Data Structures and Algorithms
(ES221)

Pointers Arithmetic

Dr. Zubair Ahmad

Pointer and Array

An array name acts like a pointer to its first element

Use pointers to access and manipulate array elements

```
int arr[5] = {10, 20, 30, 40, 50};
```

This means **arr** holds the memory address of **arr[0]**

The array name **arr** is a constant pointer to the first element (**arr[0]**).

Pointer and Array

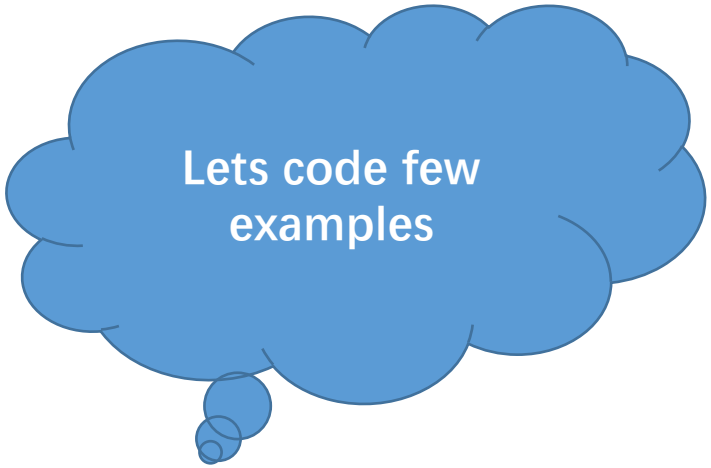
```
int myarray [20];
int * mypointer;
```

Which statement is valid?

```
mypointer =myarray;

myarray =mypointer;
```

Pointer and Array (Example)



Pointer and String

```
char str[] = ”World";
```

Automatically includes a null character (\0) at the end.

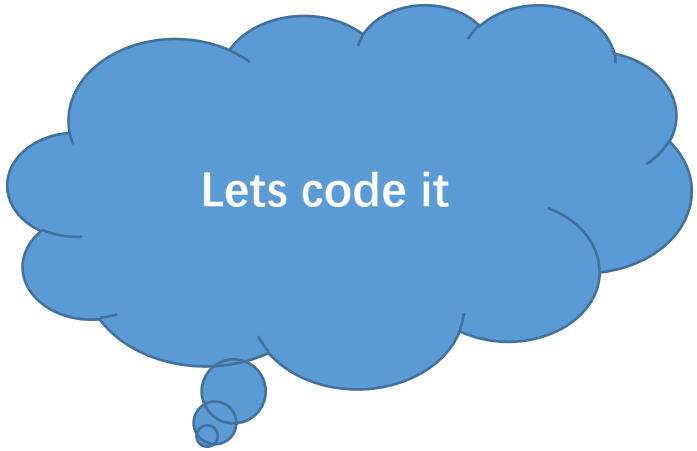
strings can be manipulated using **character arrays** or **pointers to characters**.

The name str is a **pointer** to the first character.

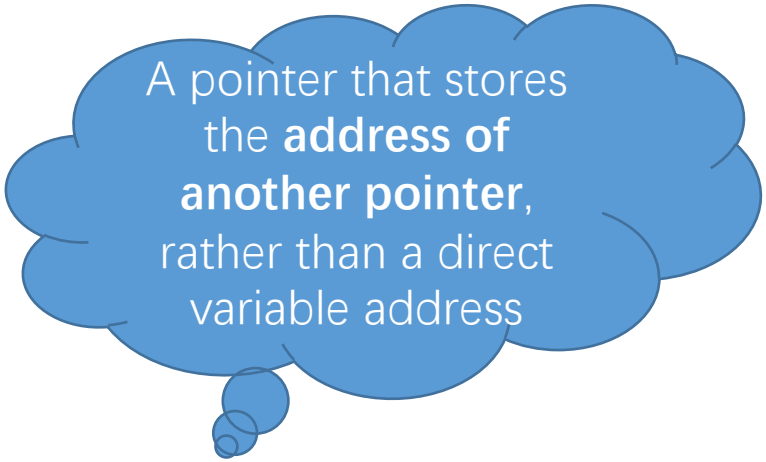
```
char *ptr = str;  // ptr now points to   ‘W

cout << *(ptr + 1);    // Outputs   ‘o'
```

