

# Arrays and Structures

## Structures & Unions

Joseph Chuang-Chieh Lin (林莊傑)

Department of Computer Science & Engineering,  
National Taiwan Ocean University

Fall 2025



# Outline

1 Arrays

2 Structures

3 Unions

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# The Arrays as An ADT

- **Arrays.**

- a set of pairs <**index, value**>.
- for each index, there is a value associated with that index.
- a consecutive set of memory locations.
- mathematical terms: **correspondence, mapping**, etc.

# Implementation of 1-D Array

- `int list[5]`
  - Five consecutive memory locations are allocated.
  - The address of `list[0]`: **base address**.
- `int list[5], *plist[5];`
  - sample **code** for the second.

variable	memory address
list[0]	base address = $b$
list[1]	$b + 1 \times \text{sizeof(int)}$
list[2]	$b + 2 \times \text{sizeof(int)}$
list[3]	$b + 3 \times \text{sizeof(int)}$
list[4]	$b + 4 \times \text{sizeof(int)}$

# Array in C

- Compare `int *list1` and `int list2[5]` in C.
  - Both `list1` and `list2` are pointers.
  - `list2` reserves **five** memory locations.
- Some notations:
  - `list2`:
  - `(list2+i)`:
  - `*(list2+i)`:

# Array in C

- Compare `int *list1` and `int list2[5]` in C.
  - Both `list1` and `list2` are pointers.
  - `list2` reserves **five** memory locations.
- Some notations:
  - `list2`: a pointer to `list2[0]`
  - `(list2+i)`: `&list2[i]`
  - `*(list2+i)`: `list2[i]`

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# Structures

- An array is a collection of data of **the same type**.
  - `int arr[] = { 0, 1, 2, 3, 4 };`
- A structure is a collection of **data items**, where each item is identified as to its type and name.

```
struct employee {
    char name[10];
    int age;
    double salary;
};
struct employee person;
```

```
struct employee {
    char name[10];
    int age;
    double salary;
} person;
```

# Usage of a struct Variable

```
struct employee {  
    char name[10];  
    int age;  
    double salary;  
} person;  
  
strcpy(person.name, "Peter");  
person.age = 10;  
person.salary = 80000;
```

```
struct employee {  
    string name; // C++  
    int age;  
    double salary;  
} person;  
  
person.name = "Peter";  
person.age = 10;  
person.salary = 80000;
```



# typedef

```
typedef int COUNT;  
COUNT num1, num2;  
typedef struct employee HUMAN_BEING;  
  
HUMAN_BEING person1, person2;  
strcpy(person1.name, "Peter");  
person.age = 10;  
person.salary = 80000;
```

# A structure within a structure is possible

```
typedef struct {
    int month;
    int day;
    int year;
} date;

typedef struct {
    char name[10];
    int age;
    float salary;
    date birthday;
} HUMAN_BEING;
```

The usage:

```
HUMAN_BEING person;
person.birthday.month = 10;
person.birthday.day = 31;
person.birthday.year = 1979;
```



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# Unions

- Similar to structures.
- The fields of a union must **share their memory space**.
- Only one field of the union is **active** at any given time.

```
typedef struct {
    int sex;
    union {
        int kid;
        int beard;
    } u;
} SEX_TYPE;
```

# Characteristics of Unions (code)

- The size of the union is the size of the **largest** member.
- Only one member can contain data at the same time.

```
union union1 {  
    int x;  
    int y;  
} U1;  
  
union union2 {  
    int arr[10];  
    char y;  
} U2;
```

```
int size1 = sizeof(U1);  
int size2 = sizeof(U2);  
printf("Sizeof U1: %d\n", size1);  
printf("Sizeof U2: %d\n", size2);
```

# An Application Example

binary tree (only leaf nodes have data)

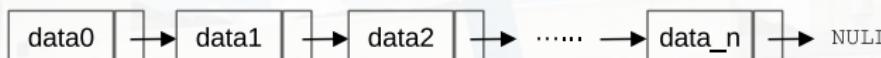
```
struct Node {  
    bool is_leaf;  
    struct Node* left;  
    struct Node* right;  
    double data;  
};
```

```
struct Node {  
    bool is_leaf;  
    union {  
        struct {  
            struct Node* left;  
            struct Node* right;  
        } internal;  
        double data;  
    } info;  
};
```

Reference: GeeksforGeeks

# Self-Referential Structures

One or more of its components is a pointer pointing to itself.



```
struct Node {  
    int data;  
    struct Node* link;  
};  
typedef struct Node list;
```

```
list item0, item1, item2;  
item0.data = data0;  
item1.data = data1;  
item2.data = data2;  
item0.link = &item1;  
item1.link = &item2;  
item2.link = NULL;
```



# Discussions