Chapter 3

Data Handling

Operators and Expression

Learning Objective:

After Having Studied this Chapter, You will be able to Understand : -

- *Operators: Unary and Binary Operators.*
- *Types of Unary and Binary Operators in detail.*
- *Operator Precedence and Associativity.*
- *Data Types like Number, String, List, Tuple and Dictionary.*
- *Mutable and Immutable Data Types.*
- *Type Conversion and Variable Internals.*
- *Functions in Math Module.*

3.1 OPERATORS

Operators are tokens that trigger some computation when applied to a variable.

Consider the following example:

c=a + b

Here a and b are the *operands* and '+' is the *operator*.

Operators are of two types.

1. Unary operators

2. Binary operators

3.2 BINARY OPERATORS

Binary operators are those operators that require two operands to operate upon.

Binary operators are of the following type.

1. Arithmetic operator

2. Comparison operators

3. Assignment operators

5. Logical Operators

6. Membership operators

7. Identity operators

3.2.1 PYTHON ARITHMETIC OPERATORS

Arithmetic operators are used with numeric values to perform common mathematical operations**.**

Python Arithmetic operators are following:

Arithmetic Operators

Operator	Meaning	Example
+	Addition	4 + 7 ⟶ 11
-	Subtraction	12 - 5 ⟶ 7
*	Multiplication	6 * 6 ⟶ 36
/	Division	30 / 5 ⟶ 6
%	Modulus	10 % 4 ⟶ 2
//	Quotient	18 // 5 ⟶ 3
**	Exponent	3 ** 5 ⟶ 243

Solved Questions on Arithmetic Operators

1. **Evaluate**

   a) 100 // 32

   b) 6.5 // 2

   Solution:

   a) 3

   b) 3.0

2. **Evaluate**

   a) 100 %32 (remainder)

   b) 6.5 % 2

   Solution:

   a) 4

   b) 0.5

3. **Evaluate**

   a) 2**3

   b) 2.5**3

   Solution:

   a) 8

   b) 15.625

4. **Evaluate**

   a) 2*3

   b) 2**3

   Solution:

   a) 6

   b) 8

3.2.2 PYTHON COMPARISON OPERATORS

These operators compare the values on either sides of them and decide the relation among them. They are also called Relational operators.

The relational or comparison operators are following.

Operator	Meaning
==	Equal to
!=	Not equal to
>	Greater than
<	Less than
>=	Greater than or equal to
<=	Less than or equal to

Solved Questions on Comparison Operators

1. **Differentiate between = and = = operator?(Imp)**

   Answer: = is the assignment operator. It assigns the value at the right hand side to the variable on the left side.

   Example:

   A=4.Will assign the value 4 to variable A.

   = = is the comparison operator. It checks for equality and gives answer as true or false.

   A==4. Will give answer as true or false.

2. **Justify if "god" <"GODD".**

   Answer: "god" >"GODD". Total sum of ord value of all characters involved is 314, whereas total sum of ord value of all characters involved in "GODD" is 282.Thus "god" >"GODD"

3. i **=4, j=5, k=4**

   Evaluate a) i>j b) k>=i c) j = = k

   Answer:

   a) F b)T c) F

3.3.3 PYTHON ASSIGNMENT OPERATORS

Assignment Operators are used to assign the value to variable. a = 5 is a ***simple assignment operator*** that assigns the value 5 on the right to the variable a on the left.

There are various ***compound assignment operators*** in Python like a += 5 that adds to the variable and later assigns the same. It is equivalent to a = a + 5.

Another name for compound assignment operators is ***Augmented Assignment Operator.(Shorthand operators)***

The various assignment operators are as follows.

Operator	Example	Equals To
=	a = 10	a = 10
+=	a += 10	a = a+10
-=	a -= 10	a = a-10
*=	a *= 10	a = a*10
/=	a /= 10	a = a / 10
%=	a %= 10	a = a % 10
//=	a //= 10	a = a // 10
**=	a **= 10	a = a ** 10

Solved Questions on Assignment Operators

1. **Give the output of the following**

   a , b, c=4,5,2

   a + = b – c

   b / / = 3

   c % = a

   print(a, b, c)

Ans : 7 1 2

2. a,b,c=5,2,1

a - = b+c

c**= b

d= a//2

e= a%2

print(a,b,c,d,e)

Ans: 2 2 1 2 1

3.3.4 PYTHON LOGICAL OPERATORS

The logical operators in Python are used to combine the true or false values (logical value) of variables (or expressions) so you can figure out their resultant truth value.

