Structures in C

Rab Nawaz Jadoon

Assistant Professor

COMSATS IIT, Abbottabad

Pakistan

Department of Computer Science

DCS

COMSATS Institute of
Information Technology

Structures in C

- Which mechanic is good enough who knows how to repair only one type of vehicle? None.
  - Same thing is true about C language. It wouldn't have been so popular had it been able to handle only all ints, or all floats or all chars at a time.
  - In fact when we handle real world data, we don't usually deal with little atoms of information by themselves—things like integers, characters and such.
    - Instead we deal with entities that are collections of things, each thing having its own attributes, just as the entity we call a 'book' is a collection of things such as title, author, call number, publisher, number of pages, date of publication, etc.

Structures in C

- As you can see all this data is dissimilar, for example author is a string, whereas number of pages is an integer.
- For dealing with such collections, C provides a data type called 'structure'.
  - A structure gathers together, different atoms of information that comprise a given entity.

Why use structures???

- We have seen earlier how ordinary variables can hold one piece of information and how arrays can hold a number of pieces of information of the same data type.
  - These two data types can handle a great variety of situations.
  - But quite often we deal with entities that are collection of dissimilar data types.

Example

- For example, suppose you want to store data about a book.
  - You might want to store its name(a string), its price (a float) and number of pages in it (an int). If data about say3 such books is to be stored, then we can follow two approaches:
    - Construct individual arrays, one for storing names, another for storing prices and still another for storing number of pages.
    - Use a structure variable.

Solution 1

```
main( )
{
      char  name[3] ;
      float  price[3] ;
      int  pages[3], i ;

      printf ( "\nEnter names, prices and no. of pages of 3 books\n" ) ;

      for ( i = 0 ; i <= 2 ; i++ )
            scanf ( "%c %f %d", &name[i], &price[i], &pages[i] );

      printf ( "\nAnd this is what you entered\n" ) ;
      for ( i = 0 ; i <= 2 ; i++ )
            printf ( "%c %f %d\n", name[i], price[i], pages[i] );
}
```

Output

```
Enter names, prices and no. of pages of 3 books
A  100.00  354
C  256.50  682
F  233.70  512

And this is what you entered
A  100.000000  354
C  256.500000  682
F  233.700000  512
```

Structures

- The program becomes more difficult to handle as the number of items relating to the book go on increasing.
  - For example, we would be required to use a number of arrays, if we also decide to store name of the publisher, date of purchase of book, etc.
  - To solve this problem, C provides a special data type—the structure.

Structures

- A structure contains a number of data types grouped together.
- These data types may or may not be of the same type.
- The following example illustrates the use of this data type.
  - Program at slide 6 can be dealt efficiently using structure on the next slide.

Structures

```
main( )
{
    struct book
    {
        char  name ;
        float  price ;
        int  pages ;
    } ;
    struct book  b1, b2, b3 ;

    printf ( "\nEnter names, prices & no. of pages of 3 books\n" ) ;
    scanf ( "%c %f %d", &b1.name, &b1.price, &b1.pages ) ;
    scanf ( "%c %f %d", &b2.name, &b2.price, &b2.pages ) ;
    scanf ( "%c %f %d", &b3.name, &b3.price, &b3.pages ) ;

    printf ( "\nAnd this is what you entered" ) ;
    printf ( "\n%c %f %d", b1.name, b1.price, b1.pages ) ;
    printf ( "\n%c %f %d", b2.name, b2.price, b2.pages ) ;
    printf ( "\n%c %f %d", b3.name, b3.price, b3.pages ) ;
}
```

Declaration of structures

- In our example program, the following statement declares the structure type:

```
struct book
{
 char name;
 float price;
 int pages;
};
```

This statement defines a new data type called struct book. Each variable of this data type will consist of a character variable called name, a float variable called price and an integer variable called pages.

Declaration of structures

- Once the new structure data type has been defined one or more variables can be declared to be of that type.
  - For example the variables b1, b2, b3 can be declared to be of the type struct book, as, struct book b1, b2, b3 ; This statement sets aside space in memory.
  - It makes available space to hold all the elements in the structure—in this case, 7 bytes—one for name, four for priceand two for pages.
  - These bytes are always in adjacent memory locations.

