DATA HANDLING

DATA TYPES OPERATORS MUTABLE AND IMMUTABLE TYPES EXPRESSION

LEARNING OUTCOMES :

- ❑ DATA TYPES
- ❑ OPERATORS
- ❑ MUTABLE AND IMMUTABLE TYPES
- ❑ EXPRESSION

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DATA TYPES

Data type in Python specifies the type of data we are going to store in any variable, the amount of memory it will take and type of operation we can perform on a variable. Data can be of many types e.g. character, integer, real, string etc.

Python supports following data types:

- Numbers (int, float, complex)
- String
- List
- Tuple
- Dictionary

NUMBERS

From the name it is very clear the Number data types are used to store numeric values. Numbers in Python can be of following types:

(i) Integers
   a) Integers(signed)
   b) Booleans

(ii) Floating point numbers

(iii) Complex Numbers

INTEGERS

Integers allows to store whole numbers only and there is no fraction parts.
Integers can be positive and negative e.g. 100, 250, -12, +50

There are two integers in Python:

1) **Integers(signed) :** it is normal integer representation of whole numbers. Integers in python can be on any length, it is only limited by memory available. In Python 3.x int data type can be used to store big or small integer value whether it is +ve or –ve.

2) **Booleans:** it allows to store only two values **True** and **False**. The internal value of boolean value True and False is **1 and 0** resp. We can get boolean value from 0 and 1 using **bool()** function.

INTEGERS

```
>>>bool(1)
True
>>>int(False)
0
>>>str(False)
'False'          # str() function is used to convert argument to string type.
```

FLOATING POINT NUMBERS

It allows to store numbers with decimal points. For e.g. 2.14. The decimal point indicate that it is not an integer but a float value. 100 is an integer but 100.5 is a float value. In Previous chapter we have already discussed float values can be of type type:

1. **Fractional Form** : 200.50, 0.78, -12.787
2. **Exponent Form :** it is represented with mantissa and exponent. For e.g

```
>>>x = 1.5E2                  # means 1.5 x 10^2 which is 150
>>>print(x)                   # 150.0
>>>y=12.78654E04
>>>print(y)                   # 127865.4
```

FLOATING POINT NUMBERS

Floating point number are mainly used for storing values like distance, area, temperature etc. which have a fractional part.

Floating point numbers have two advantage over integers:

- ✓ they can represent values between the integers
- ✓ they can represent a much greater range of values

But floating point numbers suffers from one disadvantage also:

- ✓ Floating point operations are usually slower than integer operations.

In Python floating point numbers represent machine level double precision floating point numbers i.e. 15 digit precision.

COMPLEX NUMBERS

Python represent complex numbers in the form A+Bj. To represent imaginary numbers, Python uses j or J in place of i. So in Python j = $\sqrt{-1}$. Both real and imaginary parts are of type **float**

e.g.

```
a = 0 + 6j
b = 2.5 + 3J
```

```
>>>a=4+5j
>>>print(a)                    # (4+5j)
>>>b=0+2j
>>>b                           #(2j)
```

COMPLEX NUMBERS

Python allows to retrieve real and imaginary part of complex number using attributes: **real and imag**

If the complex number is a then we can write **a.real** or **a.imag**

Example

```
>>>a=1+3.54j
>>>print(a.real)          # 1.0
>>>print(a.imag)          # 3.54
```

STRING

In previous chapter we have already discussed about string. Let us recall the things:

1. String is a collection of any valid characters in a quotation marks (‘ or “)
2. Each character of String in Python is a Unicode character
3. Strings are used to store information like name, address, descriptions. Etc

For example:

“hello”, ‘welcome’, “sales2018”, “python@kvoef.com”

STRING

In Python string is a sequence of characters and each character can be individually access using **index**. From beginning the first character in String is at index 0 and last will be at **len-1**. From backward direction last character will be at index **-1** and first character will be at **–len.**

Forward indexing

	0	1	2	3	4	5	6
message	W	E	L	C	O	M	E
	-7	-6	-5	-4	-3	-2	-1

Backward indexing

STRING

To access individual character of String (Slicing). we can use the syntax:

StringName[index position]

```
>>>stream="Science"
>>>print(stream[0])
S
>>>print(stream[3])
e
>>>print(stream[-1])
e
```

STRING

What will be the output:

```
>>>stream="Science"

>>>print(stream[5])                    #Output 1
>>>print(stream[-4])                    #Output 2
>>>print(stream[-len(stream)])          #Output 3
>>>print(stream[8])                     #Output 4
```

STRING

We cannot change the individual letters of string by assignment because string in python is immutable and hence if we try to do this, Python will raise an error "**object does not support Item assignment**"

```
>>>name="Ronaldo"
>>>name[1]='i'        # error
```

However we can assign string to another string. For e.g

```
>>>name="Ronaldo"
>>>name="Bekham"            # no error
```

LISTS AND TUPLES

Lists and Tuples are compound data types i.e. they allows to store multiple values under one name of different data types.

The main difference between Lists and Tuples is **List can be changed/modified i.e. mutable type** whereas **Tuples cannot be changes or modified i.e. immutable type**.

Let us take this with example:

Lists: A list in python represents a list of comma-separated values of any data type between **square brackets**.

[10,20,30,40,50]

['a','e','o','i','u']

["KV",208004,97.5]

EXAMPLES - LIST

```
>>> family=["Mom","Dad","Sis","Bro"]
>>> family
['Mom', 'Dad', 'Sis', 'Bro']
>>> print(family)
['Mom', 'Dad', 'Sis', 'Bro']
>>> Employee=["E001","Naman",50000,10.5]
>>> Employee
['E001', 'Naman', 50000, 10.5]
>>> print(Employee)
['E001', 'Naman', 50000, 10.5]
```

EXAMPLES - LIST

The values stored in List are internally numbered from 0 onwards. i.e. first element will be at position 0 and second will be at 1 and so on.

```
>>> Employee=["E001","Naman",50000,10.5]
>>> print(Employee[1])
```

Naman

```
>>> Employee[2]=75000
>>> print(Employee)
```

['E001', 'Naman', 75000, 10.5]

You can check the number of items in list using len() function

```
>>> print(len(Employee))
```

4

TUPLES

Tuples as those list which cannot be changed i.e. not modifiable. Tuples are defined inside parenthesis and values separated by comma

