Computer Programming (b)

E1124

Lecture 9

Records (structs)

INSTRUCTOR

DR / AYMAN SOLIMAN

Contents

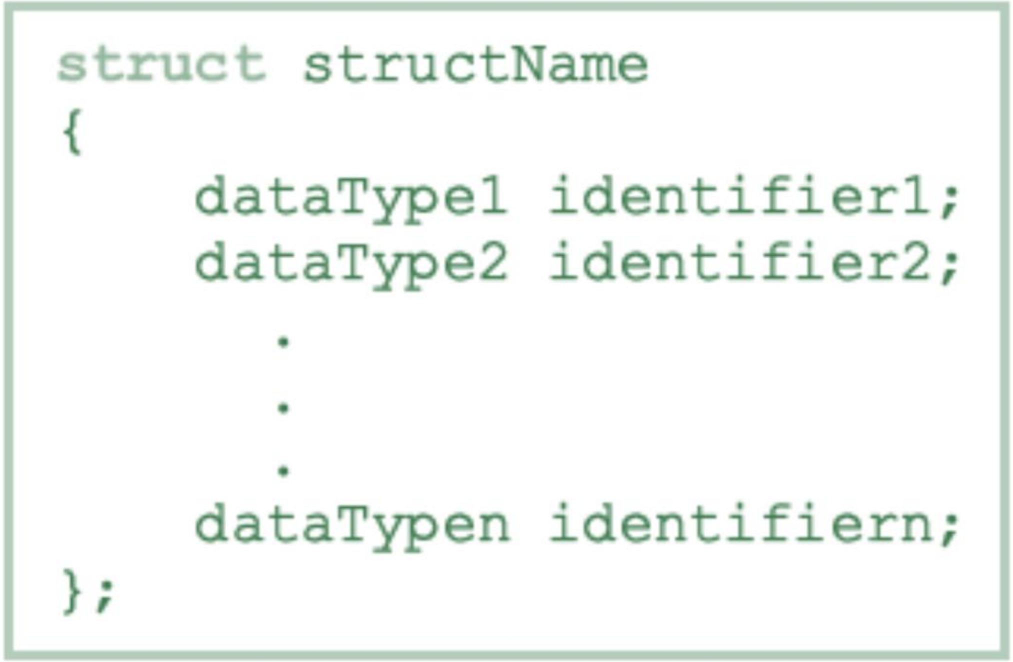
- Objectives
- Records (structs)
- Accessing struct Members
- Assignment
- struct Variables and Functions
- Arrays versus structs
- structs within a struct

Objectives

- Learn about records (structs)
- Examine various operations on a struct
- Explore ways to manipulate data using a struct
- Learn about the relationship between a struct and functions
- Discover how arrays are used in a struct
- Learn how to create an array of struct items

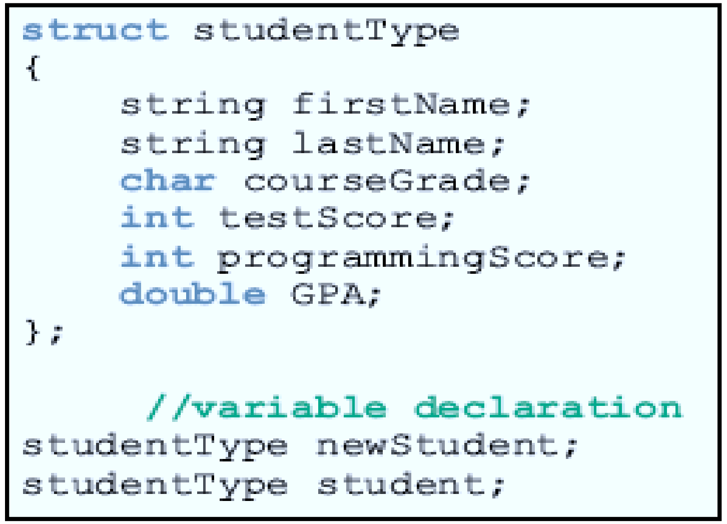
Records (structs)

- **struct**: collection of a fixed number of components (members), accessed by name
- A struct is a definition, not a declaration
- Members may be of different types
- Syntax:

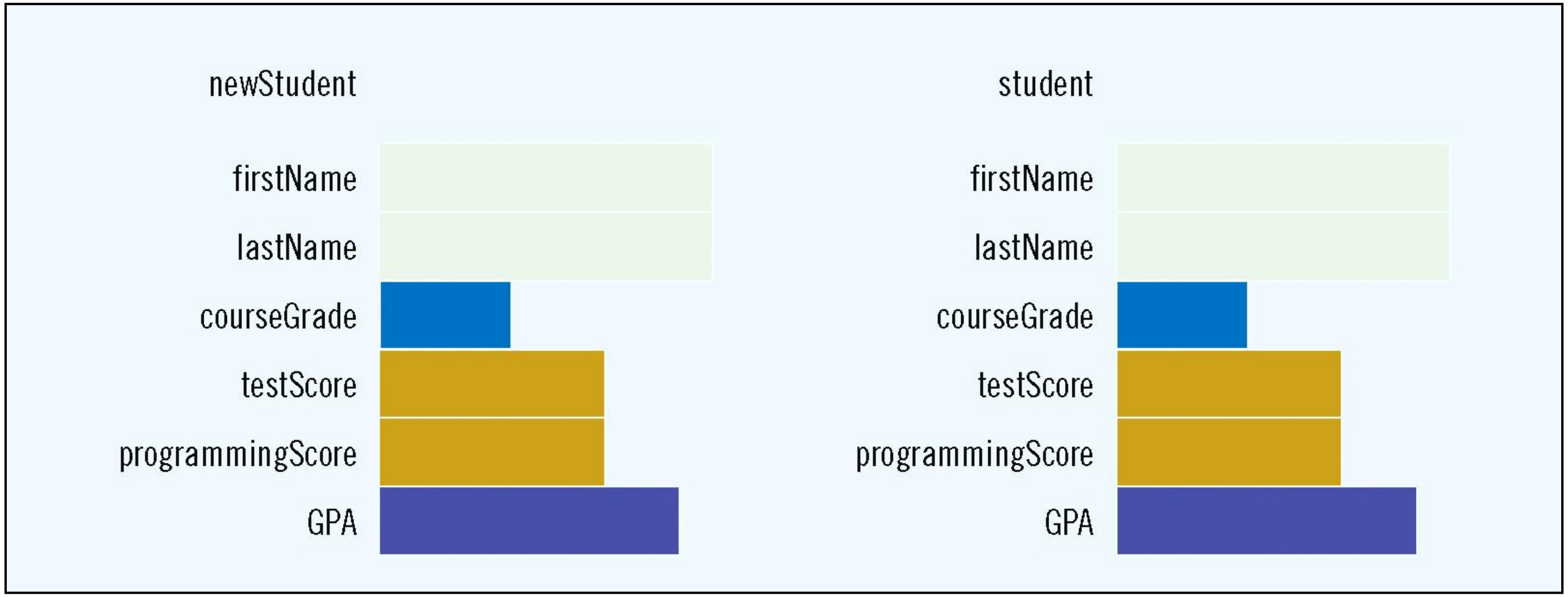


```
struct structName
{
    dataType1 identifier1;
    dataType2 identifier2;
        .
        .
        .
    dataTypen identifiern;
};
```

➢ Records (structs)

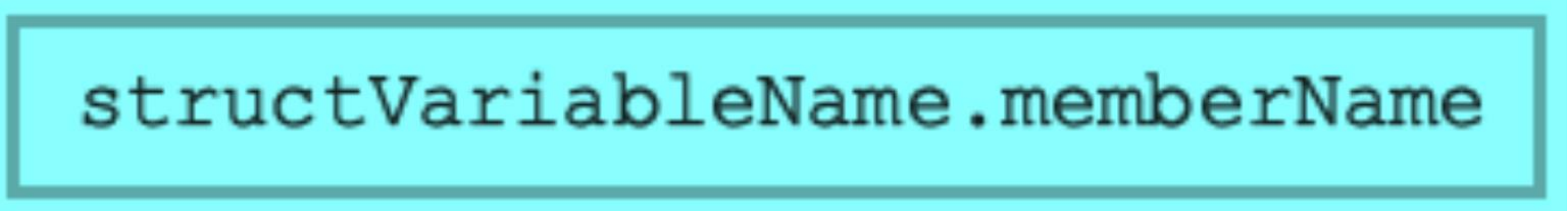


```
struct studentType
{
     string firstName;
     string lastName;
     char courseGrade;
     int testScore;
     int programmingScore;
     double GPA;
};

      //variable declaration
studentType newStudent;
studentType student;
```



Accessing struct Members

- The syntax for accessing a struct member is:



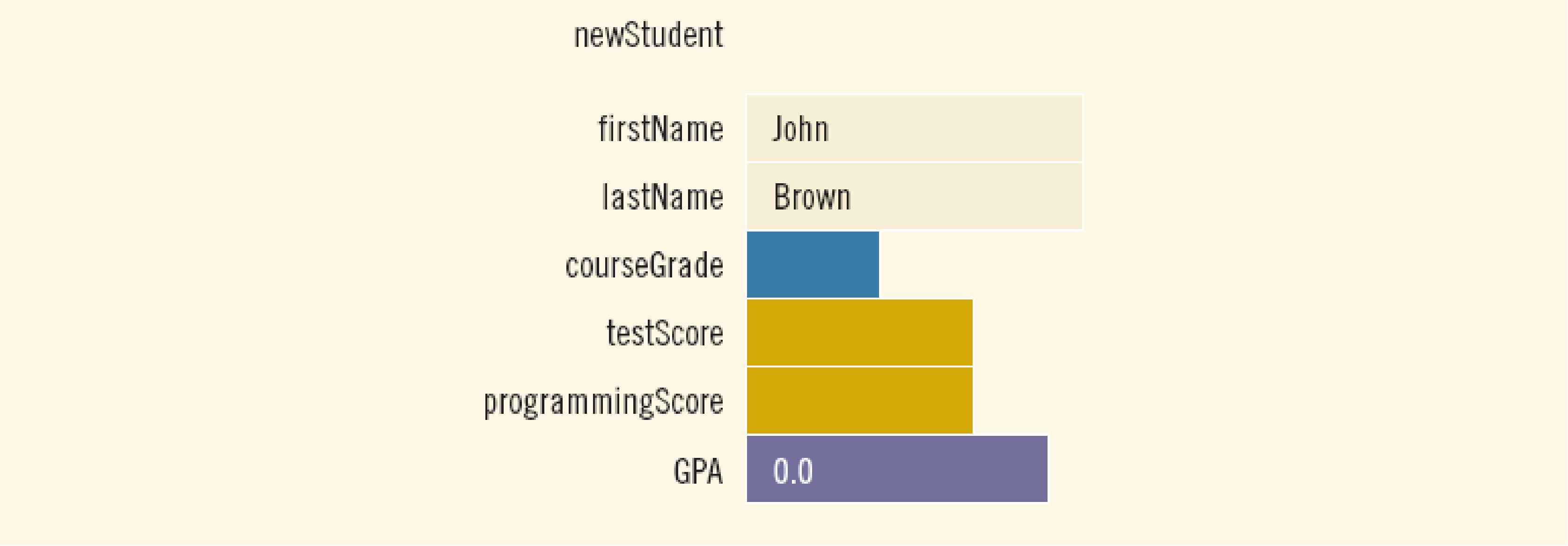
```
structVariableName.memberName
```

- The dot (.) is an operator, called the member access operator

Accessing struct Members (cont.)

- To initialize the members of newStudent:

```
newStudent.GPA = 0.0;
newStudent.firstName = "John";
newStudent.lastName = "Brown";
```

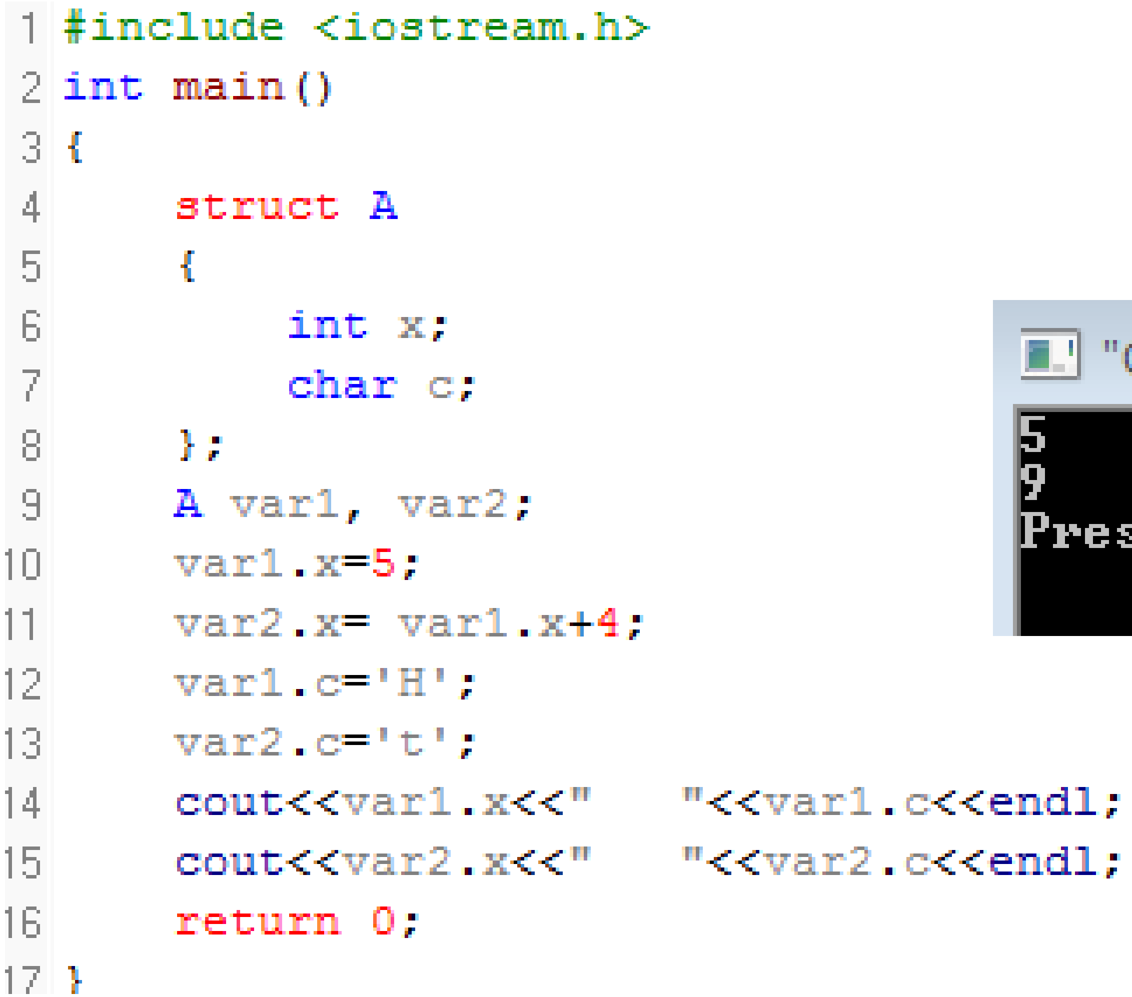


Accessing struct Members (cont.)

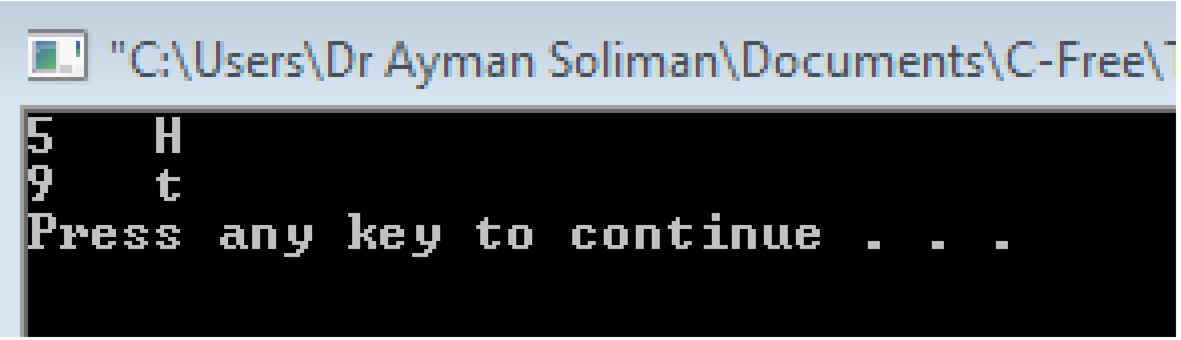
More examples:

```
cin >> newStudent.firstName;
cin>>newStudent.testScore>>newStudent.programmingScore;
score = (newStudent.testScore + newStudent.programmingScore) / 2;
if (score >= 90)
    newStudent.courseGrade = 'A';
else if (score >= 80)
    newStudent.courseGrade = 'B';
else if (score >= 70)
    newStudent.courseGrade = 'C';
else if (score >= 60)
    newStudent.courseGrade = 'D';
else
    newStudent.courseGrade = 'F';
```

➢ Example 1



```
#include <iostream.h>
int main()
{
    struct A
    {
        int x;
        char c;
    };
    A var1, var2;
    var1.x=5;
    var2.x= var1.x+4;
    var1.c='H';
    var2.c='t';
    cout<<var1.x<<"   "<<var1.c<<endl;
    cout<<var2.x<<"   "<<var2.c<<endl;
    return 0;
}
```



"C:\Users\Dr Ayman Soliman\Documents\C-Free\

```
5    H
9    t
Press any key to continue . . .
```

➢ Assignment

- ➢ Value of one struct variable can be assigned to another struct variable of the same type using an assignment statement
- ➢ The statement:

```
student = newStudent;
```

- ➢ copies the contents of newStudent into student

Assignment (cont.)