Declaration of structures

```
struct book
{
        char  name ;
        float  price ;
        int  pages ;
} ;
struct book  b1, b2, b3 ;
```

```
struct book
{
        char  name ;
        float  price ;
        int  pages ;
} b1, b2, b3 ;
```

Declaration of structures

- Like primary variables and arrays, structure variables can also be initialized where they are declared.
  - The format used is quite similar to that used to initiate arrays.

```
struct book
{
      char  name[10] ;
      float  price ;
      int  pages ;
} ;
struct book  b1 = { "Basic", 130.00, 550 } ;
struct book  b2 = { "Physics", 150.80, 800 } ;
```

Important points

- The closing brace in the structure type declaration must be followed by a semicolon.
- It is important to understand that a structure type declaration does not tell the compiler to reserve any space in memory. All a structure declaration does is, it defines the 'form' of the structure.
- Usually structure type declaration appears at the top of the source code file, before any variables or functions are defined.

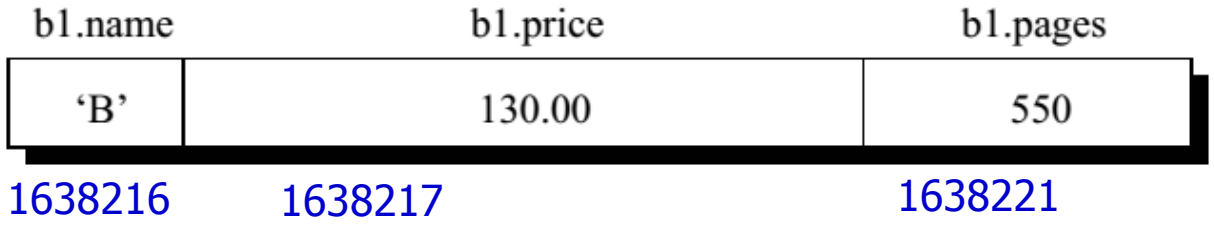
Accessing structure elements

- In arrays we can access individual elements of an array using a subscript.
- Structures use a different scheme.
  - They use a dot (.) operator.
  - So to refer to pages of the structure defined in our sample program we have to use, b1.pages
  - Similarly, to refer to price we would use, b1.price
    - Note that before the dot there must always be a structure variable and after the dot there must always be a structure element.

How structure elements are stored?

```
#include<stdio.h>
#include<conio.h>
main( )
{
struct book
{
        char name;
        float price;
        int pages;
};
 struct book b1 = { 'B', 130.00, 550, 1234 };
 printf ( "\nAddress of name = %u", &b1.name );
 printf ( "\nAddress of price = %u", &b1.price);
 printf ( "\nAddress of pages = %u", &b1.pages );
 getche();
}
```

Address of name = 1638216
Address of price = 1638217
Address of pages = 1638221



Arrays of structures

- In our sample program, to store data of 100 books we would be required to use 100 different structure variables from b1to b100, which is definitely not very convenient.
- A better approach would be to use an array of structures.
  - Program on next slide shows how to use an array of structures.

Program

```
#include<stdio.h>
#include<conio.h>
main( )
{
struct book
{
        char name;
        float price;
        int pages;
};
struct book b[3];
int i ;
for ( i = 0 ; i <= 2 ; i++ ){
 printf ( "\nEnter name, price and pages " );
 fflush(stdin);
 scanf ( "%c %f %d", &b[i].name, &b[i].price, &b[i].pages );}
for ( i = 0 ; i <= 2 ; i++ ){
  printf ( "\n%c %f %d", b[i].name, b[i].price, b[i].pages );}
getche();
}
```

Output…

```
Enter name, price and pages a 12.4 123
Enter name, price and pages s 123.8 23
Enter name, price and pages g 23.6 2345

a 12.400000 123
s 123.800003 23
g 23.600000 2345
```


Thank You!