SNS COLLEGE OF ENGINEERING
Kurumbapalayam (Po), Coimbatore – 641 107
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

19IT103 – COMPUTATIONAL THINKING AND PYTHON PROGRAMMING

- **A readable, dynamic, pleasant, flexible, fast and powerful language**

Recap:

- An algorithm is **a sequence of non ambiguous instructions** for solving a problem in a finite amount of time.
- An input to an algorithm specifies an instance of the problem the algorithm solves.
- Algorithm can be specified in a natural language or a pseudocode; they can also be implemented as computer programs.

Recap:

- ***Algorithm design techniques*** are general approaches to solving problems algorithmically, applicable to a verity of problems from different areas of computing.
- **The same problem can often be solved by several algorithms.**
- Algorithms operate on data. This makes the issue of data structuring critical for efficient algorithmic problem solving.

1.7 Simple strategies for developing algorithms:

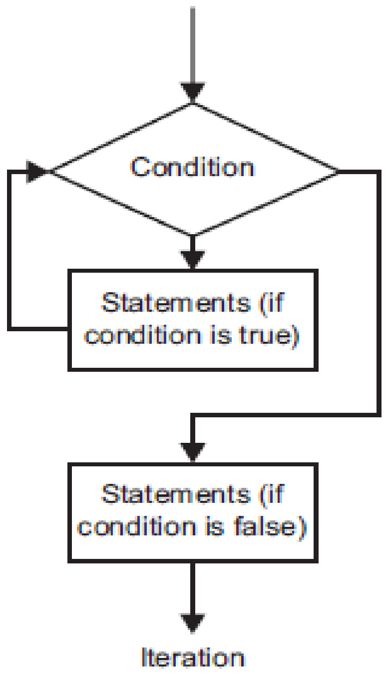
- An algorithm is a defined set of step-by-step procedures that provides the correct answer to a particular problem.
- There are some simple strategies for developing algorithms:
    - **Iteration**
    - **Recursion**
    - Brute force.
    - Backtracking.
    - Greedy Method (Heuristics)
    - Divide and Conquer.
    - Dynamic Programming.
    - Branch and Bound.

1.7 Simple strategies for developing algorithms:

1.7.1 Iteration:

- A sequence that is executed repeatedly so long as a certain condition holds.

- A sequence of statements is executed until a specified condition is true is called ***iterations.***
  - for loop
  - while loop



1.7 Simple strategies for developing algorithms:

1.7.1 Iteration:

for loop:

- The **for-loop** sets up a **control variable** that manages execution of the loop.
- Execution iterates over the items in a sequence (the value of each item is assigned to the control variable at the beginning of each pass through the loop).
- That sequence could, for example, be a list.
- In the following code sample, the variable ***word*** is used as a control variable.
- At the beginning of each iteration of the loop, it is assigned the next value from the list ***words*** from beginning to end.

1.7 Simple strategies for developing algorithms:

1.7.1 Iteration:

for loop:

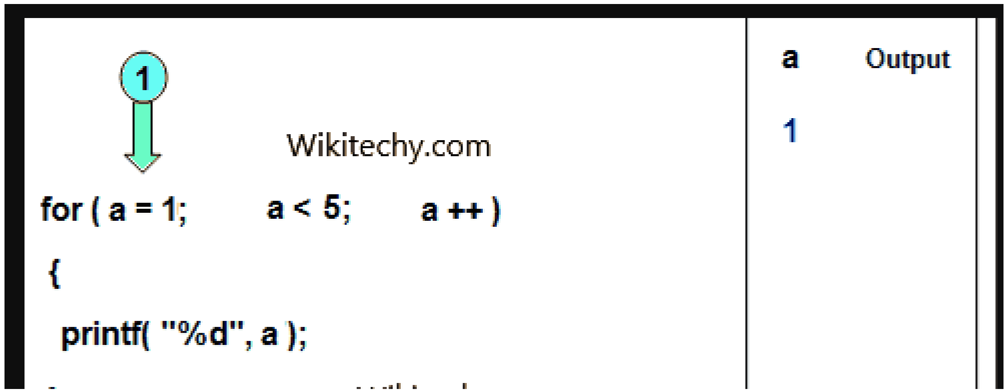
- Syntax of for loop:

FOR(start-value to end-value) DO

Statement

...