The logical operators supported by python are AND, OR, NOT.

Operator	Description
a **and** b	Logical AND If both operands are True than it returns True
a **or** b	Logical OR If one of the operands is True then it returns True
not	Logical NOT

Solved Questions on Logical Operators

1. Give the output of the following

   a, b, c=4,5,2

```
d = a > b AND  a > c

e = not (a)

f = b > a  or b < c

print(d,e,f)

Ans : False False True

2.

a,b,c= 5, 8, 3

d=( a>=b) AND  a<c

e= c<a

f= not(b)

print(d,e,f)

false, true, false
```

3.3 OPERATOR PRECDENCE IN PYTHON(PEDMAS)

The operator precedence in Python are listed in the following table. It is in descending order, upper group has higher precedence than the lower ones.

Operator precedence rule in Python	
Operators	Meaning
()	Parentheses
**	Exponent
*, /, //, %	Multiplication, Division, Floor division, Modulus

+, -	Addition, Subtraction
==, !=, >, >=, <, <=, is, is not, in, not in	Comparisons, Identity, Membership operators
Not	Logical NOT
And	Logical AND
Or	Logical OR

3.5 ASSOCIATIVITY OF PYTHON OPERATORS

We can see in the above table that more than one operator exists in the same group. These operators have the same precedence.

When two operators have the same precedence, associativity helps to determine which the order of operations.

Associativity is the order in which an expression is evaluated that has multiple operator of the same precedence. Almost all the operators have left-to-right associativity.

For example, multiplication and floor division have the same precedence. Hence, if both of them are present in an expression, left one is evaluates first.

SOLVED EXAMPLES ON OPERATORS

 # Left-right associativity

```
print(5 * 2 // 3)

# Output: 3
```

 # Shows left-right associativity

```
print(5 * (2 // 3))

# Output: 0
```

Solved Examples Operator precedence in python

1. x, y, z=10, 5, 11
(x > = y) or (not (z = = y) and (z < x))

(10> = 5) or (not (11 = = 5) and (11 < 10))
(T) or ((not F) and (F))

(T) or (T and F)
T or F
T

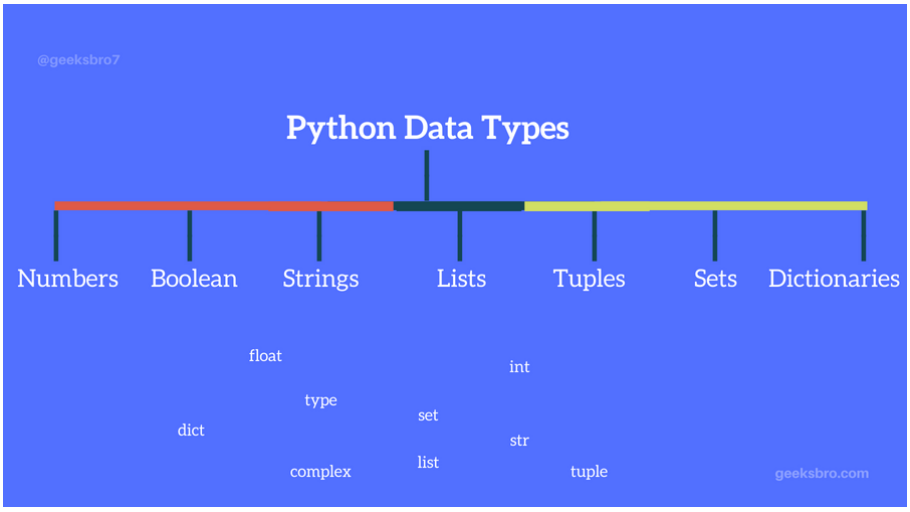
2. a, b, c, d=3, 6, 4, 2
((a +b > c) and (b – c < d)) or ((b + d)>=(a + c))
(3 + 6 > 4) and (2 < 2)) or (8 > = 7)
(T and F) or (T)
F or T
T

3. a, b, c, d=2,4,5,7
z=(a +b * c // d)
= (2 + 4 * 5 // 7)
= (2 + 20 // 7)
=(2+2)
=4

3.6 DATA TYPES IN PYTHON

Data types are a classification of data that tells the compiler or the interpreter how you want to use the data. The type defines the operations that can be done on the data and the structure in which you want the data to be stored.

