How to design a program?

Computer Program

A computer program is **a collection of instructions** that can be executed by a computer to perform a specific task.

- usually written by a computer programmer in a high-level programming language (Python，Java，C++).

- is human-readable form of source code

- a compiler or assembler is required to generate machine code—a form consisting of instructions that the computer can directly execute.

```
7
8   def factorial(n):
9       if n == 1:
10          return n
11      else:
12          return n * factorial(n-1)
13
14  first_line = "Type the number you want to do a factorial for."
15  print(first_line)
16  say(first_line)
17  number = input('?')
18  answer = factorial(number)
19  answer_string = "The answer is %d" % answer
20  print(answer_string)
21  say(answer_string)
22
```
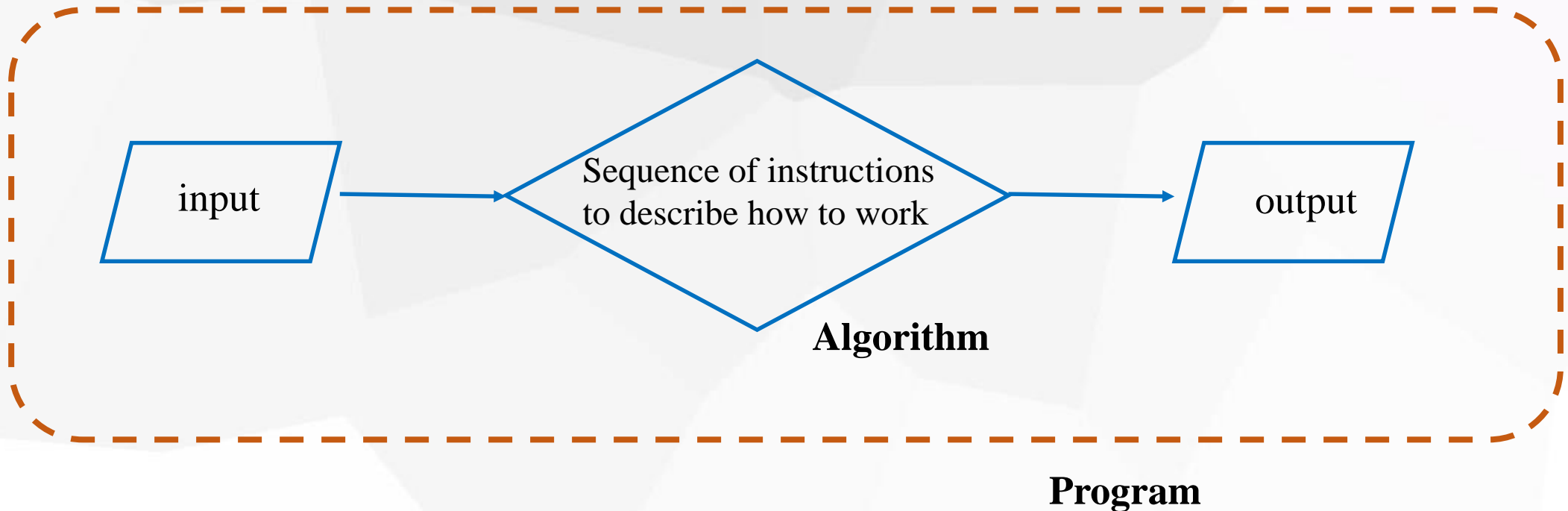
Computer Program
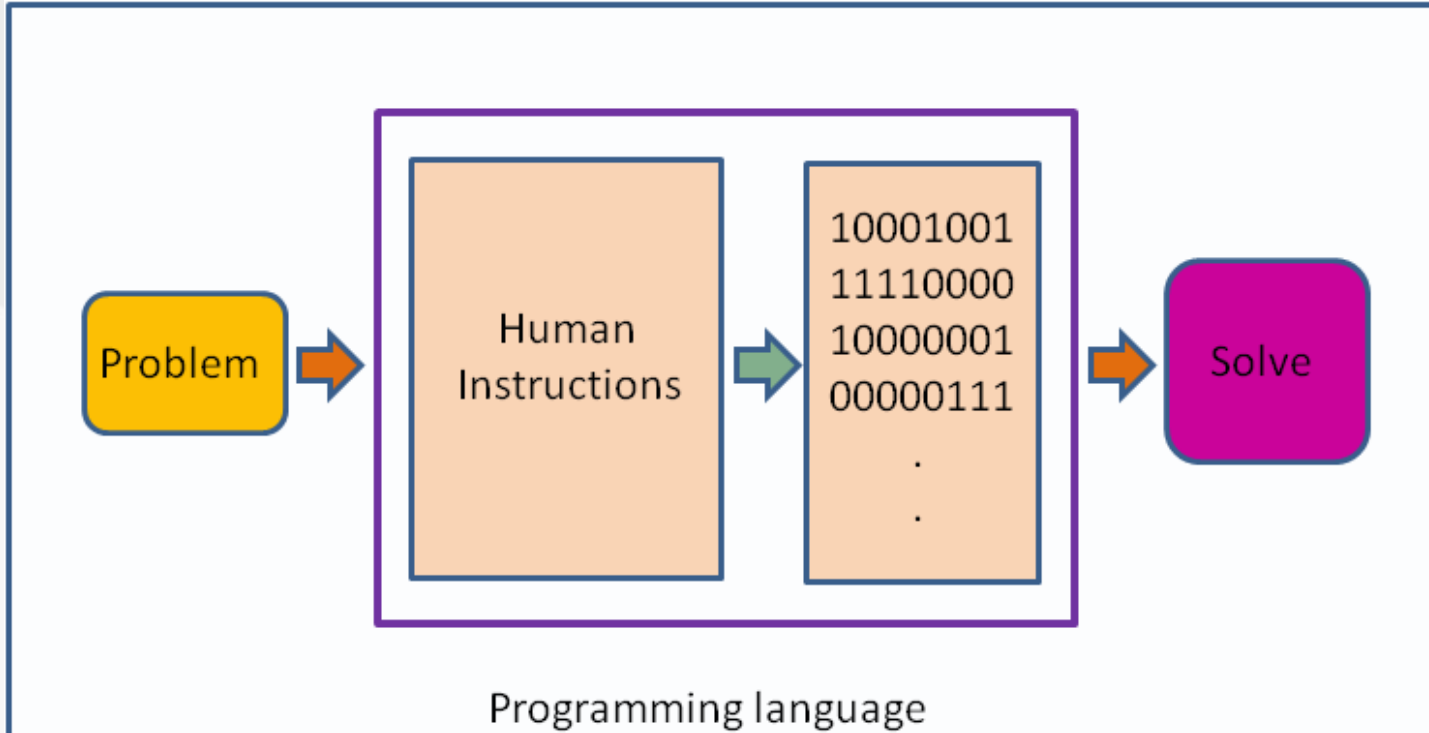
A computer program is a **executable software that runs on a computer**, helping to solve problems, which designed by human instruction, and executed by machine code

