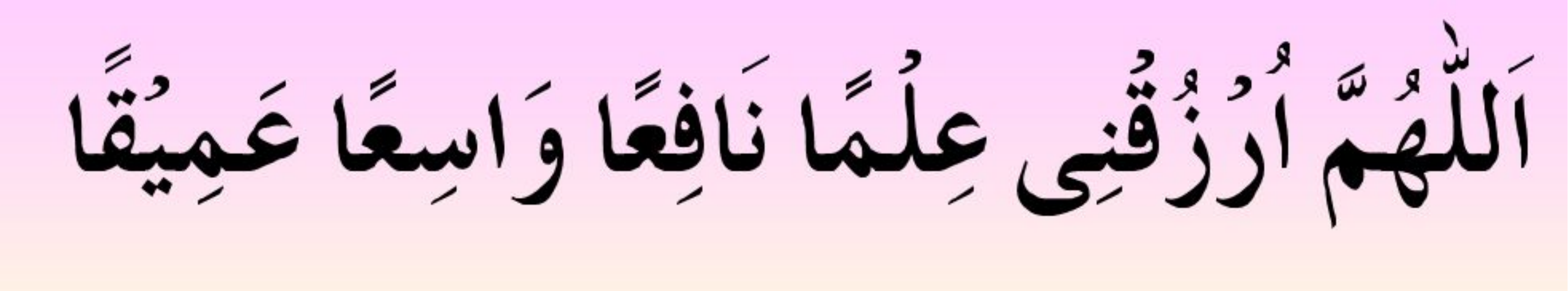
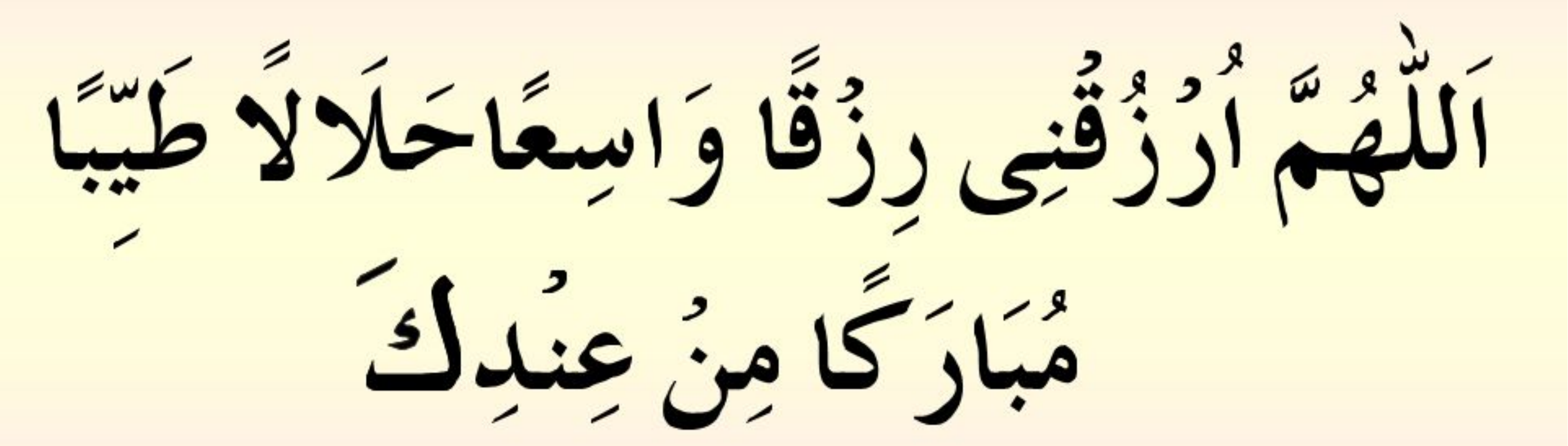
Variables, DataTypes, Arithmetic Operators and Expression



اَللّٰهُمَّ اُرُزُقُنِى عِلُمًا نَافِعًا وَاسِعًا عَمِيُقًّا



اَللّٰهُمَّ اُرْزُقْنِى رِزْقًا وَاسِعًا حَلَالًا طَيِّبًا

مُبَارَكًا مِنْ عِنْدِكَ

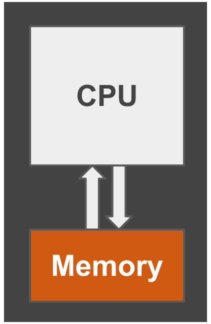
Memory and Variables

Review: Memory

- When CPU takes input from devices, it stores information into memory before processing it.

