C++ PROGRAMMING LANGUAGE

DATA TYPES & THE OPERATORS

In most programming languages there are three types of data are included:

1- Numbers: → a- Integer
   b- Float

2- Characters: → 1 character

3- Strings: → Many of characters (word or statement)

While writing program in any language, you need to use various variables to store various information.

Variables are reserved locations in the memory to store values.

This means that when you create a variable you reserve some space in memory.

A variable provides us with named storage that our programs can manipulate. Each variable in C++ has a specific type, which determines the size and layout of the variable's memory; the range of values that can be stored within that memory; and the set of operations that can be applied to the variable.

1- Integer numbers:

Type	Typical Bit Width	Typical Range
int	4bytes	-2,147,483,648 to 2,147,483,647
Short	2bytes	-32768 to 32767
long	4bytes	-2,147,483,648 to 2,147,483,647

Example of declaration

```
#include <iostream>
using namespace std;
int main()
{
    int a;
    short b;
```

```
    long c;
    a=5;
    b=6;
    c=7;
    cout <<"a="<<a<< endl;
    cout <<"b="<<b<< endl;
    cout <<"c="<<c<< endl;
    return 0;
}
```

Output:

```
a=5
b=6
c=7
```

2- Floating numbers:

Type	Typical Bit Width	Typical Range
float	4bytes	+/- 3.4e +/- 38
double	8bytes	+/- 1.7e +/- 308
Long double	10bytes	+/- 3.4e +/- 4932

Example of declaration

```
#include <iostream>
using namespace std;
int main()
{
    float a;
    double b;
    a=3.;
    b=5.1;
    cout <<"a="<<a<< endl;
    cout <<"b="<<b<< endl;
    return 0;
}
```

Output

```
a=3
b=5.1
```

3- Characters:

Type	Typical Bit Width	Typical Range
char	1bytes	-127 to 127 or 0 to 255

Example of declaration

```
#include <iostream>
using namespace std;
int main()
{
    char ch;
    ch='a';
    cout <<"ch="<<ch<< endl;
    return 0;
}
```

Output

```
ch=a
```

4- Boolean:

Type	Typical Bit Width	Typical Range
bool	1bytes	False or True (0 or 1)

Example of declaration

```
#include <iostream>
using namespace std;
int main()
{
    bool a,b;
    a=5>1;
    b=5<1;
    cout <<"a="<<a<< endl;
    cout <<"b="<<b<< endl;
    return 0;
}
```

Output

```
a=1
b=0
```

Note: 1- sizeof operator returns the size of a variable. For example, sizeof(a), where 'a' is integer, and will return 4.

2- We can the floating number ($a*10^n$) → ae+n

Variable Names

The names given to variables (and other program features) are called identifiers.

What are the rules for writing identifiers?

1- You can use only 1 character to naming a variable.
2- Identifiers can be as long as you like, but most compilers will only recognize the first few hundred characters.
3- You can use upper- and lowercase letters, and the digits from 1 to 9. You can also use the underscore (_).
4- The first character must be a letter or underscore.
5- The compiler distinguishes between upper- and lowercase letters, so Var is not the same as var or VAR.
6- You can't use a C++ keyword as a variable name.
A keyword is a predefined word with a special meaning. int, class, if, and while are examples of keywords

THE OPERATORS

An operator is a symbol that tells the compiler to perform specific mathematical or logical manipulations. C++ is rich in built-in operators and provide the following types of operators:

- Arithmetic Operators
- Relational Operators
- Logical Operators
- Assignment Operators
- Increment and Decrement Operators.

1- Arithmetic Operators

Operator	Description
+	Adds two operands
-	Subtracts second operand from the first
*	Multiplies both operands
/	Divides numerator by denominator
%	Modulus Operator and remainder of after an integer division

2- Relational Operators

Operator	Description
>	Greater than
<	Less than
>=	Greater than or equal to

<=	Less than or equal to
==	equal to
!=	Not equal to

3- **Logical Operators**

Operator	Description
&&	AND
||	OR
!	NOT

4- **Assignment Operators**

Operator	Description
+=	A+=5 mean A=A+5
-=	A-=5 mean A=A-5
*=	A*=5 mean A=A*5
/=	A/=5 mean A=A/5
%=	A%=5 mean A=A%5

5- Increment and Decrement Operators.

Operator	Description
++	A++ mean A=A+1 postfix
	++A mean A=A+1 prefix
--	A-- mean A=A-1 postfix
	--A mean A=A-1 prefix

This example illustrates the difference between postfix and prefix:

```
#include <iostream>
using namespace std;
int main()
{
    int a=5,b;
    cout <<"a="<<a<< endl;
    ++a;
    cout <<"a="<<a<< endl;
    b=++a;
    cout <<"a="<<a<< endl;
    cout <<"b="<<b<< endl;
    return 0;
}
```

Output:

```
a=5
a=6
a=7
b=7
```

```
#include <iostream>
using namespace std;
int main()
{
    int a=5,b;
    cout <<"a="<<a<< endl;
    a++;
    cout <<"a="<<a<< endl;
    b=a++;
    cout <<"a="<<a<< endl;
    cout <<"b="<<b<< endl;
    return 0;
}
```

Output:

```
a=5
a=6
a=7
b=6
```

Operators Precedence in C++

operator	Precedence
( )	**highest**
*** / %**	
+ -	**lowest**

Note: if the precedence is equal (such as *, /), we must perform which locate on the left before the other.

Examples Find the result for following:

1- 10/5*(2+4) = 10/5*6 = 2*6 = 12
2- 30/3/5 = 10/5 = 2
3- 2+(5 * (6+7) +3) = 2+(5*13+3) = 2+(65+3) = 2+68 = 70
4- 15/4=3
5- 3/6+(18+20) = 3/6+38 = 0+38 = 38
6- 3.0/6+(18+20) = 3.0/6+38 = 0.5+38 = 38.5
7- 27%5+2 = 2+2 = 4
8- 15-14%3 =15-2=13
9- 15-14%(-3) =15-2=13

Examples Write the following expression in c++ language:

1- $\frac{x+y}{a+b}$ = (x+y)/(a+b)

2- $x + \frac{y}{a+b}$ = x+y/(a+b)

3- $a - f\frac{a-b}{x-y} =$ a-f*(a-b)/(x-y)

4- $\frac{a+b}{c(d+e)}$ = (a+b)/(c*(d+e)

5- $2 + 5(6 + \frac{x-y}{a-b})$ = 2+5*(6+(x-y)/(a-b)

Example Write a program to calculate the number of hours and minutes and seconds in a time=10000 seconds:

```
#include <iostream>
using namespace std;
int main()
{
    int hrs,mins,secs=10000;
    mins=secs/60;  // 1 minutes = 60 seconds.
    secs=secs%60;  // To find the rest of the number of seconds
    hrs=mins/60;   // 1 hours = 60 minutes.
    mins=mins%60;  // To find the rest of the number of minutes
    cout<<hrs<<":"<<mins<<":"<<secs<<endl;
    return 0;
}
```

References:

- Object-Oriented Programming in C++, Fourth Edition
- Tutorials Point https://www.tutorialspoint.com/cplusplus/