Pointers

(11) *(&y) ⟶ 10, ~~10~~, 101, 100

Q. How to swap??

- using a function

Reason: function is call-by-value. : value is copied, original variable is not used

① Get the address of the variables (to swap)

- address-of operator & (prefix)

② How to store an address.

- pointers (a different type of variable)

- its type is determined by the pointee.
  (the value it is pointing to).

③ Getting the value (bucket) pointed by a pointer.

- dereference operator, i.e. (*) prefix of an address

* → multiplication
* → pointer declaration
* → dereference (pointer variable / address) — legal

```
int x = 4;
int *xptr = &x;
```

pointer storing address of int x;

```
cout << *xptr;
```

⇒ ④

Pointer is used to store the location of other variables.

- it helps in passing values by reference to functions.

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char c;

cout << &ch; → unexpected output.

Pointer type-casting.

Function is called — by — value: values are copied, original variables are not passed.
⇒ changes remain within function

reference
we are refering to the original variable and not its copy. ⇒ changes are reflected in call-scope.

copies (value)

```
f(int a, int b) {
}
```

any changes here remain here

```
main {
  f(a, b);
}
```

call scope

call by reference → ① Using pointers → 3 step process

```
f(int *a, int *b) {

}
main {
  f(&a, &b);
}
```

) have passed the address / reference to original variables

any changes in function (f) will be reflected in main (call scope).

② Using reference variables

→ Variables which simply point to the bucket of another variable.

→ this feature doesn't exist C. :(

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functions

call by

- value
- reference (original variable is used)
  - using pointers
  - using reference variables

→ {using addresses (pointers) itself are passed called by value.}

Q. Can we return pointers from function??

Yes ✓

No

return_type: int*
void*
char*
??

Q. Should we return pointer from functions?

- [ ] Yes
- [ ] No
- [x] Depends

int

return_type of a function can be : { int *
void *
char *
double *
float
- - -

use case

Linked List

stack } LL
queue

Q. Passing arrays in functions.

```
func (int arr[], ....){

}
```

[] → diff between int and int array

```
main (){
    int a[n];
    func(a, ---- );
}
```

Observation: Arrays are always passed by reference.

Pointer - Array duality:

there is an intricate link b/w pointers & arrays

An array is actually a pointer that points to the first element of the array (arr[0])

- as the array is a pointer variable, we may dereference it, and perform pointer arithmetic.

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Array name is just the alias of the address of first element.

there is no seperate storage for it.

- it behaves as a pointer, but isn't a pointer.

```
int arr[10];

cout << arr;
cout << &arr[0];
```
} ⇒ same

Pointer Arithmetic

- addition, multiplication, division of two addresses is senseless

- Addition of a constant integer value is equivalent as

int* ptr + x ⇒ the cell/byte/block which is 5 * sizeof(int) ahead of ptr.

int * ptr = 3760;

int * next_ptr = ptr + 2; 3768

ptr + 2 * (sizeof(int))

3760 + 2x(4)

3760 + 8 = 3768

long int * ptr = 501; 501 + 1 * (sizeof(long int))

