PYTHON FUNDAMENTALS

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Python Character Set

Is a set of valid characters that python can recognize. A character represent letters, digits or any symbol. Python support UNICODE encoding standard. Following are the Python character set

- **Letters** : A-Z, a-z
- **Digits** : 0-9
- **Special symbols** :space +-*/()~`!@#$%^ & [{]};:'",<.>/?
- **White spaces** : Blank space, Enter, Tab
- **Other character** : python can process all ASCII and UNICODE as a part of data or literal

TOKENS

In a passage of text, individual words and punctuation marks are called tokens or lexical units or lexical elements. The smallest individual unit in a program is known as Tokens. Python has following tokens:

- ✓ Keywords
- ✓ Identifiers(Name)
- ✓ Literals
- ✓ Operators
- ✓ Punctuators

KEYWORDS

Keywords are the reserved words and have special meaning for python interpreter. Every keyword is assigned specific work and it can be used only for that purpose.

A partial list of keywords in Python is

and	del	from	not
while	as	elif	global
or	with	assert	else
if	pass	yield	break
except	import	print	class
exec	in	raise	continue
finally	is	return	def
for	lambda	try	

IDENTIFIERS

Are the names given to different parts of program like variables, objects, classes, functions etc.

Identifier forming rules of Python are :

- Is an arbitrarily long sequence of letters and digits
- The first character must be letter or underscore
- Upper and lower case are different
- The digits 0-9 are allowed except for first character
- It must not be a keyword
- No special characters are allowed other than underscore is allowed.
- Space not allowed

The following are some ***valid*** identifiers

GradePay	File_12_2018	JAMES007
GRADEPAY	_ismarried	_to_update

The following are some ***invalid*** identifiers

Grade-Pay	12_2018_File	$JAMES007
if	RollNo.	Roll No

Literals / Values

- Literals are data items that have a fixed value. Python supports several kinds of literals:
  - String Literal
  - Numeric Literals
  - Boolean Literals
  - Special Literals – ***None***
  - Literal Collections

String Literals

- It is a collection of character(s) enclosed in a double or single quotes
- Examples of String literals
  - “Python”
  - “Mogambo”
  - ‘123456’
  - ‘Hello How are your’
  - ‘$’, ‘4’,”@@”
- In Python both single character or multiple characters enclosed in quotes such as “kv”, ‘kv’,’*’,”+” are treated as same

Non-Graphic (Escape) characters

- They are the special characters which cannot be type directly from keyboard like backspace, tabs, enter etc. When the characters are typed they perform some action. These are represented by escape characters. Escape characters are always begins from backslash(\) character.

List of Escape characters

Escape Sequence	What it does	Escape Sequence	What it does
\\	Backslash	\r	Carriage return
\'	Single quotes	\t	Horizontal tab
\"	Double quotes	\uxxxx	Hexadecimal value(16 bit)
\a	ASCII bell	\Uxxxx	Hexadecimal value(32 bit)
\b	Back Space	\v	vertical tab
\n	New line	\ooo	Octal value

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String type in Python

- Python allows you to have two string types:
  - **Single Line Strings**
    - The string we create using single or double quotes are normally single-line string i.e. they must terminate in one line.
    - For e.g if you type as
      - Name="KV and press enter
      - Python we show you an error "EOL while scanning string literal"
    - *The reason is quite clear, Python by default creates single-line string with both single quotes and it must terminate in the same line by quotes*

String type in Python

- **Multiline String**
  - Some times we need to store some text across multiple lines. For that Python offers multiline string.
  - To store multiline string Python provides two ways:

    (a) By adding a backslash at the end of normal Single / Double quoted string. For e.g.

```
>>> Name="1/6 Mall Road \
Kanpur"
>>> Name
'1/6 Mall RoadKanpur'
>>>
```

String type in Python

- Multiline String

  (b) By typing text in triple quotation marks

  for e.g.

```
>>> Address="""1/7 Preet Vihar
New Delhi
India"""
>>> print(Address)
1/7 Preet Vihar
New Delhi
India
>>> Address
'1/7 Preet Vihar\nNew Delhi\nIndia'
```

Size of String

- Python determines the size of string as the **count of characters** in the string. For example size of **string "xyz" is 3** and of **"welcome" is 7**. But if your string literal has an escape sequence contained in it then make sure to count the **escape sequence as one character**. For e.g.

