Short-term Hands-on Supplementary Course on C Programming

SESSION 11: Structures

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Time: 6:30 - 8:00 PM
Date: July 27th, 2022
Location: Online

Agenda

1. Administrative Instructions
2. What are Structures in C?
3. Declaring Structures in C
4. Structures in Memory
5. Initializing Structures
6. Accessing data in Structures
7. Array of Structures
8. Nested Structures
9. Functions and Structures
10. Tutorial
11. Next Session: More Structures

Administrative Instructions

- Please fill out the feedback form - will be shared in the chat
- Join us on Microsoft Teams,
  Team Code: **rzlaicv**

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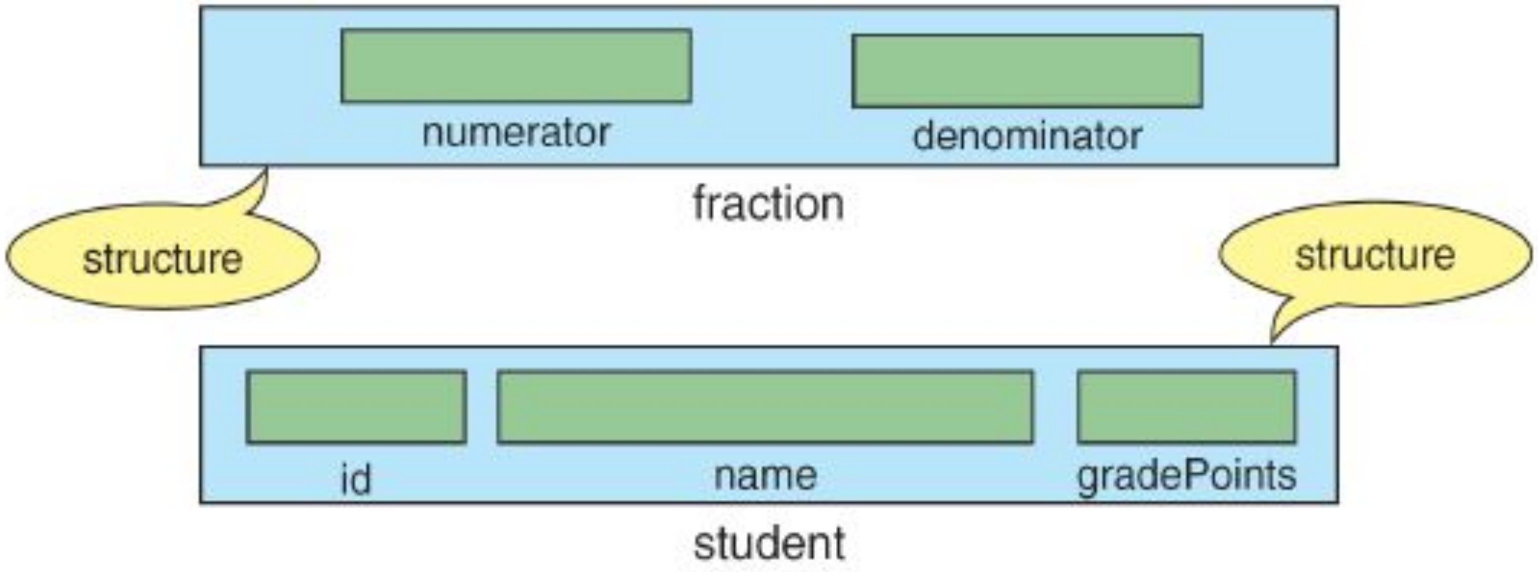
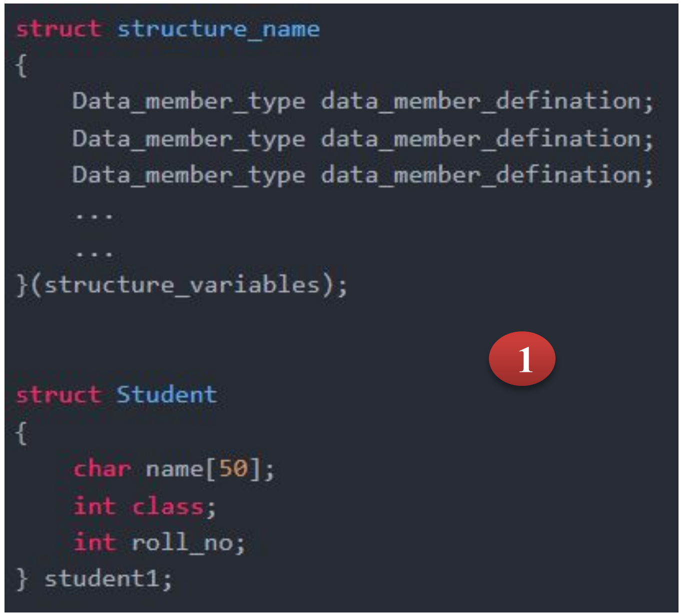
What are structures in C?