Example:

```
>>> favorites=("Blue","Cricket","Gajar Ka Halwa")
>>> student=(1,"Aman",97.5)
>>> print(favorites)
('Blue', 'Cricket', 'Gajar Ka Halwa')
>>> print(student)
(1, 'Aman', 97.5)
```

TUPLES

Like List, Tuples values are also internally numbered from 0 and so on.

```
>>> print(favorites[1])
Cricket
>>> print(student[2])
97.5
```

```
>>> student[2]=99
>>> student[2]=99   # Error, tuple does not support assignment i.e. immutable
```

DICTIONARY

Dictionary is another feature of Python. It is an unordered set of comma separated **key:value** pairs. Dictionary Items are defined in **Curly Brackets { }**

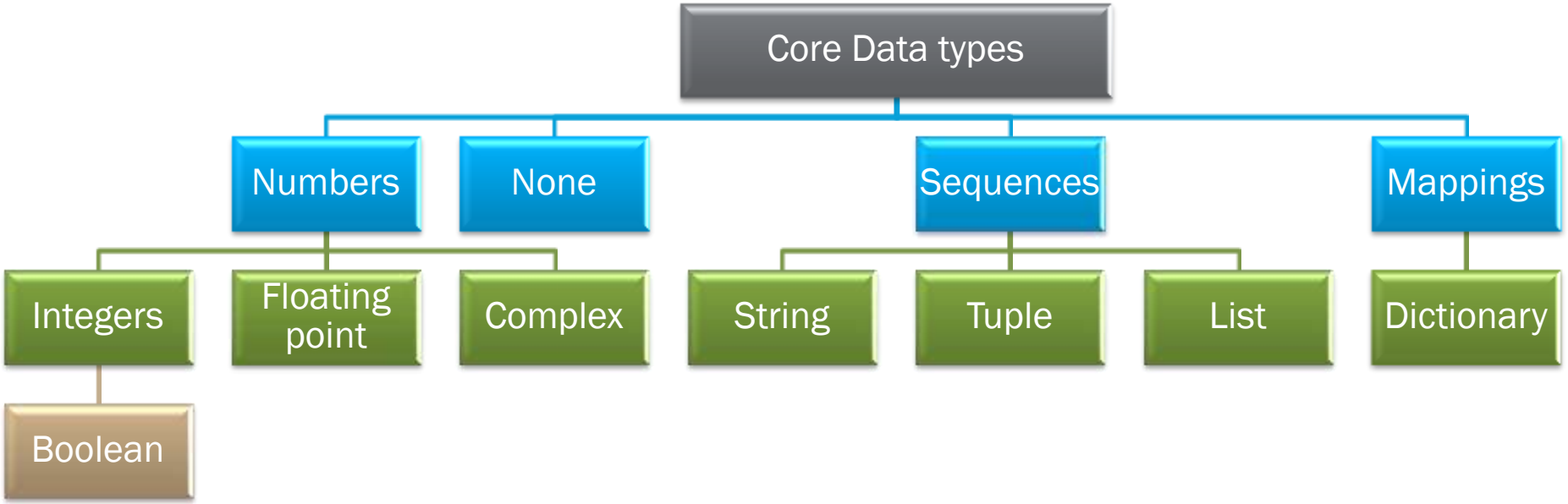
Keys defined in Dictionary cannot be same i.e. no two keys can be same.

```
>>> student={'Roll':1,'Name':"Jagga",'Per':91.5}
>>>print(student)
>>> print(student['Per'])
91.5
>>> val={1:100,2:300,4:900}                    # Key name can be string / numeric
>>> print(val[1])
100
```

Dictionary is mutable. i.e. We can modify dictionary elements.

```
>>>val[2]=1000
>>>print(val)          # {1: 100, 2: 1000, 4: 900}
```

DATA TYPE SUMMARY



MUTABLE AND IMMUTABLE TYPES

Python data object can be broadly categorized into two types – mutable and immutable types. In simple words changeable/modifiable and non-modifiable types.

1. Immutable types: are those that can never change their value in place. In python following types are immutable: **integers, float, Boolean, strings, tuples**

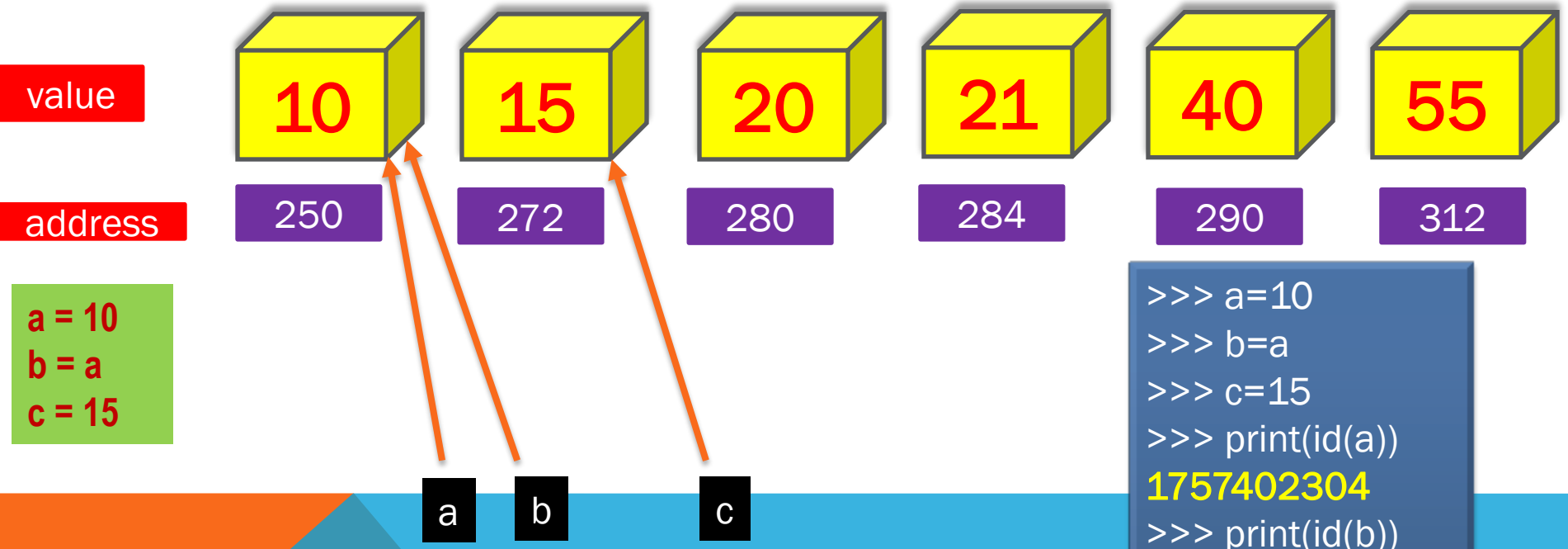
Sample Code:

```
a = 10
b = a
c = 15          # will give output 10,10,30
a = 20
b = 40
c = b
```