String	Size
'\\'	1
'abc'	3
'\ab'	2
"Meera\'s Toy"	11
"Vicky's"	7

- You can check these size using **len() function of Python**. For example
- **>>>len('abc') and press enter, it will show the size as 3**

Size of String

- For multiline strings created with triple quotes : while calculating size the **EOL character as the end of line is also counted in the size**. For example, if you have created String Address as:

```
>>> Address="""Civil lines
Kanpur"""
>>> len(Address)
18
```

- For multiline string created with **single/double quotes the EOL is not counted**.

```
>>> data="ab\
bc\
cd"
>>> len(data)
6
```

Numeric Literals

- The numeric literals in Python can belong to any of the following numerical types:

  1) Integer Literals: it contain at least one digit and must not contain decimal point. It may contain (+) or (-) sign.

  - Types of Integer Literals:

    a) Decimal : 1234, -50, +100

    b) Octal : it starts from symbol **0o (zero followed by letter 'o')**

    - For e.g. **0o10** represent decimal 8

Numeric Literals

>>> num = **0o10**

>>> print(num)

It will print the value 8

c) Hexadecimal : it starts from **0x (zero followed by letter 'x')**

>>> num = **0oF**

>>> print(num)

it will print the value 15

Numeric Literals

- **2) Floating point Literals:** also known as real literals. Real literals are numbers having fractional parts. It is represented in two forms Fractional Form or Exponent Form
- **Fractional Form:** it is signed or unsigned with decimal point
  - For e.g. 12.0, -15.86, 0.5, 10. (will represent 10.0)
- **Exponent Part:** it consists of two parts "Mantissa" and "Exponent".
  - For e.g. 10.5 can be represented as $0.105 \times 10^2 = 0.105E02$ where 0.105 is mantissa and 02 (after letter E) is exponent

Points to remember

- Numeric values with commas are not considered int or float value, rather Python treats them as **tuple**. Tuple in a python is a collection of values or sequence of values. (will be discussed later on)
- **You can check the type of literal using type() function. For e.g.**

```
>>> a=100
>>> type(a)
<class 'int'>
>>> b=10.5
>>> type(b)
<class 'float'>
>>> name="hello“
>>> type(name)
<class 'str'>
>>> a=100,50,600
>>> type(a)
<class 'tuple'>
```

Boolean Literals

A Boolean literals in Python is used to represent one of the two Boolean values i.e. **True or False**

These are the only two values supported for Boolean Literals

For e.g.

```
>>> isMarried=True
>>> type(isMarried)
<class 'bool'>
```

Special Literals *None*

Python has one special literal, which is None. It indicate absence of value. In other languages it is knows as NULL. It is also used to indicate the end of lists in Python.

```
>>> salary=None
>>> type(salary)
<class 'NoneType'>
```

Complex Numbers

Complex: Complex number in python is made up of two floating point values, one each for real and imaginary part. For accessing different parts of variable (object) x; we will use x.real and x.image. Imaginary part of the number is represented by "j" instead of "I", so 1+0j denotes zero imaginary.

part.

Example

```
>>> x = 1+0j
>>> print x.real,x.imag
1.0 0.0
```

Example

```
>>> y = 9-5j
>>> print y.real, y.imag
9.0 -5.0
```

Conversion from one type to another

- Python allows converting value of one data type to another data type. If it is done by the programmer then it will be known as type conversion or type casting and if it is done by compiler automatically then it will be known as implicit type conversion.

Example of Implicit type conversion

```
>>> x = 100
>>> type(x)
<type 'int'>
>>> y = 12.5
>>> type(y)
<type 'float'>
>>> x=y
>>> type(x)
<type 'float'>      # Here x is automatically converted to float
```

Conversion from one type to another

Explicit type conversion

To perform explicit type conversion Python provide functions like int(), float(), str(), bool()

```
>>> a=50.25
>>> b=int(a)
>>> print b
50
```

Here 50.25 is converted to int value 50

```
>>>a=25
>>>y=float(a)
>>>print y
25.0
```

Simple Input and Output

- In python we can take input from user using the built-in function input().
- Syntax

  variable = input(<message to display>)

Note: value taken by input() function will always be of String type, so by default you will not be able to perform any arithmetic operation on variable.

```
>>> marks=input("Enter your marks ")
Enter your marks 100
>>> type(marks)
<class 'str'>
```