A **structure** in C is a user-defined data type. It is used to bind the two or more similar or different data types or data structures together into a single type. Structure is created using struct keyword and a structure variable is created using struct keyword and the structure tag name.a single name.

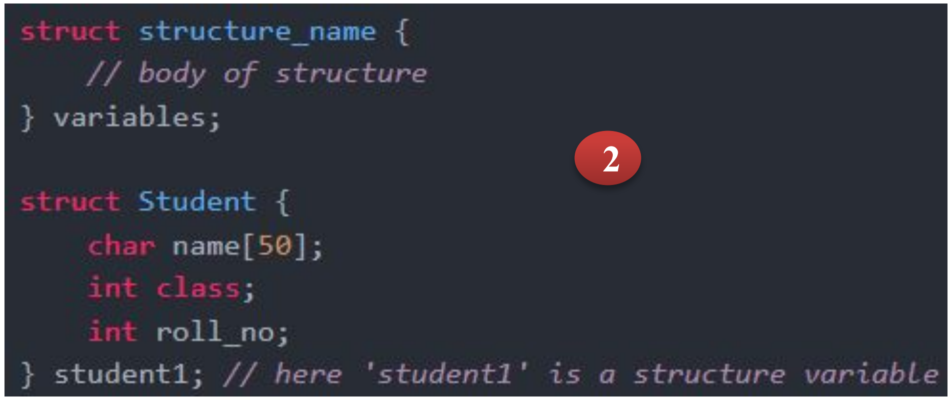


Declaring structures in C



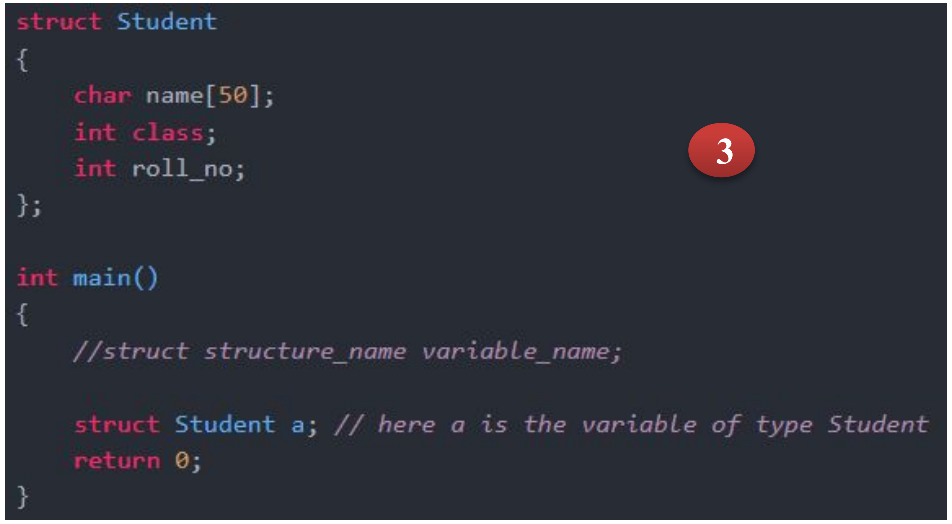
```c
struct structure_name
{
    Data_member_type data_member_defination;
    Data_member_type data_member_defination;
    Data_member_type data_member_defination;
    ...
    ...
}(structure_variables);


struct Student
{
    char name[50];
    int class;
    int roll_no;
} student1;
```

