

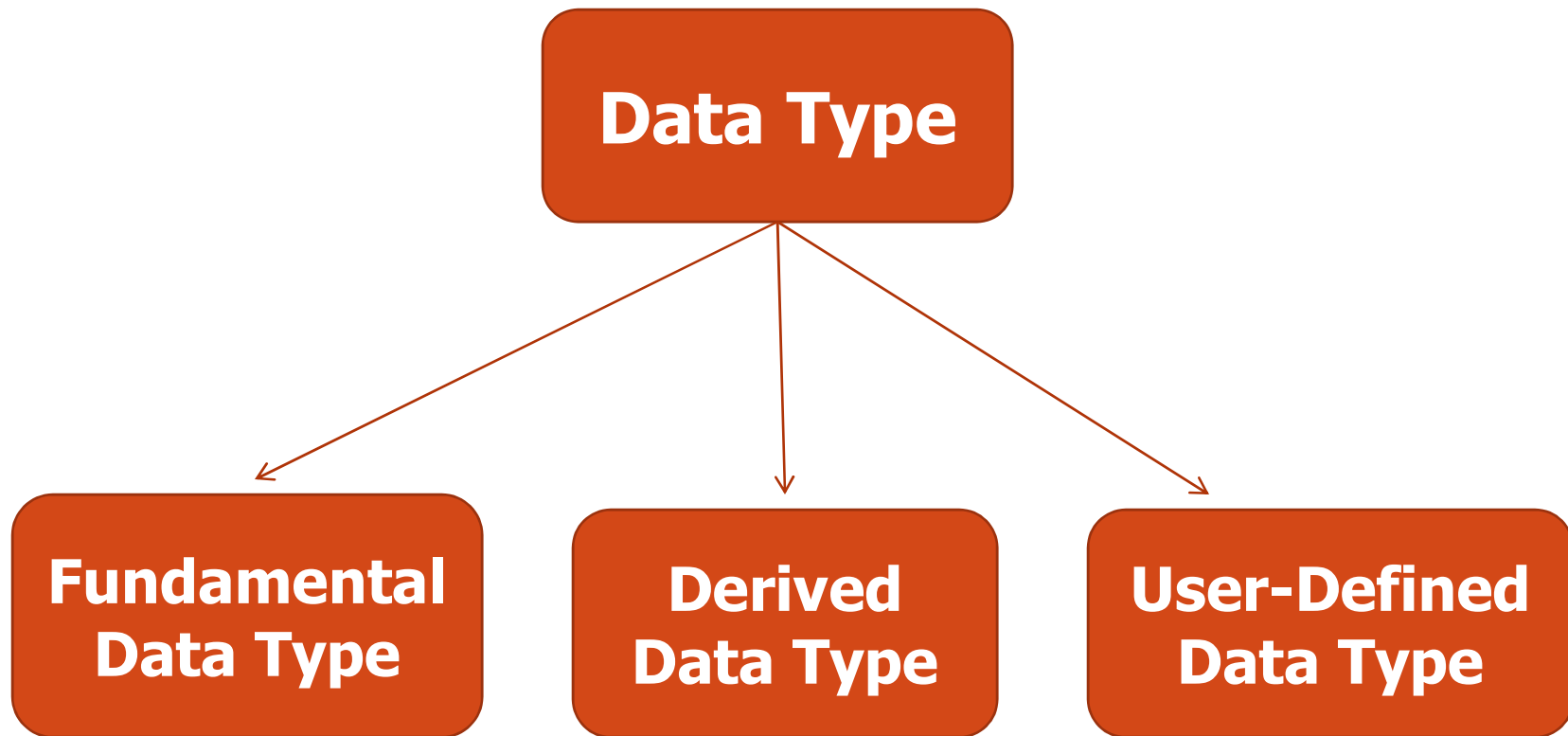
Programming in C

Structure and Union

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What is Structure ??





