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Unit-02.1
Python Operators

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Outline

- ✓ Arithmetic operators
- ✓ Assignment operators
- ✓ Comparison operators
- ✓ Logical operators
- ✓ Identity operators
- ✓ Membership operators
- ✓ Bitwise operators

Operators in Python

- Operators are used to performing operations on variables and values.
- We can segregate python operators in following groups,
  - Arithmetic operators
  - Assignment operators
  - Comparison operators
  - Logical operators
  - Bitwise operators
  - Identity operators
  - Membership operators

Arithmetic Operators

- Arithmetic operators can be used with numeric values or variables to perform common mathematical operations
- Note : consider A = 10 and B = 3

Operator	Description	Example	Output
+	Addition	A + B	13
-	Subtraction	A - B	7
/	Division	A / B	3.3333333333333335
*	Multiplication	A * B	30
%	Modulus return the remainder	A % B	1
//	Floor division returns the quotient	A // B	3
**	Exponentiation	A ** B	10 * 10 * 10 = 1000

- Imp. Point: Python does not support pre/post increment(++)/decrement(--) operators

Assignment Operators

- Assignment Operators are used to assigning values to variables.
- Note : consider A = 3, B = 5 and C = 0

Operator	Description	Example	Output
=	Assign	C = A + B	8
+=	Add and Assign	A+=B	8
-=	Subtract and Assign	A-=B	-2
*=	Multiply and Assign	A*=B	15
/=	Divide and Assign	A/=B	0.6
%=	Modulus and Assign	A%=B	3
//=	Divide(floor) and Assign	A//=B	0

Relational Operators

- Relational operators are used for comparing the values. It either returns True or False according to the condition.
- Note : consider A = 9, B = 5

Operator	Description	Example	Output
>	Greater than	A > B	True
<	Less than	A < B	False
==	Equal to	A == B	False
!=	Not Equal to	A != B	True
>=	Greater than or equal to	A >= B	True
<=	Less than or equal to	A <= B	False

Logical Operators

- Logical Operators are used to perform logical operations on the values of variables. The value is either true or false. We can figure out the conditions by the result of the truth values.
- Note : consider A = 10 and B = 3

Operator	Description	Example	Output
and	Returns True if both statements are true	A > 5 **and** B < 5	True
or	Returns True if one of the statements is true	A > 5 **or** B > 5	True
not	Negate the result, returns True if the result is False	**not** (A > 5)	False

Bitwise Operators

- The bitwise operators are used to performing bitwise calculations on integers. The integers are first converted into binary and then operations are performed on bit by bit, hence the name bitwise operators. Then the result is returned in decimal format.
- Note : consider A = 10(binary - 1010) and B = 4(binary - 0100)

Operator	Description	Example	Output
A	Bitwise AND	A & B	0
|	Bitwise OR	A | B	14
~	Bitwise NOT	~A	-11
^	Bitwise XOR	A ^ B	14
>>	Bitwise right shift	A>>	5
<<	Bitwise left shift	A<<	20

Example

Example.py

```python
x , y = 5,2
a,b = True,False

#Arithmetic operator
print('x // y =',x//y)
print('x ** y =',x**y)

#Assignemnt Operator
x+=5 # x = 10
y+=2 # y = 4
print('x y =',x,y)

#Comparison Operator
print('x >= y is',x>=y)
print('x <= y is',x<=y)

#Logical Operator
print('x and y is',a and b)
print('x or y is',a or b)
print('not x is',not a)

#Bitwise Operators
print('x & y is',x & y)
print('x | y is',x | y)
```

Output

```
x // y = 2
x ** y = 25
x  y = 10 4
x >= y is True
x <= y is False
x and y is False
x or y is True
not x is False
x & y is 0
x | y is 14
```

Identity & Member Operators

Identity Operator

- Note : consider A = [1,2], B = [1,2] and C=A

Operator	Description	Example	Output
is	Returns True if both variables are the same object	A is B A is C	False True
is not	Returns True if both variables are **different** object	A is not B	True

Member Operator

- Note : consider A = 2 and B = [1,2,3]

Operator	Description	Example	Output
in	Returns True if a sequence with the specified value is present in the object	A in B	True
not in	Returns True if a sequence with the specified value is not present in the object	A not in B	False

Example

Example.py

```python
x2 = 'Hello'
y2 = 'Hello'
x3 = [1,2,3]
y3 = x3

x = 'Hello world'
y = {1:'a',2:'b'}
z = [1,2,3,4,5]

# Identity Operator
print("x2 is y2 = ",x2 is y2)
print("x3 is y3 = ",x3 is y3)
print("x2 is not y2 =",x2 is not y2)

# Membership Operator
print("'H' in x = ", 'H' in x)
print("'hello' not in x = ",'hello' not in x)
print("5 in z = ", 5 in z)
print("1 in y = ",1 in y)
```