1



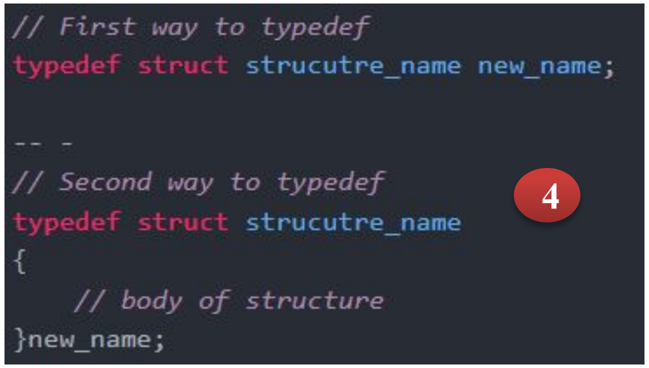
```c
struct structure_name {
    // body of structure
} variables;

struct Student {
    char name[50];
    int class;
    int roll_no;
} student1; // here 'student1' is a structure variable
```

2



```c
struct Student
{
    char name[50];
    int class;
    int roll_no;
};

int main()
{
    //struct structure_name variable_name;

    struct Student a; // here a is the variable of type Student
    return 0;
}
```

3

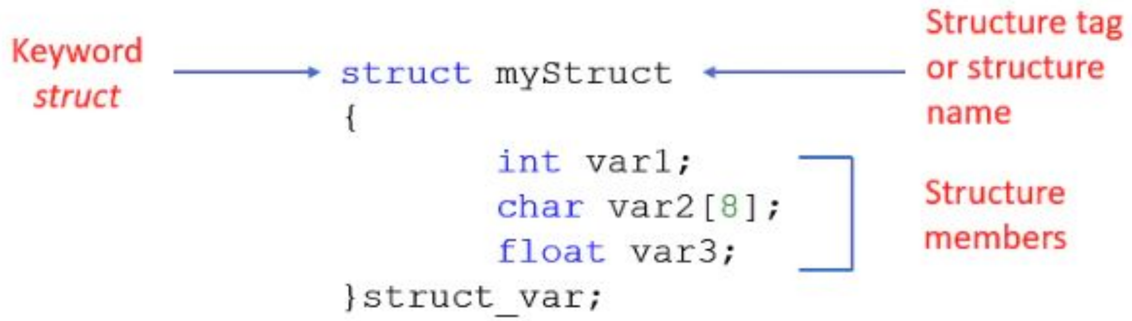


```c
// First way to typedef
typedef struct strucutre_name new_name;

-- -
// Second way to typedef
typedef struct strucutre_name
{
    // body of structure
}new_name;
```

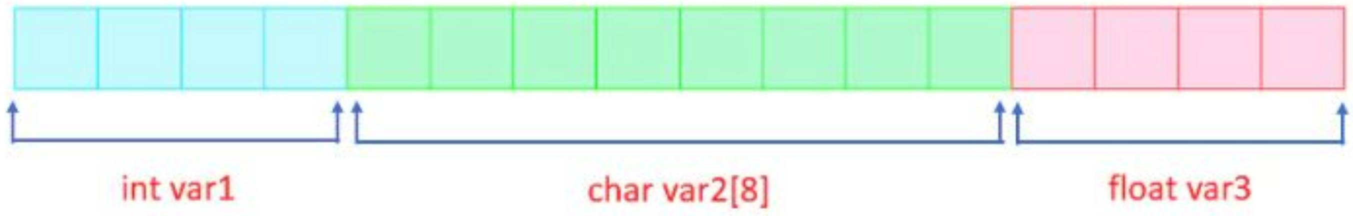
4

Structures in Memory

If we create an object of some structure, then the compiler allocates **contiguous memory** for the **data members** of the structure. The size of allocated memory is ***at least** the **sum of sizes of all data members***. The compiler can use **padding** and in that case there will be **unused space** created between two data members.

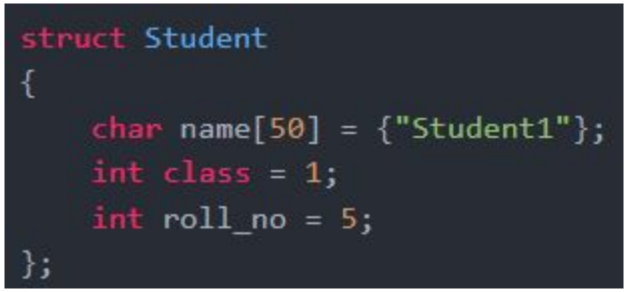


```
struct myStruct
{
        int var1;
        char var2[8];
        float var3;
}struct_var;
```



