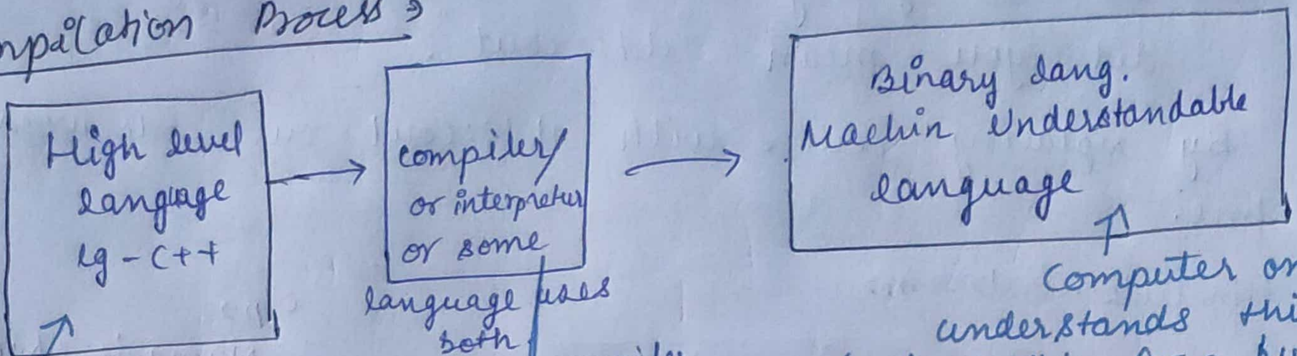
28 Jan

Lec-2

Create your first program & a lot more

⊙ Compilation Process and Programming Language →

⊙ Compilation Process ⇒



High level language Eg - C++
compiler/ or interpreter or some
Binary lang. Machin Understandable language

we write this, not understandable by the system.

language uses both C++ uses compiler

Compiler converts the high level lang. to binary lang.

Computer only understands this (not possible for a human to write each program in m/c lang.)

⊙ Programming Languages → Language in which we are giving instructions to our computer.

→ Every lang. has it's own compiler/ Interpreter.

Eg → C, C++, Java, Python.

H.W → Diff. b/w complier and Interpreter. Explore them.

⊙ IDE (Integrated Development Environment) → helps us to write code and execute them and provides many addtional features.

Eg → VS code, Code Blocks, Sublime etc.

⊙ Let's code our first program → "Namaste Bharat"

code between these curly braces is under ~~[illegible]~~ ~~[illegible]~~ main() function.

```
int main(){          ← Execution starts from here always.
    cout << "Namaste Bharat";
}
```

cout is used to print (in C++)

We are getting an error (use of undeclared identifies)

Because the code of cout also has written somewhere so we must import that. To import the file →

#include < iostream >

Still we are getting same error and a suggestion did you mean "std:: cout".

By replacing cout<< with std::cout our code works fine.

```
#include <iostream>
int main(){
    std:: cout << "Namaste Bharat";
}
```

o/p→
Namaste Bhabat

std is a namespace. Namespace is a particular region where scope of identifiers is defined.

We can write like this

using namespace std; (before main()).

Then we don't have to write it everytime.

In order to print something we must use cout.
and with cout we use "<<" (insertion operator).

Cout << "Hi" ; ← semicolon shows end of line.

Cout → to print

<< → insertion operater (to print onto standard display)

Hi → string

Now the code→

```
#include <iostream>
using namespace std;
int main(){
    cout << "Namaste Bharat";

}
```

cout << "2" ;	→ 2 as a string
cout << 2;	integer 2
cout << 'a';	character

- endl → endl is used to print a line.
- \n → same works as endl.

⊙ How to take input from the user →

let's see how to comment?

```
1→    // This is a comment
2→    /* This is
         a multiline
         comment */
```

↳ To take a number in input we have to store it (otherwise how will we use it (if needed)).

```
int a;        // That storage is named as a.
cin>> a;      // Taking input.
cout<< " You entered " << a << endl;
```

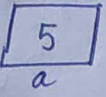
let say i have input as 5.

O/P → You entered 7

⊙ Datatypes & Variables →

Variable - named memory location.

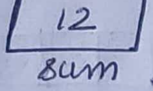
int a = 5;
↙
a is a variable.