501 + 1 x (8) = 509

cout << (ptr + 1); 509

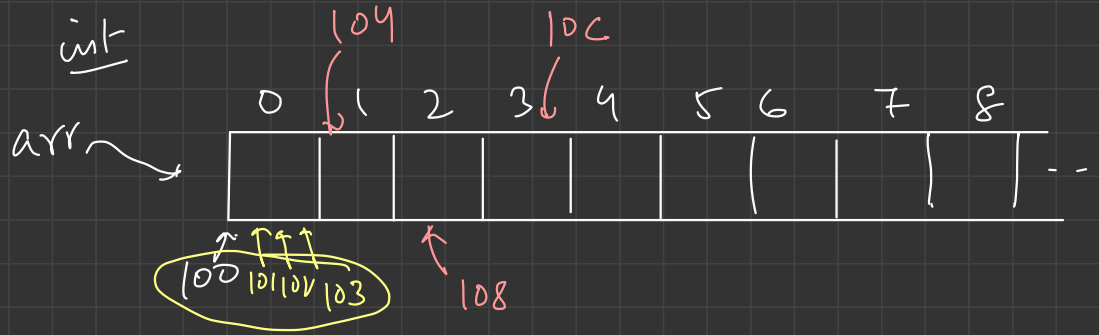
— Subtraction is similar

⇒ Subtracting two addresses ⇒ no. of blocks/elements between them

7608

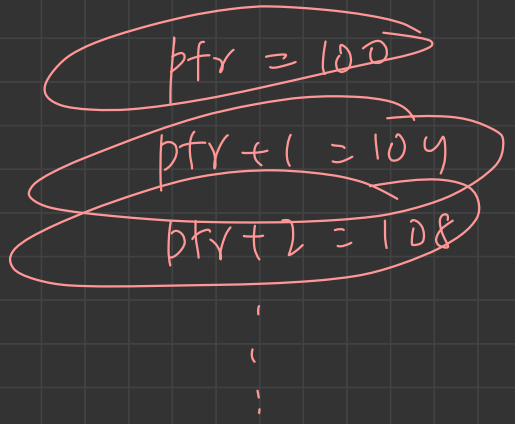
7600

$$\frac{7608 - 7600}{\text{sizeof(int)}} = \frac{8}{4} = 2$$



arr[0] → 100) size 4 bytes

arr[1] → 104



Can we iterate the array using pointer arithmetic ?!

Arrays / Pointers

sizeof : array → memory used by all the elements

pointer → memory used by pointer variable (8 byte)

& op → &arr → alias for &arr[0]

&pointer → address of the variable

int a[10];

int ptr;

ptr = a; → just a pointer pointing to the address of first element

a = ptr; ?! → a is an array, and this is illegal.

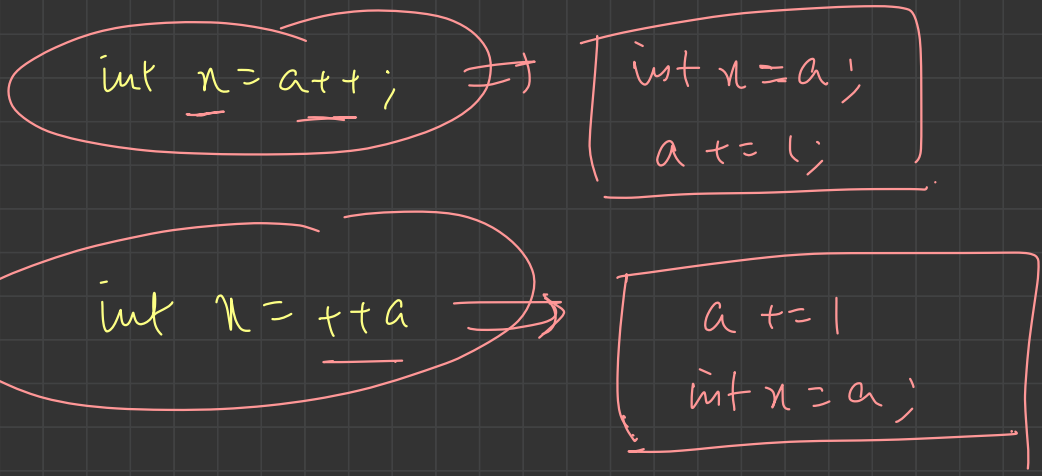
ptr++; ✓ → ptr = 80 : ptr++ ⇒ 84

a++; XX increment / decrement not allowed!

a → 70 [a++ X]

Post increment Pre increment

a++; ++a; increment



→ Operator Precedence / Associativity → reading assignment

→ Binary search
character arrays / Strings
2D / multi-dimensional arrays
} next class

Revise all (pointer, array, function).
sort