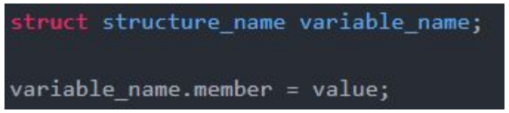
Memory representation for struct_var

Initializing data for Structures

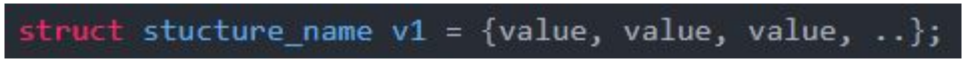


```c
struct Student
{
    char name[50] = {"Student1"};
    int class = 1;
    int roll_no = 5;
};
```

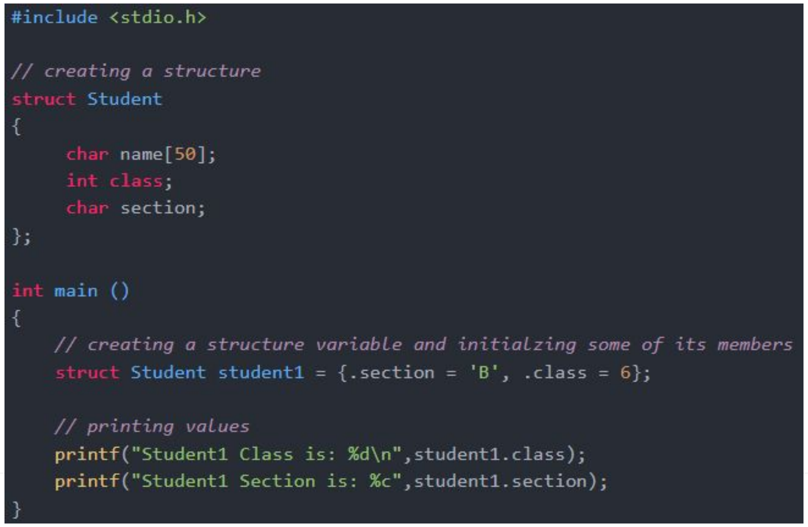
1. Using dot '.' operator
2. Using curly braces '{}'
3. Designated initializers



```c
struct structure_name variable_name;

variable_name.member = value;
```



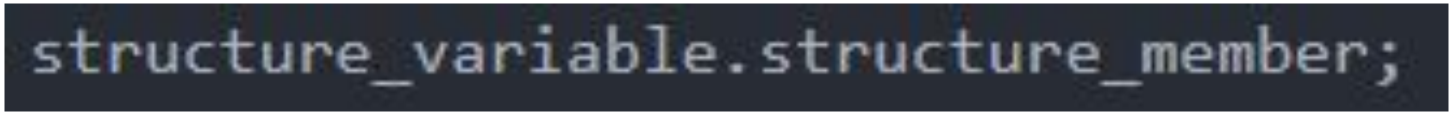
```c
struct stucture_name v1 = {value, value, value, ..};
```



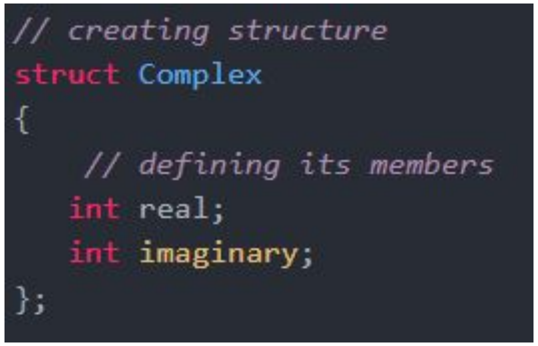
```c
#include <stdio.h>

// creating a structure
struct Student
{
    char name[50];
    int class;
    char section;
};

int main ()
{
    // creating a structure variable and initialzing some of its members
    struct Student student1 = {.section = 'B', .class = 6};

    // printing values
    printf("Student1 Class is: %d\n",student1.class);
    printf("Student1 Section is: %c",student1.section);
}
```