The below figure explains various data types in python



The type of data a variable can hold is known as data type. Data can be of any type like- character, integer, real, string. For Example, Anything enclosed in " " is considered

as string in Python. Any whole value is an integer value. Any value with fraction part is a real value.
True or False value specifies Boolean value.
Python supports following core data types-

I. Numbers (int like10, 5) (float like 3.5, 302.24) (complex like 3+5i)

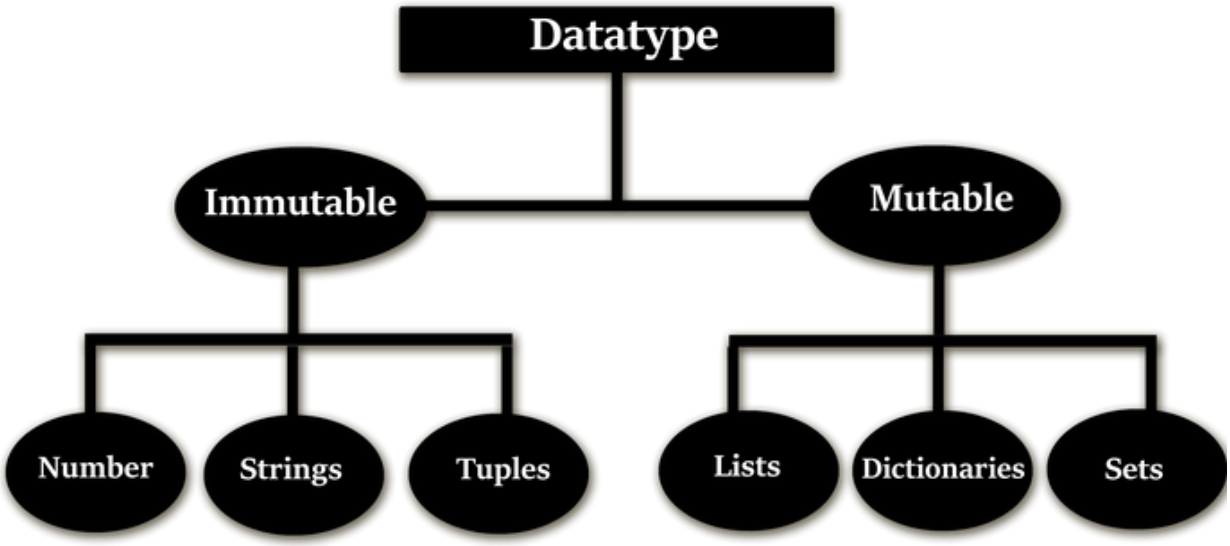
II. String (like “python”, ‘python’, ‘a’, “a”)

III. List like [3, 4, 5,”python”] its elements are Mutable.

V. Dictionary like {‘a’:1, ‘e’:2, ‘I’:3, ‘o’:4, ‘u’:5} where a, e, i, o, u are keys and 1,2,3,4,5 are their values.

3.8 MUTABLE AND NON MUTABLE DATA TYPES (Important)

• In Python, Data Objects are categorized in two types-
  • Mutable (Changeable)
  • Immutable (Non-Changeable)



3.8.1 IMMUTABLE DATA TYPES

Immutable data types are the ones which cannot change its value. In python following data types are immutable: integers, floating point numbers, Boolean, strings and tuples.

3.8.2 MUTABLE DATA TYPES

Mutable data types are the ones whose value can be changed in place. Only two datatypes are mutable in python. Lists and dictionary.

3.9 TYPE CONVERSION IN PYTHON (Imp)

The process of converting the value of one data type (integer, string, float, etc.) to another data type is called type conversion. Python has two types of type conversion.

1. Implicit Type Conversion
2. Explicit Type Conversion

3.9.1 Implicit Type Conversion:

In Implicit type conversion, Python automatically converts one data type to another data type. This process doesn't need any user involvement. In an expression when mixed data types are involved, the lower one gets upgraded to higher one. This involves no user intervention, this is being done by the interpreter directly.