From this code, you can say the value of integer a, b,c could be changed effortlessly, but this is not the case. Let us understand what was done behind the scene

IMMUTABLE TYPES

Note: In python each value in memory is assigned a memory address. So each time a new variable is pointing to that value they will be assigned the same address and no new memory allocation. Let us understand the case.



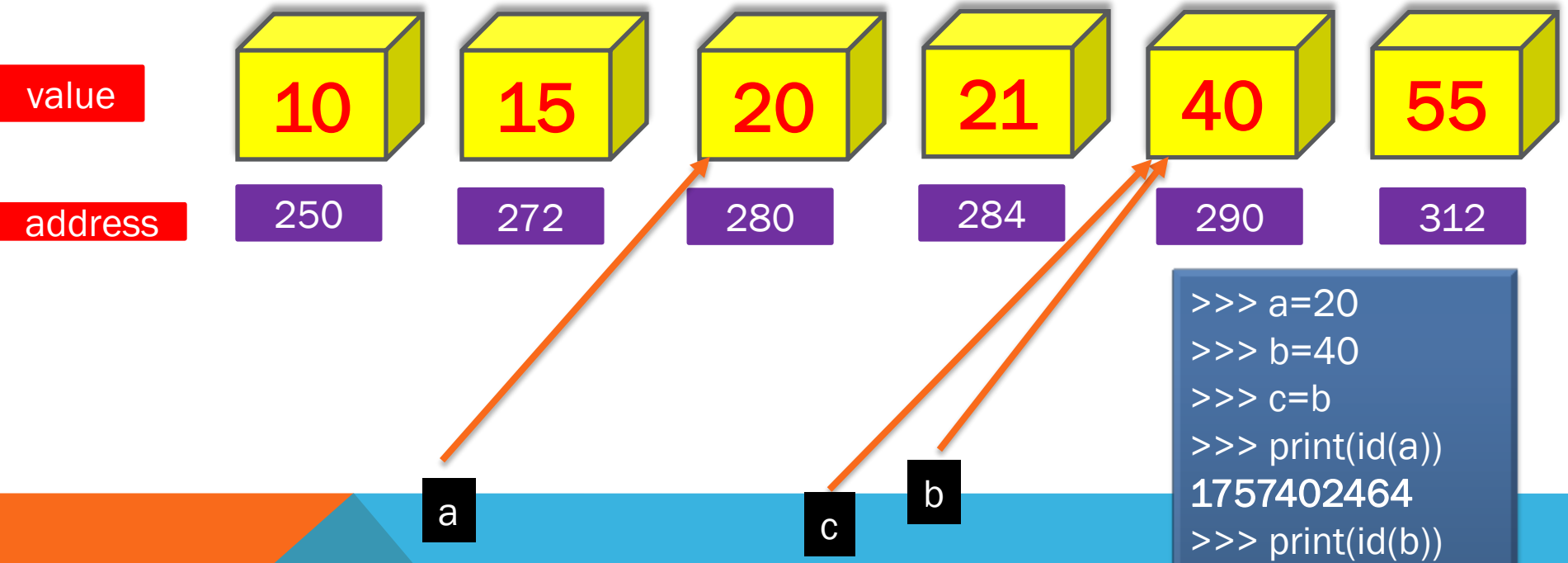

```
>>> a=10
>>> b=a
>>> c=15
>>> print(id(a))
1757402304
>>> print(id(b))
1757402304
>>> print(id(c))
1757402384
>>> print(id(10))
1757402304
```

Python provides **id()** function to get the memory address to which value /variable is referring

IMMUTABLE TYPES

Now let us understand the changes done to variable a, b,c

```
a = 20
b = 40
c = b
```




```
>>> a=20
>>> b=40
>>> c=b
>>> print(id(a))
1757402464
>>> print(id(b))
1757402784
>>> print(id(c))
1757402784
```

Python provides **id()** function to get the memory address to which value /variable is referring

IMMUTABLE TYPES

From the previous code it is clear that variable names are stored references to a value-object. Each time we change the value the variable's reference memory address changes. So it will not store new value in same memory location that's why **Integer, float, Booleans, strings and tuples are immutable.**

Variables (of certain type) are NOT LIKE storage containers i.e. with fixed memory address where value changes every time. Hence they are immutable

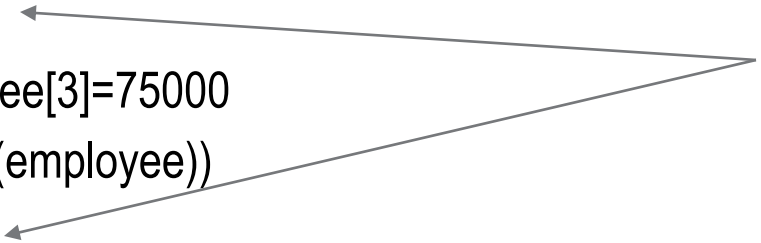
MUTABLE TYPE

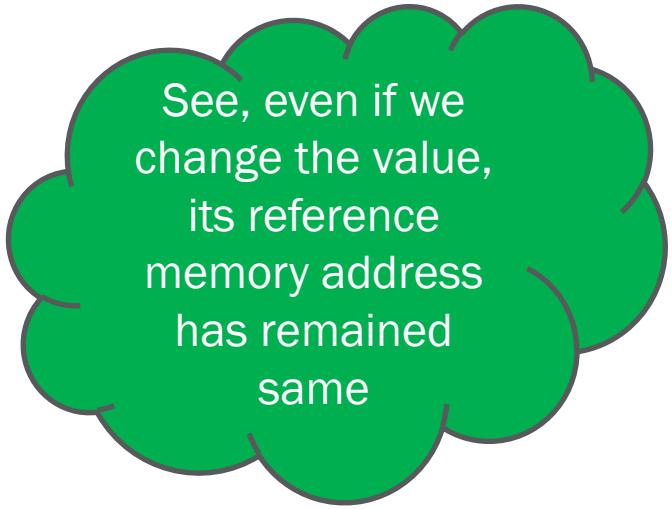
Mutable means in same memory address, new value can be stored as and when it is required. Python provides following mutable types:

1. Lists
2. Dictionaries
3. Sets

Examples: (using List)

```
>>> employee=["E001","Rama","Sales",67000]
>>> print(id(employee))
71593896
>>> employee[3]=75000
>>> print(id(employee))
71593896
>>>
```





VARIABLE INTERNALS

Python is an object oriented language. So every thing in python is an object. An object is any identifiable entity that have some characteristics/properties and behavior. Like integer values are object – they hold whole numbers only(characteristics) and they support all arithmetic operations (behavior).

Every python object has three key attributes associated with it:

1. **type** of object
2. **value** of an object
3. **id** of an object

TYPE OF AN OBJECT

type of an object determines the operations that can be performed on the object.

Built – in function **type()** returns the type of an object

Example:

```
>>> a=100
>>> type(a)
<class 'int'>
>>> type(100)
<class 'int'>
>>> name="Jaques"
>>> type(name)
<class 'str'>
```

VALUE OF AN OBJECT

The data items stored in the object is a value of object. The value stored in an object is a literals. We can using **print()** to get the value of an object

Example:

```
>>> a=100
>>> print(a)
100
>>> name="Kallis"
>>> print(name)
Kallis
>>>
```

ID OF AN OBJECT

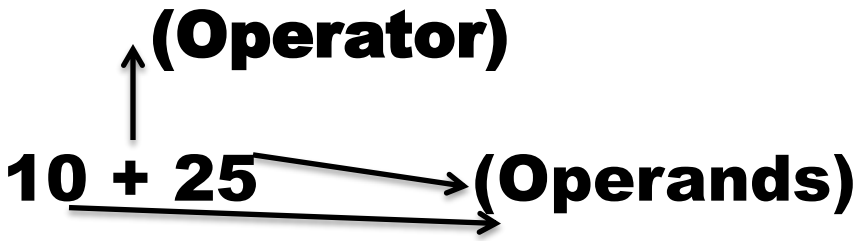
It is the memory address of any object. Although id is dependent upon the system where it is installed but in most cases it returns the memory location of the object. Built in function **id()** returns the id of an object

Example:

```
>>> a=5
>>> id(5)
1911018608
>>> print(id(a))
1911018608
>>>
```

OPERATORS

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



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 - ARITHMETIC

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

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

TYPES OF OPERATORS - ARITHMETIC

Unary Operators They require only one operand to operate like unary + and –

For e.g.

```
>>> a=5
>>> print(+a)
5
>>> print(-a)
-5
>>>
```

EXAMPLE – BINARY ARITHMETIC OPERATOR

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

EXAMPLE – BINARY ARITHMETIC OPERATOR

```
>>> val = num1 / num2
>>> print(val)
2.857142857142857
>>> val = num1 // num2
>>> print(val)
2
```

JUST A MINUTE...

What will be the output of following code

```
>>> a,b,c,d = 13.2,20,50.0,49
>>> print(a/4)
>>> print(a//4)
>>> print(20**3)
>>> print(b**3)
>>> print(c//6)
>>> print(d%5)
>>> print(d%100)
```

JUST A MINUTE...

What will be the output of following code

```
>>> x,y=-8,-15
>>> print(x//3)
>>> print(8/-3)
->>> print(8//-3)
```

JUST A MINUTE...

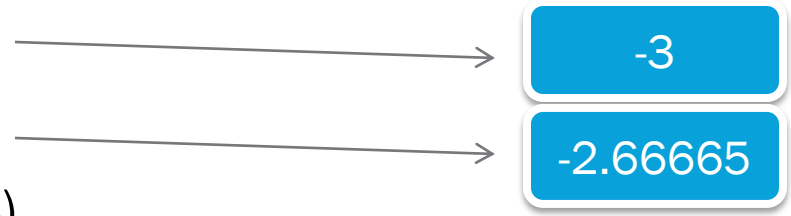
What will be the output of following code

```
>>> x,y=-8,-15
>>> print(x//3)
>>> print(8/-3)
->>> print(8//-3)
```

JUST A MINUTE...

What will be the output of following code

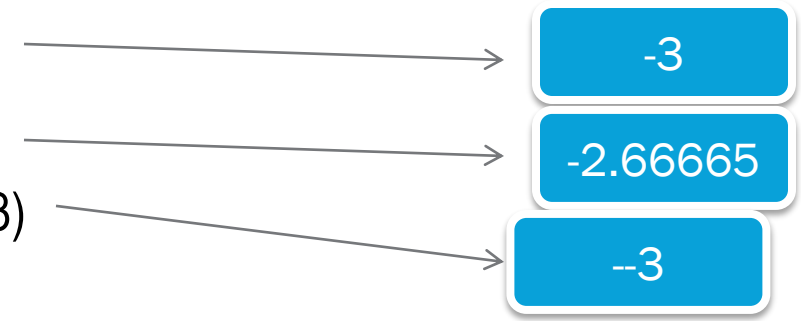
```
>>> x,y=-8,-15
>>> print(x//3)
>>> print(8/-3)
->>> print(8//-3)
```



JUST A MINUTE...

What will be the output of following code

```
>>> x,y=-8,-15
>>> print(x//3)
>>> print(8/-3)
->>> print(8//-3)
```



JUST A MINUTE...

What will be the output of following code

```
>>> -11 // 5
>>> -11 % 5
>>> 11 % - 5
>>> 11 // -5
```

JUST A MINUTE...