Fundamental Data Type

int char float void

Derived Data Type

Array Function Pointer

User-Defined Data Type

Structure Union Typedef

Data Types

C programming language which has the ability to divide the data into different types. The type of a variable determine the what kind of values it may take on. The various data types are:

1. Primary (Fundamental) data type- int, char, float, void
2. Derived data type- Array, Functions, Pointers
3. User-defined data type- Structure, Union, Enum

Why do Structure come into Picture

- Array and Strings are collection of same type of elements.
- Many Real world applications needs group of different types of logically related data. e.g Record of a student
 - Name --- String
 - Roll No. --- Int
 - CGPA --- Float
 - Branch --- String
 - Section --- Character
- So we need a Data type which is capable of storing different type data in a single logical unit. e.g
Structure

Structure Data Type

- ❑ A structure is a user defined data type that groups logically related data items of different data types into a single unit. All the elements of a structure are stored at contiguous memory locations.
- ❑ A variable of structure type can store multiple data items of different data types under the one name.
- ❑ **As the data of employee in company that is name, Employee ID, salary, address, phone number is stored in structure data type.**

Defining of Structure

A structure has to be defined, before it can be used. The syntax of defining a structure is

```
struct  <struct_name>
{
<data_type>  <variable_name>;
<data_type>  <variable_name>;
.....
<data_type>  <variable_name>;
};
```


Structure : Declaration

- It is a heterogeneous user defined datatype which contains different data types and group them into a single entity.
- The data elements are referred as members.

- Syntax

```
• struct name      /* keyword */ /* Name of the Structure*/  
  {  
    datatype  member1;  
    datatype  member2;  
    .....  
    datatype  memberN;  
  } ; ← /* termination of structure datatype*/
```

Example of Structure

The structure of Employee is declared as

```
struct employee
{
    int emp_id;
    char name[20];
    float salary;
    char address[50];
    int dept_no;
    int age;
};
```

Memory Space Allocation

8000	emp_id	employee
8002	name[20]	
8022	salary	
8024	address[50]	
8074	dept_no	
8076	age	

Can We write like this ???

```
struct Student
{
    int roll=8;
    char name[7]="RAJESH";
};
```

```
struct Student
{
    int roll=8;
    char roll;
};
```

Caution

- struct student
 {
 int roll = 0; /*initialization not allowed in declaration
 */
 float marks;
 char roll; /* names should be different */
 };
- All member names should be different.

Declaring a Structure Variable

- A structure has to be declared, after the body of structure has defined.

The syntax of declaring a structure is

```
struct <struct_name> <variable_name>;
```

The example to declare the variable for defined structure “employee”

```
struct employee e1;
```

Here e1 variable contains 6 members that are defined in structure.

Initializing a Structure Members

The members of individual structure variable is initialized one by one or in a single statement. The example to initialize a structure variable is

- 1) `struct employee e1 = {1, "Hemant", 12000, "3 vikas colony new delhi", 10, 35};`
- 2)

<code>e1.emp_id=1;</code>	<code>e1.dept_no=10;</code>
<code>e1.name="Hemant";</code>	<code>e1.age=35;</code>
<code>e1.salary=12000;</code>	
<code>e1.address="3 vikas colony new delhi";</code>	

Variables of structure

- struct Student

{

char name[50];

int roll;

float cgpa;

char branch[40];

char section;

} student1, student2, student3;

- Creates three variables of Student by the name student1, student2 and student3

Variables of structure

- struct Student

```
{  
    char name[50];  
    int  roll;  
    float cgpa;  
    char branch[40];  
    char section;  
};
```

```
struct Student student1,student2,student3;
```

- Creates three variables of Student by the name student1,student2 and student3.

Structure Initialization

- struct Student

{

char name[50];

int roll;

float cgpa;

char branch[40];

char section;

};

struct Student student1 = { "xyz", 123, 7.89, "abcd", 'A' };



Accessing a Structure Members

- ❑ The structure members cannot be directly accessed in the expression.
- ❑ They are accessed by using the name of structure variable followed by a dot and then the name of member variable.
- ❑ The method used to access the structure variables are `e1.emp_id`, `e1.name`, `e1.salary`, `e1.address`, `e1.dept_no`, `e1.age`. The data with in the structure is stored and printed by this method using `scanf` and `printf` statement in c program.

