L E S S O N S E T

12 Advanced File Operations

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| --- | --- | --- |
| PURPOSE | 1. | To review the basic concept of files |
|  | 2. | To understand the use of random access files |
|  | 3. | To understand and use various types of files (binary and text) |
| PROCEDURE | 1. | Students should read the Pre-lab Reading Assignment before coming to lab. |
|  | 2. | Students should complete the Pre-lab Writing Assignment before coming to lab. |
|  | 3. | In the lab, students should complete labs assigned to them by the instructor. |

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| --- | --- | --- | --- | --- |
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| Pre-lab Writing Assignment | Pre-lab reading | 10 min. | 231 |  |
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| (Optional) | of basic I/O |  |  |  |
| Lab 12.2  Files as Parameters and | Understanding of get | 20 min. | 233 |  |
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| Lab 12.3  Binary Files and the | Completion of all | 30 min. | 235 |  |
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# P R E - LA B R E A D I N G A S S I G N M E N T

## Review of Text Files

Opening Files

Chapter three introduced the basic use of files for input and output. We briefly review those concepts in this section.

A file is a collection of information stored (usually) on a disk. Files, just like vari- ables, have to be defined in the program. The data type of a file depends on whether it is used as an input file, output file, or both. Output files have a data type called ofstream, input files have a data type of ifstream, and files used as both have the data type fstream. We must add the #include <fstream> direc- tive when using files.

*Examples:*

ofstream outfile; // defining outfile as an output file ifstream infile; // defining infile as an input file

fstream datafile; // defining datafile to be both an input and

// output file

After their definition, files must still be opened, used (information stored to or data read from the file), and then closed.

A file is opened with the open function. This ties the logical name of the file that is used in the definition to the physical name of the file used in the secondary storage device (disk). The statement infile.open("payroll.dat"); opens the file payroll.dat and lets the program know that infile is the name by which this file will be referenced within the program. If the file is not located in the same directory as the C++ program, the full path (drive, etc.) MUST be indicated: infile.open("a:\\payroll.dat"); This tying of the **logical name** infile with the **physical name** payroll.dat means that wherever infile is used in the program, data will be read from the physical file payroll.dat. A program should check to make sure that the physical file exists. This can be done by a conditional statement.

*Example*:

ifstream infile; infile.open("payroll.dat"); if (!infile)

{

cout << Error opening file. It may not exist were indicated.\n; return 1;

}

In the previous example, return 1 is used as an indicator of an abnormal occur- rence. In this case the file in question can not be found.

## Reading from a File

Files have an “invisible” end of line marker at the end of each line of the file. Files also have an invisible end of file marker at the end of the file. When reading from an input file within a loop, the program must be able to detect that marker as the sentinel data (data that meets the condition to end the loop). There are several ways to do this.

*Sample Program 12.1*:

#include <fstream> #include <iostream> #include <iomanip> using namespace std;

int main()

{

ifstream infile; // defining an input file ofstream outfile; // defining an output file

infile.open("payroll.dat");

// This statement opens infile as an input file.

// Whenever infile is used, data from the file payroll.dat

// will be read.

outfile.open("payment.out");

// This statement opens outfile as an output file.

// Whenever outfile is used, information will be sent

// to the file payment.out

int hours; // The number of hours worked float payRate; // The rate per hour paid float net; // The net pay

if (!infile)

{

cout << "Error opening file.\n";

cout << "Perhaps the file is not where indicated.\n"; return 1;

}

outfile << fixed << setprecision(2);

outfile << "Hours Pay Rate Net Pay" << endl; infile >> hours; // priming the read

while (infile)

{

infile >> payRate; net = hours \* payRate;

*continues*

outfile << hours << setw(10) << "$ " << setw(6)

<< payRate << setw(5) << "$ " << setw(7)

<< net << endl;

infile >> hours;

}

infile.close(); outfile.close();

return 0;

}

Notice the statement outfile << fixed << setprecision(2); in the above pro- gram. This shows that the format procedures learned for cout can be used for out- put files as well. Remember that setw(x) can be used as long as the iomanip header file is included.

This program assumes that a data file exists and contains an undetermined number of records with each record consisting of two data values, hours and payRate. Suppose the input data file (payroll.dat) contains the following:

|  |  |
| --- | --- |
| 40 | 10.00 |
| 30 | 6.70 |
| 50 | 20.00 |

The program will produce the following output file (payment.out).