- CPU stores results of the processing into the memory.

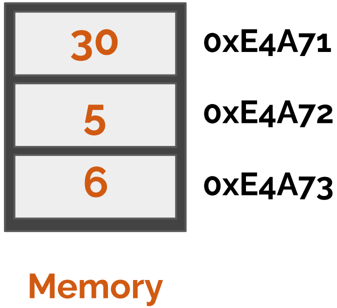
- CPU stores information into the memory before sending it to output devices.



How to Allocate Memory: Variables

To store data into the Memory, we need to reserve the space in the Memory.

When the space is reserved, we can store or retrieve data from the Memory through its Memory Addresses.



30	0xE4A71
5	0xE4A72
6	0xE4A73

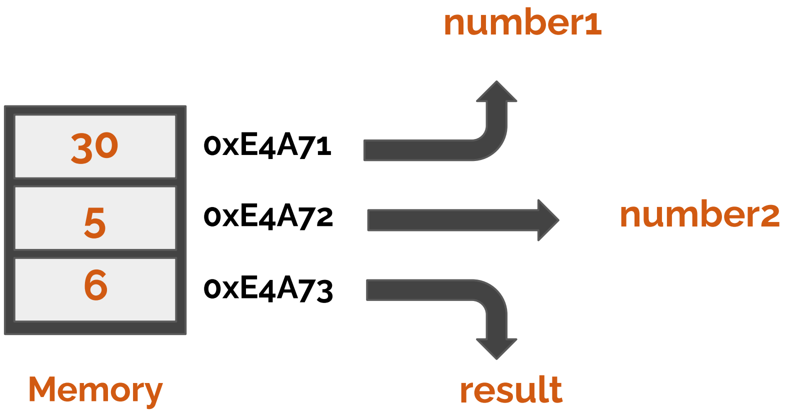
Memory

Variable Name

Variables: Names

It is difficult to remember the Addresses of these Memory locations.

High Level Languages allow us to give Names to these reserved Memory locations.



30

5

6

0xE4A71

0xE4A72

0xE4A73

number1

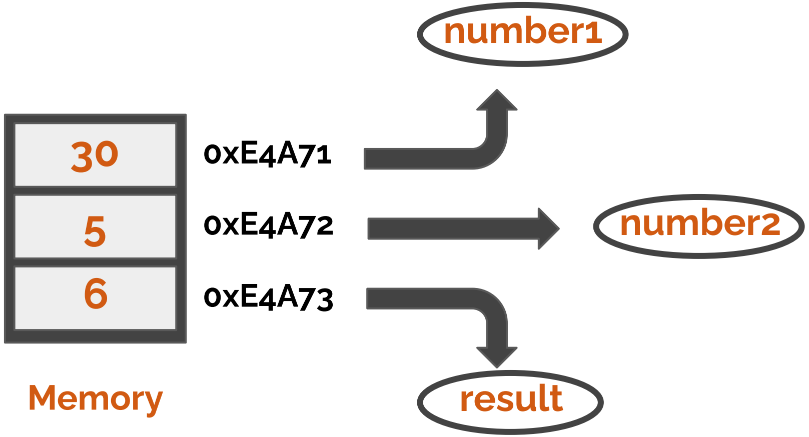
number2

result

Memory

Variables: Names

These Names are called the Variables.
Variables are the names that we give to the Memory Locations.



30
0xE4A71
number1

5
0xE4A72
number2

6
0xE4A73
result

Memory

Variables: Names

All High Level Languages apply some Naming Rules on the variables

- The name can not have Spaces
- The name can not start with Numbers
- The name can not have any Special Character (&, !, %, # etc)