Structure Assignment

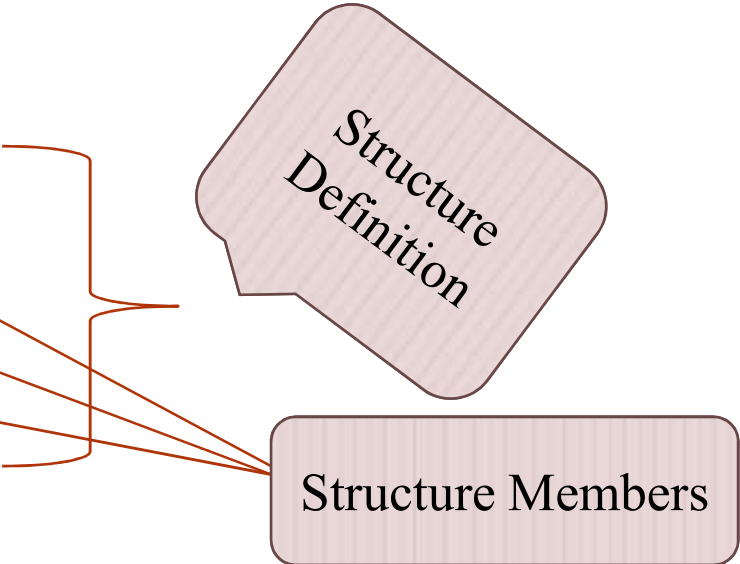
The value of one structure variable is assigned to another variable of same type using assignment statement. If the e1 and e2 are structure variables of type employee then the statement

$e1 = e2;$

assign value of structure variable e2 to e1. The value of each member of e2 is assigned to corresponding members of e1.

Program to implement the Structure

```
#include <stdio.h>
#include <conio.h>
struct employee
{
    int emp_id;
    char name[20];
    float salary;
    char address[50];
};
void main( )
{
    struct employee e={ 100,"Harish",5000.00, "Bhbaneswar"};
    printf("%d %s %f %s", e.emp_id,e.name,e.salary,e.address);
    getch();
}
```



OutPut of the Program:

100 Harish 5000.000000 Bhubaneswar

Quiz Questions:

1. Which keyword is used in structure definition?

struct

2. Is Structure is a user defined or primary data type?

User defined

3. An array is a collection of different data types and structure is a collection of related data elements of same type. (True/ False)

False

4. We can initialize individual members inside the structure definition. (Yes/No)

NO

5. struct x

{

int a;

float b;

}

; is missing

Is this the correct structure declaration?

Write a program to find out details about two employee using Structure

```
#include <stdio.h>
#include <conio.h>
struct employee
{
int emp_id;
char name[20];
float salary;
char address[50];
int dept_no;
int age;
};
```

Continued...

```
void main ( )  
{  
    struct employee e1,e2;  
    printf ("Enter the employee id of employee");  
    scanf ("%d",&e1.emp_id);  
    printf ("Enter the name of employee");  
    scanf ("%s",e1.name);  
    printf ("Enter the salary of employee");  
    scanf ("%f",&e1.salary);  
    printf ("Enter the address of employee");  
    scanf ("%s",e1.address);  
    printf ("Enter the department of employee");  
    scanf ("%d",&e1.dept_no);  
    printf ("Enter the age of employee");
```


Continued...

```
scanf("%d",&e1.age);  
printf ("Enter the employee id of employee");  
scanf("%d",&e2.emp_id);  
printf ("Enter the name of employee");  
scanf("%s",e2.name);  
printf ("Enter the salary of employee");  
scanf("%f",&e2.salary);  
printf ("Enter the address of employee");  
scanf("%s",e2.address);  
printf ("Enter the department of employee");  
scanf("%d",&e2.dept_no);  
printf ("Enter the age of employee");  
scanf("%d",&e2.age);
```

Continued...

```
printf ("The employee id of employee is : %d", e1.emp_id);  
printf ("The name of employee is : %s", e1.name);  
printf ("The salary of employee is : %f", e1.salary);  
printf ("The address of employee is : %s", e1.address);  
printf ("The department of employee is : %d", e1.dept_no);  
printf ("The age of employee is : %d", e1.age);  
printf ("The employee id of employee is : %d", e2.emp_id);  
printf ("The name of employee is : %s", e2.name);  
printf ("The salary of employee is : %f", e2.salary);  
printf ("The address of employee is : %s", e2.address);  
printf ("The department of employee is : %d", e2.dept_no);  
printf ("The age of employee is : %d", e2.age);  
getch();  
}
```

Output of Program

Enter the employee id of employee 1

Enter the name of employee Rahul

Enter the salary of employee 15000

Enter the address of employee 4,villa area, Delhi

Enter the department of employee 3

Enter the age of employee 35

Enter the employee id of employee 2

Enter the name of employee Rajeev

Enter the salary of employee 14500

Enter the address of employee flat 56H, Mumbai

Enter the department of employee 5

Enter the age of employee 30

Continued...