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

The input file contains data for one employee on each line. Each time through the while loop, information is processed for one employee. The loop executes the same number of times as there are lines (employee records in this case) in the data file. Since there are two items of data for each line (hours and payRate), these items are read in each time through the loop. Notice that one of the input variables was input before the while loop. This is called “priming the read.” Input can be thought of as a stream of values taken one at a time. Before the while loop condition can be tested, there has to be something in that stream. We **prime** the read by reading in at least one variable before the loop. Observe that the state- ment infile >> hours; is given twice in the program: once before the input loop and as the last statement in the loop. The other item, payRate, is read in at the very beginning of the loop. This way each variable is read every time through the loop. Also notice that the heading of the output file is printed out- side the loop before it is executed.

There are other ways of determining when the end of the file is reached. The eof( ) function reports when the end of a file is encountered. The loop in Sample Program 12.1 can be replaced with the following:

infile >> hours;

**while (!infile.eof())**

{

infile >> payRate; net = hours \* payRate;

outfile << hours << setw(10) << "$ " << setw(6) << payRate << setw(5)

<< "$ " << setw(7) << net << endl; infile >> hours;

}

In addition to checking to see if a file exists, we can also check to see if it has any data in it. The following code checks first if the file exists and then if it is empty.

inData.open("sample2.dat");

**if(!inData)**

cout << "file does not exist" << endl; else **if((else if (inData.peek()) == EOF)**

cout << "File is empty" << endl; else

//rest of program

The peek function actually looks ahead in the file for the next data item, in this case to determine if it is the end of file marker. ch must be defined as char data type.

Since the peek function looks “ahead” for the next data item, it can be used to test for end of file in reading values from a file within a loop without priming the read.

The following program accomplishes the same thing as Sample Program 12.1 with- out priming the read. The portions in bold differ from Sample Program 12.1.

*Sample Program 12.2:*

#include <fstream> #include <iostream> #include <iomanip> using namespace std;

int main()

{

ifstream infile; // defining an input file ofstream outfile; // defining an output file

infile.open("payroll.dat");

// This statement opens infile as an input file.

// Whenever infile is used, data from the file payroll.dat

// will be read.

outfile.open("payment.out");

// This statement opens outfile as an output file.

*continues*

// Whenever outfile is used, information will be sent

// to the file payment.out

int hours; // The number of hours worked float payRate; // The rate per hour paid float net; // The net pay

**char ch; // ch is used to hold the next value**

**// (read as character) from the file**

if (!infile)

{

cout << "Error opening file.\n";

cout << "Perhaps the file is not where indicated.\n"; return 1;

}

outfile << fixed << setprecision(2);

outfile << "Hours Pay Rate Net Pay" << endl;

**while ((ch = infile.peek()) != EOF)**

{

infile >> hours; infile >> payRate; net = hours \* payRate;

outfile << hours << setw(10) << "$ " << setw(6)

<< payRate << setw(5) << "$ " << setw(7)

<< net << endl;

}

infile.close(); outfile.close();

return 0;

}

## Output Files

Output files are opened the same way: outfile.open("payment.out"). Whenever the program writes to outfile, the information will be placed in the physical file payment.out. Notice that the program generates a file stored in the same location as the source file. The user can indicate a different location for the file to be stored by indicating the full path (drive, etc.).

## Files Used for Both Input and Output

A file can be used for both input and output. The fstream data type, which is used for files that can handle both input and output, must have a **file access flag** as an argument to the open function so that the mode, input or output, can be determined. There are several access flags that are used to indicate the use of the file. The following chart lists frequently used access flags.

**Flag mode Meaning**

ios::in Input mode. The file is used for “reading” information. If the file does not exist, it will not be created.

ios::out Output mode. Information is written to the file. If the file already exists, its contents will be deleted.

ios::app Append mode. If the file exists, its contents are preserved and all output is written to the end of the file. If it does not exist then the file will be created. Notice how this differs from ios::out.

ios::binary Binary mode. Information is written to or read from in pure binary format (discussed later in this chapter).

*Example:*

**#include <fstream> using namespace std;**

int main()

{

fstream test ("grade.dat", ios::out)

// test is defined as an fstream file first used for output

// ios::out is the file access flag

// code of the program goes here

// the code will put values in the test file

test.close(); // close the file as an output file test.open("grade.dat", ios::in)

// the same file is reopened now as an input file

// ios::in is the file access flag

// other code goes here

test.close(); // close the file

}

In the following example, we check for a file’s existence before opening it. We first attempt to open the file for input. If the file does not exist, then the open oper- ation fails and we open it as an output file.