What will be the output of following code

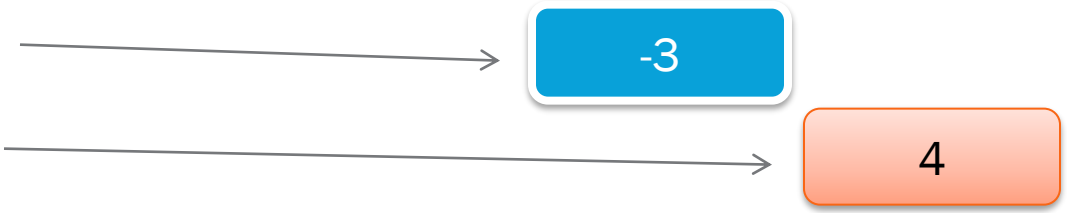
```
>>> -11 // 5
>>> -11 % 5
>>> 11 % - 5
>>> 11 // -5
```

-3

JUST A MINUTE...

What will be the output of following code

```
>>> -11 // 5
>>> -11 % 5
>>> 11 % - 5
>>> 11 // -5
```



JUST A MINUTE...

What will be the output of following code

```
>>> -11 // 5
>>> -11 % 5
>>> 11 % - 5
>>> 11 // -5
```

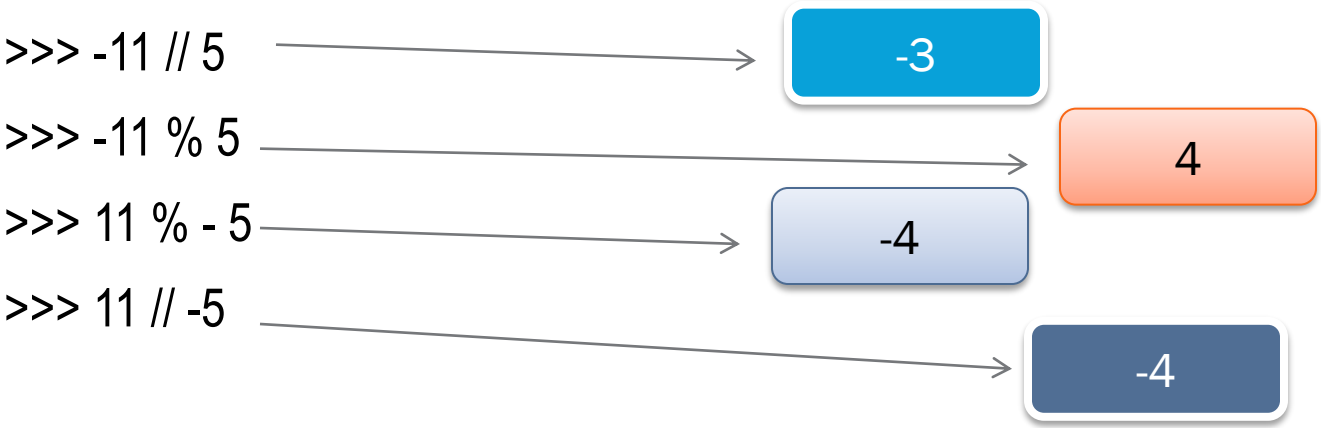
-3

4

-4

JUST A MINUTE...

What will be the output of following code



TYPES OF OPERATORS –AUGMENTED ASSIGNMENT OPERATORS

It perform operation with LHS and RHS and result will be assigned to LSH

Operator	Action	Example
+=	RHS added to LHS and result assigned to LHS	x+=5 means x=x+5
-=	RHS minus to LHS and result assigned to LHS	x-=5 means x=x-5
*=	RHS multiply to LHS and result assigned to LHS	x*=5 means x=x*5
/=	LHS divided by RHS and result assigned to LHS(FLOAT)	x/=5 means x=x/5
%=	LHS divided by RHS and remainder assigned to LHS	x%=5 means x=x%5
**=	RHS power to LHS and result assigned to LHS	x**=5 means x=x**5
//=	LHS divided by RHS and result assigned to LHS (INT)	x//=5 means x=x//5

TYPES OF OPERATORS – RELATIONAL OPERATOR

Are used to compare two values and return the result as **True** or **False** depending upon the result of comparison

Operator	Action	Example
<	Less than	50<45 returns False, 40<60 returns True
>	Greater than	50>45 returns True, 40>60 returns False
<=	Less than or equal to	50<=50 returns True, 80<=70 returns False
>=	Greater than or equal to	40>=40 returns True, 40>=90 returns False
==	Equal to	80==80 returns True, 60==80 returns False
!=	Not equal to	45!=90 returns True, 80!=80 returns False

FEW POINTS TO REMEMBER - COMPARISONS

- ✓ For numeric types, the values are compared after removing trailing zeros after decimal point from floating point number. For example 6 and 6.0 will be treated as equal.
- ✓ Capital letters (ASCII code 65-90) are considered as less than small letters (ASCII code 97-122).
- ✓ >>>'Hello'<'hello' # will give result true
- ✓ In string be careful while comparison, because special characters are also assigned to some ASCII code. Like ASCII code of space is 32, Enter is 13.
- ✓ >>>'Hello' ==' Hello' # false, because there is space before H in second string
- ✓ Like other programming language, In Python also we have to be very careful while comparing floating value because it may gives you unexpected result. So it is suggested not to use equality testing with floating values.

COMPARISON WITH FLOATING VALUES

>>> 0.1 + 0.1+ 0.1 == 0.3

Will return False

How?

Let us check the value of 0.1+0.1+0.1

>>>print(0.1+0.1+0.1)

Output :- 0.30000000000000004

That's why 0.1 + 0.1+ 0.1 == 0.3 is False

Reason: In python floating numbers are approximately presented in memory in binary form up to the allowed precision 15 digit. This approximation may yield unexpected result if you are comparing floating value using equality

RELATIONAL OPERATOR WITH ARITHMETIC OPERATORS

Relational operator have lower priority than arithmetic operators, So if any arithmetic operator is involved with relational operator then first arithmetic operation will be solved then comparison .

For example

```
>>>a,b,c = 10,20,30
>>>a+10 > b-10
```

Result : True

Here Comparison will be 20>10

WHAT IS THE DIFFERENCE?

If the value of a is 100 , What is the difference between the below 2 statements

Statement 1 : >>> a == 60

Statement 2 : >>> a = 60

IDENTITY OPERATOR

These operators are used to check if both object are pointing to same memory address or not.