Output

```
x2 is y2 =  True
x3 is y3 =  True
x2 is not y2 = False
'H' in x =  True
'hello' not in x = True
5 in z = True
1 in y = True
```

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Unit-02.2

Conditional and Looping Statements

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Outline

- ✓ If statement
- ✓ if-else statement
- ✓ nested if statement
- ✓ elif statement
- ✓ For loop statement
- ✓ While loop statement
- ✓ break
- ✓ continue
- ✓ pass keywords

Introduction

- The statements that help us to control the flow of execution in a program called control statements.
- There are two types of control statements.
- **Branching Statement :**
  - The statements that help us to select some statements for execution and skip other statements.
  - These statements are also called as **decision making statements** because they make decision based on some condition and select some statements for execution.
  - If statement
  - if-else statement
  - nested if statement
  - elif statement
- **Looping statements:**
  - The statements that help us to execute set of statements repeatedly are called as looping statements.
  - For loop statement
  - While loop statement

If statement

- if statement is written using the **if** keyword followed by **condition** and **colon**(:) .
- Code to execute when the condition is true will be ideally written in the next line with **Indentation** (white space).
- Python relies on indentation to define scope in the code (Other programming languages often use curly-brackets for this purpose).

Syntax

```
if some_condition :
    # Code to execute when condition is true
```

if statement ends with :

Indentation (tab/whitespace) at the beginning

ifdemo.py

```
x = 10

if x > 5 :
    print("X is greater than 5")
```

Output

```
X is greater than 5
```

If else statement

- This is basically a “two-way” decision statement. This is used when we must choose between two alternatives.

Syntax

```
if some_condition :
    # Code to execute when condition is true
else :
    # Code to execute when condition is false
```

ifelsedemo.py

```
x = 3

if x > 5 :
    print("X is greater than 5")
else :
    print("X is less than 5")
```

Output

```
X is less than 5
```

Example of if else

Example1.py

```python
# Program checks if the number is positive or negative
num = int(input("Enter Number="))
if num >= 0:
    print("Positive number")
else:
    print("Negative number")
```

Output

```
Enter Number = 5
Positive number
```

Example2.py

```python
# Program checks if the number is Odd or Even
num = int(input("Enter Number="))
if num % 2 == 0:
    print("Even number")
else:
    print("Odd number")
```

Output

```
Enter Number = 4
Positive number
```

Nested if statement

- An if-else statement is written within another if-else statement is called nested if statement.

Syntax

```
if some_condition1 :
    if some_condition2 :
       # Code to execute when condition is true
    else :
       # Code to execute when condition is false
```

Example1.py

```
num = float(input("Enter a number: "))
if num >= 0:
    if num == 0:
        print("Zero")
    else:
        print("Positive number")
else:
    print("Negative number")
```

Output

```
Enter a Number = 4
Positive number
```

Example

Example1.py

```python
# find maximum number from three number
a = int(input("Enter A="))
b = int(input("Enter B="))
c = int(input("Enter C="))

if a>b:
    if a>c:
        g=a
    else:
        g=c
else:
    if b>c:
        g=b
    else:
        g=c

print("Greater  = ",g)
```

Output

```
Enter A=10
Enter B=9
Enter C=2
Greater  =  10
```

If, elif and else statement

- The elif is short for else if. It allows us to check for multiple expressions.
- If the condition for if is False, it checks the condition of the next elif block and so on.
- If all the conditions are False, the body of else is executed.
- Only one block among the several if...elif...else blocks is executed according to the condition.
- The if a block can have only one else block, but it can have multiple elif blocks.
- This statement is alternative for nested if statement to overcome the complexity problem involved in nested if statement.

If, elif and else statement

Syntax

```
if some_condition_1 :
   # Code to execute when condition 1 is true
elif some_condition_2 :
   # Code to execute when condition 2 is true
else :
   # Code to execute when both conditions are false
```

ifelifdemo.py

```python
x = 10

if x > 12 :
    print("X is greater than 12")
elif x > 5 :
    print("X is greater than 5")
else :
    print("X is less than 5")
```

Output

```
X is greater than 5
```

Example

Example1.py

```python
# Python Program to find Student Grade
english = float(input(" Please enter English Marks: "))
math = float(input(" Please enter Math score: "))
computers = float(input(" Please enter Computer Marks: "))
physics = float(input(" Please enter Physics Marks: "))
chemistry = float(input(" Please enter Chemistry Marks: "))

total = english + math + computers + physics + chemistry
percentage = (total / 500) * 100

print("Total Marks = %.2f"  %total)
print("Marks Percentage = %.2f"  %percentage)

if(percentage >= 90):
    print("A Grade")
elif(percentage >= 80):
    print("B Grade")
elif(percentage >= 70):
    print("C Grade")
elif(percentage >= 60):
    print("D Grade")
elif(percentage >= 40):
    print("E Grade")
else:
    print("Fail")
```

Output

```
Please enter English Marks: 50
Please enter Math score: 50
Please enter Computer Marks: 50
Please enter Physics Marks: 50
Please enter Chemistry Marks: 50
Total Marks = 250.00
Marks Percentage = 50.00
E Grade
```

For loop in python

- Many objects in python are iterable, meaning we can iterate over every element in the object.
  - ⤷ such as every elements from the List, every characters from the string etc..
- We can use for loop to execute block of code for each element of iterable object.