- The assignment statement:

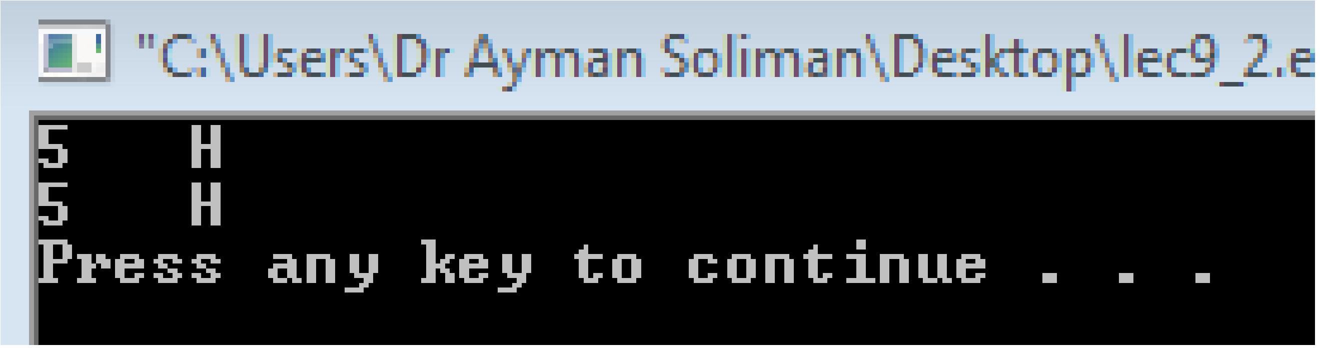
```
student = newStudent;
```

- is equivalent to the following statements:

```
student.firstName = newStudent.firstName;
student.lastName = newStudent.lastName;
student.courseGrade = newStudent.courseGrade;
student.testScore = newStudent.testScore;
student.programmingScore = newStudent.programmingScore;
student.GPA = newStudent.GPA;
```

➢ Example 2

```cpp
#include <iostream.h>
int main()
{
    struct A
    {
        int x;
        char c;
    };
    A var1, var2;
    var1.x=5;
    var1.c='H';
    var2=var1;
    cout<<var1.x<<"   "<<var1.c<<endl;
    cout<<var2.x<<"   "<<var2.c<<endl;
    return 0;
}
```



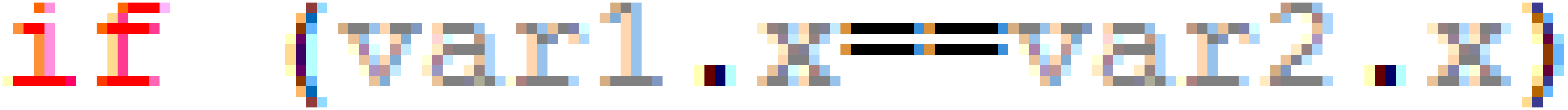
"C:\Users\Dr Ayman Soliman\Desktop\lec9_2.e

```
5   H
5   H
Press any key to continue . . .
```

➢ Comparison (Relational Operators)

- ➢ Compare struct variables member-wise

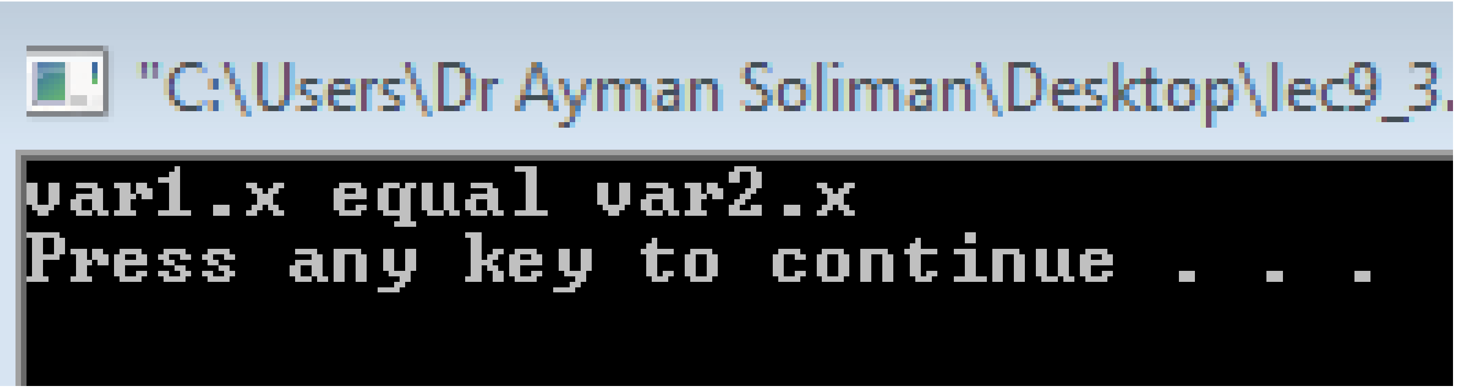
- ➢ To compare the values of var1 and var2:



```
if (var1.x==var2.x)
```

➢ Example 3

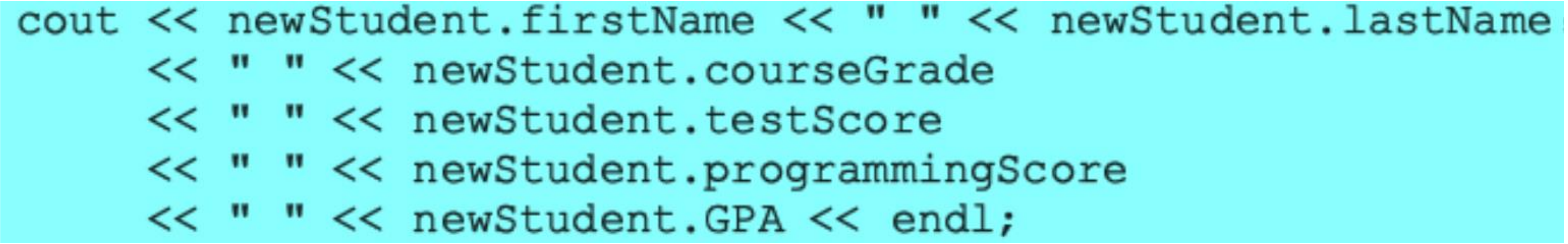
```cpp
#include <iostream.h>
int main()
{
    struct A
    {
        int x;
        char c;
    };
    A var1, var2;
    var1.x=5;
    var2.x= 5;
    var1.c='H';
    var2.c='t';
    if (var1.x==var2.x)
        cout<<"var1.x"<<" equal "<<"var2.x"<<endl;
        else
        cout<<"not equal"<<endl;
        return 0;
}
```



```
var1.x equal var2.x
Press any key to continue . . .
```

➢ Input/output

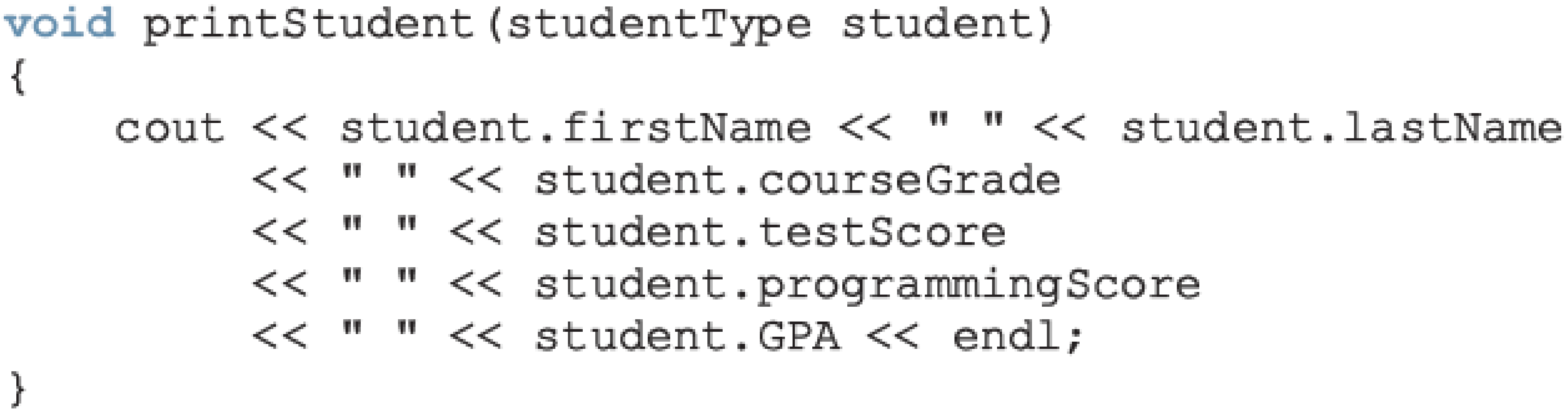
- ➢ No aggregate input/output operations on a struct variable
- ➢ Data in a struct variable must be read one member at a time
- ➢ The contents of a struct variable must be written one member at a time



```
cout << newStudent.firstName << " " << newStudent.lastName
     << " " << newStudent.courseGrade
     << " " << newStudent.testScore
     << " " << newStudent.programmingScore
     << " " << newStudent.GPA << endl;
```