Pointer and String (example)



Pointer to Pointer (Double Pointer)

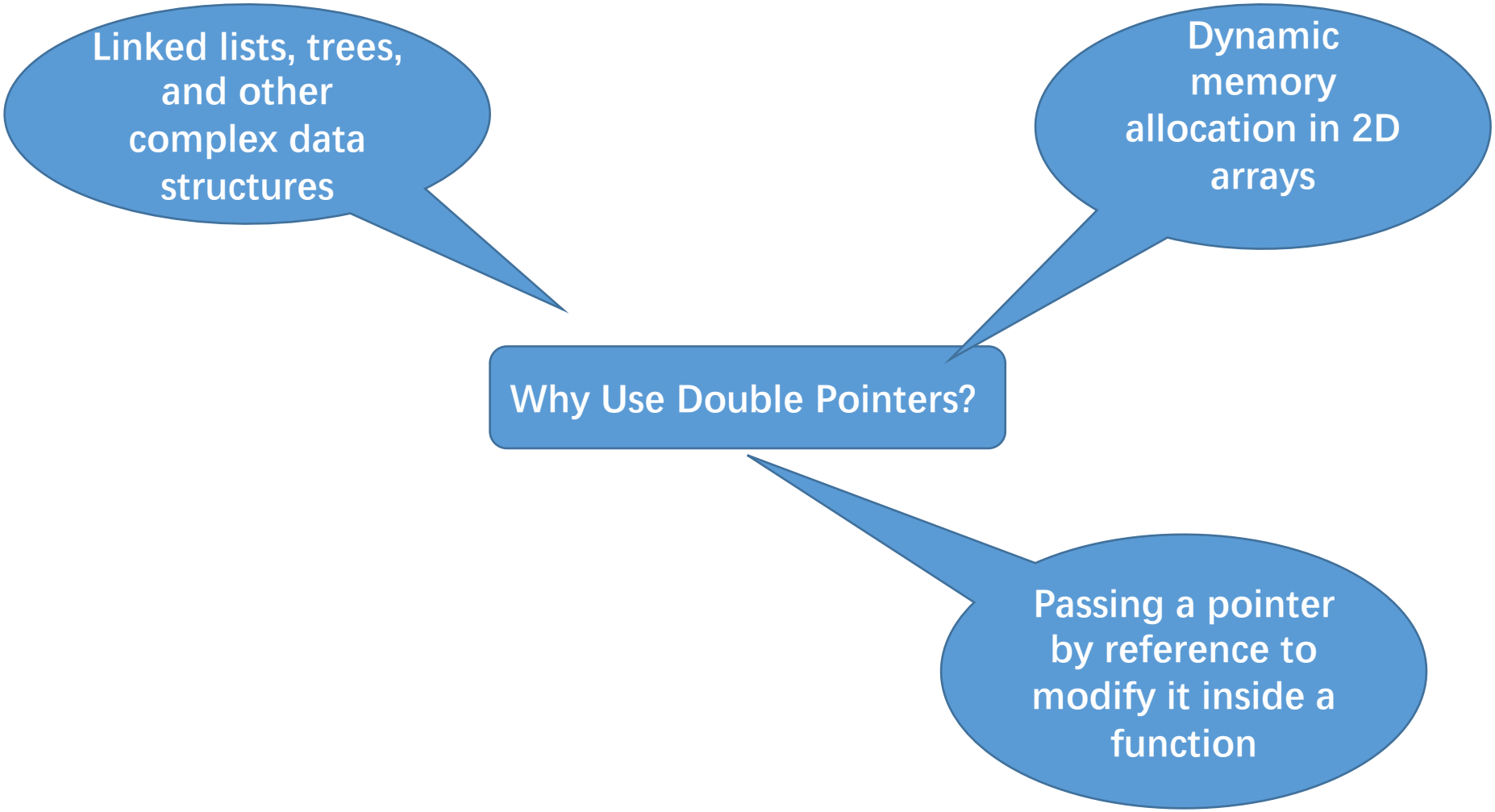


In simple terms:

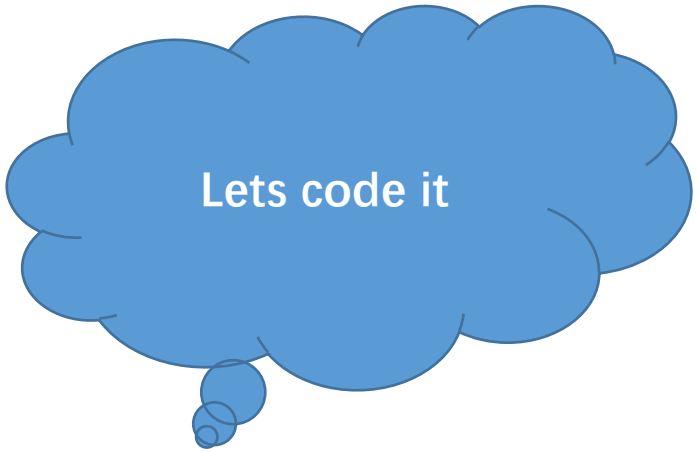
- A **single pointer (*p)** stores the address of a variable.
- A **double pointer (**pp)** stores the address of a single pointer.

```
char a;
char * b;