The employee id of employee is : 1

The name of employee is : Rahul

The salary of employee is : 15000

The address of employee is : 4, villa area, Delhi

The department of employee is : 3

The age of employee is : 35

The employee id of employee is : 2

The name of employee is : Rajeev

The salary of employee is : 14500

The address of employee is : flat 56H, Mumbai

The department of employee is : 5

The age of employee is : 30

Array of Structure

❑ C language allows to create an array of variables of structure. The array of structure is used to store the large number of similar records. For example to store the record of 100 employees then array of structure is used.

❑ The method to define and access the array element of array of structure is similar to other array. The syntax to define the array of structure is

Struct <struct_name> <array_name> [<value>];

For Example:-

Struct employee e1[100];

Program to implement the Array of Structure

```
#include <stdio.h>
#include <conio.h>
struct employee
{
int emp_id;
char name[20];
float salary;
char address[50];
int dept_no;
int age;
};
```

Continued...

```
void main ( )  
{  
    struct employee e1[5];  
    int i;  
    for (i=1; i<=100; i++)  
    {  
        printf ("Enter the employee id of employee");  
        scanf ("%d",&e[i].emp_id);  
        printf ("Enter the name of employee");  
        scanf ("%s",e[i].name);  
        printf ("Enter the salary of employee");  
        scanf ("%f",&e[i].salary);  
    }
```

Continued...

```
printf ("Enter the address of employee");
scanf ("%s", e[i].address);
printf ("Enter the department of employee");
scanf ("%d",&e[i].dept_no);
printf ("Enter the age of employee");
scanf ("%d",&e[i].age);
}
for (i=1; i<=100; i++)
{
printf ("The employee id of employee is : %d", e[i].emp_id);
printf ("The name of employee is: %s",e[i].name);
```



```
printf ("The salary of employee is: %f", e[i].salary);  
printf ("The address of employee is : %s", e[i].address);  
printf ("The department of employee is : %d", e[i].dept_no);  
printf ("The age of employee is : %d", e[i].age);  
}  
getch();  
}
```

Structures within Structures

C language define a variable of structure type as a member of other structure type. The syntax to define the structure within structure is

```
struct  <struct_name>{  
    <data_type>  <variable_name>;  
    struct  <struct_name>  
        {  
            <data_type>  <variable_name>;  
            .....}<struct_variable>;  
    <data_type>  <variable_name>;  
};
```

Example of Structure within Structure

The structure of Employee is declared as:

```
struct employee
{
    int emp_id;
    char name[20];
    float salary;
    int dept_no;
    struct date
    {
        int day;
        int month;
        int year;
    }doj;
};
```

Accessing Structures within Structures

❑ The data member of structure within structure is accessed by using two period (.) symbol.

❑ The syntax to access the structure within structure is
`struct _var. nested_struct_var. struct_member;`

For Example:-

`e1.doj.day;`

`e1.doj.month;`

`e1.doj.year;`

Pointers and Structures

❑ C language can define a pointer variable of structure type. The pointer variable to structure variable is declared by using same syntax to define a pointer variable of data type. The syntax to define the pointer to structure

```
struct <struct_name> *<pointer_var_name>;
```

For Example:

```
struct employee *emp;
```

❑ It declares a pointer variable “emp” of employee type.

Access the Pointer in Structures

- ❑ The member of structure variable is accessed by using the pointer variable with arrow operator(\rightarrow) instead of period operator(.).
- ❑ The syntax to access the pointer to structure.

`pointer_var_name \rightarrow structure_member;`

For Example:

`emp \rightarrow name;`

Here “name” structure member is accessed through pointer variable emp.

Passing Structure to Function

❑ The structure variable can be passed to a function as a parameter. The program to pass a structure variable to a function.

```
#include <stdio.h>
#include <conio.h>
struct employee
{
int emp_id;
char name[20];
float salary;
};
```

Passing Structure to Function

```
void main ( )  
{  
    struct employee e1;  
    printf ("Enter the employee id of employee");  
    scanf ("%d",&e1.emp_id);  
    printf ("Enter the name of employee");  
    scanf ("%s",e1.name);  
    printf ("Enter the salary of employee");  
    scanf ("%f",&e1.salary);  
    printdata (struct employee e1);  
    getch();  
}
```