Syntax

```python
for temp_item in iterable_object :
    # Code to execute for each object in iterable
```

For loop ends with :

Indentation (tab/whitespace) at the beginning

fordemo1.py

```python
my_list = [1, 2, 3, 4]
for list_item in my_list :
    print(list_item)
```

Output :

```
1
2
3
4
```

fordemo2.py

```python
my_list = [1,2,3,4,5,6,7,8,9]
for list_item in my_list :
    if list_item % 2 == 0 :
        print(list_item)
```

Output :

```
2
4
6
8
```

range() function

- The range() function returns a sequence of numbers, starting from 0 by default, and increments by 1 (by default), and stops before a specified number.

Syntax

```
range(start, stop, step)
```

Example1.py

```python
x = range(3, 6)
for n in x:
    print(n)
```

Output

```
3
4
5
```

Example2.py

```python
x = range(3, 20, 2)
for n in x:
    print(n)
```

Output

```
3
5
-
19
```

Example3.py

```python
x = range(20)
for n in x:
  print(n)
```

Output

```
0
1
-
19
```

Example4.py

```python
x = reversed(range(20))
for n in x:
  print(n)
```

Output

```
19
18
-
0
```

For loop (tuple unpacking)

- Sometimes we have nested data structure like List of tuples, and if we want to iterate with such list we can use tuple unpacking.

withouttupleunapacking.py

```python
my_list = [(1,2,3), (4,5,6), (7,8,9)]
for list_item in my_list :
    print(list_item[1])
```

Output :

```
2
5
8
```

withtupleunpacking.py

```python
my_list = [(1,2,3), (4,5,6), (7,8,9)]
for a,b,c in my_list :
    print(b)
```

This technique is known as tuple unpacking

Output :

```
2
5
8
```

For loop with else

- The else block just after for/while is executed only when the loop is NOT terminated by a break statement.

Example1.py

```python
for i in range(1, 4):
    print(i)
else:
    print("No Break")
```

Output

```
1
2
3
No Break
```

Example2.py

```python
for i in range(1, 4):
    print(i)
    break
else: # Not executed as there is a break
    print("No Break")
```

Output

```
1
```

Example

Example1.py

```python
#odd numbers between 1 to n
num = int(input("Enter Number = "))
for i in range(1,num+1):
    if i % 2 != 0:
        print(i)
```

Output

```
Enter Number = 5
1
3
5
```

Example2.py

```python
#series 1 + 4 + 9 + 16 + 25 + 36 + ...n
num = int(input("Enter Number = "))
sum = 0
for i in range(1,num+1):
    sum = sum + i**2
print("Sum=",sum)
```

Output

```
Enter Number = 10
Sum= 385
```

Example

Example3.py

```python
# Find factorial of the given number
num = int(input("Enter Number = "))
fact = 1
for i in range(1,num+1):
    fact = fact * i
print("Factorial =", fact )
```

Output

```
Enter Number = 5
Factorial = 120
```

Example4.py

```python
#series 1 – 2 + 3 – 4 + 5 – 6 + 7 ... n
num = int(input("Enter Number = "))
sum = 0
for i in range(1,num+1):
    if i % 2 == 0:
        sum = sum - i
    else:
        sum = sum + i
print("Sum=",sum)
```

Output

```
Enter Number = 10
Sum= -5
```

While loop

- While loop will continue to execute block of code until some condition remains True.
- For example,
  - while felling hungry, keep eating
  - while have internet pack available, keep watching videos

Syntax

```
while some_condition :
    # Code to execute in loop
```

while loop ends with :

Indentation (tab/whitespace) at the beginning

whiledemo.py

```
x = 0
while x < 3 :
    print(x)
    x += 1    # x++ is invalid in pytho
```

Output :

```
0
1
2
```

withelse.py

```
x = 5
while x < 3 :
    print(x)
    x += 1    # x++ is invalid in python
else :
    print("X is greater than 3")
```

Output :

X is greater than 3

Example

Example1.py

```python
#odd numbers between 1 to n
num = int(input("Enter Number = "))
i=0
while(i<=num):
    if i % 2 != 0:
        print(i)
    i+=1
```