char ** c;
a = 'z';
b = &a;
c = &b;
```

Pointer to Pointer (Double Pointer)



Pointer to Pointer (Double Pointer)

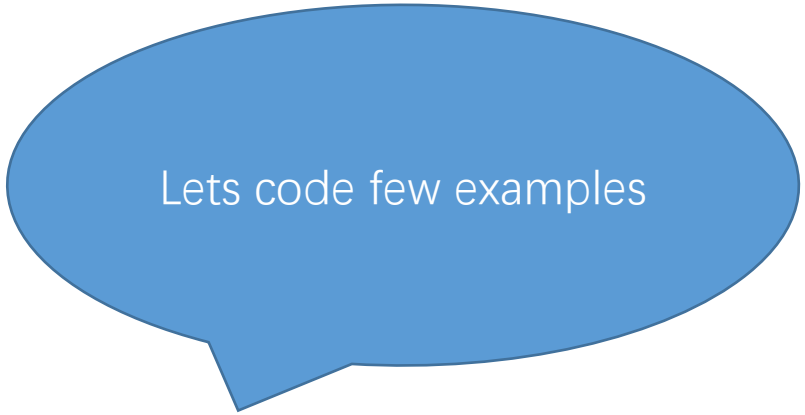


Pointer to Function

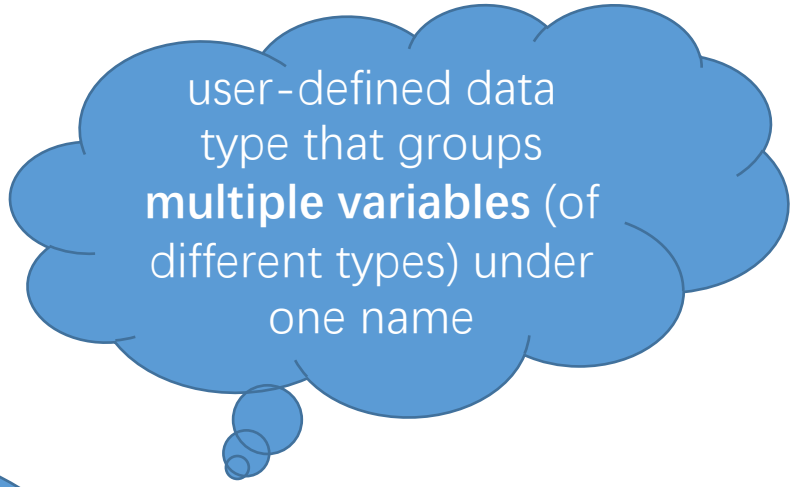
Useful for scenarios like callback functions, function tables, and dynamic function selection