Algorithm in Program

Algorithm as a recipe that describes the exact steps needed for the computer to solve a problem

input → Sequence of instructions to describe how to work → output

Algorithm

Program

Algorithm in Program

Algorithms, in general can be designed as

- Flow charts-visually present the design
- Pseudocode-describe the steps with human language
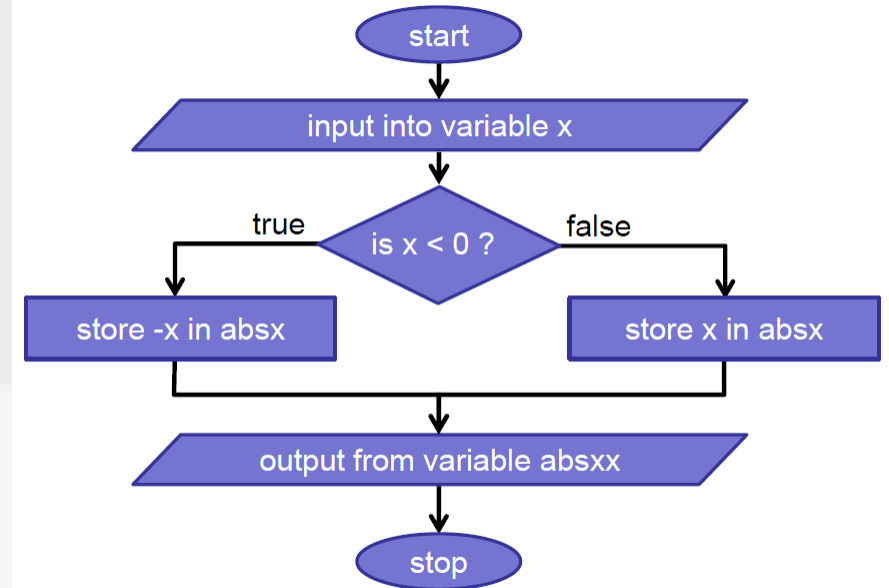- Program code-translate into program instructions

Algorithm in Program

Flowcharts

- Allow organizing control flow more visually.
- *Check the path of the control based on input.*
- Change the path based on input.

Example

- Read a number.
- If the number is positive, then store the number as is.
- If the number is negative, store the negative of the number

- Could you draw a flowchart for registering a new semester?
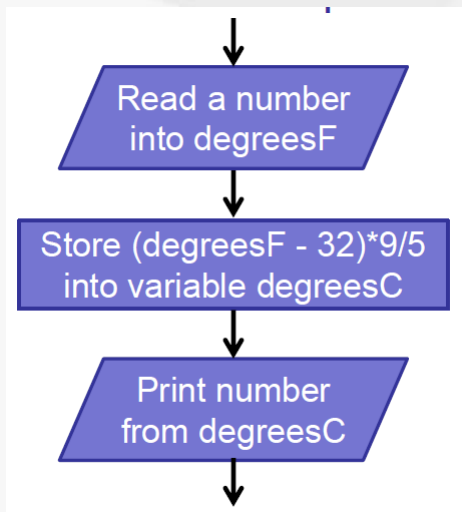
Algorithm in Program

Pseudo code

- Pseudocode is an informal way of programming description, understood by the programmers of all types

- does not require any strict programming language syntax

- used for creating an outline or a rough draft of a program.

- enables the programmer to concentrate only on the algorithm part of the code development.

```
An algorithm that detects if the value
inputted is greater than 10

INPUT number
IF number > 10 THEN
    OUTPUT "Yes"
ELSE
    OUTPUT "No"
```

Algorithm in Program

With flow chart and Pseudo code, the algorithms can be achieved by any program language.

Read a number into degreesF

Store (degreesF - 32)*9/5 into variable degreesC

Print number from degreesC

READ degF

COMPUTE degC **AS** (degF $-$ 32)*5/9

DISPLAY degC

degF = input("F-temperature? ")

degC = (degF $-$ 32)*5/9

print(degC)

Flow chart ⟶ Pseudo code ⟶ Python code

Problem. Write a program to find the larger of two numbers.