➢ struct Variables and Functions

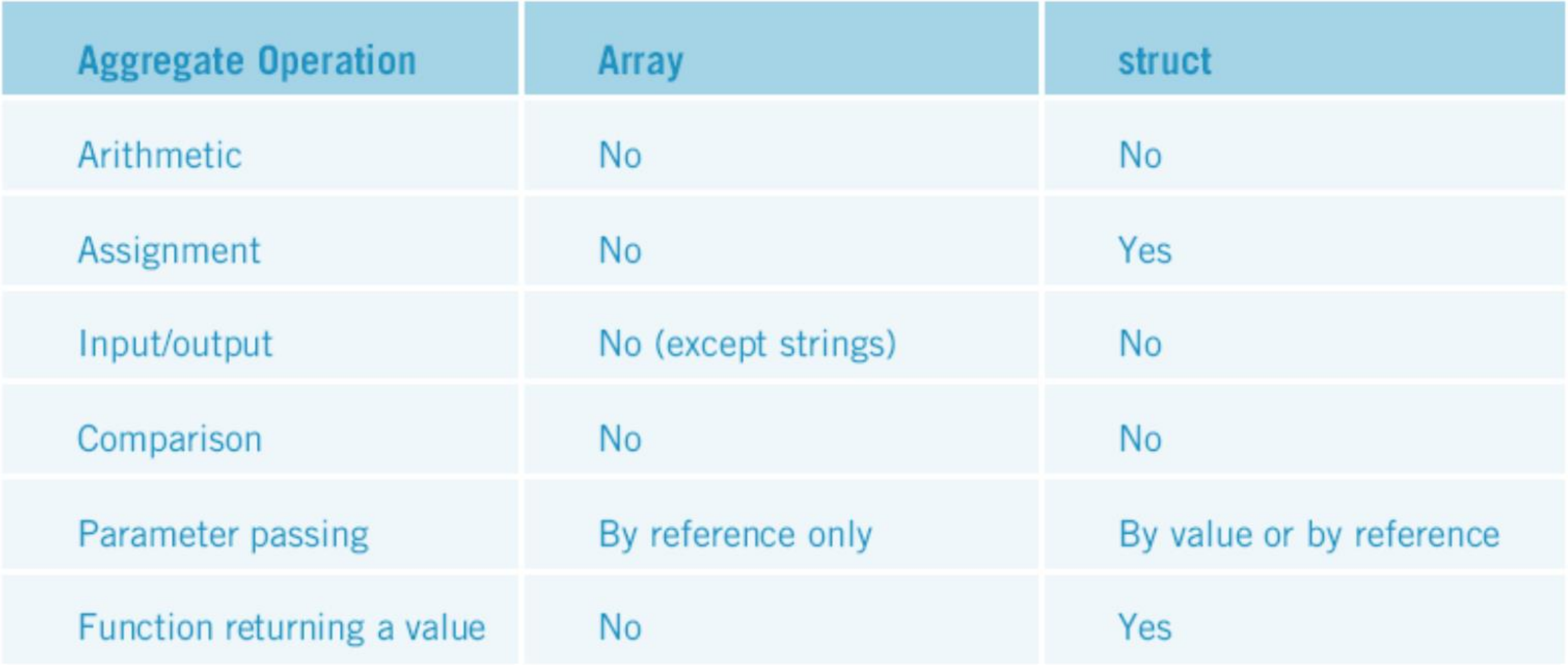
- ➢ A struct variable can be passed as a parameter by value or by reference



```
void printStudent(studentType student)
{
    cout << student.firstName << " " << student.lastName
         << " " << student.courseGrade
         << " " << student.testScore
         << " " << student.programmingScore
         << " " << student.GPA << endl;
}
```

- ➢ A function can return a value of type struct

➢ Arrays versus structs



Aggregate Operation	Array	struct
Arithmetic	No	No
Assignment	No	Yes
Input/output	No (except strings)	No
Comparison	No	No
Parameter passing	By reference only	By value or by reference
Function returning a value	No	Yes

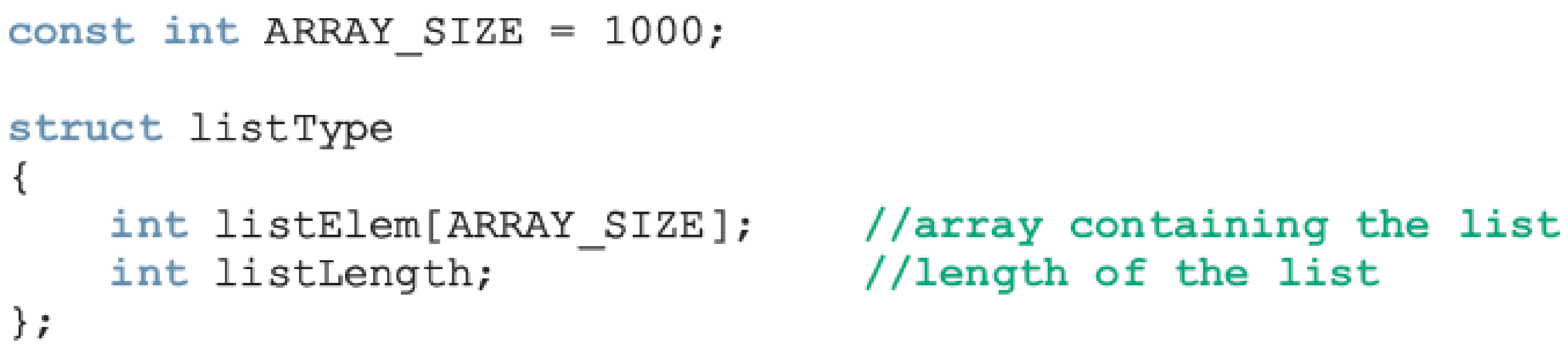
Arrays in structs

- Two key items are associated with a list:

  Values (elements)

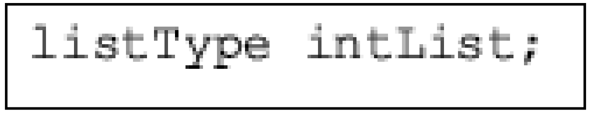
  Length of the list

- Define a struct containing both items:

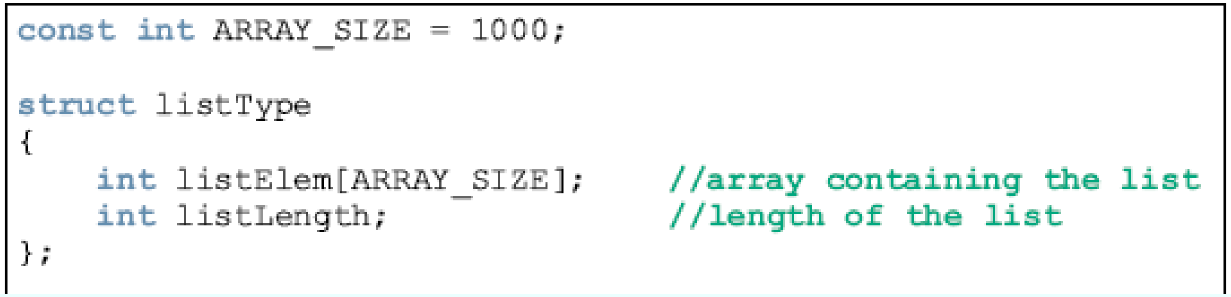


```
const int ARRAY_SIZE = 1000;

struct listType
{
    int listElem[ARRAY_SIZE];    //array containing the list
    int listLength;              //length of the list
};
```