*Example:*

fstream dataFile; dataFile.open("grades.txt", ios::in); if (dataFile.fail())

// The fail directive indicates the file did not open

// since it does not exist

{

// The file does not exist, so create it.

dataFile.open("grades.txt", ios::out);

// file is processed here: data sent to the file

}

else // the file already exists.

{

cout << "The file grades.txt already exists. \n";

// process file here dataFile.close();

## Closing a File

}

Just as cin >> is used to read from the keyboard and cout << is used to write to the screen, filename >> is used to read from the file filename and filename << is used to write to the file filename.

Files should be closed before the program ends to avoid corrupting the file and/ or losing valuable data.

infile.close(); outfile.close(); dataFile.close();

## Passing Files as Parameters to Functions

Files can be passed as parameters just like variables. Files are always passed by reference. The & symbol must be included after the data type in the function heading and prototype.

*Example:*

void GetData(ifstream& infile, ofstream& outfile); // prototype of function

// with files as parameters

void GetData(ifstream& infile, ofstream& outfile) // heading of function with

// files as parameters

## Review of Character Input

Chapter 10 introduced the basics of characters and strings. We briefly review those concepts since they apply to files as well.

Recall that each file has an end of line marker for each line as well as the end of file marker at the end of the file. Whenever whitespace (blanks, newlines, controls, etc.) is part of a file, a problem exists with the traditional >> operator in inputting character data. When reading input characters into a string object, the

>> operator skips any leading whitespace. It then reads successive characters into the character array, stopping at the first trailing whitespace character (which is NOT consumed, but rather which remains as the next character to be read in the file). The >> operator also takes care of adding the null character to the end of the string. Stopping at the first trailing whitespace creates a problem for names containing spaces. A program reading first names into some string variable (array of characters) has a problem reading a name like Mary Lou since it has a blank space in it. The blank space between Mary and Lou causes the input to stop when using the >> operator. The get function can be used to input such strings.

infile.get(firstname, 20);

The get function does NOT skip leading whitespace characters but rather con- tinues to read characters until it either has read, in the example above, 19 char- acters or it reaches the newline character \n (which it does NOT consume). Recall from Lesson Set 10 that the last space is reserved for the null character.

Since the get function does not consume the end of line character, there must be something done to consume it so that a new line can be read.

*Example:* Given the following data file

Mary Lou <eol> Becky <eol>

Debbie <eol>

<eof>

Note: Both the <eol> and <eof> are NOT visible to the programmer or user.

There are several options for reading and printing this data.

char dummy; // created to read the end of line character char firstname[80]; // array of characters for the first name outfile << "Name " << endl;

**infile.get(firstname,80);** // priming the read inputs the first name

while(infile)

{

**infile.get(dummy);** // reads the end of line character into dummy outfile << firstname << endl; // outputs the name **infile.get(firstname,80);** // reads the next name

}

In the above example, dummy is used to consume the end of line character. input.get(firstname,80); reads the string Mary Lou and stops just before read- ing the <eol> end of line character. The infile.get(dummy) gets the end of line character into dummy.

Another way to do this is with the ignore function, which reads characters until it encounters the specific character it has been instructed to look for or until it has

skipped the allotted number of characters, whichever comes first. The statement infile.ignore(81,'\n') skips up to 81 characters stopping if the new line '\n' character is encountered. This newline character IS consumed by the function, and thus there is no need for a dummy character variable.

*Example:*

char firstname[80];

outfile << "Name " << endl; infile.get(firstname,80);

while(!infile.fail())

{

**infile.ignore(81,'\n');** // read and consume the end of line character outfile << firstname << endl;

infile.get(firstname,80);

}

The following sample program shows how names with embedded whitespace along with numeric data can be processed. Parts in bold indicate the changes from Sample Program 12.2. Assume that the payroll.dat file has the following infor- mation:

|  |  |  |
| --- | --- | --- |
| John Brown | 40 | 10.00 |
| Kelly Barr | 30 | 6.70 |
| Tom Seller | 50 | 20.00 |

The program will produce the following information in payment.out:

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Hours** | **Pay Rate** | **Net Pay** |
| John Brown | 40 | $10.00 | $ 400.00 |
| Kelly Barr | 30 | $ 6.70 | $ 201.00 |
| Tom Seller | 50 | $20.00 | $1000.00 |

*Sample Program 12.3:*

#include <fstream> #include <iostream> #include <iomanip> using namespace std;

const int MAX\_NAME = 11;

int main()

{

ifstream infile; // defining an input file ofstream outfile; // defining an output file

infile.open("payroll.dat");

// This statement opens infile as an input file.