Here you can see even we are entering value 100 but it will be treated as string and will not allow any arithmetic operation

Simple Input and Output

```
>>> salary=input("Enter your salary ")
Enter your salary 5000
>>> bonus = salary*20/100
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: unsupported operand type(s) for /: 'str' and 'int'
```

Reading / Input of Numbers

- Now we are aware that input() function value will always be of string type, but what to do if we want number to be entered. ***The solution to this problem is to convert values of input() to numeric type using int() or float() function.***

Possible chances of error while taking input as numbers

1. Entering float value while converting to int

```
>>> num1=int(input("Enter marks "))
Enter marks 100.5
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ValueError: invalid literal for int() with base 10: '100.5'
```

2. Entering of values in words rather than numeric

```
>>> age=int(input("What is your age "))
What is your age Eighteen
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ValueError: invalid literal for int() with base 10: Eighteen'
```

Possible chances of error while taking input as numbers

3. While input for float value must be compatible. For e.g.

Example 1

```
>>> percentage=float(input("Enter percentage "))
Enter percentage 12.5.6
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ValueError: could not convert string to float: '12.5.6'
```

Example 2

```
>>> percentage=float(input("Enter percentage "))
Enter percentage 100 percent
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ValueError: could not convert string to float: '100 percent'
```

Program 1

Open a new script file and type the following code:

```
num1=int(input("Enter Number 1 "))
num2=int(input("Enter Number 2 "))
num3 = num1 + num2
print("Result =",num3)
```

Save and execute by F5 and observe the result

Let us write few programs

- WAP to enter length and breadth and calculate area of rectangle
- WAP to enter radius of circle and calculate area of circle
- WAP to enter Name, marks of 5 subject and calculate total & percentage of student
- WAP to enter distance in feet and convert it into inches
- WAP to enter value of temperature in Fahrenheit and convert it into Celsius.
- WAP to enter radius and height of cylinder and calculate volume of cylinder.

Operators

- are symbol that perform specific operation when applied on variables. Take a look at the expression:

(Operator)

10 + 25 (Operands)

Above statement is an expression (combination of operator and operands)

i.e. operator operates on operand. some operator requires two operand and some requires only one operand to operate

Types of Operators

- Unary operators: are those operators that require one operand to operate upon. Following are some unary operators:

Operator	Purpose
+	Unary plus
-	Unary minus
~	Bitwise complement
Not	Logical negation

Types of Operators

- Binary Operators: are those operators that require two operand to operate upon. Following are some Binary operators:

1. Arithmetic Operators

Operator	Action
+	Addition
-	Subtraction
*	Multiplication
/	Division
%	Remainder
**	Exponent
//	Floor division

Example

```
>>> num1=20
>>> num2=7
>>> val = num1 % num2
>>> print(val)
6
>>> val = 2**4
>>> print(val)
16
>>> val = num1 / num2
>>> print(val)
2.857142857142857
>>> val = num1 // num2
>>> print(val)
2
```

Bitwise operator

Operator	Purpose	Action
&	Bitwise AND	Return 1 if both inputs are 1
^	Bitwise XOR	Return 1, if the number of 1 in input is in odd
|	Bitwise OR	Return 1 if any input is 1

Bitwise operator works on the binary value of number not on the actual value. For example if 5 is passed to these operator it will work on 101 not on 5. Binary of 5 is 101, and return the result in decimal not in binary.

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Example

```
>>> print(12 & 7)
4
```

Guess the output with | and ^ ?

Binary of 12 is 1100 and 7 is 0111, so applying &
1100
0111

0100 Which is equal to decimal value 4

Let us see one practical example, To check whether entered number is divisible of 2 (or in a power of 2 or not) like 2, 4, 8, 16, 32 and so on
To check this, no need of loop, ***simply find the bitwise & of n and n-1, if the result is 0 it means it is in power of 2 otherwise not***

```
n = int(input("Enter any number "))
r = n & n-1
print(r)
```

```
Enter any number 32
0
```

Here we can see 0, it means 32 is in power of 2

```
Enter any number 24
16
```

Here we can see 16, it means 24 is not in power of 2

Later on by using 'if' we can print meaningful message

Shift Operators

Operators	Purpose
<<	Shift left
>>	Shift right

Identity Operators

Operators	Purpose
is	Is the Identity same?
is not	Is the identity not same?