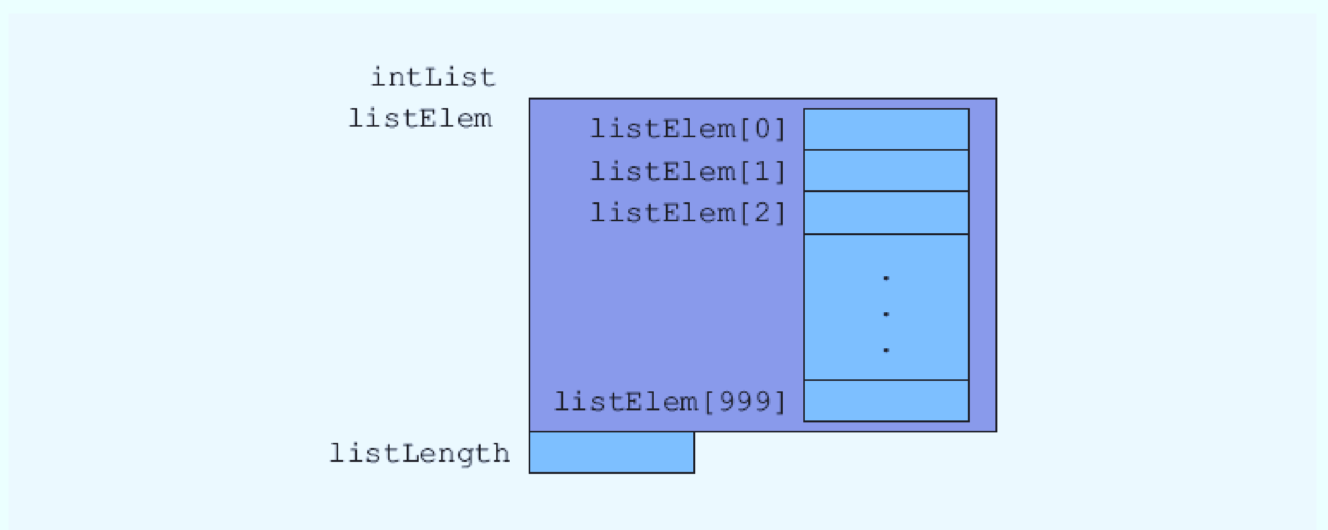
Arrays in structs



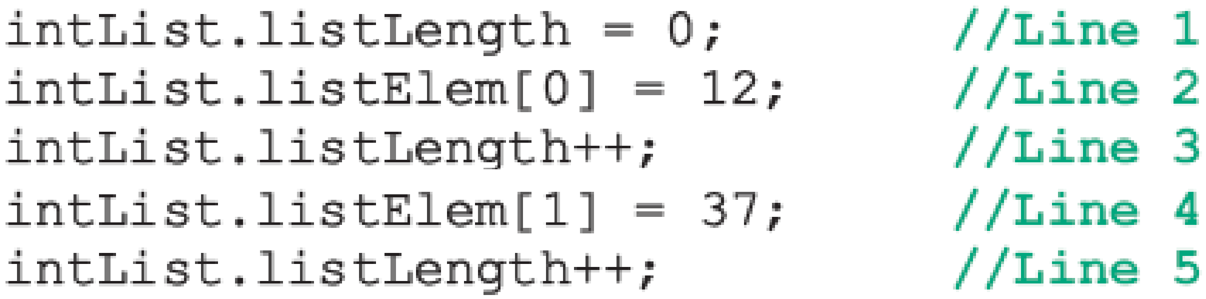
```
listType intList;
```



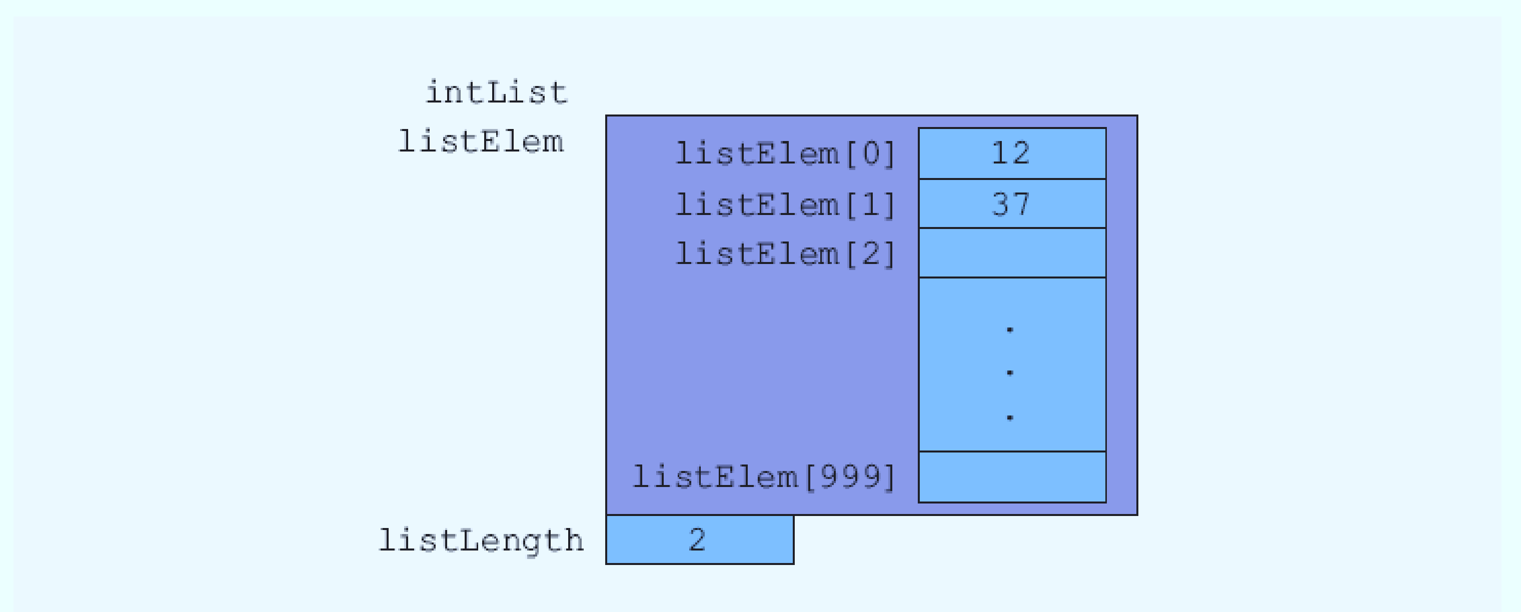
```
const int ARRAY_SIZE = 1000;

struct listType
{
    int listElem[ARRAY_SIZE];     //array containing the list
    int listLength;               //length of the list
};
```



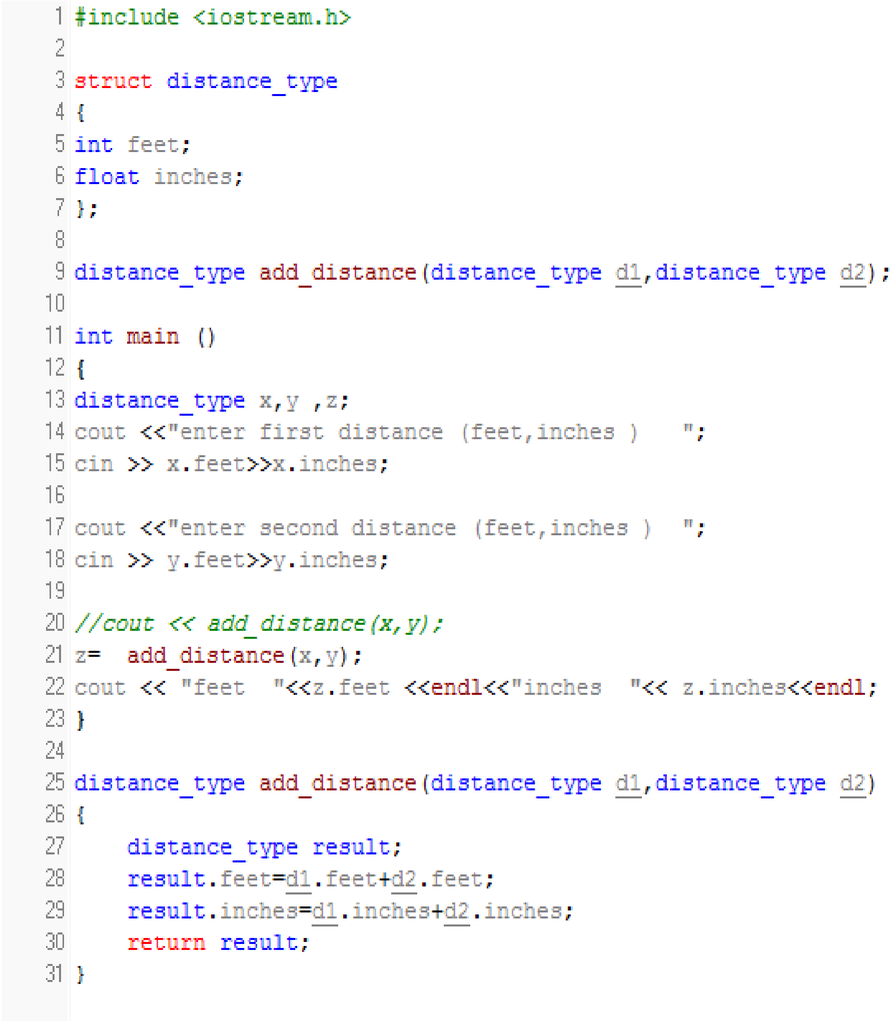
➢ Arrays in structs



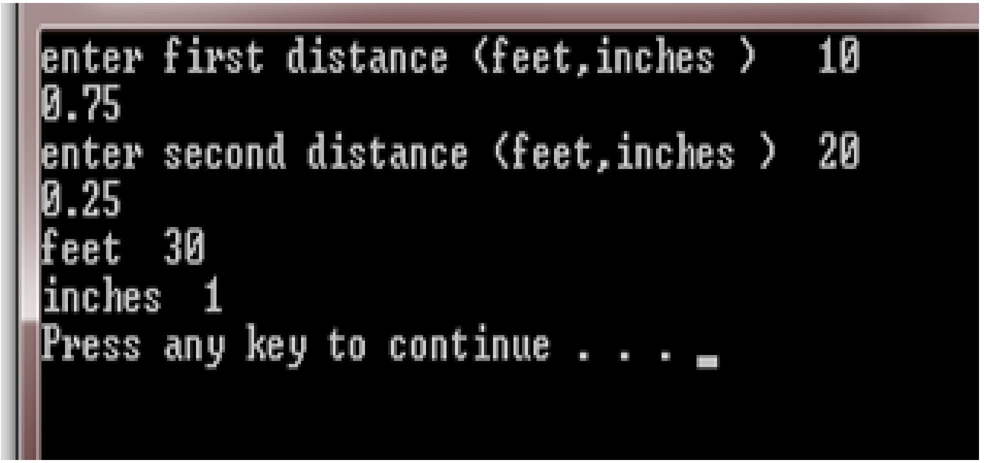
```
intList.listLength = 0;          //Line 1
intList.listElem[0] = 12;        //Line 2
intList.listLength++;            //Line 3
intList.listElem[1] = 37;        //Line 4
intList.listLength++;            //Line 5
```