Operator	Usage	Description
is	a is b	Return True, if both operands are pointing to same memory location, otherwise False
is not	a is not b	Return True, if both operands are not pointing to same memory location, otherwise False

EXAMPLE OF IDENTITY OPERATORS

```
>>> a = 10
>>> b = 10
>>> c = 20
>>> a is b                  # True
>>> a is c                  # False
>>> a is not c              # True
>>> c -=10
>>> a is c                  # True
```

EQUALITY(==) VS IDENTITY(IS)

When we compare two variables pointing to same value, then both Equality (==) and identity (is) will return True.

```
>>> a ,b = 10, 10
>>>a==b            # True
>>>a is b          # True
```

But in few cases, when two variables are pointing to same value == will return True and **is** will return False

EXAMPLE

```
>>> s1='kvoef'
>>>s2=input('Enter any String')
Enter any String: kvoef
>>> s1==s2                    # True
>>> s1 is s2                  # False
>>>s3 = 'kvoef'
>>>s1 is s3                  # True
```

FEW CASES-PYTHON CREATES TWO DIFFERENT OBJECT THAT STORE THE SAME VALUE

- Input of String from the console
- Dealing with large integer value
- Dealing with floating point and complex literals

LOGICAL VALUE – ASSOCIATION WITH OTHER TYPE

In python every value is associated with Boolean value True or False. Let us See which values are True and False

False values	True values
None	All other values are considered as true
False	
Zero (0)	
Empty Sequence “ “, [], (), {}	

LOGICAL OPERATORS

Python supports 3 logical operators : **and , or, not**

or operator : it combines 2 expressions, which make its operand. The or operator works in 2 ways:

(i) Relational expression as operand

(ii) Numbers or string or lists as operand

RELATIONAL EXPRESSION AS OPERANDS

When relational expression is used as operand then **or** operator return True if any expression is True. If both are False then only **or** operator will return False.

```
>>> (5>6) or (6>5)          # True
>>> (4==4) or (7==9)        # True
>>> (6!=6) or (7>100        # False
```

NUMBERS/STRINGS AS OPERANDS

When numbers/strings are used as operand then output will be based on the internal Boolean value of number/string. The result will not be the True or False but the value used with **or**. However internal value of result will be True or False.

```
>>> (0) or (0)          # 0
>>> (0) or (10)         # 10
>>> (4) or (0.0)        # 4
>>> 'kv' or ''          # kv
>>> (9) or (7)          # 9
>>> 'abc' or 'xyz'      # abc
```

```
>>> 20>10 or 8/0 >5
>>> 20<10 or 8/0 >5
```

and operators: it combines 2 expressions, which make its operand. The and operator works in 2 ways:

(i) Relational expression as operand

(ii) Numbers or string or lists as operand

RELATIONAL EXPRESSION AS OPERANDS

When relational expression is used as operand then **and** operator return True if both expressions are True. If any expression is False then **and** operator will return False.

```
>>> (8>6) and (6>5)                    # True
>>> (4==4) and (7==9)                  # False
>>> (7!=6) and (10+10>18)              # True
```

NUMBERS/STRINGS AS OPERANDS

When numbers/strings are used as operand then output will be based on the internal Boolean value of number/string. The result will not be the True or False, but the value used with **and**. However internal value of result will be True or False.

```
>>> (0) and (0)          # 0
>>> (0) and (10)         # 0
>>> (4) and (0.0)        # 0
>>> 'kv' and ''          # ''
>>> (9) and (7)          # 7
>>> 'abc' and 'xyz'      # xyz
```

```
>>> 20<10 and 8/0 >5
>>> 20>10 or 8/0 >5
```

CHAINED COMPARISON

Python can chain multiple comparisons which are like shortened version of larger Boolean expressions. In python rather than writing **10<20 and 20<30**, you can even write **10<20<30**, which is chained version of **10<20 and 20<30**.

Suppose you want to check **age is greater than or equal to 13 and less than or equal to 19** then you can write using chain of condition like:

13<=age<=19

Suppose you want to check **A is greater than B and C**, you can write using chain of condition like:

B<=A>=C

BITWISE OPERATORS

Python provides another category of operators – Bitwise operators. Similar to logical operators except it works on binary representation of actual data not on its decimal value.

Operators	Operations	Use	Description
&	Bitwise and	Op1 & Op2	It compares two bits and generate a result of 1 if both bits are 1; otherwise it return 0
|	Bitwise or	Op1 | Op2	It compares two bits and generate a result of 1 if any bits are 1; otherwise it return 0
^	Bitwise xor	Op1 ^ Op2	It compares two bits and generate a result of 1 if either bit is 1; otherwise if both Operand are 1 or 0 it will return False
~	Bitwise compliment	~Op1	The Compliment operator is used to invert all of the bits of the operand

EXAMPLES - &

```
>>> a = 10
>>> b = 12
>>> bin(a)          # 0b1010
>>> bin(b)          #0b1100
>>> a & b           # 8
>>> bin(a & b)      # 0b1000
```

EXAMPLES - |

```
>>> a = 10
>>> b = 12
>>> bin(a)          # 0b1010
>>> bin(b)          #0b1100
>>> a | b           # 8
>>> bin(a & b)      # 0b1110
```

EXAMPLES - ^

```
>>> a = 10
>>> b = 12
>>> bin(a)          # 0b1010
>>> bin(b)          #0b1100
>>> a ^ b           # 6
>>> bin(a & b)      # 0b0110
```

EXAMPLES - ~

```
>>> a = 10
>>> b = 12
>>> bin(a)                    # 0b1010
>>> bin(b)                    #0b1100
>>> ~a                        # -11
```

Reason: -

First the binary of a i.e. 10 is **1010,** now using ~ operator it will invert all the bits so bits will be **0101** , Now Python will find 2's compliment of bits as : 1011 and result will be -ve

OPERATOR PRECEDENCE

Highest

Operators	Description	Associativity
()	Parenthesis	Left-to-right
**	Exponent	Right-to-left
~x	Bitwise compliment	Left-to-right
+x, -x	Positive or negative	Left-to-right
*, /, //, %	Arithmetic operator	Left-to-right
+, -	Add, Sub	Left-to-right
&	Bitwise &	Left-to-right
^	Bitwise XOR	Left-to-right
|	Bitwise OR	Left-to-right
<,<=,>,>=,<>,!=,==, is, is not	Comparison & Identity	Left-to-right
not x	Boolean Not	Left-to-right
and	Boolean AND	Left-to-right
or	Boolean OR	Left-to-right