Let's see an example where Python promotes conversion of lower datatype (integer) to higher data type (float) to avoid data loss.

a = 123

b = 1.23

a = a + b

print("Value of a is:",a)

print("datatype of a is :",type(a))

When we run the above program, the output will be

Value of c: 124.23

datatype of c: <class 'float'>

In the above example, data type of c gets upgraded to float.

3.9.2 Explicit Type Conversion:

In Explicit Type Conversion, users convert the data type of an object to required data type. We use the predefined functions like `int()`, `float()`, `str()`, etc to perform explicit type conversion.

This type conversion is also called ***typecasting*** because the user casts (change) the data type of the objects.

X=3.14

Print(int(x))

3

This is called typecasting.

3.10 WORKING WITH MATH MODULE IN PYTHON

The math module is a standard module in Python and is always available. To use mathematical functions under math module, you have to import the module using statement import ***math.***

It gives access to the underlying Python library functions. For example,

```
Python 3.7.0 (v3.7.0:1bf9cc509
l)] on win32
Type "copyright", "credits" or
>>> # Square root calculation

import math
math.sqrt(4)
```

List of Functions in Python Math Module	
Function	Description
ceil(x)	Returns the smallest integer greater than or equal to x. Math.ceil(43.2)=44
fabs(x)	Returns the absolute value of x
factorial(x)	Returns the factorial of x
floor(x)	Returns the largest integer less than or equal to x
trunc(x)	Returns the truncated integer value of x
exp(x)	Returns e**x
log10(x)	Returns the base-10 logarithm of x
pow(x, y)	Returns x raised to the power y

sqrt(x)	Returns the square root of x
cos(x)	Returns the cosine of x
sin(x)	Returns the sine of x
tan(x)	Returns the tangent of x

SOLVED MULTIPLE CHOICE QUESTIONS

1. Which is the correct operator for power(x^y)?
a) X^y
b) X**y
c) X^^y
d) None of the mentioned
2. Which one of these is floor division?
a) /
b) //
c) %
d) None of the mentioned

3. What is the order of precedence in python?
i) Parentheses
ii) Exponential
iii) Multiplication
iv) Division
v) Addition
vi) Subtraction
a) i,ii,iii,iv,v,vi
b) ii,i,iii,iv,v,vi
c) ii,i,iv,iii,v,vi
d) i,ii,iii,iv,vi,v

4. What is answer of this expression, 22 % 3 is?
a) 7
b) 1
c) 0
d) 5

5. Operators with the same precedence are evaluated in which manner?
a) Left to Right
b) Right to Left
c) Can’t say
d) None of the mentioned

6. What is the output of this expression, 3*1**3?
a) 27
b) 9
c) 3
d) 1

7. Which one of the following have the same precedence?
a) Addition and Subtraction
b) Multiplication and Division
c) Both Addition and Subtraction AND Multiplication and Division
d) None of the mentioned

8. The expression int(x) implies that the variable x is converted to integer. State whether true or false.
a) True
b) False

9. Which one of the following have the highest precedence in the expression?
a) Exponential
b) Addition

c) Multiplication
d) Parentheses

10. Which of these in not a core data type?
a) Lists
b) Dictionary
c) Tuples
d) Class

11. Following set of commands are executed in shell, what will be the output?

>>>str="hello"

>>>str[:2]

>>>

a) he

b) lo

c) olleh

d) hello

12. What is the return type of function id?

a) int

b) float

c) bool

d) dict

13. In python we do not specify types, it is directly interpreted by the compiler, so consider the following operation to be performed.

>>>x = 13? 2

Objective is to make sure x has a integer value, select all that apply (python 3.xx)

a) x = 13 // 2

b) x = int(13 / 2)

c) x = 13 % 2

d) All of the mentioned

14. What data type is the object below?

L = [1, 23, ‘hello’, 1].

a) list

b) dictionary

c) array

d) tuple

15. In order to store values in terms of key and value we use what core data type.

a) list

b) tuple

c) class

d) dictionary

16. Which of the following is not a complex number?

a) k = 2 + 3j

b) k = complex(2, 3)

c) k = 2 + 3l

d) k = 2 + 3J

Answers :