Output

```
Enter Number = 5
1
3
5
```

Example2.py

```python
#series 1 + 4 + 9 + 16 + 25 + 36 + ...n
num = int(input("Enter Number = "))
sum = i = 0
while(i<=num):
    sum = sum + i**2
    i+=1
print("Sum=",sum)
```

Output

```
Enter Number = 10
Sum= 385
```

Exercise programs

- Do Following programs using for and while loop.
  - WAP to find out sum of first and last digit of a given number
  - WAP to find whether the given number is prime or not.
  - WAP to find out prime numbers between given two numbers
  - WAP to print given number in reverse order.
  - WAP to check whether the given number is Armstrong or not.
  - WAP to find the sum of 1 + (1+2) + (1+2+3) + (1+2+3+4)+ …+(1+2+3+4+….+n).

break keyword

- Breaks out of the current closest enclosing loop.
- Break Statement is a loop control statement that is used to terminate the loop.
- As soon as the break statement is encountered from within a loop, the loop iterations stop there, and control returns from the loop immediately to the first statement after the loop.
- Basically, break statements are used in situations when we are not sure about the actual number of iterations for the loop or we want to terminate the loop based on some condition.

Syntax

```
break
```

breakdemo.py

```
for temp in range(5) :
    if temp == 2 :
        break

    print(temp)
```

Output :

```
0
1
```

continue keyword

- Goes to the top of the current closest enclosing loop.
- Continue statement is a loop control statement that forces to execute the next iteration of the loop while skipping the rest of the code inside the loop for the current iteration only i.e.
- When the continue statement is executed in the loop, the code inside the loop following the continue statement will be skipped for the current iteration and the next iteration of the loop will begin.

Syntax

```
continue
```

continuedemo.py

```
for temp in range(5) :
    if temp == 2 :
        continue

    print(temp)
```

Output :

```
0
1
3
4
```

pass keyword

- Does nothing at all, will be used as a placeholder in conditions where you don’t want to write anything.
- The pass statement is a null statement. But the difference between pass and comment is that comment is ignored by the interpreter whereas pass is not ignored.

Syntax

```
pass
```

passdemo.py

```
for temp in range(5) :
    pass
```

Output : (nothing)

Python Programming(2101CS405)

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Unit-02.3
Functions

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Outline

- ✓ Creating function
- ✓ DOCSTRING
- ✓ Types of arguments
- ✓ Calling function
- ✓ return statement
- ✓ Scope of Variables
- ✓ Lambda expression
- ✓ Recursion

Functions in python

- Creating clean repeatable code is a key part of becoming an effective programmer.
- A function is a block of code which only runs when it is called.
- In Python a function is defined using the def keyword:

Syntax

```
def function_name() :
    #code to execute when function is called
```

ends with :

Indentation (tab/whitespace) at the beginning

Functiondemo.py

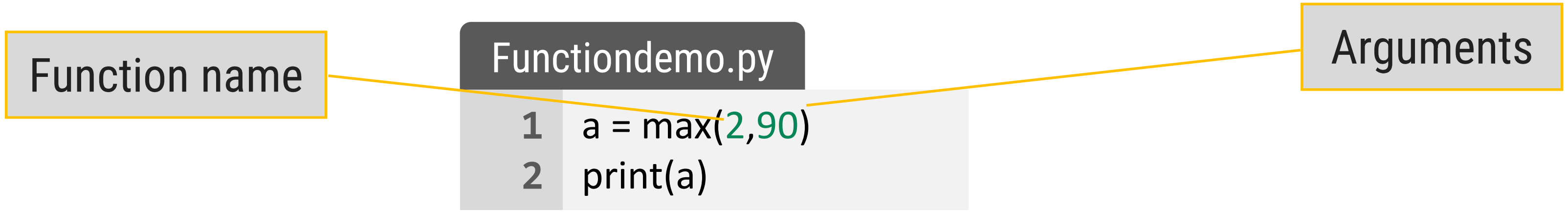
```
def seperator() :
    print('==============================')

print("hello world")
seperator()
print("from darshan college")
seperator()
print("rajkot")
```

Output :

```
hello world
==============================
from darshan college
==============================
rajkot
```

Function (cont.)

- There are two kinds of functions in Python.
- Built-in functions that are provided as part of Python - input(), print()...
- Functions that we define ourselves and then use
- We treat the of the built-in function names as "new" reserved words (i.e. we avoid them as variable names)
- In Python a function is some reusable code that takes arguments(s) as input does some computation and then returns a result(s)
- We call/invoke the function by using the function name, parenthesis and arguments in an expression



```
a = max(2,90)
print(a)
```

Function Names

- Use a naming scheme, and use it consistently (camel case syntax).
- For all names, avoid abbreviations, unless they are both standardized and widely used.
- The name should describe the data's meaning rather than its type (e.g., amount_due rather than money),
- Functions and methods should have names that say what they do or what they return (depending on their emphasis), but never how they do it—since that might change.
- All three functions below return the index position of the first occurrence of a name in a list of names, starting from the given starting index and using an algorithm that assumes the list is already sorted.