Relational Operators

Operators	Purpose
<	Less than
>	Greater than
<=	Less than or Equal to
>=	Greater than or Equal to
==	Equal to
!=	Not equal to

Logical Operators

Operators	Purpose
and	Logical AND
or	Logical OR
not	Logical NOT

Assignment Operators

Operators	Purpose
=	Assignment
/=	Assign quotient
+=	Assign sum
-=	Assign difference
*=	Assign product
**=	Assign Exponent
//=	Assign Floor division

Membership Operators

Operators	Purpose
in	Whether variable in sequence
not in	Whether variable not in sequence

Punctuators

- Punctuators are symbols that are used in programming languages to organize sentence structure, and indicate the rhythm and emphasis of expressions, statements, and program structure.
- **Common punctuators are: ‘ “ # $ @ []{}=:;(),.**

Barebones of Python Program

- **It means basic structure of a Python program**
- **Take a look of following code:**

```
#This program shows a program's component
# Definition of function SeeYou() follows
def SeeYou():
        print("This is my function")
#Main program
A=10
B=A+20
C=A+B
if(C>=100)                          #checking condition
        print("Value is equals or more than 100")
else:
        print("Value is less than 100")
SeeYou()                            #Calling Function
```

Comments

Function

Expressions

Inline Comment

Statements

Block

Indentation

Expression

- An expression is any legal combination of symbols that represents a value. An expression is generally a combination of operators and operands

  Example:

  expression of values only

  20, 3.14

  Expression that produce a value when evaluated

  A+10

  Salary * 10 / 100

Statement

- It is a programming instruction that does something i.e. some action takes place.
- Example

```
print("Welcome to python")
```

The above statement call print function

When an expression is evaluated a statement is executed i.e. some action takes place.

```
a=100
b = b + 20
```

Comments

- Comments are additional information written in a program which is not executed by interpreter i.e. ignored by Interpreter. Comment contains information regarding statements used, program flow, etc.
- Comments in Python begins from #
- **Python supports 3 ways to enter comments:**
  1. *Full line comment*
  2. *Inline comment*
  3. *Multiline comment*

Comments

- **Full line comment**

Example:

```
#This is program of volume of cylinder
```

- **Inline comment**

Example

```
area = length*breadth        # calculating area of rectangle
```

- **Multiline comment**

Example 1 (using #)

```
# Program name: area of circle
# Date: 20/07/18
#Language : Python
```

Comments

- **Multiline comment (using “ “ “) triple quotes**

Example

```
“ “ “
        Program name : swapping of two number
        Date         : 20/07/18
        Logic        : by using third variable
”””
```

Functions

- Function is a block of code that has name and can be reused by specifying its name in the program where needed. It is created with **def** keyword.

Example

```
def drawline():
        print("======================")
print("Welcome to Python")
drawline()
print("Designed by Class XI")
drawline()
```

Block and Indentation

- Group of statement is known as block like function, conditions or loop etc.
- For e.g.

```
def area():
    a = 10
    b = 5
    c = a * b
```

Indentation means extra space before writing any statement. Generally **four** space together marks the next indent level.

Variables

- Variables are named temporary location used to store values which can be further used in calculations, printing result etc. Every variable must have its own Identity, type and value. Variable in python is created by simply assigning value of desired type to them.
- ***For e.g***
- ***Num = 100***
- ***Name="James"***

Variables

- ***Note: Python variables are not storage containers like other programming language. Let us analyze by example.***
- **In C++, if we declare a variable radius:**

radius = 100

[suppose memory address is 41260]

Now we again assign new value to radius

radius = 500

Now the memory address will be still same only value will change

Variables

- ***Now let us take example of Python:***

radius = 100 [memory address 3568]

radius = 700 [memory address 8546]

Now you can see that In python, each time you assign new value to variable it will not use the same memory address and new memory will be assigned to variable. In python the location they refer to changes every time their value change.(This rule is not for all types of variables)

Lvalues and Rvalues

- **Lvalue :** expression that comes on the Left hand Side of Assignment.
- **Rvalue :** expression that comes on the Right hand Side of Assignment

Lvalue refers to object to which you can assign value. It refers to memory location. It can appear LHS or RHS of assignment

Rvalue refers to the value we assign to any variable. It can appear on RHS of assignment

