

Pointers - 1

```
int a = 5;
```

In memory,

104 ← address
5
a

a integer block stored 5 in it, and it's name is a.

But we can't give name to a mem loc. The only way of accessing
Symbol Table is to use address.

Symbol Table

a	→	104
---	---	-----

In symbol table variables are mapped with their addresses.

① Does $a=5$, $b=5$ points to same memory block?

```
int a = 5;
```

```
int b = 5;
```

Symbol Table	
a	1004
b	1008

We don't decide the addresses of these variables.

This memory mgmt is done by OS.

① Can we find out the address of a variable?

⇒ Yes, by address of (&) operator.

```
int a = 5;
```

cout << a;

$$110/p \rightarrow 5$$
$$L_{out} \ll L_a;$$

```
int b = 5;
```

0/p → 0xfabc def1234 ← some hexa-decimal value.

cout << "b";

o/p \rightarrow 0x45321 \leftarrow

This address of b will be different from address of a .

pointer \rightarrow A type of ^{variable}~~datatype~~ that store address.

is a int a = 5;

pointer
to integ
data.

Print *

$$\underline{p} = \frac{k}{r} a;$$

→ variable

address of operator.

↙ / syntax
dereference
operator

✓ variable name.

→ p is a pointer to integer data.

is a
pointer to -
char data.

Char ★

```
ptr = &ch;
```

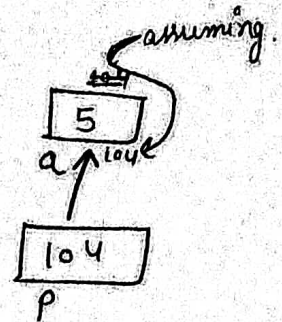
→ ptr is a pointer to char data.

int a = 5; // location
 int* ptr = &a; ←
 // access the value ptr is pointing to
 cout << *ptr;
 ↳ difference operators.

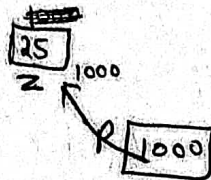
ptr is a pointer to a which contains integer data.

o/p → 5

int a = 5;
 int* p = &a;



int z = 25;
 int* k = &z;



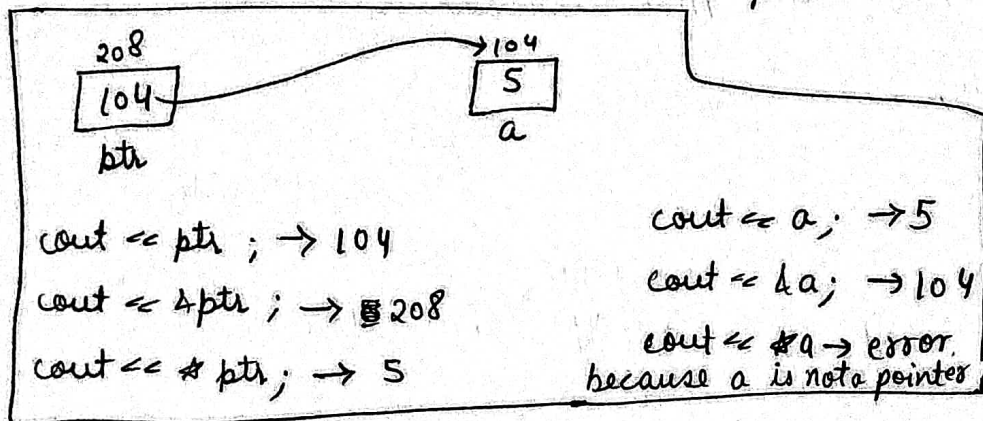
pointer → In C++, pointer is a variable that stores address of another variable.

ptr → address
 ↳ value

cout << ptr; // o/p → 104
 ↳ value stored at ptr

cout << *ptr; // o/p → 5

↳ value at location stored in ptr.



Find the size of these pointers: →

int a = 5;

int* p = &a;

char c = 'b';

char* ch = &c;

double d = 1.03;

double* dtr = &d;

All three pointers size will be same, because pointer stores address of variables ~~at~~ and address size of any type of data will be same. (no matter their datatype is same or not).

`cout << sizeof(p) << sizeof(ch) << sizeof(dtr);` → o/p → 8 8 8

`cout << sizeof(a) << sizeof(c) << sizeof(d);` o/p → 4 1 8

Here the size of pointer is 8.
↳ Architecture dependent.

Find out?

① What do you mean by 64 system?

② Why pointer's size is 8?

③ Why do we need pointers?

↳ Dynamic memory allocation

↳ Memory mgmt

↳ To access hardware.

↳ Pointers arithmetic, handling NULL pointers

↳ To pass a function as an argument inside another function.

④ Declaring a pointer →

`int* ptr;` // declaration.

In this case a garbage value is assigned to the ptr.

`cout << *ptr;` ← And here we are trying to access that memory.

We get segmentation fault. (means we trying to access that memory which either don't exist or out of the allotted memory space of program.

This is a BAD PRACTISE.

Now how to correct this?

↳ Null pointer.

`int* ptr = 0;`

← This is how null pointer is created.

means that pointer is pointing to nothing.