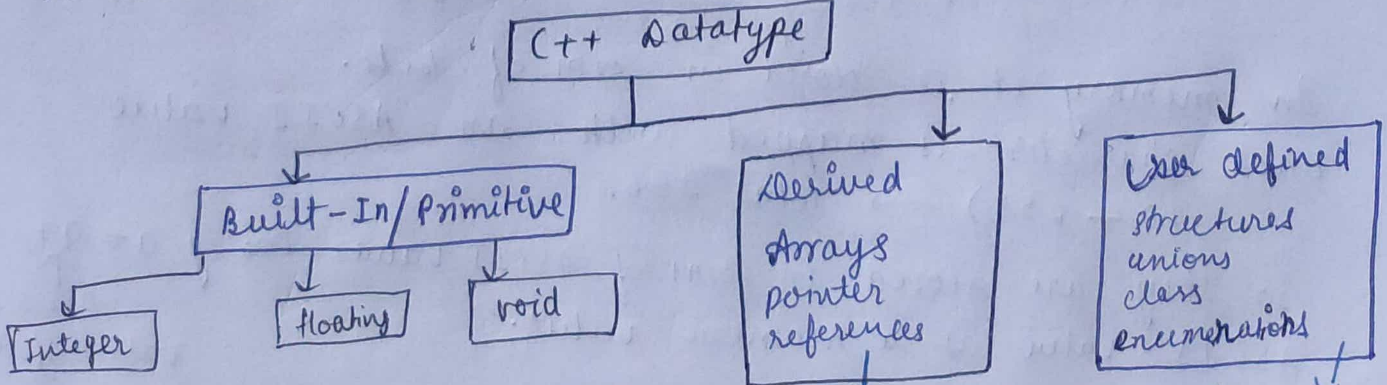
Datatype - It is used to tell the variable the type of data they can store. int a = 5; int is a datatype here.

eg;→ char, short, int etc.

int sum = 12; ← value
↙ ↓
datatye variablename



This lines means integer type of value will be stored in variable sum and it's value is 12.



derived by primitive ~~predefined~~ datatypes.

defined by the user

Function

```
int main(){
   --
   --
}
```

return type → int

means func will return an integer.

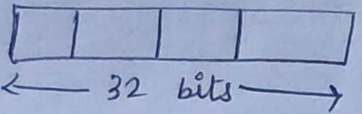
```
void main(){
   --
}
```

void ← return type

This func will return nothing.

→ integer is of 4 bytes (32 bits). (or maybe 2 bytes) It depends upon system architecture.

00000000	01010101	10101010	00000000
1 byte	1 byte	1 byte	1 byte



⟹ means 2^{32} combinations.

let's suppose we have 2 bits.
so possible combinations

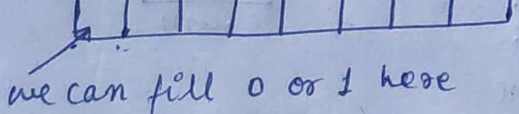
0	0
0	1
1	0
1	1

} 4 combinations $= 2^2$

→ char is of 1 bytes.
1 bytes = 8 bits.
Total combinations $= 2^8 = 256$

char ch = 'a';

ch $\boxed{a}$



so total 2 combination for 1 bit.
for 8 bits combinations $= 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^8$
$= 256$

In memory it is stored in form of bits.
Each character is mapped with an ASCII value
(0 – 255) → Total 256.

So they are stored in form of ASCII values. For eg a = 97.
↑ ASCII value of a

ASCII value is a numeric value.

H.W → Explore ASCII Table.

→ bool flag = true;

true means 1.
false means 0.

bool store either true (1) or false (0).

bool takes space of 1 bytes. Although 1 bit is sufficient to represent.

© Why is take 1 bytee and not 1 bit?
⇒ Because 1 bit is not addressable unit,
1 Byte is minimum addrexble unit

true →	0	0	0	0	0	0	0	1
false →	0	0	0	0	0	0	0	0

so yes there is wastage of memory.

→ float →

eg- float f = 1.2;

float and double both are used to store floating points.

float = 4 byte → 32 bits
double = 8 byte → 64 bits

double is more preciced than float.
Storage is different of float and double.

© What happen when we try to print 256 (by characte datatype)

```
int ch = 256;
cout << ch;
```

char's range is of (0 - 255) or (-128 to 127) now if we tried to acess 256, it is overflow condition.
And compiler may behave diffrently in this case.
(Maybe it can print a ~~gar~~ garbage value or nothing).

H.W → variable naming conventions.

⊙ How to see size a variable is taking?

```
int a = 5;
cout << sizeof (a);          // 4 or 2
char c = 'a';
cout << sizeof(c);           // 1
double d = 5 ;
cout << sizeof (d);          // 8
bool flag = 1;
cout << sizeof (flag);       // 1
```

⊙ How data is stored?

- positive integers →

int a = 5;

it's binary ~~represpr~~ representation = 101

so this is how it is stored.

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1

first bit is 0

first bit of a positive number is 0.

so the first bit of a negative number is 1.

and the first bit of a negative number is 1.

- negative no. storage → Negative numbers are stored in the form of 2's complement.

$\boxed{\text{2's complement} \Rightarrow \text{1's complement} + 1}$

1's complement ⇒ flip the bits.

for eg → 7

7 → 00000111 (for understanding we took 8 bits, actually there should be 32 bits :)

1's complement → 11111000

$$\begin{array}{r} 11111000 \\ +1 \\ \hline 11111001 \end{array}$$

2's complement → 11111001

let's store -5. a $\boxed{5}$

steps ⇒

① Ignore -ve sign $\boxed{5}$

② Find binary equivalent

$\underbrace{000 \text{ —— —— — }}_{29\text{ bits}}101$

③ Find 2's complement.