Lvalues and Rvalues

For example (valid use of Lvalue and Rvalue)

x = 100

y = 200

Invalid use of Lvalue and Rvalue

100 = x

200 = y

a+b = c

Note: values cannot comes to the left of assignment. LHS must be a memory location

Multiple Assignments

- Python is very versatile with assignments. Let's see in how different ways we can use assignment in Python:

1. Assigning same value to multiple variable

```
a = b = c = 50
```

2. Assigning multiple values to multiple variable

```
a,b,c = 11,22,33
```

Note: While assigning values through multiple assignment, remember that Python first evaluates the RHS and then assigns them to LHS

Examples:

Multiple Assignments

```
x,y,z = 10,20,30                #Statement 1
z,y,x = x+1,z+10,y-10           #Statement 2
print(x,y,z)
```

Output will be

10 40 11

Now guess the output of following code fragment

```
x,y = 7,9
y,z = x-2, x+10
print(x,y,z)
```

Multiple Assignments

Let us take another example

y, y = 10, 20

In above code first it will assign 10 to y and again it assign 20 to y, so if you print the value of y it will print ***20***

Now guess the output of following code

```
x, x = 100,200
y,y = x + 100, x +200
print(x,y)
```

Variable definition

- Variable in python is create when you assign value to it i.e. a variable is not create in memory until some value is assigned to it.
- Let us take as example(if we execute the following code)

```
print(x)
```

Python will show an error **'x' not defined**

So to correct the above code:

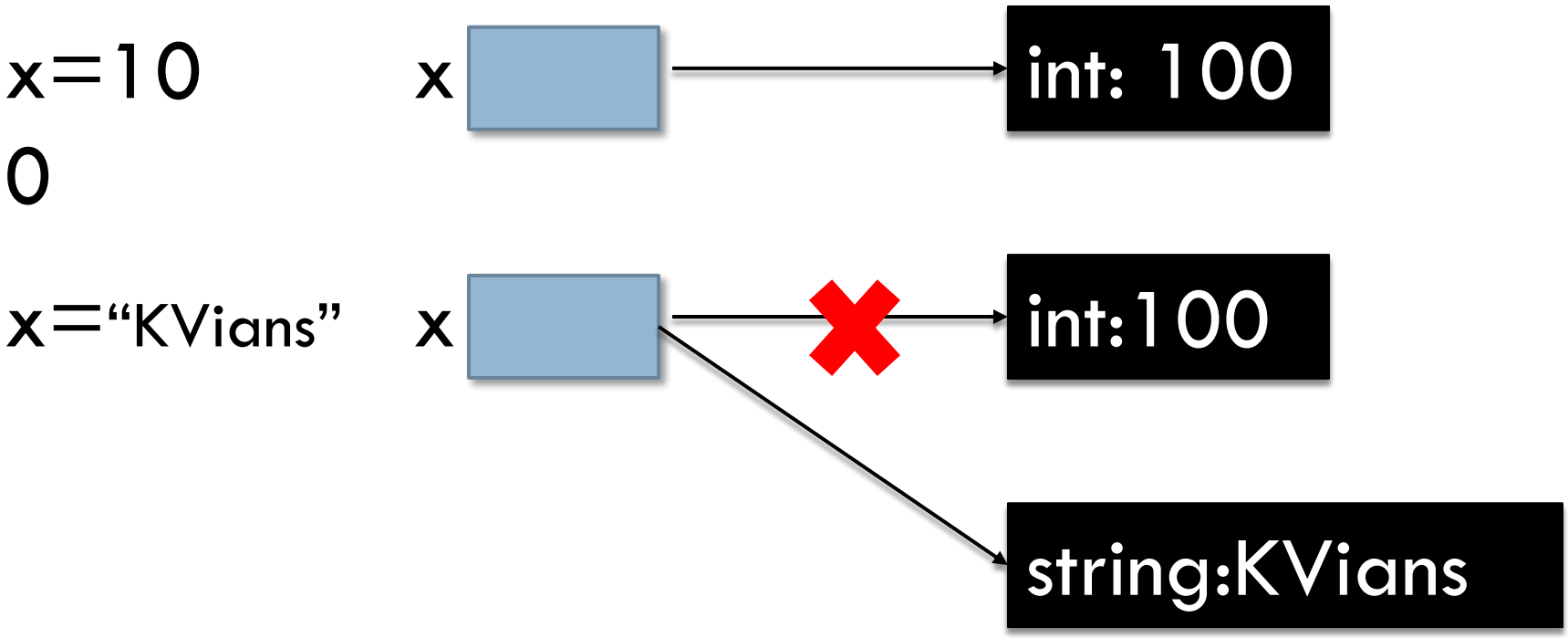
```
x=0
print(x)        #now it will show no error
```