Accessing data in Structures

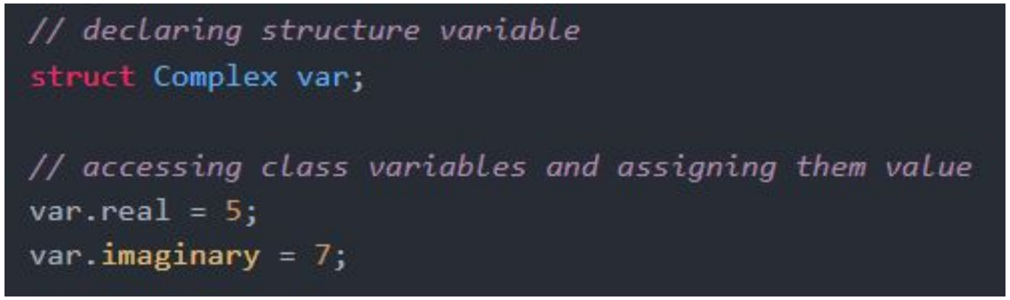
Just like initialization, we use the dot (.) operator



```
structure_variable.structure_member;
```



```
// creating structure
struct Complex
{
    // defining its members
   int real;
   int imaginary;
};
```

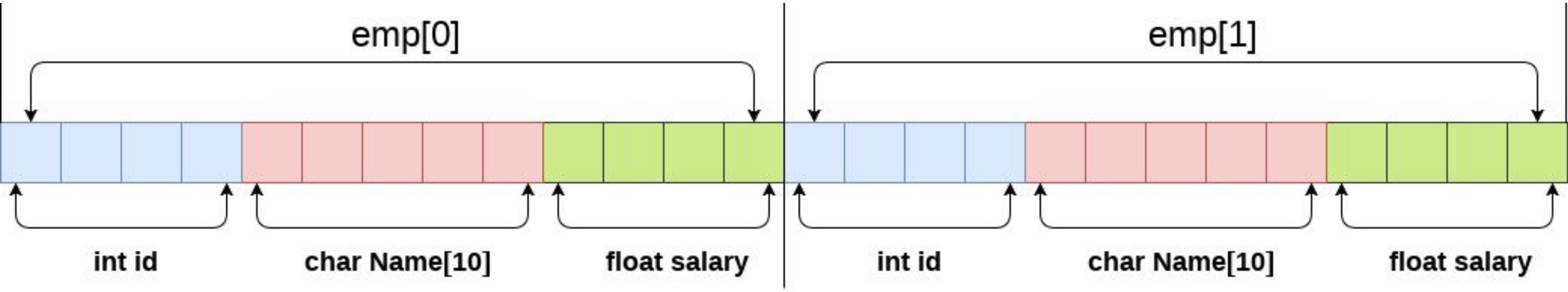


```
// declaring structure variable
struct Complex var;

// accessing class variables and assigning them value
var.real = 5;
var.imaginary = 7;
```

KARTHIK!!

Array of Structures

- Collection of multiple structure variables.
- Each variable contains information about a different entity.



```
struct employee
{
    int id;
    char name[5];
    float salary;
};
struct employee emp[2];
```