// Whenever infile is used, data from the file payroll.dat

// will be read.

outfile.open("payment.out");

// This statement opens outfile as an output file.

// Whenever outfile is used, information will be sent

// to the file payment.out

|  |  |  |
| --- | --- | --- |
| int hours; | // | The number of hours worked |
| float payRate; | // | The rate per hour paid |
| float net; | // | The net pay |
| char ch; | // | ch is used to hold the next value |
|  | // | (read as character) from the file |
| **char name[MAX\_NAME];** | **//** | **array of characters for the name of** |
|  | **//** | **a student, with at most 10 characters** |
| if (!infile)  { | |  |

cout << "Error opening file.\n";

cout << "Perhaps the file is not where indicated.\n"; return 1;

}

outfile << fixed << setprecision(2);

outfile << **"Name** Hours Pay Rate Net Pay" << endl;

while ((ch = infile.peek()) != EOF) // no need to prime the read

{

**infile.get(name,MAX\_NAME); // gets names with blanks**

infile >> hours; infile >> payRate;

**infile.ignore(81,'\n'); // ignores the rest of the line**

**// and consumes end of line marker**

net = hours \* payRate;

outfile << **name << setw(10) <<** hours << setw(10) << "$ "

<< setw(6) << payRate << setw(5) << "$ " << setw(7)

<< net << endl;

}

infile.close(); outfile.close();

return 0;

}

Another way to read in lines containing whitespace characters is with the getline member function.

*Example:*

char firstName[80]; outfile << "Name " << endl;

**infile.getline(firstName,81);**

while (infile)

{

outfile << firstName << endl;

**intfile.getline(firstName,81);**

}

## Binary Files

So far all the files we have talked about have been text files, files formatted as ASCII text.1 Even the numbers written to a file with the << operator are changed to ASCII text. ASCII is a code that stores every datum (letter of the alphabet, digit, punctuation mark, etc.) as a character with a unique number. Although ASCII text is the default method for storing information in files, we can specify that we want to store data in pure binary format by “opening” a file in binary mode with the ios::binary flag. The write member function is then used to write binary data to the file. This method is particularly useful for transferring an entire array of data to a file. Binary files are efficient since they store everything as 1s or 0s rather than as text.

*Example:*

**fstream test("grade.dat", ios::out | ios::binary);** // This defines and opens

// the file test as an

// output binary file

int grade[arraysize] = {98, 88, 78, 77, 67, 66, 56, 78, 98, 56}; // creates and

// initializes

// an integer

// array **test.write((char\*)grade, sizeof(grade));** // write all values of array to file test.close(); // close the file

**test.write((char\*)grade, sizeof(grade));** in the above example calls the

write function. The name of the file to be written to is test. The first argument is a character pointer pointing to the starting address of memory, in this case to the beginning of the grade array. The second argument is the size in bytes of the item written to the file. sizeof is a function that determines the size.

1 Or some other alphanumberic code.

The following sample program initializes an array and then places those val- ues into a file as binary numbers. The program then adds 10 to each element of the array and prints those values to the screen. Finally the program reads the val- ues from the same file and prints them. These values are the original numbers. Study the program and its comments very carefully.

*Sample Program 12.4:*

#include <fstream> #include <iostream> using namespace std;

const int ARRAYSIZE = 10;

int main()

{

fstream test("grade.dat", ios::out | ios::binary);

// note the use of | to separate file access flags

int grade[ARRAYSIZE] = {98,88,78,77,67,66,56,78,98,56};

int count; // loop counter

test.write((char\*)grade, sizeof(grade));

// write values of array to file test.close(); // close file

// now add 10 to each grade

cout << "The values of grades with 10 points added\n"; for (count =0; count < ARRAYSIZE; count++)

{

grade[count] = grade[count] + 10;

// this adds 10 to each elemnt of the array cout << grade[count] << endl;

// write the new values to the screen

}

test.open("grade.dat", ios::in);

// reopen the file but now as an input file test.read((char\*) grade, sizeof(grade));