Functiondemo.py

```python
def find(l, s, i=0): # BAD
def linear_search(l, s, i=0): # BAD
def first_index_of(sorted_name_list, name, start=0): # GOOD
```

Function (cont.) (DOCSTRING & return)

- Doc string helps us to define the documentation about the function within the function itself.

Syntax

```
def function_name() :
    '''
        DOCSTRING: explains the function
        INPUT: explains input
        OUTPUT: explains output
    '''
    #code to execute when function is called
```

Enclosed within triple quotes

- Unlike conventional source code comments, the docstring should describe what the function does, not how.
- The docstrings can be accessed using the __doc__ method of the object or using the help function.

Help.py

```
Function_name. __doc__
```

Function Types

- Four kinds of functions can be created in Python: global functions, local functions, lambda functions, and methods.
- Global function
  - Global objects (including functions) are accessible to any code in the same module (i.e., the same .py file) in which the object is created.
- Local functions
  - (also called nested functions) are functions that are defined inside other functions. These functions are visible only to the function where they are defined;
  - They are especially useful for creating small helper functions that have no use elsewhere.
- Lambda functions
  - Lambda functions are expressions, so they can be created at their point of use;
  - however, they are much more limited than normal functions.
- Methods
  - *Methods* are functions that are associated with a particular data type and can be used only in conjunction with the data type (when we cover object-oriented programming.)

Exercise

- WAP to count simple interest using function.
- WAP to find maximum number from given two numbers using function.
- WAP that defines a function exchange to interchange the values of two variables, say x and y.

Function Arguments

- A function by using the following types of formal arguments:
  - Required arguments
  - Keyword arguments
  - Default arguments
  - Variable-length arguments
- Required arguments
  - Required arguments are the arguments passed to a function in correct positional order.
  - During a function call, values passed through arguments should be in the order of parameters in the function definition.

Demo.py

```python
def add_number(n1,n2):
        print("Sum = ", n1+n2)

add_number(2,3)
add_number(3,5)
```

Output

```
Sum =  5
Sum =  8
```

Function Arguments(cont.)

Keyword arguments

- When you use keyword arguments in a function call, the caller identifies the arguments by the parameter name.
- This allows you to skip arguments or place them out of order because the Python interpreter is able to use the keywords provided to match the values with parameters.
- Functions can also be called using keyword arguments of the form kwarg=value
- During a function call, values passed through arguments need not be in the order of parameters in the function definition. This can be achieved by keyword arguments.

Demo.py

```python
def subtract_number(n1,n2):
        print("Subtraction = ", n1-n2)

subtract_number(20,10)
subtract_number(n2=20,n1=10) Keyword Arguments
```

Output

```
Subtraction =  10
Subtraction =  -10
```

Function Arguments(cont.)

Default arguments

- A default argument is an argument that assumes a default value if a value is not provided in the function call for that argument.
- Default arguments are values that are provided while defining functions.
- The assignment operator = is used to assign a default value to the argument.
- Default arguments become optional during the function calls.
- If we provide a value to the default arguments during function calls, it overrides the default value.
- Default arguments should follow non-default arguments.

Demo.py

```python
def add_number(n1,n2 = 10):
        print("Sum = ", n1+n2)

add_number(2,3)
add_number(3)
```

Output

```
Sum =  5
Sum =  13
```

Function Arguments(cont.)

Variable-length arguments

- Variable-length arguments are also known as arbitrary arguments. If we don't know the number of arguments needed for the function in advance, we can use arbitrary arguments.
- There are two types of variable length arguments

Arbitrary positional arguments

- You may need to process a function for more arguments than you specified while defining the function.
- These arguments are called *variable-length* arguments and are not named in the function definition, unlike required and default arguments.

Syntax

```
def functionname([formal_args,] *var_args_tuple ):
    #code to execute when function is called
```

Tuple representing variable length arguments

- An asterisk (*) is placed before the variable name that will hold the values of all non keyword variable arguments.
- This tuple remains empty if no additional arguments are specified during the function call

Function Arguments(cont.)

- Arbitrary positional arguments example

Demo.py

```python
def add_number(n1,*n):
    sum = n1
    for i in n:
        sum = sum + i
    print("Sum = ", sum)

add_number(2)
add_number(10,10,10,10)
```

Output

```
Sum =  2
Sum =  40
```

Function Arguments(cont.)

Arbitrary keyword arguments

- For arbitrary positional argument, a double asterisk (**) is placed before a parameter in a function which can hold keyword variable-length arguments.