ENDFOR



1.7 Simple strategies for developing algorithms:

1.7.1 Iteration:

- for loop: example 1:

- # This prints out the length of each word in a list of words

```
words = ['my', 'big', 'meal', 'comes', 'mostly', 'bearing', 'doubtful', 'garnishes']
for word in words:
    # The following line prints the length of the word
    print(len(word))
    # Prints: 2 3 4 5 6 7 8 9
```

1.7 Simple strategies for developing algorithms:

1.7.1 Iteration:

- for loop: example 2:

- if you know exactly how many iterations to execute, a range:

```
for number in range(1, 13):
    print(number * 42)
    # Prints out the 42 times table
```

1.7 Simple strategies for developing algorithms:

1.7.1 Iteration:

- for loop: example 3: Print ***n*** natural numbers

```
BEGIN
   GET n
   INITIALIZE i=1
   FOR (i<=n) DO
     PRINT i
     i=i+1
   ENDFOR
END
```

1.7 Simple strategies for developing algorithms:

1.7.1 Iteration:

While loop:

- The while loop **executes a block of instructions repeatedly** for as long as some condition evaluates to true.
- The **value of the condition is only checked at the beginning of each iteration**.
- As soon as the condition evaluates to false, the loop ends and execution jumps immediately to the next line following the end of the while block.

1.7 Simple strategies for developing algorithms:

1.7.1 Iteration:

While loop:

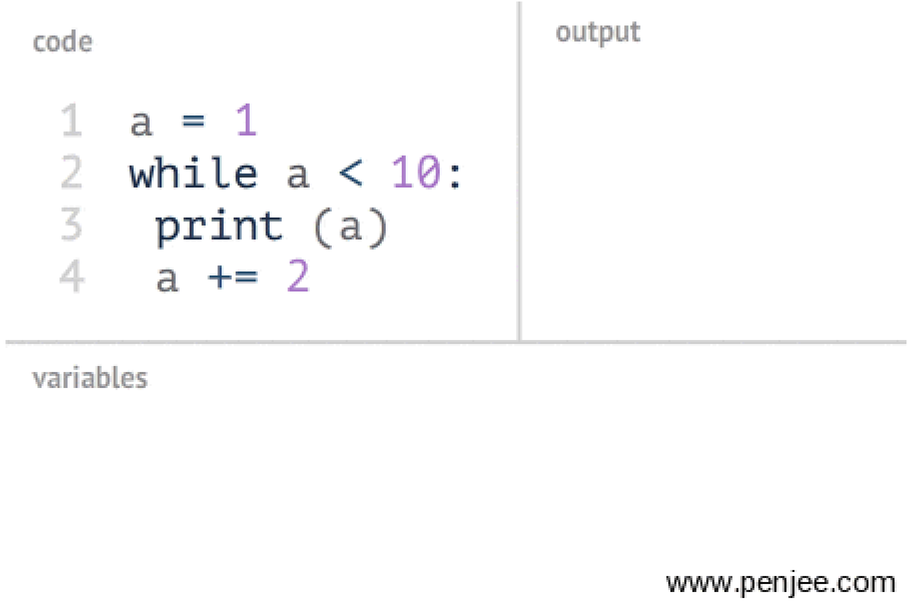
- Syntax of while loop:

  WHILE (condition) DO

  Statement

  ...

