Structures

- C structures are similar to records in Pascal, they allow us to collect together several pieces of related data into one block. The individual pieces of data are called structure elements or structure members

- The declaration of a structure does not allocate memory, it just provides a template for the structure. It specifies the quantities that are being grouped together

- For example, we could have the following for the declaration of a name structure

```
struct Person {
   char* first;
   char* last;
};
```

- This structure has two elements, the pointers first and last, which are used to access an array of characters. Other variables can have the same name as structure elements, and the same element name can be used in different structure declarations. You will not find this to be a problem, because the compiler recognizes all potential ambiguities.

- There are several ways to create a variable that has a structure type

```
struct  StructureName  VariableName;
```

- So with our example Person structure (struct Person) we could create two instances, fred and andrew:

```
   struct Person fred, andrew;
```

This declaration creates two variables (called fred and andrew) and allocates space for them. Each variable (structure) has two elements, each element points to an array of characters that may be used to hold the first and last names, respectively.

We use the **.** (dot) operator to form individual instances of a structure element. For example:

```
   fred.first = "Fred";
   fred.last  = "Flintstone";
```

equally one might write

```
   andrew = {"Andrew", "Choi"};
```

- The **.** (dot) operator is used to extract the individual elements from a structure variable. In the case of our Person structure we have:

```
char* FirstName;
char* LastName;
   FirstName = andrew.first
   LastName  = andrew.last
```

- A slightly different syntax is used for pointers to structures, for example

```
   struct Person* ptr;
```

- The variable ptr is now a pointer to a structure of type Person. From our previous knowledge about pointers we can use the following to get the value of the first element of the structure that is accessed via ptr

either

```
      (*ptr).first
```

or

```
      ptr->first
```

- Thus **(*ptr).** is equivalent to **ptr->**

The -> operator takes a pointer to a struct, follows the pointer to the structure value and then extracts the field--this is a shorthand, but it makes sense

- We can have arrays of structures, just as we can have arrays of any other data type. This is often quite convenient, and is done in the following way:

```
   struct StructureName VariableName [ size ];
```

- In the case of our Person structure, we could have an initialized array of names formed in the following way:

```
struct  Person  People[ ] = {
   { "Andrew", "Choi" },
   { "Fred", "Flintstone" },
       :
       :
   { NULL, NULL }
};
```

- We can use an explicit NULL value to indicate the end of the array, if we wish.

- We can include pointers to a structure within the declaration of the structure. We might use this technique to build linked lists and binary trees

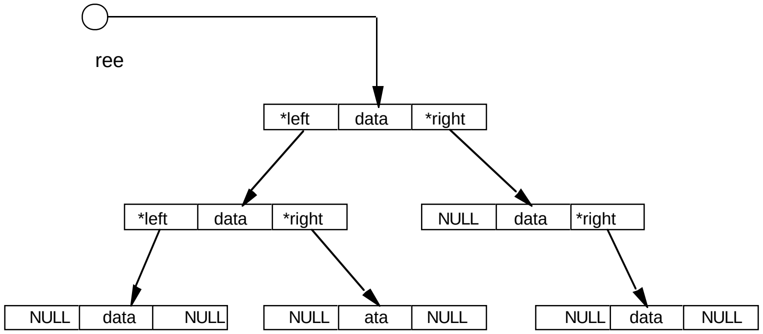
- We can use the following structure declaration for a node in a binary tree

```
typedef  struct  Tnode*  NodePtr;

     struct  Tnode {
          NodePtr  left;
          char  data;
          NodePtr  right;
     };

NodePtr  Tree;
```

- Note that left and right must be pointers to structures, they cannot be structure variables, otherwise we will have a structure that includes two copies of itself



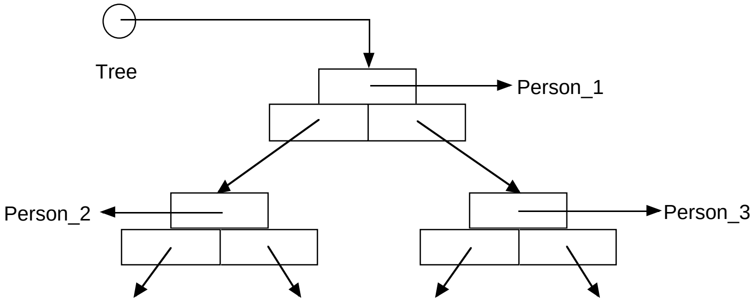
Commonly the data item itself is a pointer to another structure or string. Consider:

```
typedef  struct  Tnode*  NodePtr;

     struct  Tnode {
          struct  Person*  Nameptr;
          NodePtr  left;
          NodePtr  right;
     };

NodePtr  Tree;
```

// Creates only the entry node Tree, not the sample structure below.


Tree
Person_1
Person_2
Person_3