Demo.py

```python
def add_Number(**a):
    sum = 0
    sum = a['a'] + a['b']
    print("Sum=",sum)
    for i in a.items():
        print(i)
    print(a)

add_Number(a=4,b=3,c=4)
```

Output

```
Sum= 7
('a', 4)
('b', 3)
('c', 4)
{'a': 4, 'b': 3, 'c': 4}
```

Pass by reference vs value

- In call by value method, the value of the actual parameters is copied into the formal parameters.
- In call by reference, the address of the variable is passed into the function call as the actual parameter.
- In python value is passed as “Call by Object Reference” or “Call by assignment”.
- When we pass whole numbers, strings or tuples to a function, the passing is like call-by-value because you can not change the value of the immutable objects being passed to the function.
- Whereas passing mutable objects can be considered as call by reference because when their values are changed inside the function, then it will also be reflected outside the function.

pass by reference
cup =
fillCup( )
pass by value
cup =
fillCup( )

Pass by reference vs value

CallByValue.py

```python
# Call by Value
def modifiy_String(s):
    s = "Darshan University"
    print("Inside Function:", s)


str = "Darshan"
modifiy_String(str)
print("Outside Function:",str)
```

Output

```
Inside Function: Darshan University
Outside Function: Darshan
```

CallByReference.py

```python
# Call by Reference
def add_more(list):
    list.append(50)
    print("Inside Function:", list)


list = [1,2,3,4,5]
add_more(list)
print("Outside Function:",list)
```

Output

```
Inside Function: [1, 2, 3, 4, 5, 50]
Outside Function: [1, 2, 3, 4, 5, 50]
```

Pass by reference vs value

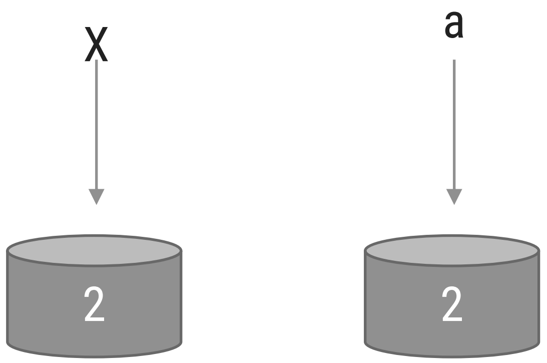
```
def printA(a):
        a = 3
```

```
def printList(a):
        a.append(3)
```

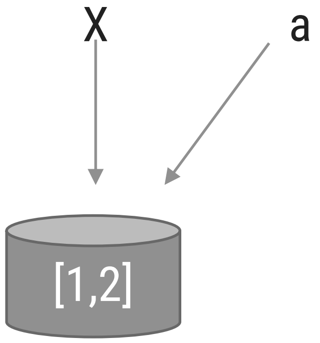
```
x=2
printA(x)
print("A = ",x)
```

```
x= [1,2]
printList(x)
print("List",x)
```

Call by Value



Call by Reference



return Statement

- **return statement** : return allows us to assign the output of the function to a new variable, return is use to send back the result of the function, instead of just printing it out.
- A return statement is used to end the execution of the function call. The statements after the return statements are not executed.
- If the return statement is without any expression, then the special value None is returned.
- In python we can return multiple values from function using object, tuple, list, Dictionary.

returnDemo.py

```python
def add_number(n1,n2) :
    return n1 + n2

sum1 = add_number(5,3)
sum2 = add_number(6,1)
print(sum1)
print(sum2)
```

Output :

```
8
7
```

return Multiple values

returndemo.py

```python
def test():
    a=1
    b=2
    c=3
    return a,b,c # return multiple values

x = test()
a,b,c = test()
print(x)
print(x[1])
print("a, b, c=",a,b,c)
```

Output

```
(1, 2, 3)
2
a, b, c= 1 2 3
```

Exercise

- WAP that define a function to find factorial of given number.
- WAP that defines a function which returns 1 if the number is prime otherwise return 0.
- WAP to generate Fibonacci series of N given number using function name fibbo.
- WAP that defines a function to add first n numbers.

Scope of Variables

- All variables in a program may not be accessible at all locations in that program. This depends on where you have declared a variable.
- The scope of a variable determines the portion of the program where you can access a particular identifier. There are two basic scopes of variables in Python:
  - Global variables
  - Local variables
- Variables that are defined inside a function body have a local scope, and those defined outside have a global scope.
- This means that local variables can be accessed only inside the function in which they are declared.
- whereas global variables can be accessed throughout the program body by all functions.
- When we call a function, the variables declared inside it are brought into scope.

Scope of Variables (cont.)