Variables: Names

All High Level Languages apply some Naming Rules on the variables

These are some of the Valid names of the Variables

number1

num_1

num1

numb2

nu_2

_n2

result_1

Res

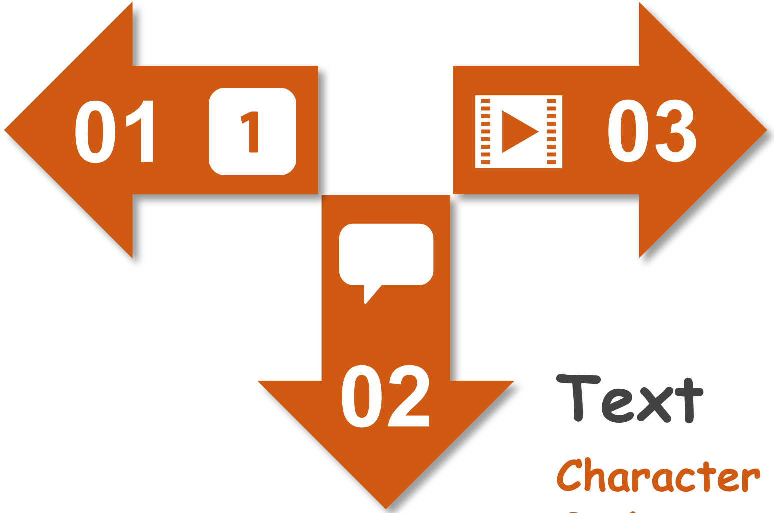
_Res

Variable Datatypes

What Type of Data in Memory?

Now, We know that we can deal with memory using Variables. But the question is What type of Data is in memory?