/\* The above statement reads from the file test and places the values found into the grade array. As with the write function, the first argument is a character pointer even though the array itself is an integer. It points to the starting address in memory where the file information is to be transferred

\*/

*continues*

cout << "The grades as they were read into the file” << endl;

for (count =0; count < ARRAYSIZE; count++)

{

cout << grade[count] << endl;

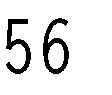
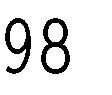
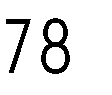
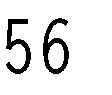
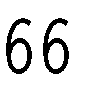
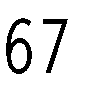
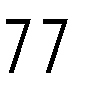
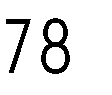
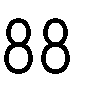
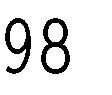
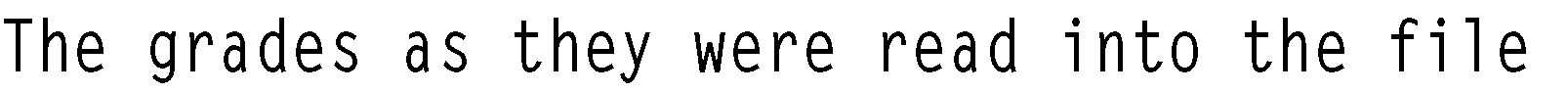
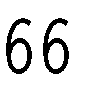
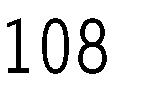
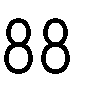
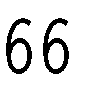
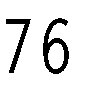
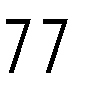
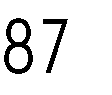
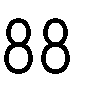
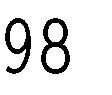
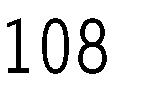
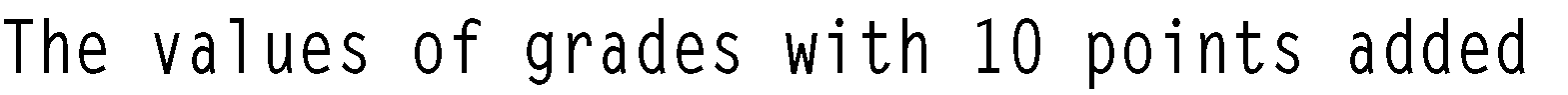
// write the original values to the screen

}

test.close(); return 0;

}

The output to the screen from this program is as follows:



## Files and Records

Files are often used to store records. A “field” is one piece of information and a “record” is a group of fields that logically belong together in a unit.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Example:* | **Name** | **Test1** | **Test2** | **Final** |
|  | Brown | 89 | 97 | 88 |
|  | Smith | 99 | 89 | 97 |

Each record has four fields: Name, Test1, Test2, and Final. When records are stored in memory, rather than in files, C++ structures provide a good way to organize and store them.

struct Grades

{

char name[10]; int test1;

int test2; int final;

};

An identifier defined to be a Grades structure can hold one record.

The write function, mentioned in the previous section, can be used to write records to a file.

fstream test("score.dat", ios::out|ios::binary);

Grades student; // defines a structure variable

// code that gets information into the student record

**test.write((char \*) &student, sizeof(student));**

The test.write function used to write a record stored as a struct is similar to the write function used for an array with one big difference. Notice the inclusion of (&). Why is this necessary here and not when writing an array? In this exam- ple we need to pass by reference which requires the (&) symbol. Arrays are passed by pointer. The following sample program takes records from the user and stores them into a binary file.

*Sample Program 12.5:*

#include <fstream> #include <iostream>

#include <cctype> // for toupper function using namespace std;

const int NAMESIZE = 31;

struct Grades // declaring a structure

{

};

int main()

{

char name[NAMESIZE]; int test1;

int test2; int final;

fstream tests("score.dat", ios::out | ios::binary);

// defines tests as an output binary file

Grades student; // defines student as a record (struct) char more; // used to determine if there is more input

do

{

cout << "Enter the following information" << endl; cout << "Student’s name: "; **cin.getline(student.name,NAMESIZE);**

*continues*

cout << "First test score :"; cin >> student.test1;

**cin.ignore(); // ignore rest of line**

cout << "Second test score: "; cin >> student.test2; **cin.ignore();**

cout << "Final test score: "; cin >> student.final; **cin.ignore();**

// write this record to the file

**tests.write((char \*) &student, sizeof(student));**

cout << "Enter a y if you would like to input more data\n "; cin >> more;