draw a flowchart
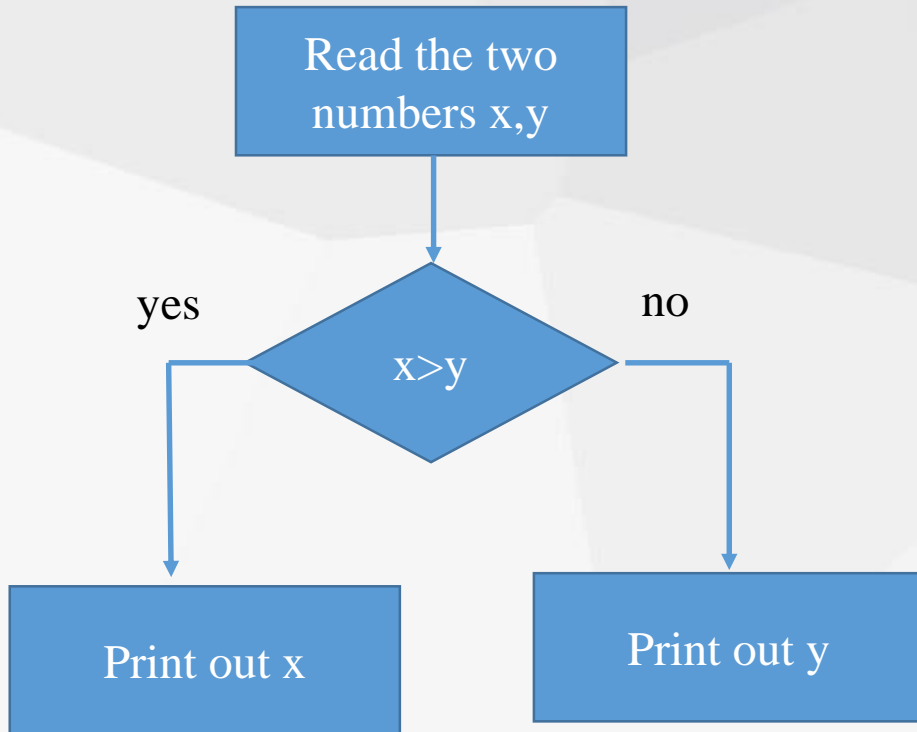
Algorithm.

READ firstNumber x,

READ secondNumber y,

IF x > y **THEN** **DISPLAY** firstNumber

ELSE

   DISPLAY secondNumber

ENDIF

## Problem. Write a program to find the larger of two numbers.

Python code:

```
x=eval(input("input the first number"))
y=eval(input("input the second number"))
if x>y:
    print("the larger one is ", x)
else:
    print("the larger one is ", y)
```

```
input the first number 3
input the second number 5
the larger one is  5
```

Problem. Determine if an integer is even or odd.

draw a flowchart

Read the number x

yes   no

x%2==0

Print out x is even   Print out x is odd
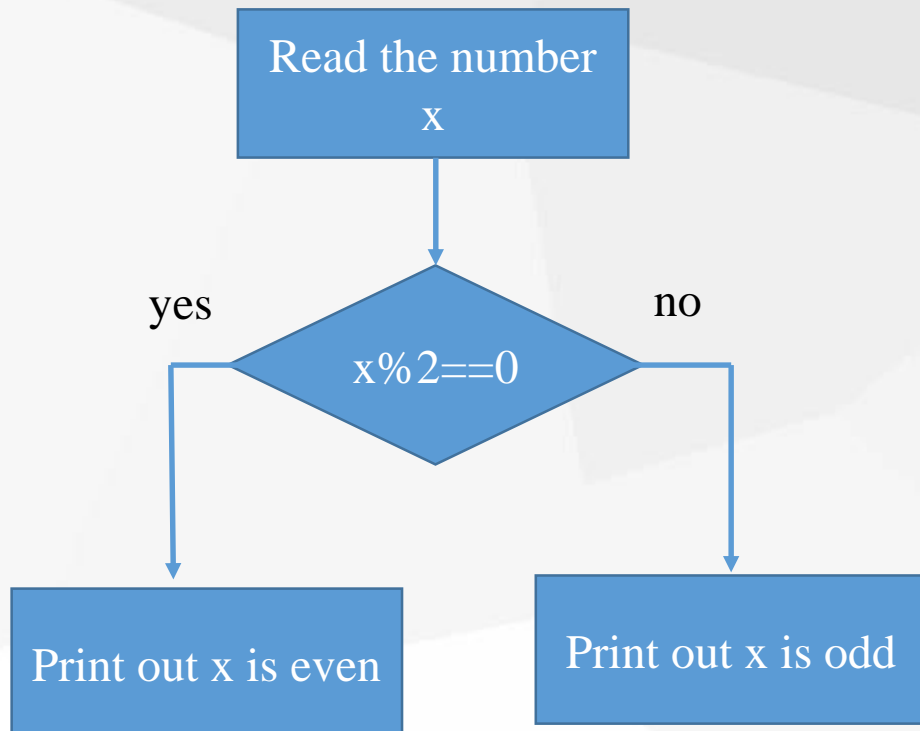
ALGORITHM:

READ number
IF number % 2 **IS** 0   **THEN**
   DISPLAY even
ELSE
   DISPLAY odd
ENDIF

Problem. Determine if an integer is even or odd.