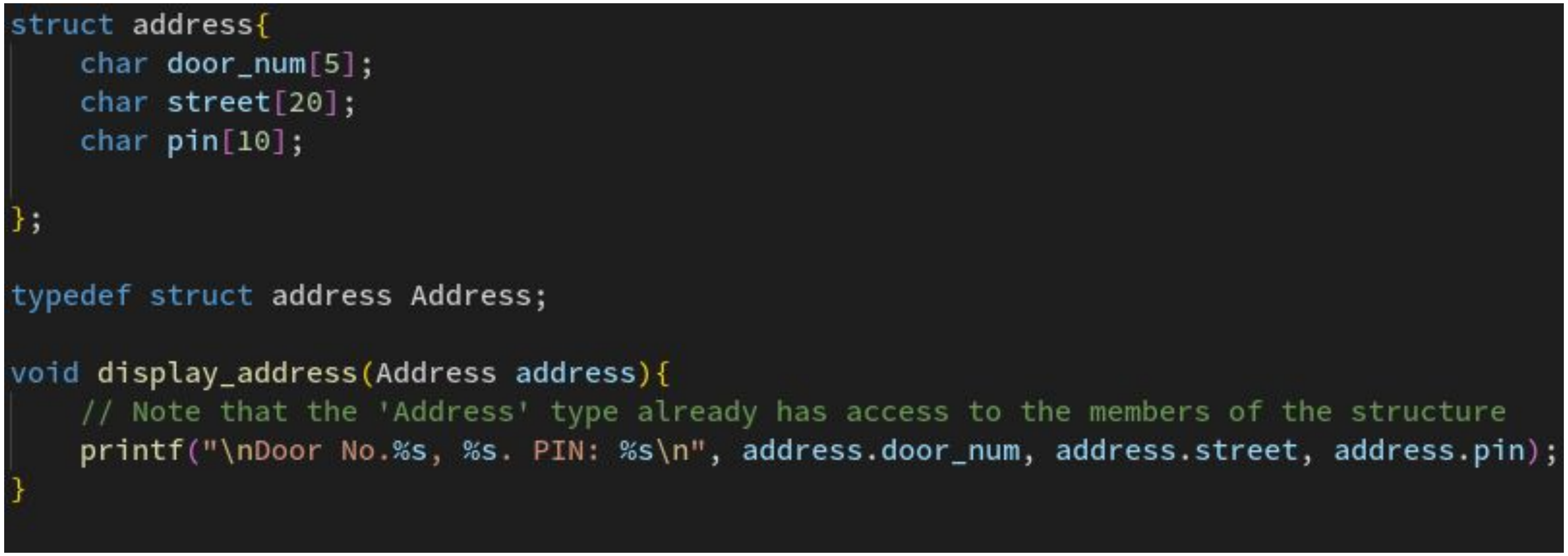
sizeof (emp) = 4 + 5 + 4 = 13 bytes

sizeof (emp[2]) = 26 bytes

Code Walkthrough

Functions and Structures

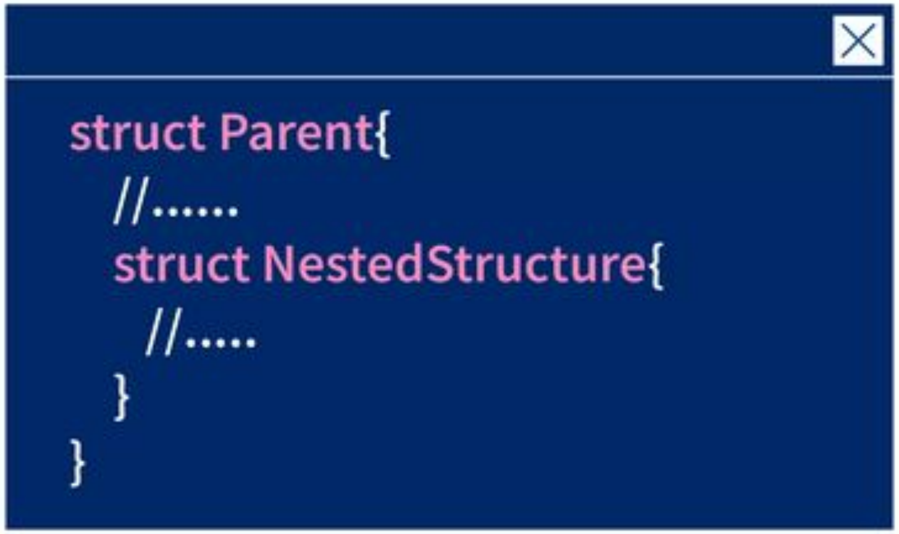
- Structure instances can be passed around as arguments, like any other data type.
- They can also be returned by any function.



```c
struct address{
    char door_num[5];
    char street[20];
    char pin[10];

};

typedef struct address Address;

void display_address(Address address){
    // Note that the 'Address' type already has access to the members of the structure
    printf("\nDoor No.%s, %s. PIN: %s\n", address.door_num, address.street, address.pin);
}
```

Code Walkthrough

Nested Structures



```
struct Parent{
  //......
  struct NestedStructure{
    //.....
  }
}
```