Dynamic Typing

- In Python, a variable declared as numeric type can be further used to store string type or another.
- Dynamic typing means a variable pointing to a value of certain type can be made to point to value/object of different type.
- Lets us understand with example

```
x = 100                 # numeric type
print(x)
x="KVians"              # now x point to string type
print(x)
```

Dynamic Typing



Caution with Dynamic Typing

- Always ensure correct operation during dynamic typing. If types are not used correctly Python may raise an error.
- Take an example

```
x = 100
y = 0
y = x / 2
print(y)
x='Exam'
y = x / 2    # Error, you cannot divide string
```

Determining type of variable

- Python provides type() function to check the datatype of variables.

```
>>> salary=100
>>> type(salary)
<class 'int'>
>>> salary=2000.50
>>> type(salary)
<class 'float'>
>>> name="raka"
>>> type(name)
<class 'str'>
```

Output through print()

- Python allows to display output using print().
- Syntax:

  print(message_to_print[,sep="string",end="string"])

  Example 1

  print("Welcome")

  Example 2

  Age=20

  print("Your age is ", Age)

Output through print()

Example 3

```
r = int(input("Enter Radius "))
print("Area of circle is ",3.14*r*r)
```

Note: from the Example 2 and Example 3 we can observe that while printing numeric value print() convert it into equivalent string and print it. In case of expression (Example 3) it first evaluate it and then convert the result to string before printing.

Output through print()

Note:

print() automatically insert space between different values given in it. The default argument of ***sep*** *parameter of print() is space(' ') .*

Example

```
print("Name is","Vicky")
```

Output

```
Name is Vicky
```

Output through print()

Note:

Python allows to change the separator string.

Example

print("Name is","Vicky","Singh",sep="##")

Output

Name is ##Vicky##Singh

Output through print()

Note:

Be default each print statement print the value to next line. The default value of end is "\n"

Example

print("Learning Python")

print("Developed by Guido Van Rossum")

Output

Learning Python

Developed by Guido Van Rossum

Output through print()

Note:

We can change the value of **end** to any other value.

Example

```
print("Learning Python",end=" ")
print("Developed by Guido Van Rossum")
```

Output

```
Learning Python Developed by Guido Van Rossum
```

Output through print()

Can you Guess the output

```
Name="James"
Salary=20000
Dept="IT"
print("Name is ",Name,end="@")
print(Dept)
print("Salary is ",Salary)
```

Just a minute…

- What is the difference between keywords and identifiers
- What are literals in Python? How many types of literals in python?
- What will be the size of following string

‘\a’ , “\a” , “Reena\’s”, ‘\””, “It’s”, “XY\ YZ” , “ “ “XY↵ YZ”””””

- How many types of String in python?

Just a minute…

- What are the different ways to declare multiline String?
- Identify the type of following literal:

41.678, 12345, True, 'True', "False", 0xCAFE, 0o456,0o971

- Difference between Expression and Statement
- What is the error inn following python program:

```
print("Name is ", name)
```

Suggest a solution

Just a minute…

- Which of the following string will be the syntactically correct? State reason.
  1. ***"Welcome to India"***
  2. ***'He announced "Start the match" very loudly'***
  3. ***"Sayonara'***
  4. ***'Revise Python Chapter 1'***
  5. ***"Bonjour***
  6. ***"Honesty is the 'best' policy"***

Just a minute…

- The following code is not giving desired output. We want to enter value as 100 and obtain output as 200. Identify error and correct the program

```
num = input("enter any number")
double_num = num * 2
Print("Double of",num,"is",double_num)
```

Just a minute…

- Why the following code is giving error?

```
Name="James"
        Salary=20000
        Dept="IT"
        print("Name is ",Name,end='@')
print(Dept)
print("Salary is ",Salary)
```

Just a minute…

- WAP to obtain temperature in Celsius and convert it into Fahrenheit.
- What will be the output of following code:

```
x, y = 6,8
x,y = y, x+2
print(x,y)
```

- What will be the output of following code:

```
x,y = 7,2
x,y,x = x+4, y+6, x+100
print(x,y)
```