Variables: Types of Data



Numbers

Integer
Float
Double
Boolean

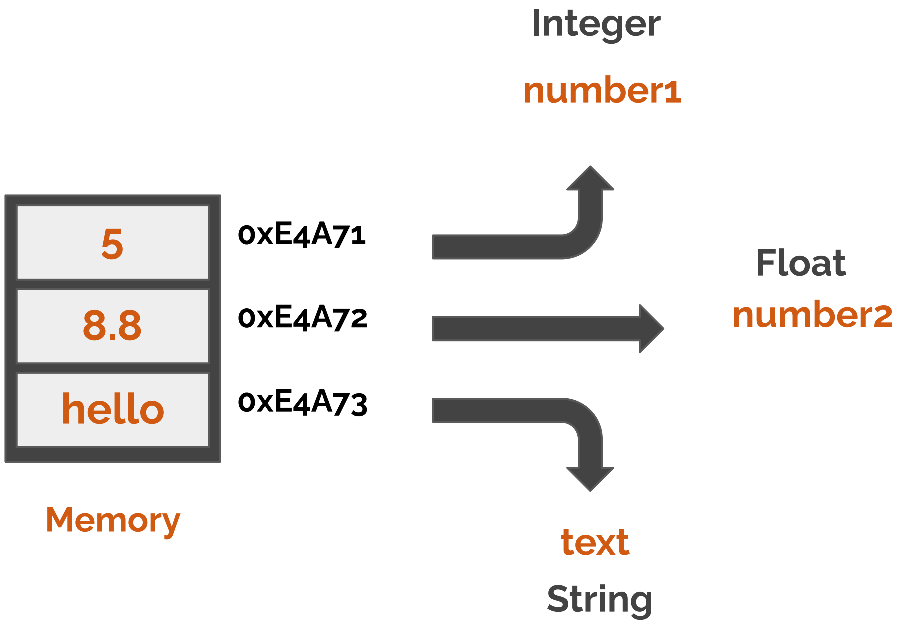
Text

Character
String

Multimedia

Image
Audio
Video

Variables: What Kind of Data Inside



Integer

number1

5

8.8

hello

0xE4A71

0xE4A72

0xE4A73

Float

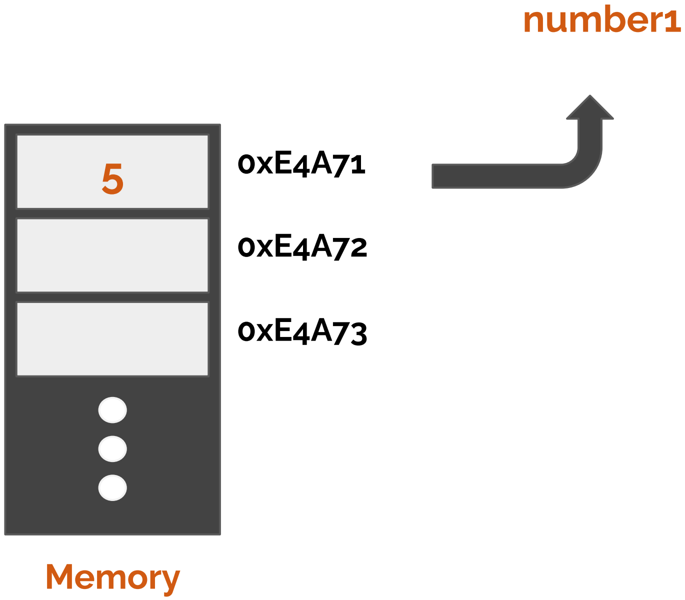
number2

Memory

text

String

Variables: What Kind of Data Inside



number1

5

0xE4A71

0xE4A72

0xE4A73

Memory

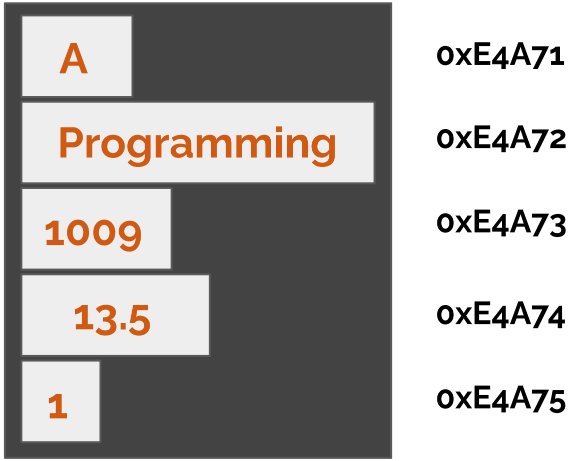
Data Types: Why Inform Memory

Data Types: Why Inform Memory

- To **Adjust Size** of Allocated Memory Cell
- To **Check** the Validity of the Operations

Data Types: Size of Memory

Different types of data require **Different sizes** of cells in memory.



A 0xE4A71

Programming 0xE4A72

1009 0xE4A73

13.5 0xE4A74

1 0xE4A75

Memory

Data Types: Validity of Operations

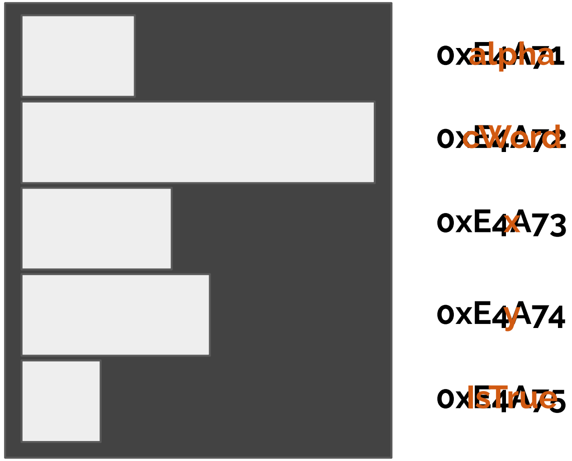
We also need to Check whether an Operation applied on the data is Valid or Not.

For Example:

- 20 + 20.5 ✓
- 20 + Programming ✗

Variable Declaration: Reserve Memory

Reserving the memory location through Variables for certain type of data is also called Variable Declaration.



Memory

Variable Declaration:Reserve Memory

In many High Level Languages like C++, Java and C# the variable declaration is done as

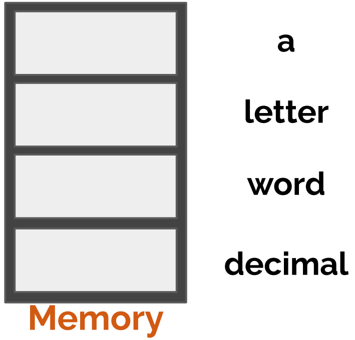
```
Datatype nameOfTheVariable;

int a;

char letter;

string word;

float decimal;
```



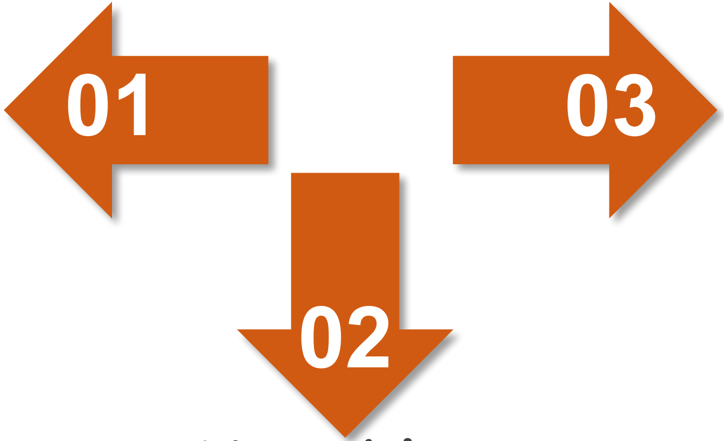
Uses of Variables

- assign values to these variables according to their
- data types
- retrieve values from these variables
- We can apply different mathematical

  addition,multiplication,subtraction) and other operations (we will see those in next lecture) on these variables.