  ENDWHILE



1.7 Simple strategies for developing algorithms:

1.7.1 Iteration:

While loop: example 1:

- #This program invites the user to guess a number (set in the# age variable). As long as they haven’t guessed correctly, the program keeps asking.

```
age = 25
guess = 0
while age != guess:
    # Whereas a == b tests whether a and b are equal, a != b tests whether a and b are not equal
    # The int() function turns the user’s input (which is text) into an integer.
    guess = int(input(‘Guess how old I am> ‘))
print(‘You got it right!’)
```

1.7 Simple strategies for developing algorithms:

1.7.1 Iteration:

While loop: example 2: Print ***n*** natural numbers :

```
BEGIN
GET n
INITIALIZE i=1
WHILE(i<=n) DO
PRINT i
i=i+1
ENDWHILE
END
```

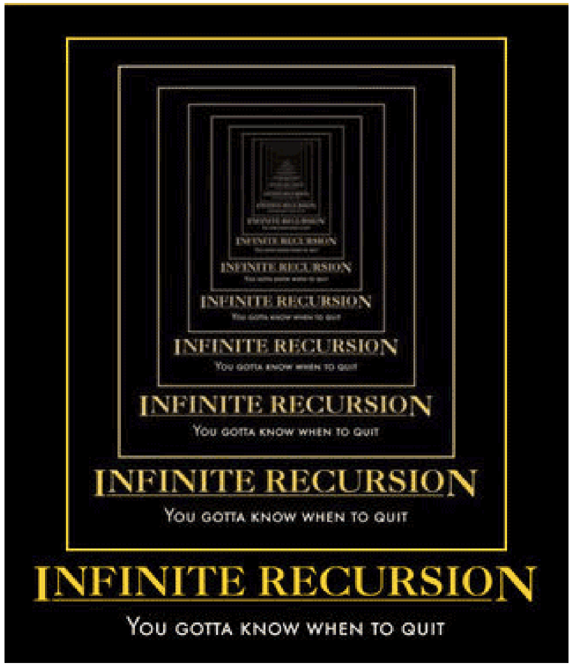
1.7 Simple strategies for developing algorithms:

1.7.1 Iteration:

While loop: example 3: To find power of a number :

```
TASK: To Find Power of a number
READ number
READ Power
Initialize result with number and pow with Power
WHILE pow< Power:
    result = result * number
    Increase pow by 1
End Loop
PRINT result
End
```

1.7 Simple strategies for developing algorithms:



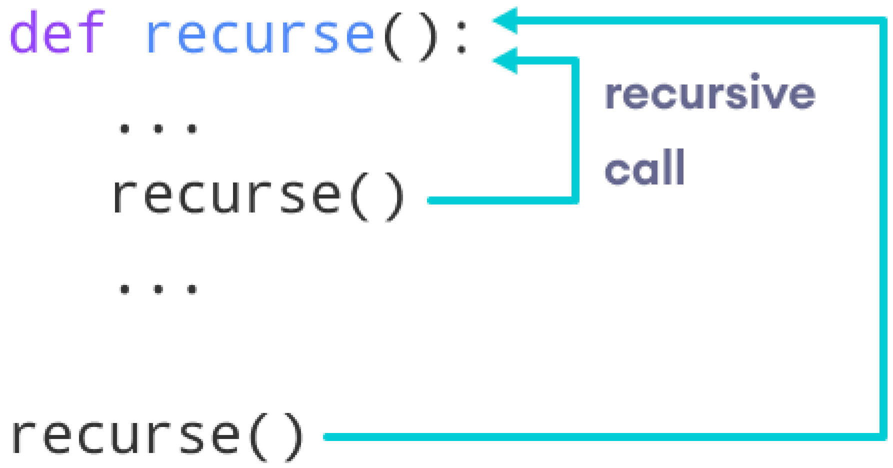
1.7.2 Recursion:

- **A function that calls itself** is known as ***recursion***.
- Recursion is a process by which a function calls itself repeatedly until some specified condition has been satisfied.
- A physical world example would be to **place two parallel mirrors facing each other.** Any object in between them would be reflected recursively.