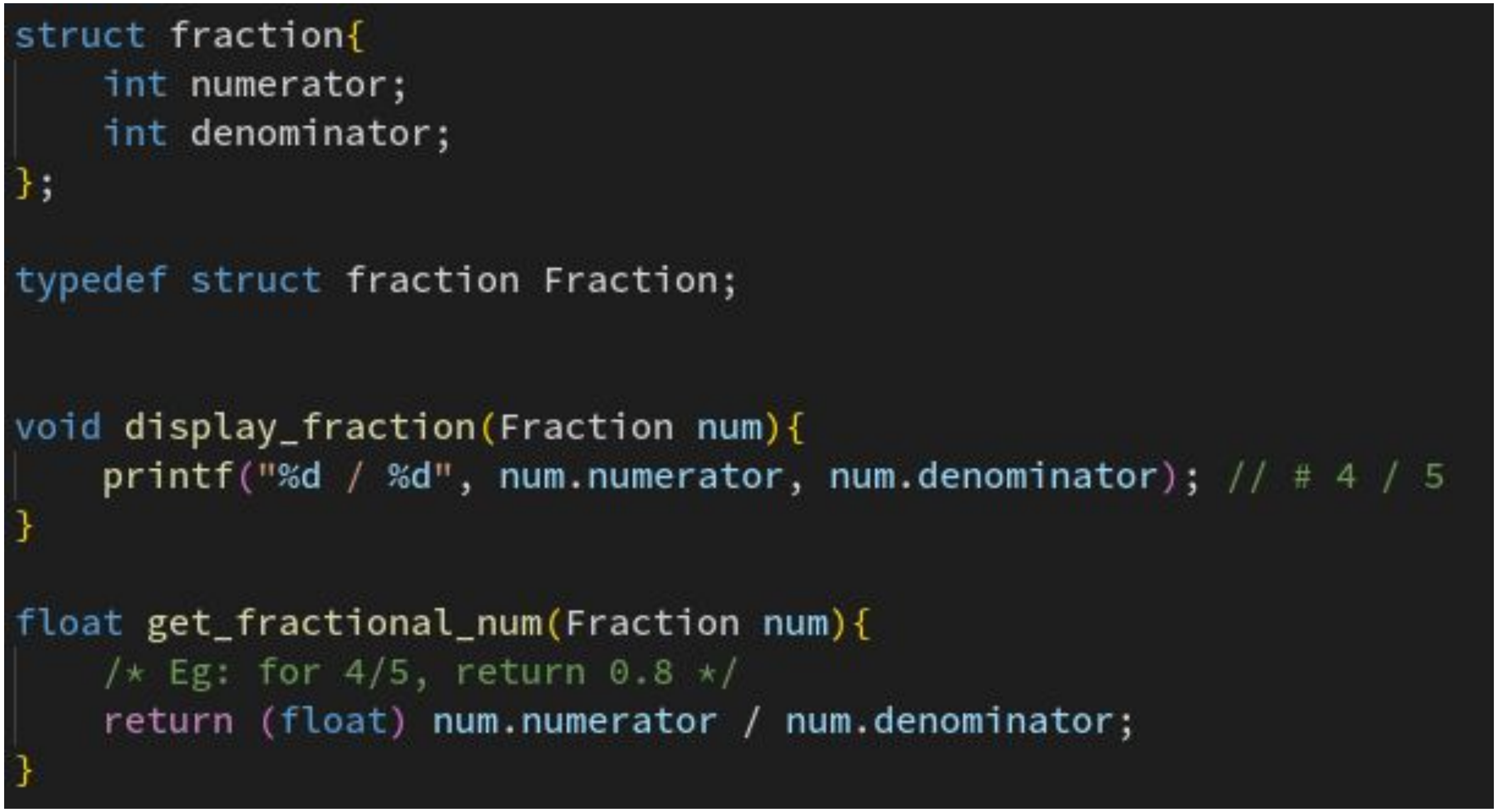
- **Embedded Structure**
  Define **one structure in the definition of another** structure.

- **Separate Structure**
  The **dependent structure** is used inside the Main/Parent structure by **taking a member of the dependent structure type** in the definition of the parent structure.

Code Walkthrough

TUTORIAL

Handling Rational Numbers using Structures !



```c
struct fraction{
    int numerator;
    int denominator;
};

typedef struct fraction Fraction;


void display_fraction(Fraction num){
    printf("%d / %d", num.numerator, num.denominator); // # 4 / 5
}

float get_fractional_num(Fraction num){
    /* Eg: for 4/5, return 0.8 */
    return (float) num.numerator / num.denominator;
}
```

Refer to the implementation on the course page, where we **implement other operations on fractions**

Next Session

POINTERS & STRUCTURES!

Linked Lists be like

Self-referential Structures!!!!

Any Questions