Local.py

```python
total = 0
def sum( arg1, arg2 ):
    total = arg1 + arg2
    print ("Inside the function local total : ", total)
    return total;
# Now you can call sum function
sum( 10, 20 );
print ("Outside the function global total : ", total)
```

Output

```
Inside the function local total :  30
Outside the function global total :  0
```

Global.py

```python
total = 0
def sum( arg1, arg2 ):
    global total
    total = arg1 + arg2
    print ("Inside the function local total : ", total)
    return total;
# Now you can call sum function
sum( 10, 20 );
print ("Outside the function global total : ", total)
```

Output

```
Inside the function local total :  30
Outside the function global total :  30
```

Lambda Function

- We can use the lambda keyword to create small anonymous functions.
- These functions are called anonymous because they are not declared in the standard manner by using the *def* keyword.
- Lambda forms can take any number of arguments but return just one value in the form of an expression. They cannot contain multiple expressions.
- An anonymous function cannot be a direct call to print because lambda requires an expression.
- Lambda functions have their own local namespace and cannot access variables other than those in their parameter list and those in the global namespace.
- Although it appears that lambda's are a one-line version of a function, they are not equivalent to inline statements in C or C++

Lambda Function (cont.)

Syntax

```
lambda arg1,arg2..argN: expression
```

- The parameters are optional, and if supplied they are normally just comma- separated variable names, that is, positional arguments.
- Lambda functions accept all kinds of arguments, just like normal def function
- The expression can not contain branches or loops (although conditional expressions are allowed), and cannot have a return statement. The result of a lambda expression is an anonymous function.
- When a lambda function is called it returns the result of computing the expression as its result.

Example.py

```python
sum = lambda arg1,arg2: arg1 + arg2
print("Total",sum(5,5))
```

Output

```
Total 10
```

Lambda Function (cont.)

Cube.py

```python
def cube(y):
    return y*y*y
lambda_cube = lambda y: y*y*y

# using the normally defined function
print(cube(5))
# using the lambda function
print(lambda_cube(5))
```

Output

```
125
125
```

WithIfElse.py

```python
# Example of lambda function using if-else
Max = lambda a, b : a if(a > b) else b
print(Max(1, 2))
```

Output

```
2
```

call.py

```python
# Lambda functions can be Immediately Invoked
print((lambda x: x*x)(3))
```

Output

```
9
```

Exercise

- WAP to find square of given number using lambda expression.
- WAP to find simple interest using lambda function.
- WAP to make simple calculator using lambda expression.

Map

- map() function returns a map object(which is an iterator) of the results after applying the given function to each item of a given iterable (list, tuple etc.)

Syntax

```
map(fun, iterable)
```

demo1.py

```
def addition(n):
        return n * n

numbers = [1, 2, 3, 4]
result = list(map(addition, numbers))
# result = list(map(lambda n:n*n,numbers))
print(result)
```

Output

```
[1, 4, 9, 16]
```

demo2.py

```
strdata = ["Darshan","University"]
lengthdata = list(map(len,strdata))
print(lengthdata)
```

Output

```
[7, 10]
```

Functional Programming Tools: filter and reduce

- To find out items based on a test function we can use a Filter.
- For example, the following filter call picks out items in a sequence that are divide by 2:

demo1.py

```python
lista = [1,2,3,4,5,6,7,8,9,10]
ans = list(filter(lambda x: x % 2 == 0 ,lista))
print(ans)
```

Output

```
[2, 4, 6, 8, 10]
```

Functional Programming Tools: filter and reduce

- Apply functions to pairs of items and running results (reduce(fun,seq)).
  - In the first step, the first two elements of the sequence are chosen, and the result is obtained.
  - The result is then stored after applying the same function to the previously obtained result and the number just succeeding the second element.
  - This process is repeated until there are no more elements in the container.
  - The final result is returned and printed to the console.

demo1.py

```python
from functools import reduce
lista = [1,2,3,4,5,6,7,8,9,10]
ans = reduce(lambda a,b : a+b,lista)
print(ans)
```

Output

```
55
```

demo2.py

```python
from functools import reduce
lista = [1,2,3,4,5,6,7,8,9,10]
ans = reduce(lambda a,b : a if a>b else b,lista)
Print(ans)
```

Output

```
10
```

Recursion

- Any function which calls itself is called recursive function and such function calls are called recursive calls.
- Recursion cannot be applied to all problems, but it is more useful for the tasks that can be defined in terms of a similar subtask.
- It is idea of representing problem a with smaller problems.
- Any problem that can be solved recursively can be solved iteratively.
- When recursive function call itself, the memory for called function allocated and different copy of the local variable is created for each function call.
- Some of the problem best suitable for recursion are
  - Factorial
  - Fibonacci
  - Tower of Hanoi