Error - segmentation fault.

But here we can check this before running,

if ($\text{ptr} == 0$)

cout << "ptr is a NULL pointer";

Other way to create NULL pointer →

$\text{int* ptr} = \text{NULL};$

New/modern way to create NULL pointer →

$\text{int* ptr} = \text{nullptr};$

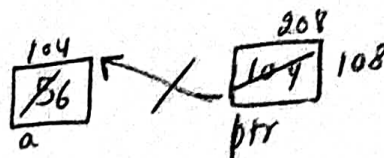
①

→ $\text{int } a = 5;$

$\text{int* ptr} = \&a;$

$a = a + 1;$

$\text{ptr} = \text{ptr} + 1;$



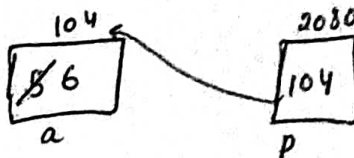
104
 $\text{ptr} + 1 = 108$

→ $\text{int } a = 5;$

$\text{int* p} = \&a;$

$\&p = \&p + 1$

↓
value at
address stored in p

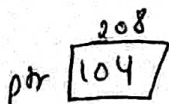


$\&p = 5$

$\&p = \&p + 1$

$5 + 1 = 6$

→



→ $a \rightarrow 10$

→ $\&a \rightarrow 104$

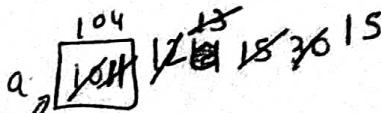
→ $\text{ptr} \rightarrow 104$

→ $\&\text{ptr} \rightarrow 10$

→ $\&\text{ptr} \rightarrow 208$

→ $\&\text{ptr} * 2 \rightarrow 20$

→ $(\&\text{ptr})++ \rightarrow 10$



→ $++(\&\text{ptr}) \rightarrow 12$

→ $a = a + 1 \rightarrow 10 + 1 = 11$

→ $\&\text{ptr} = \&\text{ptr} + 2 \rightarrow 15$

→ $\&\text{ptr} = \&\text{ptr} * 2 \rightarrow 30$

→ $\&\text{ptr} = (\&\text{ptr} / 2) \rightarrow 15$

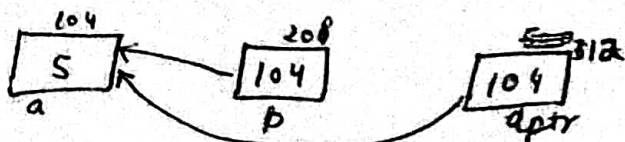
① Can a pointer copy another pointer?

Yes,

$\text{int } *q = p;$

← p is also a pointer.

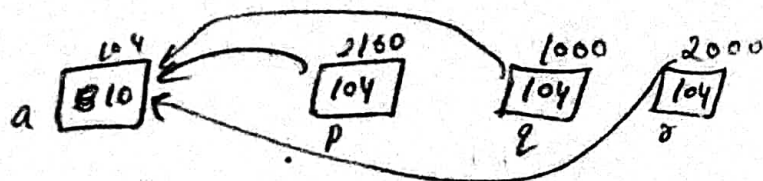
- $\text{int } a = 5;$
 $\text{int } *p = a;$ → gives error. so can't assign pointer to a with a value, we have to give address.
- $\text{int } a = 5;$
 $\text{int } *p = \&a;$
 $\text{int } *dptr = p;$ → copy a pointer into another.



$*p \rightarrow 5$
 $*dptr \rightarrow 5$

$a \rightarrow 5$
 $\&a \rightarrow 104$
 $p \rightarrow 104$
 $\&p \rightarrow 208$
 $*p \rightarrow 5$
 $q \rightarrow 104$
 $\&q \rightarrow 312$
 $*q \rightarrow 5$
 $(*p/2) \rightarrow 2 \rightarrow 5/2 = 2$
 $*q/2 \rightarrow 2 \rightarrow 5/2 \rightarrow 2$

② $\text{int } a = 10;$
 $\text{int } *p = \&a;$
 $\text{int } *q = p;$
 $\text{int } *r = q;$



$\text{cout} \ll a \ll \&a \ll p \ll \&p \ll *p \ll q \ll \&q \ll *q \ll$
 $r \ll \&r \ll (*p + *q + *r) \ll (*p)*2 + (*r)*3$
 $\ll (*p/2) - (*q/2) \ll \text{endl};$

$a \rightarrow 10$
 $\&a \rightarrow 104$
 $p \rightarrow 104$
 $\&p \rightarrow 2160$
 $*p \rightarrow 10$
 $q \rightarrow 104$

$\&q \rightarrow 1000$
 $*q \rightarrow 10$
 $r \rightarrow 104$
 $\&r \rightarrow 2000$
 $*r \rightarrow 10$

$(*p + *q + *r) \rightarrow 10 + 10 + 10 = 30$
 $(*p)*2 + (*r)*3 \rightarrow 10 \times 2 + 10 \times 3 = 50$
 $(*p/2) - (*q/2) \rightarrow 10/2 - 10/2 = 0$