➢ Example 4

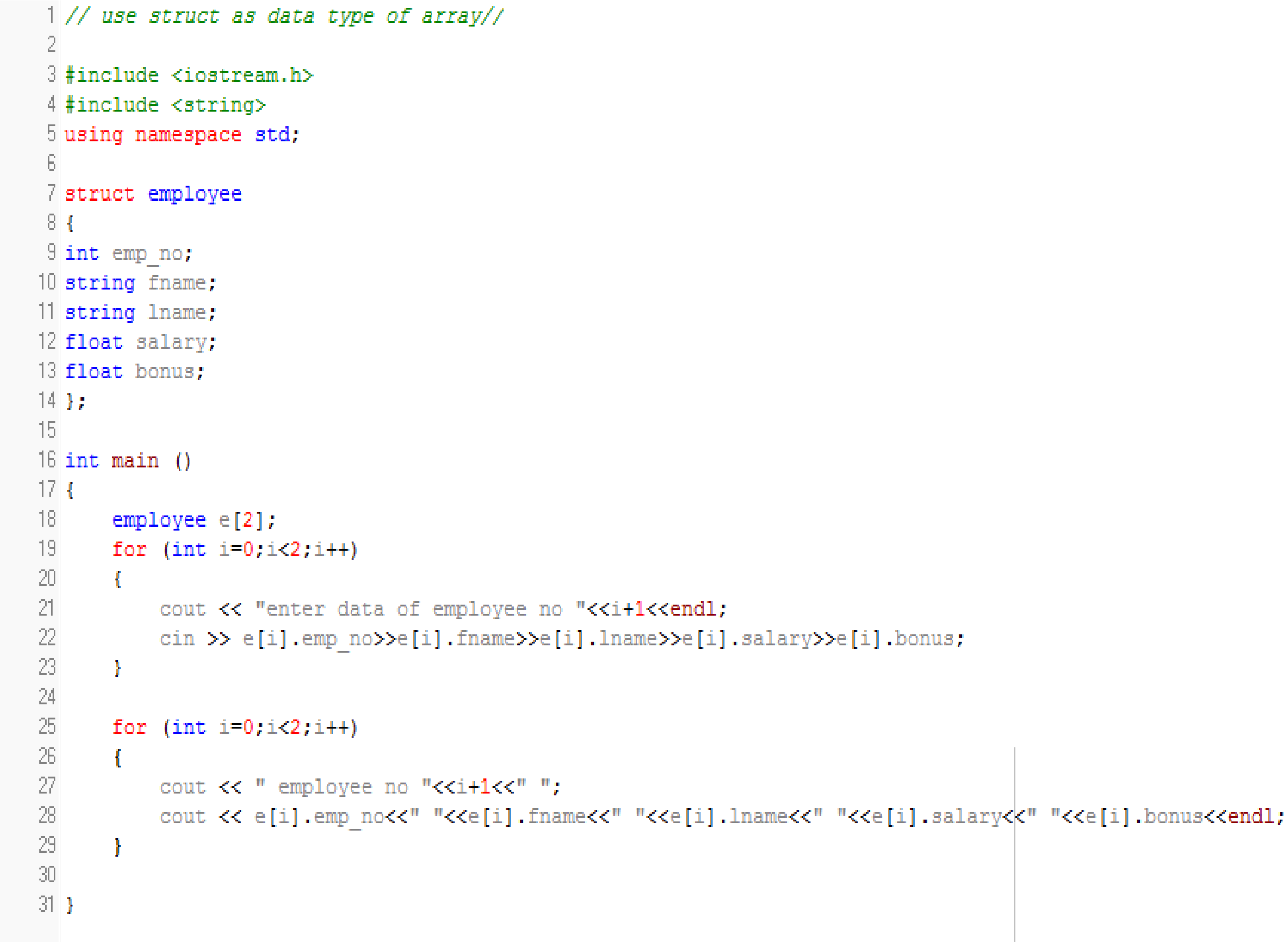


```
#include <iostream.h>

struct distance_type
{
int feet;
float inches;
};

distance_type add_distance(distance_type d1,distance_type d2);

int main ()
{
distance_type x,y ,z;
cout <<"enter first distance (feet,inches )   ";
cin >> x.feet>>x.inches;

cout <<"enter second distance (feet,inches )   ";
cin >> y.feet>>y.inches;

//cout << add_distance(x,y);
z=  add_distance(x,y);
cout << "feet  "<<z.feet <<endl<<"inches  "<< z.inches<<endl;
}

distance_type add_distance(distance_type d1,distance_type d2)
{
    distance_type result;
    result.feet=d1.feet+d2.feet;
    result.inches=d1.inches+d2.inches;
    return result;
}
```

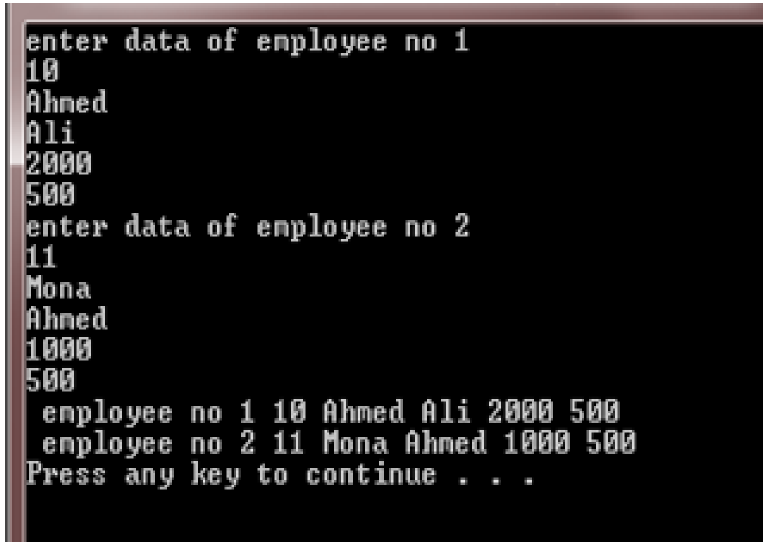


```
enter first distance (feet,inches )   10
0.75
enter second distance (feet,inches )  20
0.25
feet  30
inches  1
Press any key to continue . . . _
```

➢ struct in Array



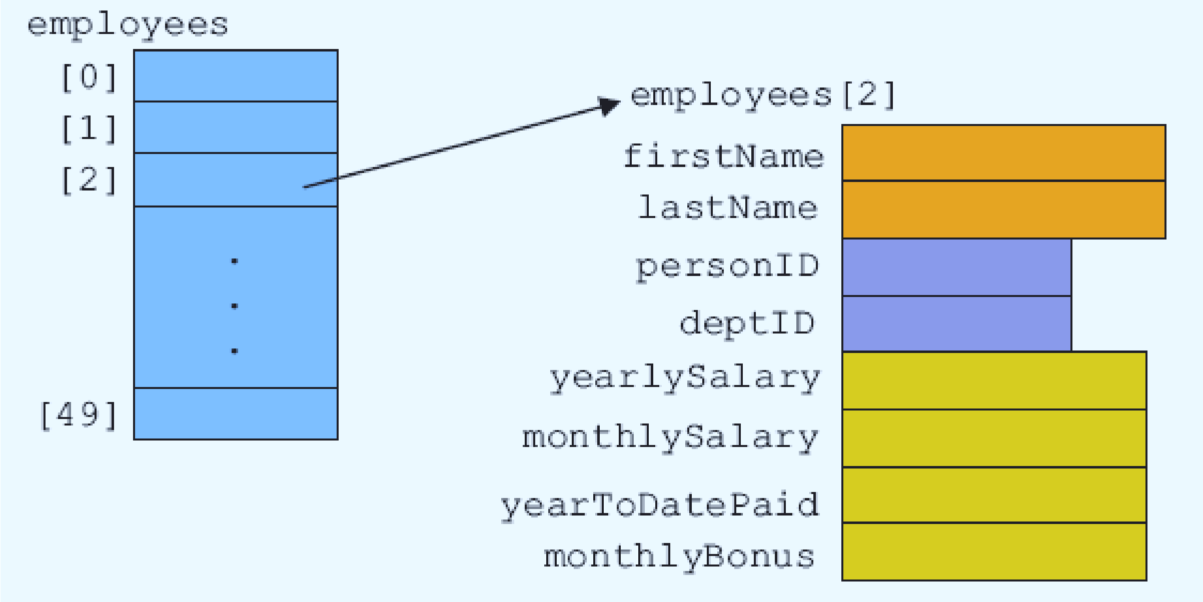
```cpp
// use struct as data type of array//

#include <iostream.h>
#include <string>
using namespace std;

struct employee
{
int emp_no;
string fname;
string lname;
float salary;
float bonus;
};

int main ()
{
    employee e[2];
    for (int i=0;i<2;i++)
    {
        cout << "enter data of employee no "<<i+1<<endl;
        cin >> e[i].emp_no>>e[i].fname>>e[i].lname>>e[i].salary>>e[i].bonus;
    }

    for (int i=0;i<2;i++)
    {
        cout << " employee no "<<i+1<<" ";
        cout << e[i].emp_no<<" "<<e[i].fname<<" "<<e[i].lname<<" "<<e[i].salary<<" "<<e[i].bonus<<endl;
    }

}
```

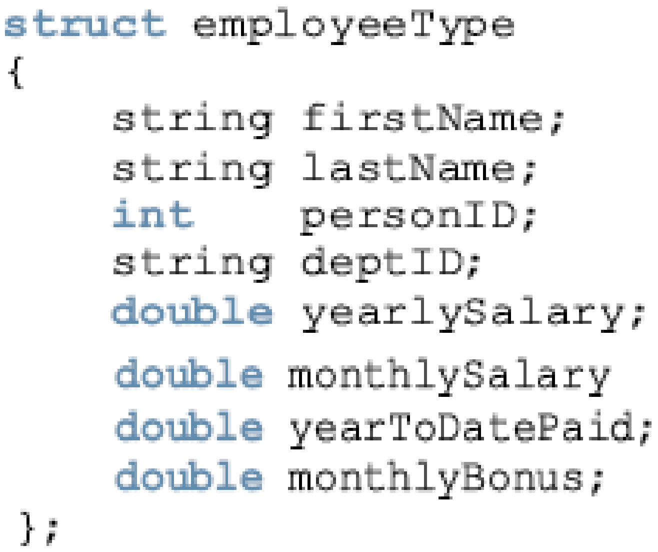


```
enter data of employee no 1
10
Ahmed
Ali
2000
500
enter data of employee no 2
11
Mona
Ahmed
1000
500
 employee no 1 10 Ahmed Ali 2000 500
 employee no 2 11 Mona Ahmed 1000 500
Press any key to continue . . .
```