Lowest

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ASSOCIATIVITY OF OPERATORS

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

For example if an expression contains multiplication, division and modulus then they will be evaluated from left to right. Take a look on example:

```
>>> 8 * 9 /11 //2
>>> (((8*9) / 11) // 2)
>>> 8 * ((9/11)//2)
>>> 8 * (40/ (11//2))
```

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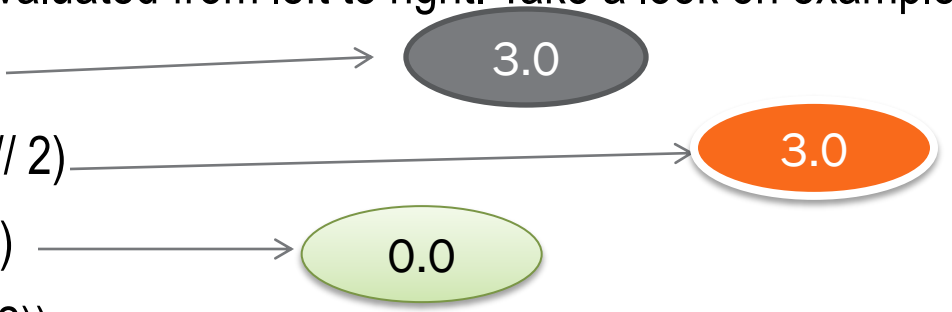

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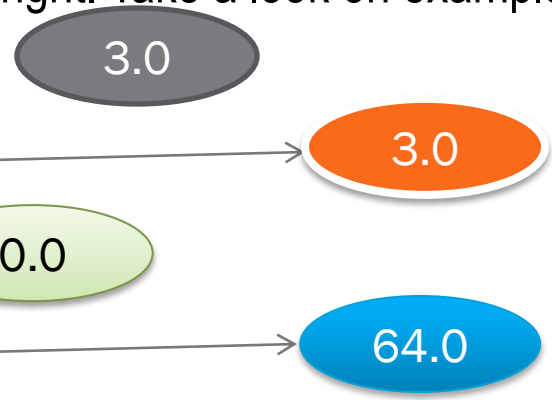

ASSOCIATIVITY OF OPERATORS

An expression having multiple ** operator is evaluated from right to left. i.e.

3 ** 4 ** 2 will be evaluated as 3 ** (4 ** 2) not (3 **4) ** 2

Guess the output

```
>>> 3** 4 ** 2
>>> 3 ** (4 ** 2)
>>> (3**4) ** 2
```

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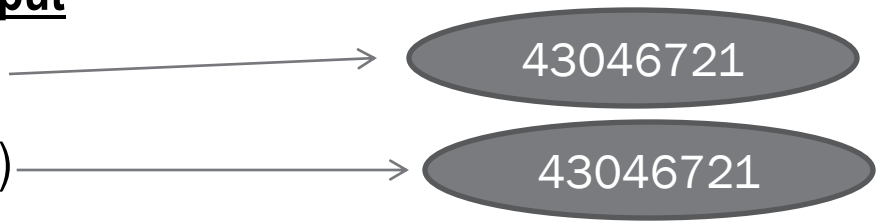

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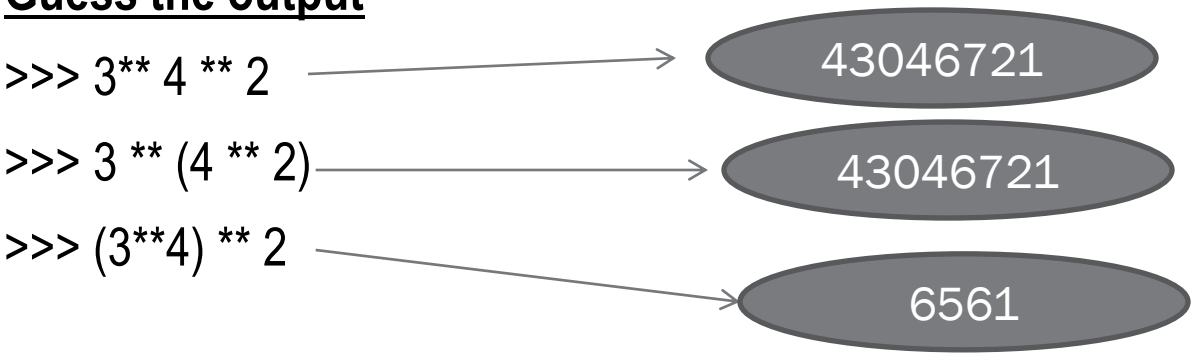

EXPRESSION

We have already discussed on expression that is a combination of operators, literals and variables (operand).

The expression in Python can be of any type:

1) Arithmetic expressions
2) String expressions
3) Relational expressions
4) Logical expressions
5) Compound expressions

ARITHMETIC EXPRESSION

```
10 + 20
30 % 10
```

RELATIONAL EXPRESSION

```
X>Y
X<Y<Z
```

LOGICAL EXPRESSION

```
a or b
not a and not b
x>y and y>z
```

STRING EXPRESSION

```
>>> “python” + “programming”        #pythonprogramming
>>> “python” * 3                    #pythonpythonpython
```

EVALUATING EXPRESSION - ARITHMETIC

- Executed based on the operator precedence and associativity
- Implicit conversion takes place if mixed type is used in expression

IMPLICIT CONVERSION (COERCION)

An implicit conversion is a conversion performed by the interpreter without programmer's intervention. It is applied generally whenever differing types are intermixed in an expression, so as not to lose information.

The rule is very simple, Python convert all operands up to the type of the largest operand(type promotion)

IMPLICIT CONVERSION (COERCION)

If both arguments are standard numeric types, the following coercions are applied:

- If either argument is a complex number, the other is converted to complex
- Otherwise, if either a argument is a floating number, the other is converted to floating point
- No conversion if both operand are integers

EXAMPLE – OUTPUT?

```
n1=10
n2=5
n4=10.0
n5=41.0
A=(n1+n2)/n4
B=n5/n4 * n1/2
print(A)
print(B)
```

EXAMPLE – OUTPUT?