1.7 Simple strategies for developing algorithms:

1.7.2 Recursion:

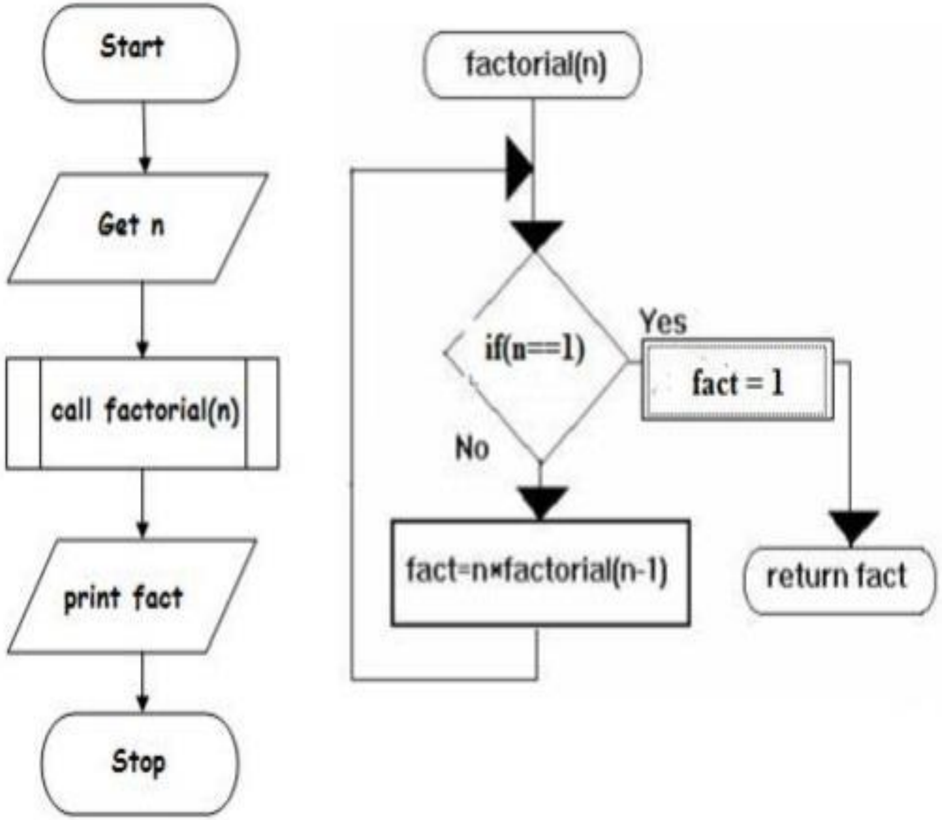
- Python Recursive Function



1.7 Simple strategies for developing algorithms:

1.7.2 Recursion:

- Algorithm for factorial of **n** numbers using recursion:



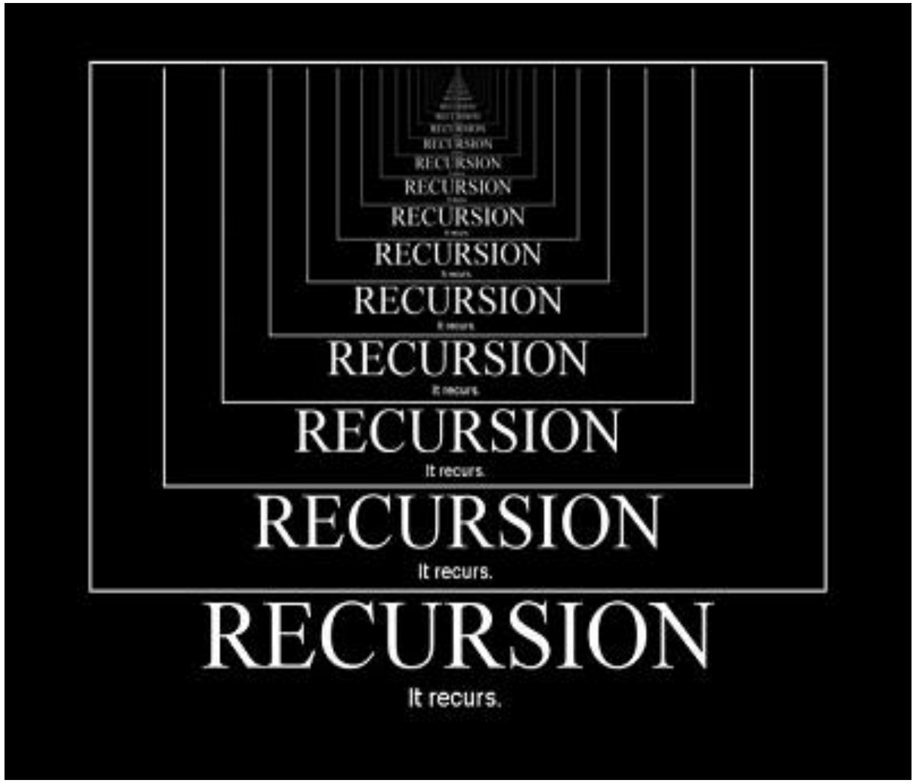
Main function:
Step1: Start
Step2: Get n
Step3: call factorial(n)
Step4: print fact
Step5: Stop

Sub function factorial(n):
Step1: if(n==1) then fact=1 return **fact**
Step2: else fact=n*factorial(n-1) and return **fact**

1.7 Simple strategies for developing algorithms:

1.7.2 Recursion:

- **Pseudo code for factorial using recursion:**



Main function:

```
BEGIN
GET n
CALL factorial(n)
PRINT fact
END
```

Sub function factorial(n):

```
IF(n==1) THEN
        fact=1
        RETURN fact
ELSE
        RETURN fact=n*factorial(n-1)
```