➢ Example 5

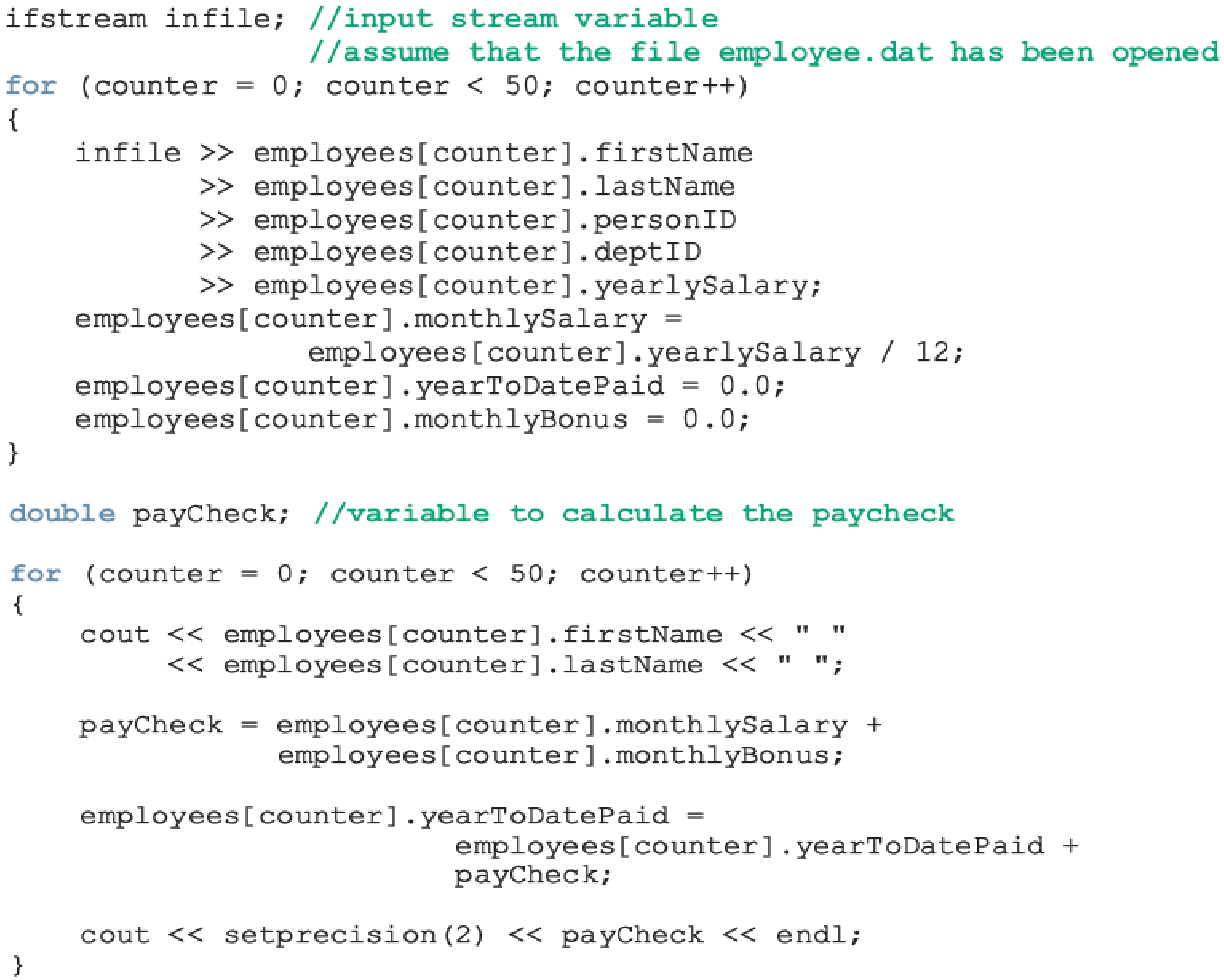
```
employeeType employees[50];
```





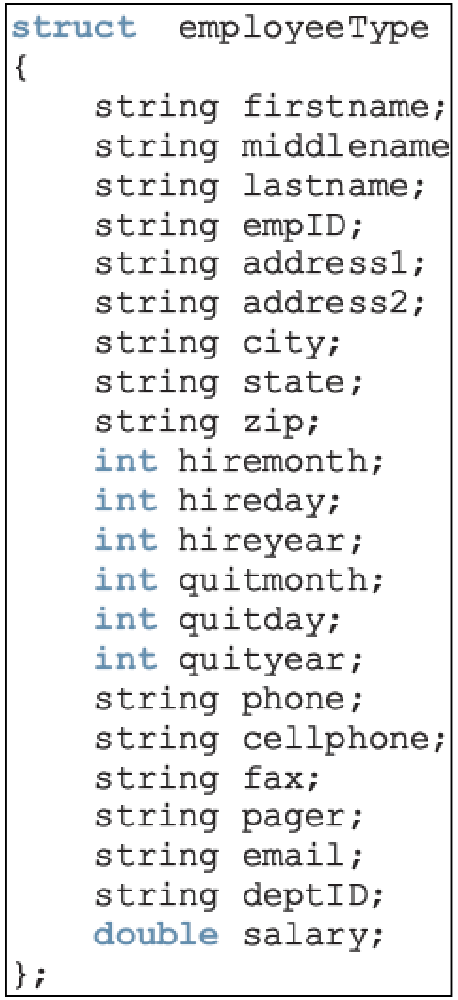
```
struct employeeType
{
      string firstName;
      string lastName;
      int    personID;
      string deptID;
      double yearlySalary;
      double monthlySalary
      double yearToDatePaid;
      double monthlyBonus;
};
```

➢ Example 5



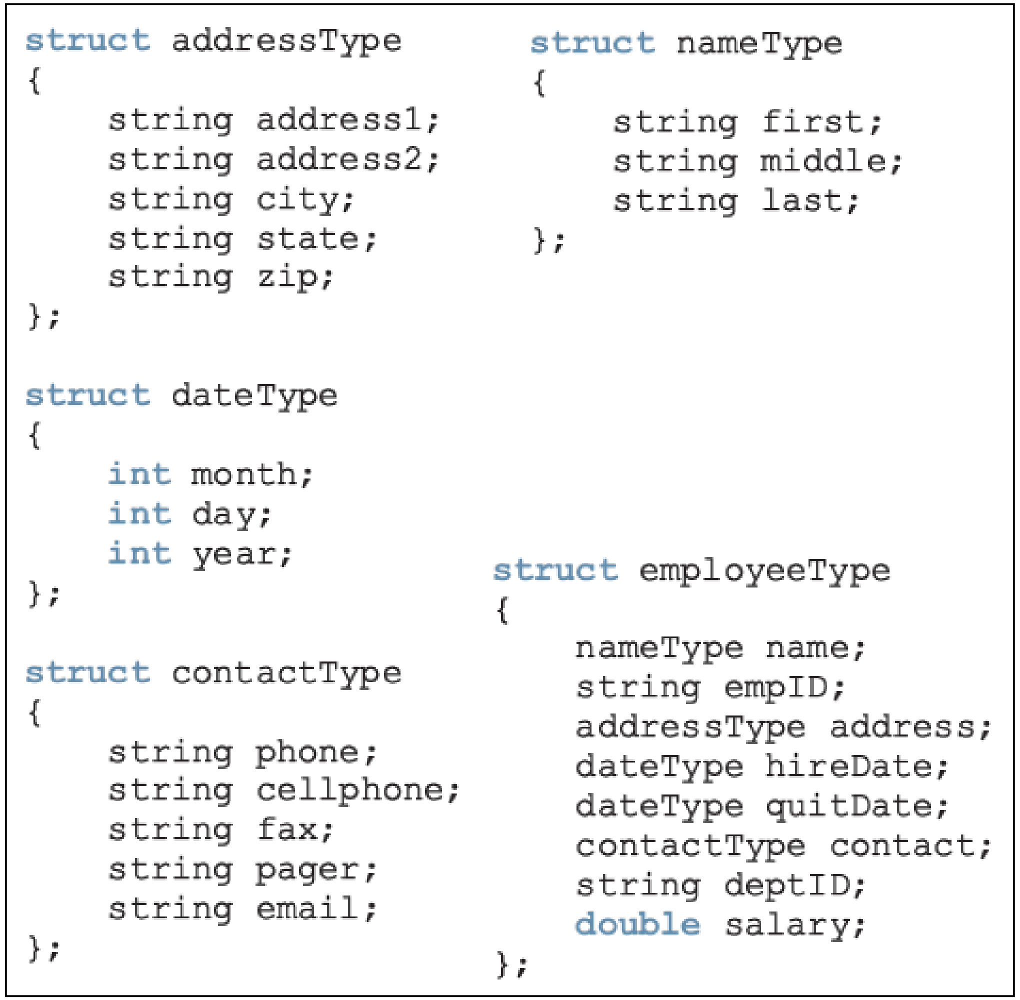
```
ifstream infile; //input stream variable
                 //assume that the file employee.dat has been opened
for (counter = 0; counter < 50; counter++)
{
    infile >> employees[counter].firstName
           >> employees[counter].lastName
           >> employees[counter].personID
           >> employees[counter].deptID
           >> employees[counter].yearlySalary;
    employees[counter].monthlySalary =
                 employees[counter].yearlySalary / 12;
    employees[counter].yearToDatePaid = 0.0;
    employees[counter].monthlyBonus = 0.0;
}

double payCheck; //variable to calculate the paycheck

for (counter = 0; counter < 50; counter++)
{
    cout << employees[counter].firstName << " "
         << employees[counter].lastName << " ";

    payCheck = employees[counter].monthlySalary +
               employees[counter].monthlyBonus;

    employees[counter].yearToDatePaid =
                         employees[counter].yearToDatePaid +
                         payCheck;

    cout << setprecision(2) << payCheck << endl;
}
```