Uses of Variables: Assignment

We can Assign a value to variable using Assignment Operator.



Constants

```
int  x = 8;
```

Variables

```
int  y = x;
```

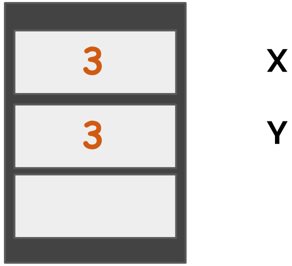
Expressions

```
int  z = 5 * 2 / x;
```

Uses of Variables: Retrieval

Here, we are **Retrieving** the value of variable x and assigning that value to variable y

```
int X = 3;
int y = x;
```

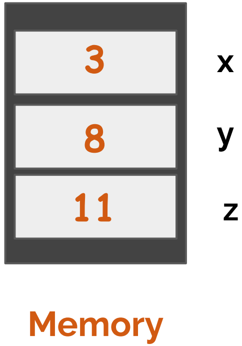


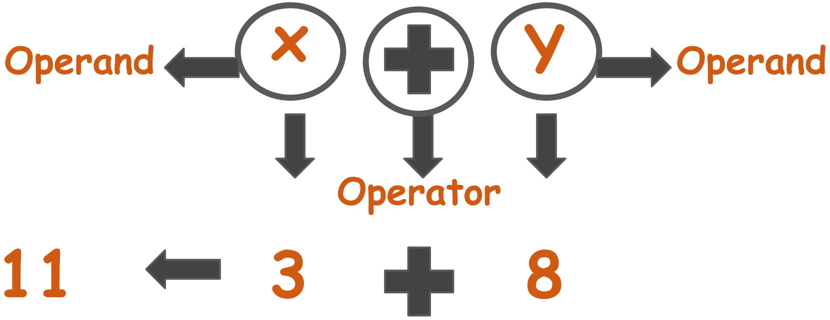
Memory

Operations on Variables: Addition

Apply mathematical operation on Variables

```
int x = 3;
int y = 8;
int z = x + y;
```





Arithmetic Operators:

Here is a list of Arithmetic Operators that can be used.

Operator	Meaning	Example
+	Addition	8+2=10
-	Subtraction	8-2=6
*	Multiplication	8*2=16
/	Division	8/2=4
%	Modulus	8%2=0

Expressions

An **Expression** is a combination of **Variables**, **Constants** and **Operators**.

For Example

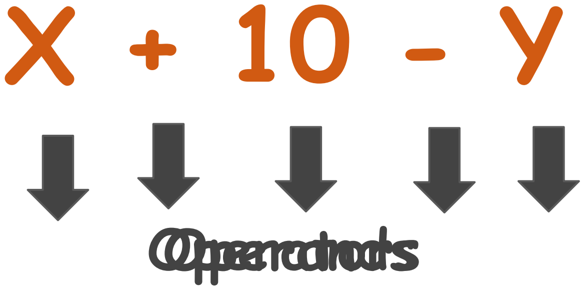
- 8 + 9 is an expression
- X/2 – 1 is also an expression

Expressions

It consists of

- One or more Operands
- Zero or more Operators

For Example:



X + 10 - Y

Operands

Operators

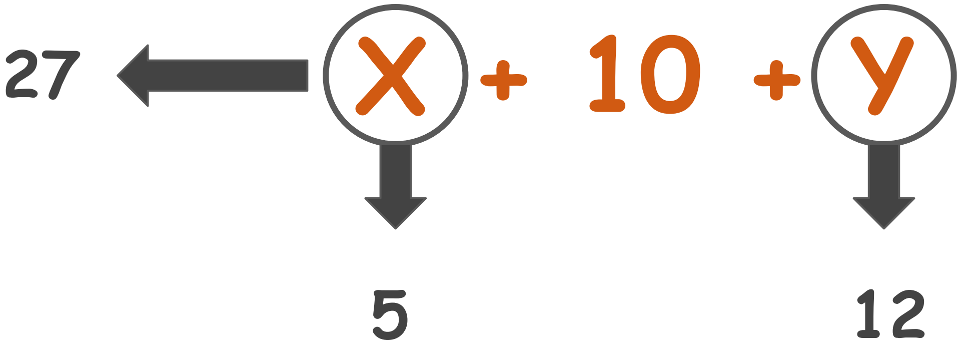
Operations on Variables: Expression

Expression containing only Constants and Operators

$$2 + 10 + 8$$

Operations on Variables: Expression

Expression containing combination of Variables, Constants and Operators



$x + 10 + y$

27

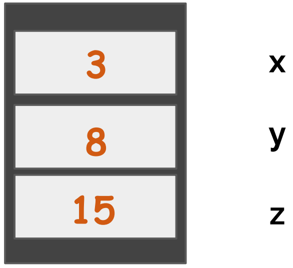
5

12

Expressions

We can write Expression using Variables and Constants and Assign these Expressions to some Variables.

```
int x = 3;
int y = 8;
int z = y-x+10;
```



Memory

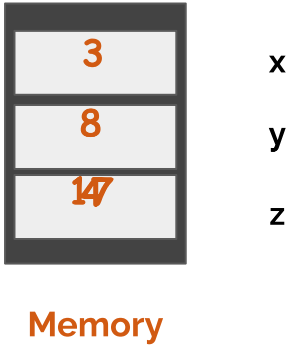
Expressions

Lets see some more examples

```
int x  =  3;

int y  =  8;

int z  =  2y/*25 + 7;
```



3 x

8 y

147 z

Memory

Operations on Variables: Expression

Z = 10 + 10 * 5

Operations on Variables: Expression

60 = 10 + 50

Z = 10 + 10 * 5

100 = 20 * 5

Operations on Variables: Expression

$Z = 60$ ✓

$Z = 10 + 10 * 5$

~~$Z = 100$~~

Operations on Variables: Expression

$$Z = 60$$

$$Z = (10 + 10) * 5$$

$$Z = 1020 * 5$$

Expression : Precedence Order

Here is the precedence order of Arithmetic Operators

Operator	Symbol	Precedence
Parentheses	( )	1
Exponential	X^y	2
Multiplication Division	* /	3 3
Addition Subtraction	+ -	4 4

Expression: PEMDAS RULE

Simply, we can Remember the order of precedence through the PEMDAS Rule.

Rule	Operator	Symbol
P	Parentheses	( )
E	Exponential	X^y
M D	Multiplication Division	* /
A S	Addition Subtraction	+ -

Working Examples: Expressions

Lets see some working examples of Expressions

Z = 2 + 3 / 4

Z = 2.75 0.75

Working Examples: Expressions

Lets see some working examples of Expressions

$$Z = 10 - 2 * 4$$

$$Z = 2\,10 - 8$$

Learning Objective

Write expression using Arithmetic Operator, Variables, and constants while following precedence rule.

Self Assessment

1. What is a Variable?
2. How we can store and load data from the Memory using variables?
3. From the given table below, tell which Variable Names are Valid and which are not.

Variable	Valid/Invalid
mul*	
Foo	
Do it	

Self Assessment

4. Define Variable Declaration. And Declare a variable to store a value of 58.9

5. Write the Datatypes of the following data given in the table

Data	Datatype
400.6	
My name is Kaka	
C	
12	

6. Declare the variables to store the above mentioned data in the variables.

Hint: float a; (a is a variable that will store float type of data)

Self Assessment

1. Find constant, variable and operator from the following statements

Statement	Constant	Variable	Operator
Foo = 4 * result			
Var = 5 % 3			
X = num1 - num2			

2. Solve the following Expressions and write the answer.

Statement	Answer
Foo = 4 * 10 / 2	
Var = 5 % 3	
X = 5 - 2 + 62 - 2	

Self Assessment

3. Evaluate the following expressions and Write the answers.

No.	Expression	Answer
1	2 / 1 + 5	
2	3 / 4 + (2 - 1)	
3	7 + (600 - 100) * 8	
4	500 * 400 / 4 + 10	
5	18 / 2 * 18 - 1	

Conclusion

- We can have multiple uses of variables
  1. Assign Values 2. Retrieve Values 3. Apply Mathematical Operations
- Assignment is done using Assignment Operator.
- There are 3 ways in which we can assign values to the variables
  1. Constants 2. Variables 3. Expressions
- An Expression is a combination of Variables, Constants and Operators.
- Expressions are evaluated with the Precedence order of Operators.
- The precedence order is given by PEMDAS Rule.