1.7 Simple strategies for developing algorithms:

1.7.2 Recursion:

factorial(3)   # 1st call with 3

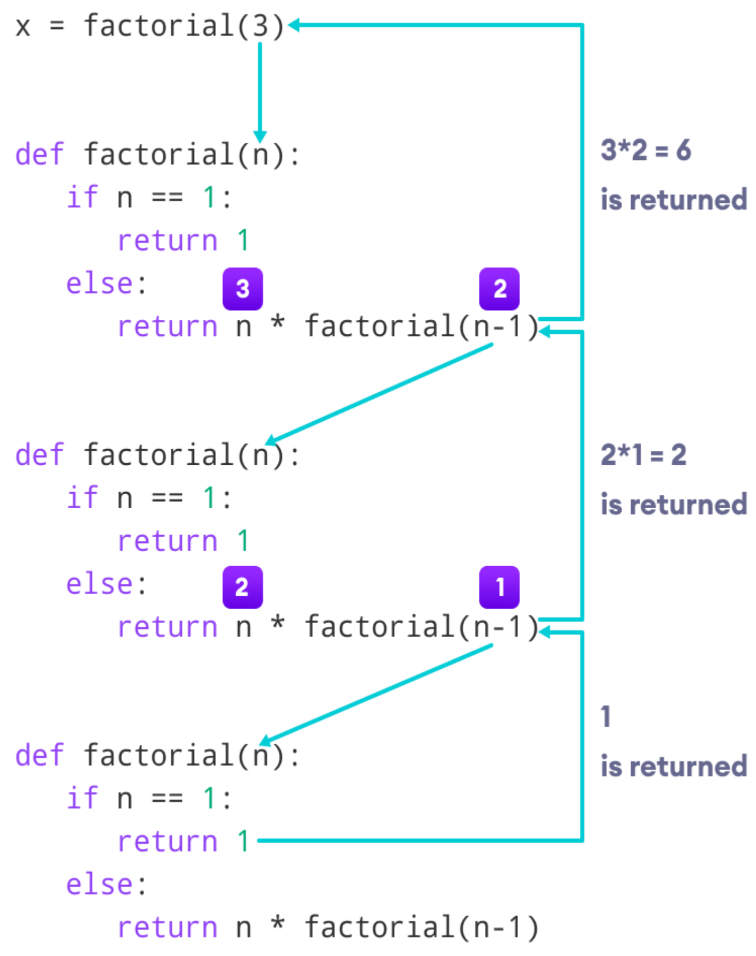
3 * factorial(2)   # 2nd call with 2

3 * 2 * factorial(1) # 3rd call with 1

3 * 2 * 1   # return from 3rd call as number=1

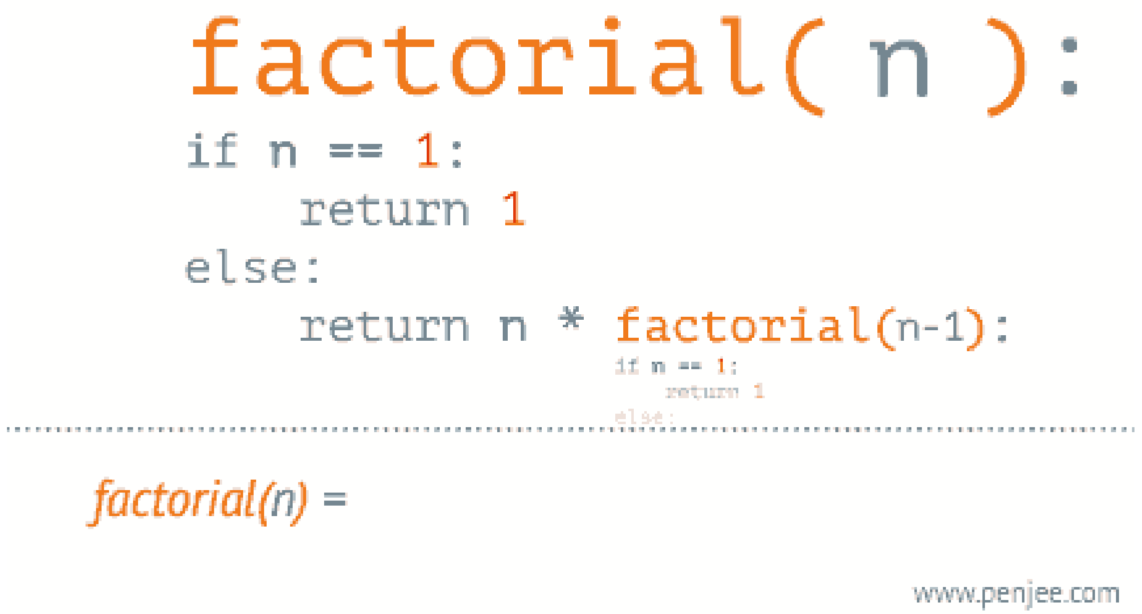
3 * 2   # return from 2nd call

6   # return from 1st call



1.7 Simple strategies for developing algorithms:

1.7.2 Recursion:



1.7 Simple strategies for developing algorithms:

1.7.2 Recursion:

Advantages of Recursion:

- Recursive functions **make the code look clean** and **elegant**.
- **A complex task can be broken down into simpler sub-problems** using recursion.
- **Sequence generation is easier** with recursion than using some nested iteration.

1.7 Simple strategies for developing algorithms:

1.7.2 Recursion:

Disadvantages of Recursion:

- Sometimes the **logic behind recursion is hard to follow** through.
- Recursive calls are expensive (inefficient) as they **take up a lot of memory and time.**
- Recursive functions are **hard to debug.**

Summary:

- Simple strategies for developing algorithms:
  - Iteration
  - Recursion
- Iteration: A sequence that is executed repeatedly so long as a certain condition holds. A sequence of statements is executed until a specified condition is true is called iterations.
  - for loop
  - While loop
- Recursion: A function that calls itself is known as recursion.
- Recursion is a process by which a function calls itself repeatedly until some specified condition has been satisfied.


THANK YOU