➢ structs within a struct



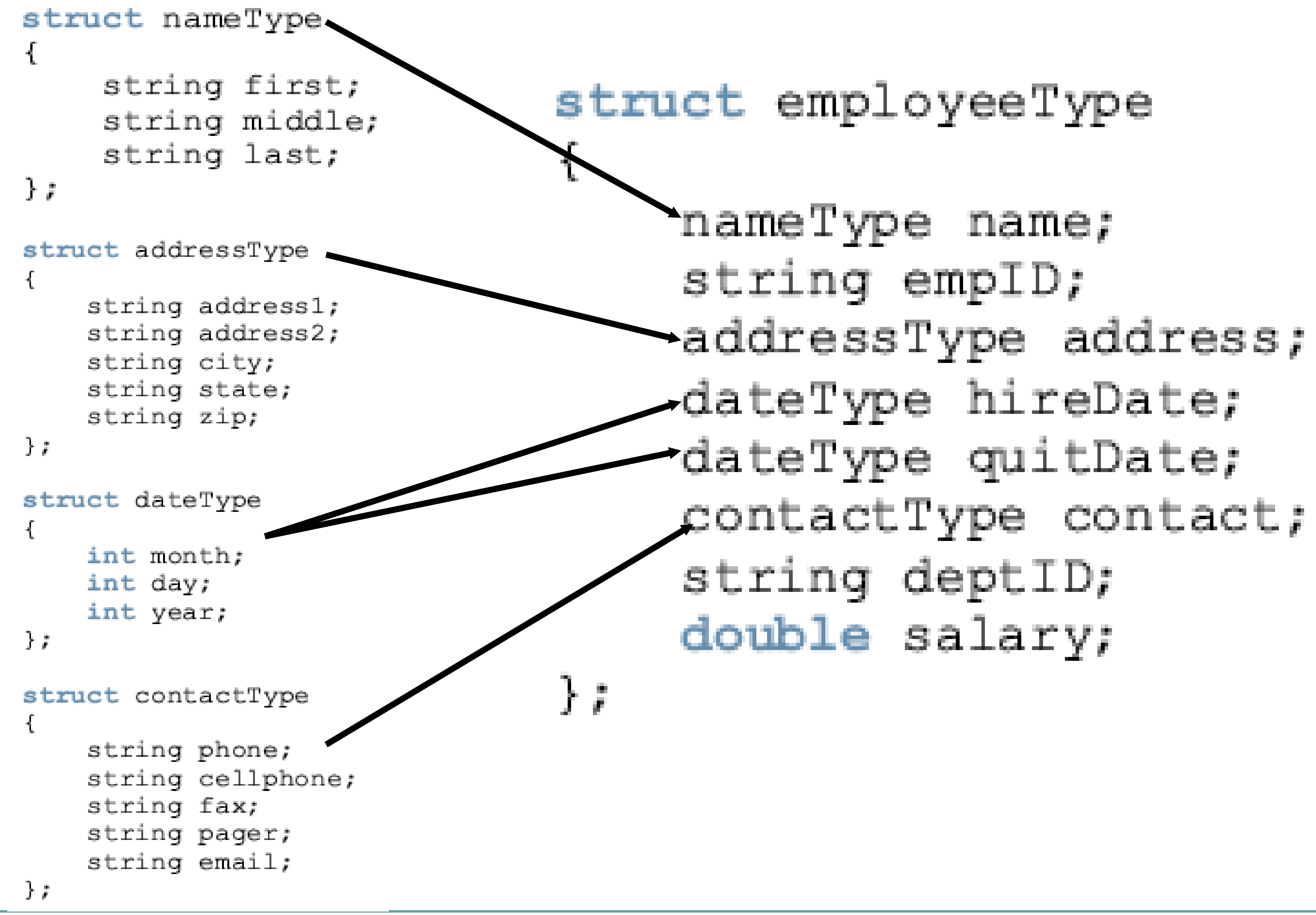
```
struct  employeeType
{
    string firstname;
    string middlename
    string lastname;
    string empID;
    string address1;
    string address2;
    string city;
    string state;
    string zip;
    int hiremonth;
    int hireday;
    int hireyear;
    int quitmonth;
    int quitday;
    int quityear;
    string phone;
    string cellphone;
    string fax;
    string pager;
    string email;
    string deptID;
    double salary;
};
```

versus



```
struct addressType
{
    string address1;
    string address2;
    string city;
    string state;
    string zip;
};

struct dateType
{
    int month;
    int day;
    int year;
};

struct contactType
{
    string phone;
    string cellphone;
    string fax;
    string pager;
    string email;
};
```

```
struct nameType
{
    string first;
    string middle;
    string last;
};

struct employeeType
{
    nameType name;
    string empID;
    addressType address;
    dateType hireDate;
    dateType quitDate;
    contactType contact;
    string deptID;
    double salary;
};
```

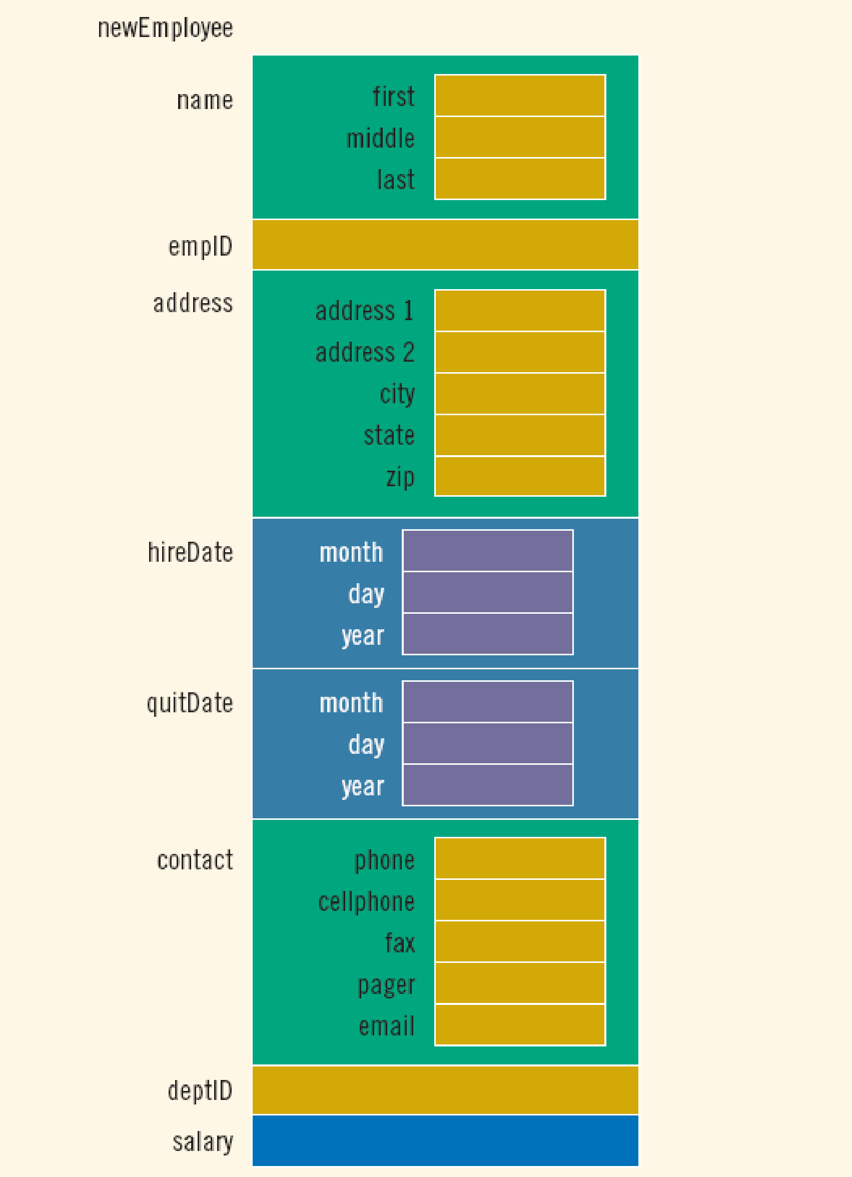


```
struct nameType
{
    string first;
    string middle;
    string last;
};

struct addressType
{
    string address1;
    string address2;
    string city;
    string state;
    string zip;
};

struct dateType
{
    int month;
    int day;
    int year;
};

struct contactType
{
    string phone;
    string cellphone;
    string fax;
    string pager;
    string email;
};
```

```
struct employeeType
{
    nameType name;
    string empID;
    addressType address;
    dateType hireDate;
    dateType quitDate;
    contactType contact;
    string deptID;
    double salary;
};
```

➢ Memory locations

```
employeeType newEmployee;
```



Thank you