Python code:

```
x=eval(input("input the number"))
if (x%2==0):
    print("the number is even")
else:
    print("the number is odd ")
```
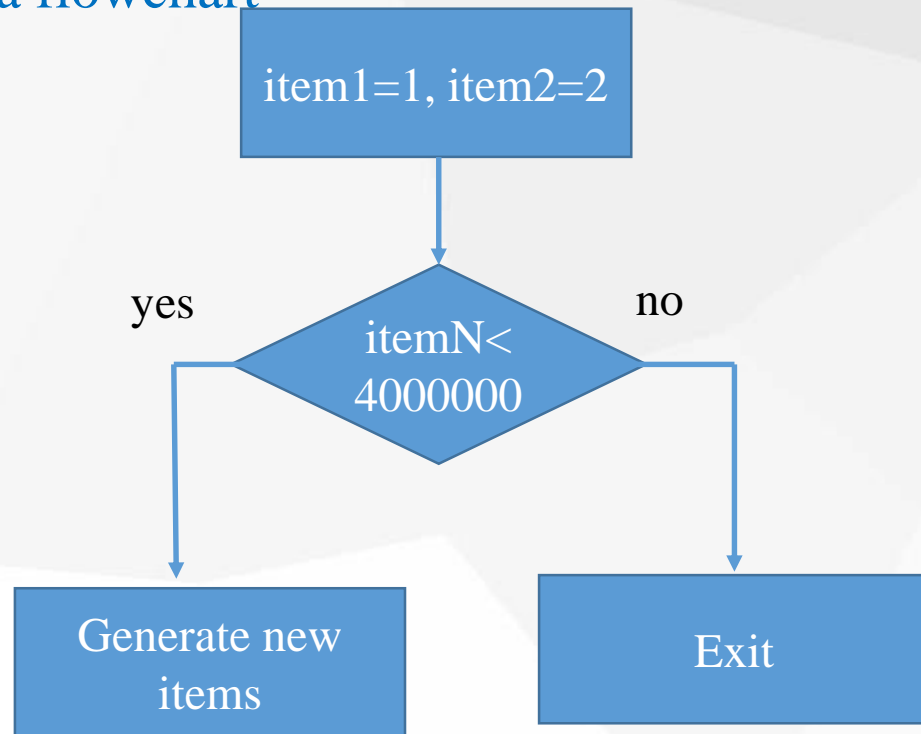
作答

Problem. Print out the Fibonacci sequence with four million (4000000), by starting with 1 and 2.

Fibonacci sequence is generated by adding the previous two terms, like the first 10 terms will be: 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, …

draw a flowchart

item1=1, item2=2

yes

no

itemN< 4000000

Generate new items

Exit

ALGORITHM:

Initialize total=0,
Initialize item 1=1 and item 2=2

While the new item < 4000000

  renew the item 1 and item 2
  item 1=item2
  item2=item1+item2

Problem. By considering the terms in the Fibonacci sequence whose values do not exceed four million (4000000), print the Fibonacci sequence .

.

```
total = 0
f1, f2 = 1, 2
print(f1,f2,sep='\n')
while f1 < 4000000:
    f1, f2 = f2, f1 + f2
    print(f2)
```

```
1
2
3
5
8
13
21
34
55
89
144
233
377
610
987
1597
2584
4181
6765
10946
17711
28657
46368
75025
121393
196418
317811
514229
832040
1346269
2178309
3524578
```

作答