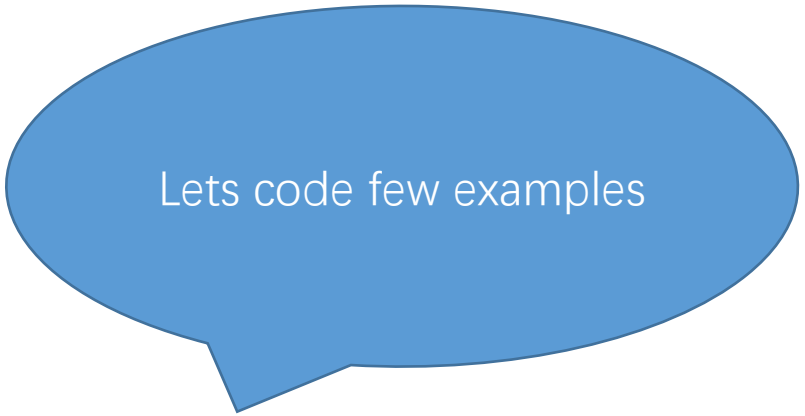
A **pointer to a function** allows us to store the address of a function and invoke it indirectly

Pointer to Function (Examples)



Pointer and Structures

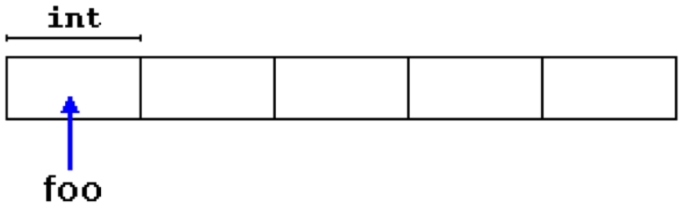




Dynamic memory allocation

```
int * foo;
foo = new int [5];
```

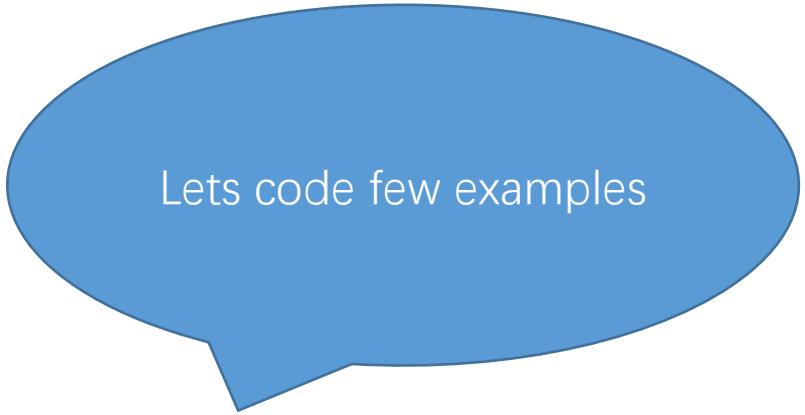
In this case, the system dynamically allocates space for five elements of type int and returns a pointer to the first element of the sequence, which is assigned to foo (a pointer). Therefore, foo now points to a valid block of memory with space for five elements of type int.



where the memory needs of a program can only be determined during runtime

```
delete pointer;
delete[] pointer;
```

Dynamic memory allocation



Questions?

zahmaad.github.io