1. b) x**y	2. b) //	3. a) i),ii), iii),iv),v),vi)	4. b) 1	5. a) left to right
6. c) 3	7. c) Both addition and Subtraction and Multiplication and Division	8. a)True	9. d) Paranthesis	10. D)Class

11.a) He	12. a)Int	13. d)All of the above mentioned	14. a)list	15. d) Dictionary
16. c) k = 2 + 3l				

SOLVED QUESTIONS

1. Express python equivalent expression for the following

   $a)\ \frac{3^2+9^3}{2}$ b) $ut + {}^1/_2\, at^2$

   Import math

Ans a)(math.pow(3,2) + math.pow(9,3))/2

b) u * t + 0.5 * a * math.pow(t,2)

2. Evaluate the following expression.

   12 * 3 % 5 + 2 * 6 // 4

Ans 36%5+12//4

1+3

4

3. What will be the output of the following code

   a, b, c, e=10, 20, 30, 0

   d=20

   e + = a + b + c – d

   f=a + b + c

print(e)

print(f)

Ans 40

60

4. What will be the output of the following code?

a, b, c, e=10, 20, 30, 0

d=20

e+=a + b + c - d

f=c // a

g=f % 2

print(e)

print(f)

print(g)

Ans 40

3

1

5. Differentiate between (555 / 222) ** 2 and (555.0 / 222) ** 2.

Ans Both are same.

6. How are these numbers different from each other?

33, 33.0, 33+j.

Ans 33 is integer

33.0 is floating point number

33+j is a complex number.

7. What will be the output produced by the following code?

a = 5 - 4 - 3

b=3**2**3

print(a)

print(b)

Ans -2

6561

8. What will be the output produced by the following code?

x, y=4 , 8

z=x / y * y

print(z)

Ans 4.0

9. What is the result produced by i) bool (0) ii) bool(str(0))?

Ans i)False

ii)True

10. What will be the output produced by the following code?

a, b, c=2, 3, 6

d=a + b * c / b

print(d)

Ans 8.0

11. What will be the output produced by the following code?

a = 3

b = 3.0

print (a = = b)

print (a is b)

Ans True

False

12. a, b, c = 1, 1, 2

d=a + b

e=1.0

f=1.0

g=2.0

h=e + f

print(c = = d)

print(c is d)

print(g = = h)

print(g is h)

Ans True

True

True

False

13. Write the following expressions in python

a)$1/3b^2h$

b) $s = ut + ½ at^2$

c) $a= b^2-\sqrt{q/2*r}$

d) $A=\sqrt{(x1-x2)^2+(y1-y2)^2}$

Ans a) 1 / 3 * math.pow(b , 2)*h

b) s = u * t + 1 / 2 * a *math.pow(t , 2)

c) math.pow(b , 2) - math.sqrt(q, 2*r)

d) math. sqrt(math.pow(x1 – x2 , 2)+ math.pow(y1 - y2 , 2))

14 What is the difference between = and ==?

Ans = assigns the value to the variable on the left.

== checks for equality and gives answer as true or false

>>> b=5 (Assigns the value)

>>> b==10 (checks for equality)

15 Find the output of the following

```
p, q=3,5
 q, r=p-2, p+2
print(p, q, r)
```

Ans 3 1 5

16. What is the value of the below expression.

```
a, b, c, d=1, 3, 5, 2
print(a + b > c **d or a * b < c * d)
```

Ans 4>25 or 3<10

False or True

True

17. Find the value of the expression.

```
x = not ( 5 > 8 ) = = ( 3 > 4 )and 4 < 5  or 3 <2
print(x)
```

Ans Not(false)==(false) and true or false

True==false and true or false

False and true or false

False or False

False

18. What will be the output of following Python code?

```
a = 12

b = 7.4

c = 1

a- = b

print (a, b)

a * = 2 + c

print(a)

b + = a * c

print( b )
```

Ans 4.6 7.4

13.8

21.2

19. What will be the output of the following code:

```
A = 3 – 4 + 10
B = 5 * 6
C = 7.0/2.0
D = “Hello” * 3
print (“Values are :“, A, B, C, D)
```

Ans Values are : 9 30 3.5 HelloHelloHello

20.

What will be the output of the following expression

(5<10) AND (10<5) OR(3<18) AND NOT(8<18)

Ans True and false or true and false

False or false

False