Chapter 11

structs (C++ records)

In CS 1A we worked with a database program. We viewed the data in the database as being stored in records. Each record was a collection of fields. A record then was a complete set of information about a person, place or object and the fields defined the individual components of the record. C++ refers to records as *structs*.

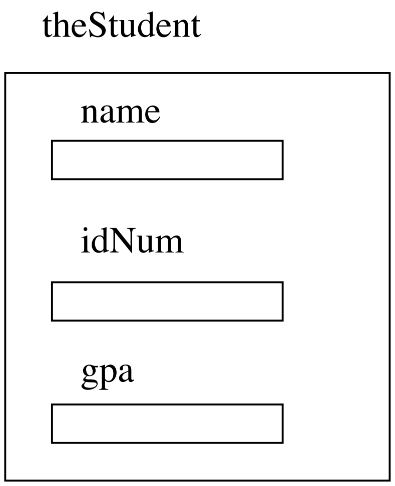
We defined an array as a collection of information all of the same type (homogeneous). A struct then is a collection of information of different data types (heterogeneous). The fields of a struct are referred to as *members*.

```
struct StructName
{
   dataType  memberName;
   .
   .
};
```

Example:

```
struct StudentRec
{
   string name;
   string idNum;
   float gpa;
};

StudentRec  theStudent;
```



The individual members of the struct must be accessed by the name of the struct followed by the name of the member.

theStudent.name = "Sally";
cin >> theStudent.idNum;
cout << theStudent.gpa;

Example:

```
// This program demonstrates the use of a record (C++ struct)
#include <iostream.h>

struct PersonRec
{
  string lastName;
  string firstName;
  int age;
};

void main(void)
{
  PersonRec thePerson;

  cout << "Enter first name: ";
  cin >> thePerson.firstName;
  cout << "Enter last name: ";
  cin >> thePerson.lastName;
  cout << "Enter age: ";
  cin >> thePerson.age;

  cout << "\n\nHello " << thePerson.firstName << ' '
       << thePerson.lastName << ".  How are you?\n";
  cout << "\nCongratulations on reaching the age of "
       << thePerson.age << ".\n";
}
```

```
// This program demonstrates the use of a nested struct
struct GradeRec
{
  float percent;
  char grade;
};

struct StudentRec
{
  string lastName;
  string firstName;
  int age;
  GradeRec courseGrade;
};

void main(void)
{
  StudentRec student;

  cout << "Enter first name: ";
  cin >> student.firstName;
  cout << "Enter last name: ";
  cin >> student.lastName;
  cout << "Enter age: ";
  cin >> student.age;
  cout << "Enter overall percent: ";
  cin >> student.courseGrade.percent;
  if(student.courseGrade.percent >= 90)
  {
    student.courseGrade.grade = 'A';
  }
  else if(student.courseGrade.percent >= 75)
  {
    student.courseGrade.grade = 'B';
  }
  else
  {
    student.courseGrade.grade = 'F';
  }

  cout << "\n\nHello " << student.firstName << ' ' << student.lastName
       << ".  How are you?\n";
  cout << "\nCongratulations on reaching the age of " << student.age
       << ".\n";
  cout << "Your overall percent score is "
       << student.courseGrade.percent << " for a grade of "
       << student.courseGrade.grade;
}
```

OUTPUT:

```
Enter first name: Sally
Enter last name: Smart
Enter age: 19
Enter overall percent: 98

Hello Sally Smart.  How are you?
Congratulations on reaching the age of 19.
Your overall percent score is 98 for a grade of A
```

```
// This program demonstrates the use of an array of structs
#include <iostream.h>

struct PersonRec
{
  string lastName;
  string firstName;
  int age;
};
typedef PersonRec PeopleArrayType[10]; //an array of 10 structs

void main(void)
{
  PeopleArrayType people;    //a variable of the array type

  for (int i = 0; i < 10; i++)
  {
    cout << "Enter first name: ";
    cin >> people[i].firstName;
    cout << "Enter last name: ";
    cin >> people[i].lastName;
    cout << "Enter age: ";
    cin >> people[i].age;
  }

  for (int i = 0; i < 10; i++)
  {
    cout << people[i].firstName << ' ' << people[i].lastName
         << setw(10) << people[i].age;
  }
}
```

```
#include <iostream.h>

struct PersonRec
{
  string lastName;
  string firstName;
  int age;
};

typedef PersonRec PeopleArrayType[10];    //an array of 10 structs

void LoadArray(PeopleArrayType peop);

void main(void)
{

  PeopleArrayType people;    //a variable of the array type

  LoadArray(people);

  // output the array
  for (int i = 0; i < 10; i++)
  {
    cout << people[i].firstName << ‘ ‘ << people[i].lastName
         << setw(10) << people[i].age;
  }
}

void LoadArray(PeopleArrayType peop)
{
  for (int i = 0; i < 10; i++)
  {
    cout << "Enter first name: ";
    cin >> peop[i].firstName;
    cout << "Enter last name: ";
    cin >> peop[i].lastName;
    cout << "Enter age: ";
    cin >> peop[i].age;
  }
}
```

structs and Aggregate Operations

- Aggregate I/O is not allowed. I/O must be performed on a member by member basis.
- Aggregate assignment is allowed. All data members (fields) are copied.
- Aggregate arithmetic is not allowed.
- Aggregate comparison is not allowed. Comparisons must be performed on a member by member basis.
- structs may be passed by value or by reference.
- A struct is a valid return type for a value returning function.

Name(s) ______________________________________ Due Date ____________

Palindrome Lab - struct

Write a C++ program to manage a user-defined string. The program will create a string from the input buffer, output the string and its length, and check the string to determine whether or not it is a palindrome. A palindrome is a string that reads the same forwards and backwards. Examples:

radar
racecar
a man a plan a canal panama

```
struct StringRec
{
    int strLen;
    char theStr[256];
};

void AddChar(StringRec& str, char theCh);      // adds one character to the string
void OutputString(StringRec str);    // outputs the string and the length of the string
bool CheckString(StringRec str);     // returns true if string is a palindrome, false otherwise

void main(void)
{
    StringRec theString;
    char theChar;

    theString.strLen = 0;
    cout << "Enter a string: ";
    cin.get(theChar);
    while(theChar != '\n')
    {
        AddChar(theString, theChar);
        cin.get(theChar);
    }
    OutputString(theString);
    if( CheckString(theString) )
        cout << "\n\nThe string is a palindrome";
    else
        cout << "\n\nThe string is not a palindrome";
}
```