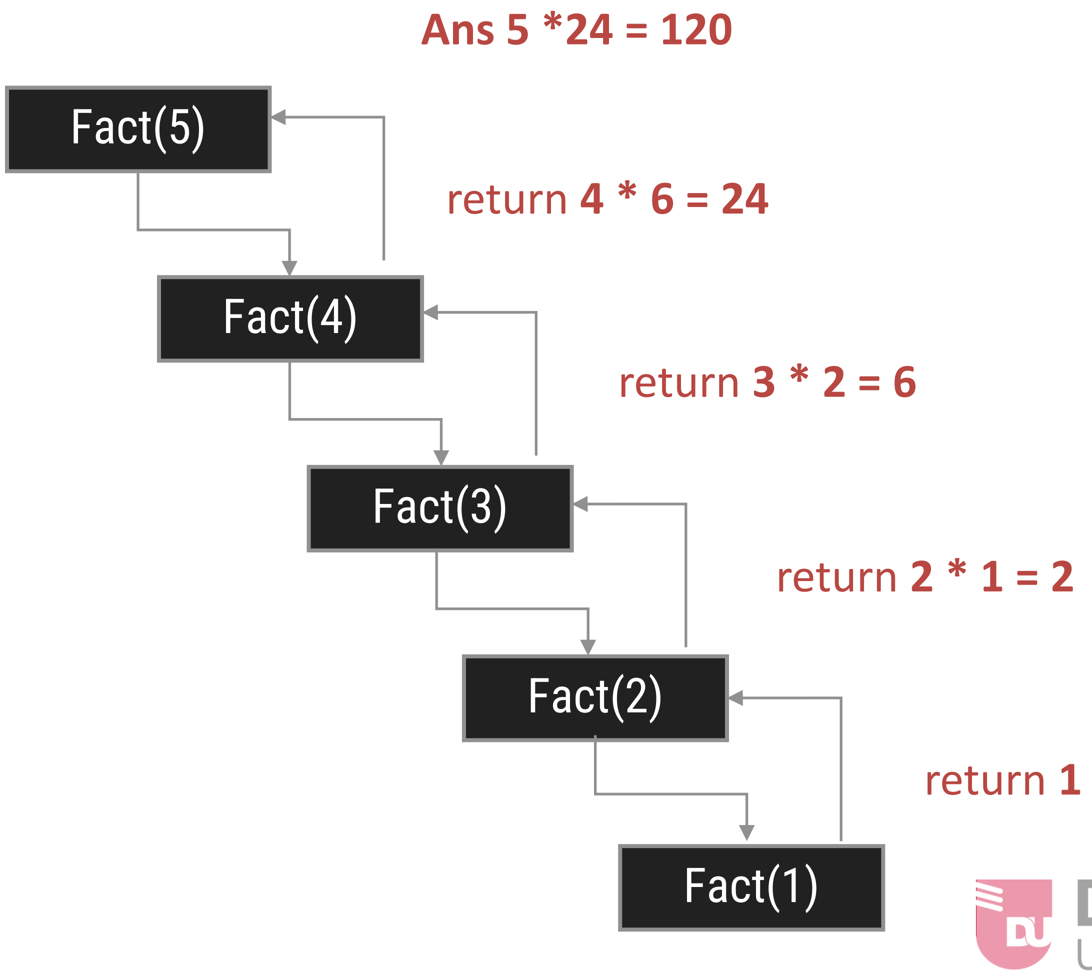
Properties of Recursion

- A recursive function can go infinite like a loop. To avoid infinite running of recursive function, there are two properties that a recursive function must have.
- Base Case or Base criteria
  - It allows the recursion algorithm to stop.
  - A base case is typically a problem that is small enough to solve directly.
- Progressive approach
  - A recursive algorithm must change its state in such a way that it moves forward to the base case.

Recursion - factorial example

- The factorial of a integer n, is product of
  - n * (n-1) * (n-2) * …. * 1
- Recursive definition of factorial
  - n! = n * (n-1)!
  - Example
    - 3! = 3 * 2 * 1
    - 3! = 3 * (2 * 1)
    - 3! = 3 * (2!)

Recursive trace



Examples

Factorial.py

```python
def recursive_factorial(n):
    if n == 1:
        return n
    else:
        return n * recursive_factorial(n-1)
        # recursive function call

# user input
num = int(input("Enter the number="))
print("Factorial of number", num, "=", recursive_factorial(num))
```

Output

```
Enter the number=5
Factorial of number 5 = 120
```

fibonacci.py

```python
def r_fibonacci(n):
    if n <= 1:
        return n
    else:
        return(r_fibonacci(n-1) + r_fibonacci(n-2))
n = 8
print("Fibonacci series:")
for i in range(n):
        print(r_fibonacci(i))
```

Output

```
Fibonacci series:
0
1
1
-
-
13
```

Exercise

- Write a program to find factorial of a given number using recursion.
- WAP to convert decimal number into binary using recursion.
- WAP to use recursive calls to evaluate F(x) = x – x3/3! + x5/5! – x7/7! + … + xn/n!