1's complement → $\underbrace{111 - - -}_{29\text{ bits}}1010$

2's complement → $\underbrace{111 - - - - -}_{29\text{ bits}}1011$

so this is how it is stored in memory.

Now how to read it from memory.

⇒ Take 2's complement.

2's complement of $\underbrace{\overset{\text{it shows -ve}}{1} - - -}_{29\text{ bits}}1011$ →

1's complement + 1 = 0 - - - 0100 . + 1

2's complement = 0 - - - - - 0101 ✓ = 5

and the sign will be negative.

so -5.

Interesting Problem →

How will we know that we have to read only 1 bytes or 4 bytes or 8 bytes from starting of a memory block?

⇒ By datatype.

datatype defines two things.

↳ which type of data will be stored?

↳ How much space it will take?

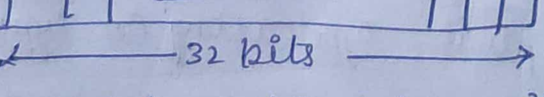
⊙ Signed v/s Unsigned data →

signed → -ve, 0, +ve

unsigned → +ve, 0

By default data is signed.

eg, int → 4 bytes = 32 bits



Total combination = 2^{32}

Total addressable range →

for signed → -2^{31} to $2^{31}-1$

for unsigned → 0 to $2^{32}-1$

short → 2 bytes → 16 bits

Total combination → 2^{16}

unsigned → 0 → $2^{16}-1$

signed → -2^{15} to $2^{15}-1$

char → 1 byte → 8 bits

Total comb → 2^{8}

unsigned → 0 to $2^{8}-1$

signed → -2^{7} to $2^{7}-1$

xyz → 6 Bytes → 48 bits

Total comb. → 2^{48}

unsigned → 0 to $2^{48}-1$

signed → -2^{47} to $2^{47}-1$

so Generic formula →

if we have n bits, total comb = 2^{n}.

so unsigned → 0 to $2^{n}-1$

signed → -2^{n-1} to $2^{n-1}-1$

○ Typecasting → It refers to the conversion of one data type to another. Two ways →
(Implicit) ↳ Automatically
(Enplicit) ↳ Manually.

→
```
char ch = 97;
cout << ch << endl;
```
o/p ⇒ a.

we gave integer as input but we got a(char).

So integer is typecasted in character.

```
int num = b;
cout << num << endl;
```
o/p ⇒ 98.

When the typecasting is done automatically by the compiler it is called Implicit Typecasting (or type conversion).

→
```
double d = 5.7;
int x = (int) d + 2;
cout << x << endl;
```
o/p ⇒ 7 $\left(\begin{matrix}5+2\\=7\end{matrix}\right)$

5.7 is typecasted to 5 manually, it is called Explicitly

Type casting or explicit type conversion.

⊙ Operators →

↳ Arithmetic (+, -, *, /, %)
↳ Relational (>, <, >=, <=, != , ==)
↳ Assignment (=
↳ Logical
↳ Bitwise

A doubt → What happens when we give char as 1024

```
char ch = 1024;
      ↓      ↓
   1 byte   10 bits        | 0 - - - - - - - -10000000000 |
      ↓
   8 bits
```

the last 8 ~~dt~~ bits or.

Maybe it will take
overflow or
Garbage value.
or error.

- Arithmetic Operator →

```
int a = 5, b = 3;
cout << a+b << a-b << a*b << a/b << a%b ;
         ⇓      ⇓      ⇓      ⇓      ⇓
         8      2      15     1      2
```

division →

$\frac{int}{int}$ = int , $\frac{int}{double}$ = double.

$\frac{float}{int}$ = float,

$\frac{double}{int}$ = double,

H.W ⇒ Explore precedence table.

- Relational Operator → Output as true or false.

```
int a = 5 , b = 3
cout << (a > b);         // o/p → 1
cout << (a < b);         // 0
cout << (a == b);        // 0
cout << (a!=b);          //1
cout << (a>=b);          //1
~~cout << (a==b~~
cout << (a<=b);          //0
```

- **Assignment Operator** - Used to assign value to a variable
  int a = 5;

- **Logical Operator** - When we have multiple conditions to decide an output.

To vote -> your age must be 18 or greater than that and you must be a citizen of India.

AND ->

```
=> cout << (age >= 18 && citizen == India)
```

~~return~~

o/p will be 1 only both condition are true.

OR ->

```
int a = 5, b = 3
                T            T
cout << (a<=5 && b<=3)            //1
cout << (a< 5 && b>=3)            //0
           F       T
cout << (a<5 || b>=3)             //1
          F       T
cout << (a>5 && b<3)              //F
          F      F
```

|| -> OR
&& -> AND
! -> NOT

```
                T
cout << !(a>=5);          => //!T = F
```

->

```
(cond 1 && cond 2 && cond3)
   ↑
 let say this is False.
```

Then our compiler is not going to check other two conditions. (Because in AND all values must be true in order to get the o/p as true).