Continued...

```
void printdata( struct employee emp)
{
    printf (“\nThe employee id of employee is : %d”, emp.emp_id);
    printf (“\nThe name of employee is : %s”, emp.name);
    printf (“\nThe salary of employee is : %f”, emp.salary);
}
```

Function Returning Structure

❑ The function can return a variable of structure type like a integer and float variable. The program to return a structure from function.

```
#include <stdio.h>
#include <conio.h>
struct employee
{
int emp_id;
char name[20];
float salary;
};
```

Function Returning Structure

```
void main ( )  
{  
    struct employee emp;  
    emp=getdata();  
    printf (“\nThe employee id of employee is : %d”, emp.emp_id);  
    printf (“\nThe name of employee is : %s”, emp.name);  
    printf (“\nThe salary of employee is : %f”, emp.salary);  
    getch();  
}
```

Function Returning Structure

```
struct employee getdata( )  
{  
    struct employee e1;  
    printf ("Enter the employee id of employee");  
    scanf ("%d",&e1.emp_id);  
    printf ("Enter the name of employee");  
    scanf ("%s",e1.name);  
    printf ("Enter the salary of employee");  
    scanf ("%f",&e1.salary);  
    return(e1);  
}
```

Some Questions:

1. Struct x

```
{
    int a=10;
    float b=3.5;
}m;
main()
{
    printf("%d %f",m.a,m.b);
}
```

O/P: Error; members cant initialize within structure definition

2. Struct x

```
{
    int a;
    float b;
}
main()
{
    struct x m={3};
    printf("%d %f", m.a,m.b);
}
```

3 0.000000
partial initialization is allowed in structure

3.

```
struct p {
    int k; char c; float f;
}; int p = 10;
int main()
{ struct p x = {1, 97};
  printf("%f %d\n", x.f, p);
}
```

4. With reference to the question 2

What is the output:

```
printf("%d ", sizeof(x));
```

2+4=6 bytes

0.000000 10

Union Data Type

❑ A union is a user defined data type like structure. The union groups logically related variables into a single unit. The union data type allocate the space equal to space need to hold the largest data member of union.

❑ The union allows different types of variable to share same space in memory. There is no other difference between structure and union than internal difference. The method to declare, use and access the union is same as structure.

Defining of Union

A union has to be defined, before it can be used. The syntax of defining a union is

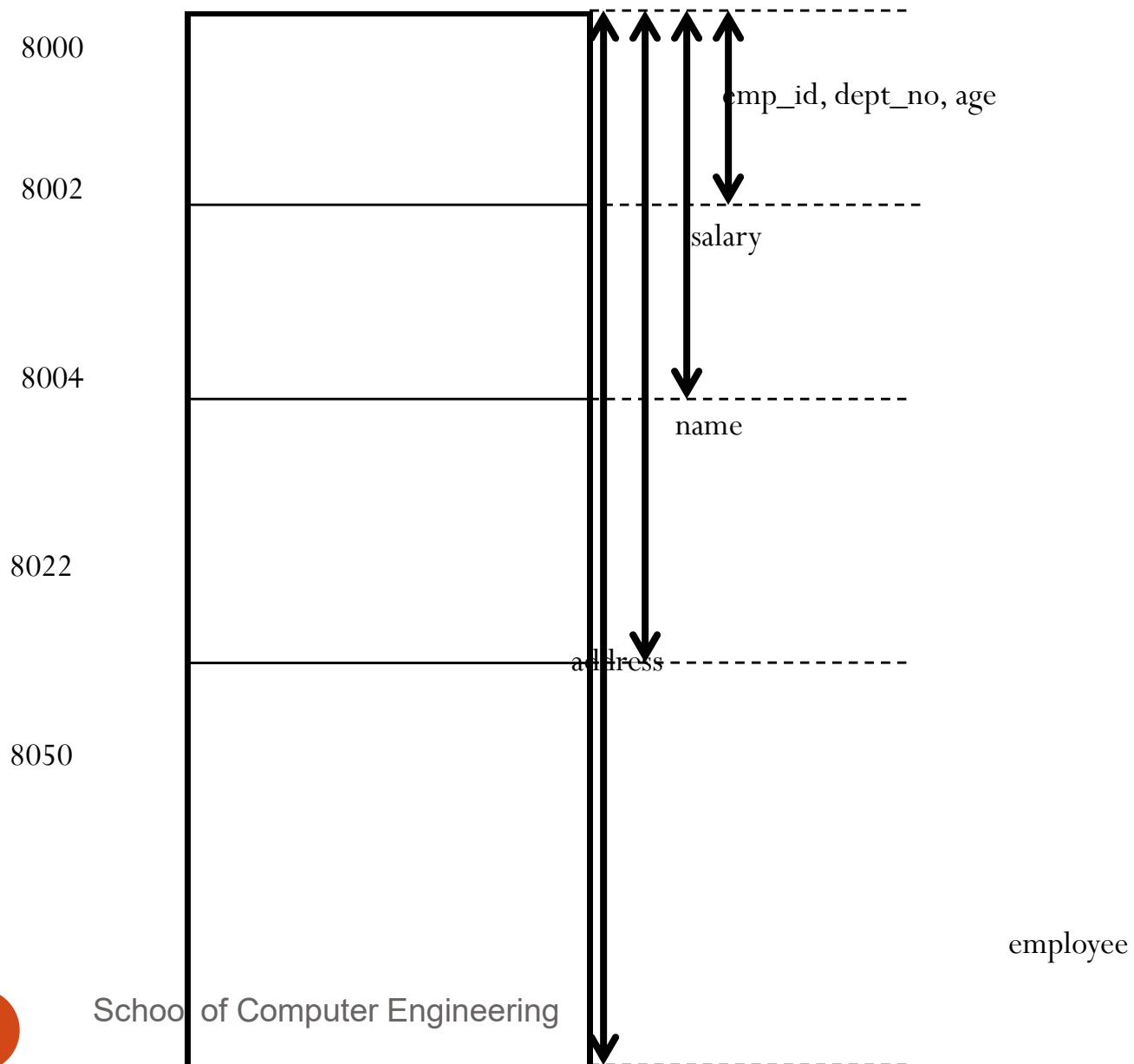
```
union    <union_name>
{
    <data_type>    <variable_name>;
    <data_type>    <variable_name>;
    .....
    <data_type>    <variable_name>;
};
```

