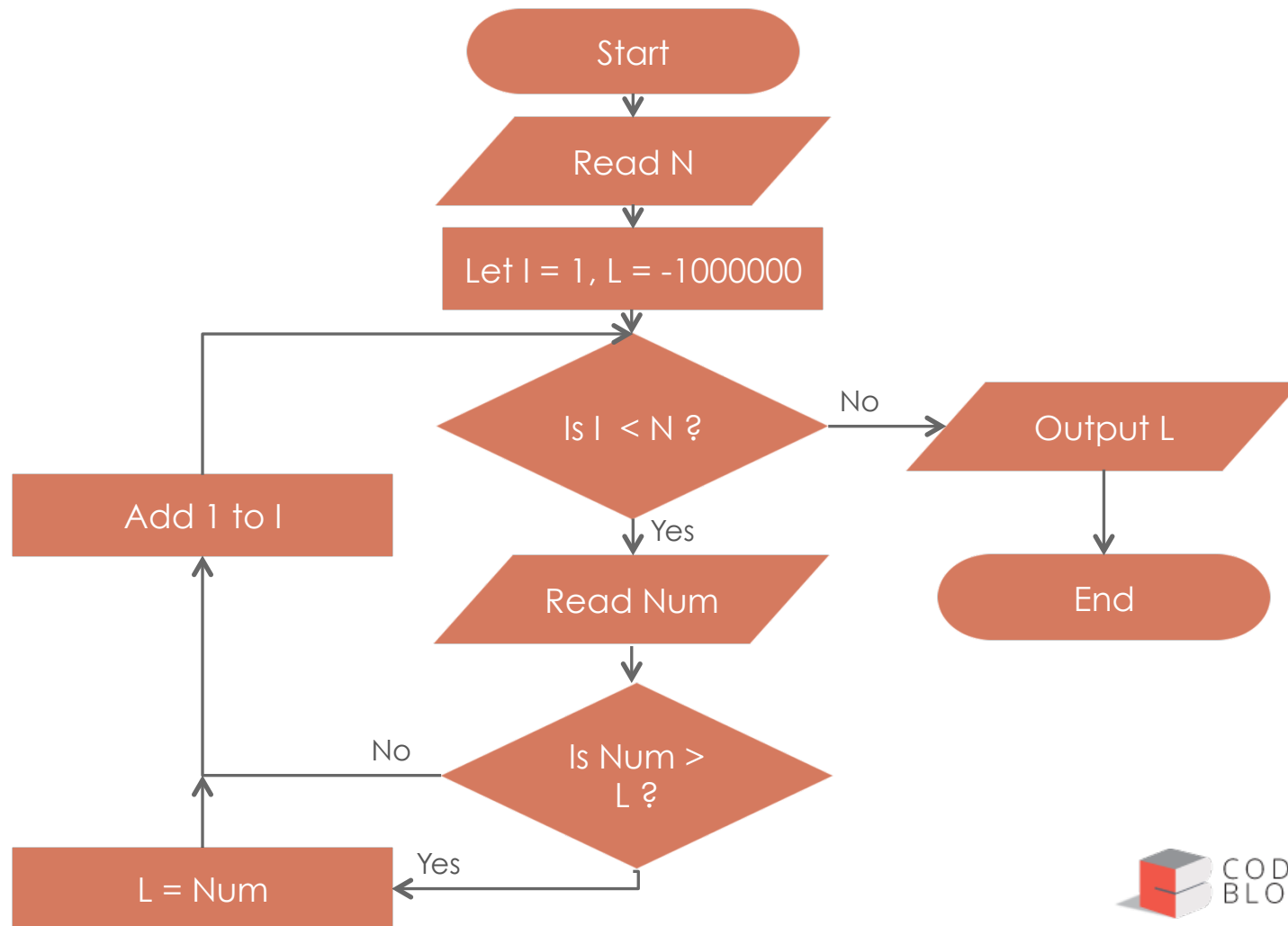CODING
BLOCKS

Check if a number is prime or not?
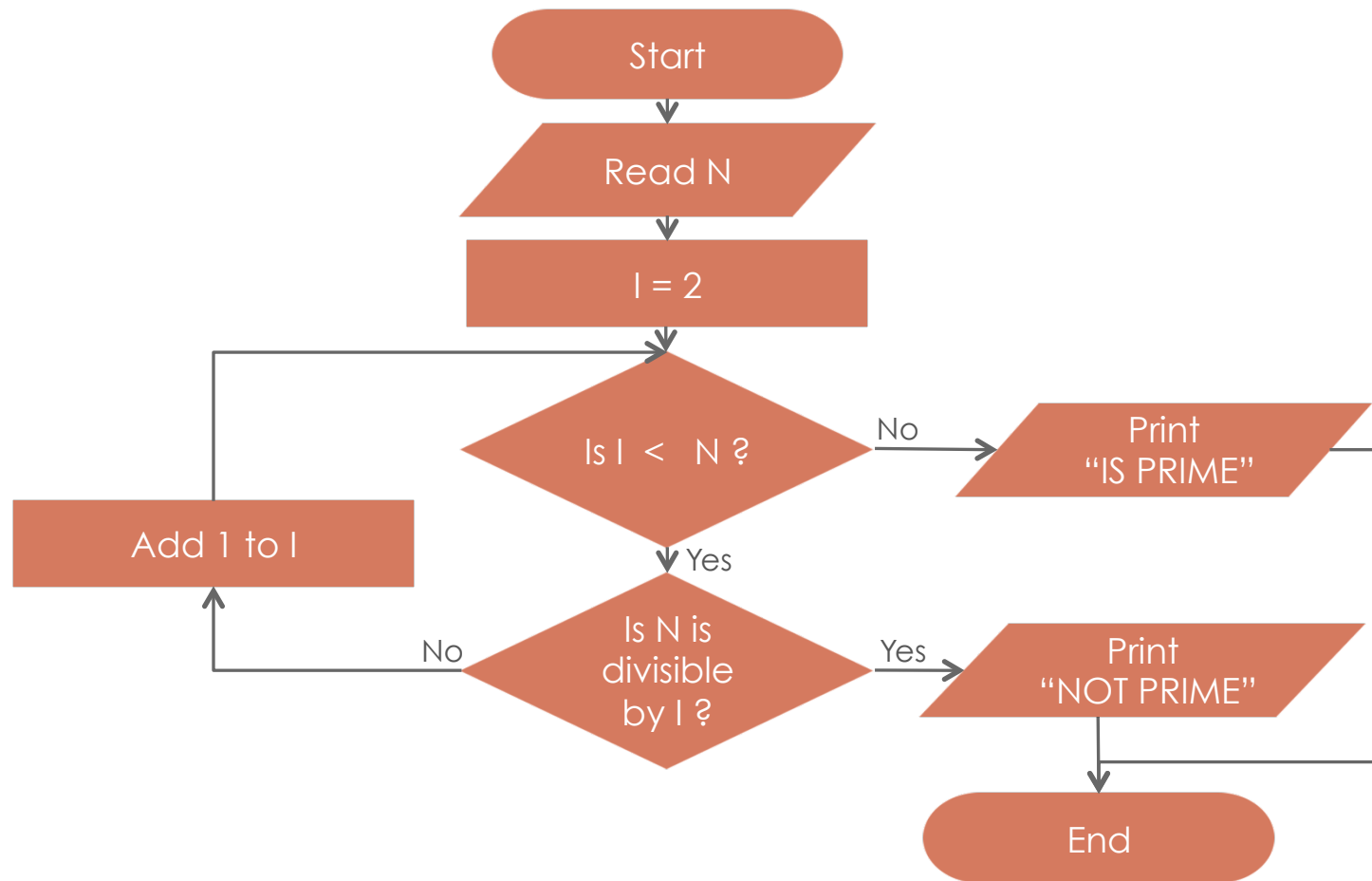
Pseudocode- Check if N is prime?

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

CODING
BLOCKS

Find largest of N numbers

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
```

CODING BLOCKS

Print following pattern

```
1
2 3
4 5 6
7 8 9 10
```

```
read N
row ← 0
value ← 1
While row < N do
        col ← 0
        while col <= row do
                print value
                value ← value + 1
                col ← col + 1
        end
        print "\n"
        row ← row + 1
end
exit
```

CODING
BLOCKS

Lets try one more pattern!

```
        1
      123
    12345
  1234567
123456789
```

```
read N
i ← 0
while i < N do
        j ← 0
        while j < n-i-1 do
                print ' '
                j ← j + 1
        end
        j ← 0, value ← 1
        while j < 2*i + 1 do
                print value
                value ← value + 1
                j ← j + 1
        end
        print '\n'
        i ← i + 1
end
```

CODING
BLOCKS

Time to try?

I.   Convert your flowcharts into pseudocode

II. Read N and print the below pattern

```
   1
  232
 34543
4567654
567898765
```

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

Time for Brain Teasers!

CODING
BLOCKS

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**.

CODING
BLOCKS

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?**

CODING BLOCKS

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?**

CODING BLOCKS

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**?

CODING BLOCKS

What is next class about?

CODING
BLOCKS

Programming Fundamentals - 1

I. Basic syntax of C++

II. Datatypes/Variables

III. Constants

IV. If else

V. while

CODING
BLOCKS

Thank you

Aman Bahl
09908124628

CODING
BLOCKS