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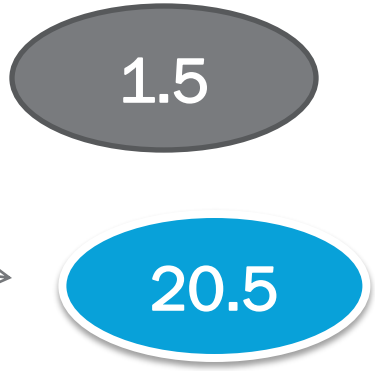

FIND THE OUTPUT?

a) a,b = 10,5

c = b / a

b) a,b = 10,5

c = b // a

c) a,b = 10,5

c = b % a

EVALUATING EXPRESSION - RELATIONAL

- Executed based on the operator precedence and associativity
- All relational expression yield Boolean value ***True***, ***False***
- for chained comparison like – x<y<z is equivalent to x<y and y<z

OUTPUT?

If inputs are

(i) a,b,c = 20,42,42

```
print(a<b)
print(b<=c)
print(a>b<=c)
```

(ii) a,b,c = 42, 20,20

EVALUATING EXPRESSION - LOGICAL

- Executed based on the operator precedence and associativity
- Executed in the order of **not, and , or**
- **Logical operators are short-circuit operators**

OUTPUT?

(10<20) and (20<10) or (5<7) and not 7<10 and 6<7<8

TYPE CASTING

We have learnt in earlier section that in an expression with mixed types, Python internally changes the type of some operands so that all operands have same data type. This type of conversion is automatic i.e**. implicit conversion** without programmer's intervention

An **explicit type** conversion is user-defined conversion that forces an expression to be of specific type. This type of explicit conversion is also known as **Type Casting**.

Remember, in case of input() with numeric type, whatever input is given to input() is of string type and to use it as a number we have to convert it to integer using int() function. It is an explicit conversion or Type Casting.

Syntax: - **datatype(expression)**

TYPE CASTING - EXAMPLES

```
>>> num1 = int(input("Enter any number "))
d = float(a)          # if a is of int type then it will be converted to float
```

OUTPUT

```
(i)    int(17.8)          # 7
(ii)   int("20")          # 20
(iii)  float(17)          # 17.0
(iv)   complex(17)        # 17 + 0j
(v)    complex(2,7)       # 2 + 7j
(vi)   str(13)            # '13'
(vii)  str(0o19)          # '17'
(viii) bool(0)            # False
(ix)   bool('a')          # True
```

MATH MODULE OF PYTON

Other than build-in function, Python provides many more function through modules in standard library. Python provides math library that works with all numeric types except for complex numbers

To use standard **math** library we have to import the library in our python program using **import** statement

```
import math
```

math library contains many functions to perform mathematical operations like finding square root of number, log of number, trigonometric functions etc.

SOME MATHEMATICAL FUNCTION

S.No	Function	Prototype	Description	Example
1	ceil()	math.ceil(num)	It returns the number rounded to next integer	math.ceil(2.3) Ans- 3
2	floor()	math.floor(num)	It returns the number rounded to previous integer	math.floor(2.3) Ans- 2
3	fabs()	math.fabs(num)	Returns the absolute value i.e. number without sign	math.fabs(-4) Ans – 4
4	pow()	math.pow(b,e)	Return the value of $(b)^e$	math.pow(2.3) Ans- 8
5	sqrt()	math.sqrt(num)	It returns the square root of number	math.sqrt(144) Ans- 12
6	sin()	math.sin(num)	Returns the sin value of number	math.sin(math. radian(90)) Ans- 1.0
7	exp()	math.exp(num)	Returns natural logarithm e raised to the num	math.exp(2) Ans- 7.3890..

SOME MATHEMATICAL FUNCTION

The math module of Python also contains two useful constant pi and e

math.pi gives you the value of constant π = **3.141592…**

math.e gives you the value of constant e = **2.718281**

So, while writing any formula which uses the constant pi you can use math.pi, like

area = math.pi * radius * radius

VALID ARITHMETIC EXPRESSION USING MATH LIBRARY

(i) math.pow(8/4,2)

(ii) math.sqrt(4*4+2*2+3*3)

(iii) 2+math.ceil(7.03)

INVALID ARITHMETIC EXPRESSION

(i) 20+/4

(ii) 2(l+b)

(iii) math.pow(0,-1)

(iv) math.log(-5)+4/2

WRITE THE CORRESPONDING PYTHON EXPRESSION FOR THE FOLLOWING MATHEMATICAL EXPRESSION

(i) $\sqrt{a^2 + b^2 + c^2}$

(ii) 2 –ye^{2y} + 4y

(iii) P + $\frac{q}{(r+s)^4}$

(iv) (cos x / tan x) + x

(v) | e^2 – x |

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JUST A MINUTE...

(i) What are data types? What are python built-in datatypes

(ii) Which data type of python handles Numbers?

(iii) Why Boolean considered a subtype of integer?

(iv) Identify the data types of the values:

5, 5j, 10.6, '100', "100", 2+4j, [10,20,30], ("a","b","c"), {1:100,2:200}

(v) What is the difference between mutable and immutable data type? Give name of one data type belonging to each category

(vi) What is the difference in output of the following ?

```
print(len(str(19//4)))
print(len(str(19/4))
```

JUST A MINUTE...

(vii) What will be the output produced by these?

12/4 14//14 14%4 14.0/4 14.0//4 14.0%4

(viii) Given two variable NM is bound to string “Malala” (NM=“Malala”). What will be the output produced by following two statement if the input given is “Malala”? Why?

MM = input(“Enter name :”)

Enter name : Malala

(a) NM == MM (b) NM is MM

JUST A MINUTE...

(ix) What will be the output of following code? Why

(i) 25 or len(25)

(ii) len(25) or 25

(x) What will be the output if input for both statement is 6 + 8 / 2

10 == input("Enter value 1:")

10==int(input("Enter value 2:")

(xi) WAP to take two input DAY and MONTH and then calculate which day of the year the given date is. For simplicity take month of 30 days for all. For e.g. if the DAY is 5 and MONTH is 3 then output should be "Day of year is : 65"