Example of Union

The union of Employee is declared as

```
union employee
{
int emp_id;
char name[20];
float salary;
char address[50];
int dept_no;
int age;
};
```


Memory Space Allocation



Difference between Structures & Union

- 1) The memory occupied by structure variable is the sum of sizes of all the members but memory occupied by union variable is equal to space hold by the largest data member of a union.
- 1) In the structure all the members are accessed at any point of time but in union only one of union member can be accessed at any given time.

Application of Structures

Structure is used in database management to maintain data about books in library, items in store, employees in an organization, financial accounting transaction in company.

Beside that other application are

- 1) Changing the size of cursor.
- 2) Clearing the contents of screen.
- 3) Drawing any graphics shape on screen.
- 4) Receiving the key from the keyboard.

Application of Structures

- 5) Placing cursor at defined position on screen.
- 6) Checking the memory size of the computer.
- 7) Finding out the list of equipments attach to computer.
- 8) Hiding a file from the directory.
- 9) Sending the output to printer.
- 10) Interacting with the mouse.
- 11) Formatting a floppy.
- 12) Displaying the directory of a disk.

Quiz Questions:

Q1. Which is the correct syntax of array of structure

- a. struct item[10] item_bank;
- b. struct item(10) item_bank;
- c. struct item item_bank[10];

Q2. struct abc{

int a;

float b;

}; struct xyz{

int x;

float y;

} ;

abc a1,a2;

xyz x1,x2;

Find the errors, if any in the following statement

a1=x1; abc.a1=10; a1=a2; int m=a+x; if(a.a1>x.x1)

Summary

- ❑ A structure is an user defined data type that groups logically related data items of different data types into a single unit.
- ❑ The elements of a structure are stored at contiguous memory locations.
- ❑ The value of one structure variable is assigned to another variable of same type using assignment statement.
- ❑ An array of variables of structure is created.
- ❑ A variable of structure type is defined as a member of other structure type called nested structure.

Summary

- ❑ The member of structure variable is accessed by pointer variable with arrow operator (\rightarrow).
- ❑ The structure variable can be passed to a function as a parameter.
- ❑ The function can return a variable of structure type.
- ❑ A union is like structure that group logically related variables into a single unit. The union allocate the space equal to space need to hold the largest data member of union.
- ❑ Structure used in database management and many more applications.

Thank You