**cin.ignore();**

} while (toupper(more) == 'Y');

}

## Random Access Files

tests.close(); return 0;

All the files studied thus far have performed **sequential file access**, which means that all data is read or written in a sequential order. If the file is opened for input, data is read starting at the first byte and continues sequentially through the file’s contents. If the file is opened for output, bytes of data are written sequentially. The writing usually begins at the beginning of the file unless the ios::app mode is used, in which case data is written to the end of the file. C++ allows a program to perform **random file access**, which means that any piece of data can be accessed at any time. A cassette tape is an example of a sequential access medi- um. To listen to the songs on a tape, one has to listen to them in the order they were recorded or fast forward (reverse) through the tape to get to a particular song. A CD has properties of a random access medium. One simply jumps to the track where a song is located. It is not truly random access, however, since one can not jump to the middle of a song.

There are two file stream member functions that are used to move the read/write position to any byte in the file. The seekp function is used for output files and seekg is used for input files.

Example:

dataOut.seekp(30L, ios::beg);

This instruction moves the marker position of the file called dataOut to 30 posi- tions from the beginning of the file. The first argument, 30L (L indicates a long integer), represents an offset (distance) from some point in the file that will be

used to move the read/write position. That point in the file is indicated by the sec- ond argument (ios::beg). This access flag indicates that the offset is calculated from the beginning of the file. The offset can be calculated from the end (ios::end) or from the current (ios::cur) position in the file.

If the eof marker has been set (which means that the position has reached the end of the file), then the member function clear must be used before seekp or seekg is used.

Two other member functions may be used for random file access: tellp and tellg. They return a long integer that indicates the current byte of the file’s read/write position. As expected, tellp is used to return the write position of an output file and tellg is used to return the read position of an input file.

Assume that a data file letterGrades.txt has the following single line of infor- mation:

ABCDEF

Marker positions always begin with 0. The mapping of the characters to their posi- tion is as follows:

A B C D E F 0 1 2 3 4 5

The following sample program demonstrates the use of seekg and tellg.

*Sample Program 12.6:*

#include <iostream> #include <fstream> #include <cctype> using namespace std;

int main()

{

fstream inFile("letterGrades.txt", ios::in); long offset; // used to hold the offset

// of the read position from

// some point

char ch; // holds character read at some

// position in the file

char more; // used to indicate if more information

// is to be given

do

{

cout << "The read position is currently at byte "

<< inFile.tellg() << endl;

*continues*

// This prints the current read position (found by the tellg

// function)

cout << "Enter an offset from the beginning of the file: "; cin >> offset;

inFile.seekg(offset, ios::beg);

// This moves the position from the beginning of the file.

// offset contains the number of bytes that the read position

// will be moved from the beginning of the file

inFile.get(ch);

// This gets one byte of information from the file cout << "The character read is " << ch << endl;

cout << "If you would like to input another offset enter a Y"

<< endl; cin >> more;

inFile.clear();

// This clears the file in case the eof flag was set

} while (toupper(more) == 'Y'); inFile.close();

return 0;

}

*Sample Run:*

**The read position is currently at byte 0**

**Enter an offset from the beginning of the file:** 2

**The character read is C**

**If you would like to input another offset enter a Y:** y

**The read position is currently at byte 3**

**Enter an offset from the beginning of the file: 0 The character read is A**

**If you would like to input another offset enter a Y:** y

**The read position is currently at byte 1**

**Enter an offset from the beginning of the file:** 5

**The character read is F**

**If you would like to input another offset enter a Y:** n

**CAUTION:** If you enter an offset that goes beyond the data stored, it prints the previous character offset.

# P R E - LA B W R I T I N G A S S I G N M E N T

## Fill-in-the-Blank Questions

1. The member function moves the read position of a file.
2. Files that will be used for both input and output should be defined as

data type.

1. The member function returns the write position of a file.
2. The ios:: file access flag indicates that output to the file will be written to the end of the file.
3. files are files that do not store data as ASCII characters.
4. The member function moves the write position of a file.
5. The function can be used to send an entire record or array to a binary file with one statement.
6. The >> operator any leading whitespace.
7. The function “looks ahead” to determine the next data value in an input file.
8. The and functions do not skip leading whitespace characters.

# L E S S O N 12 A

## LAB 12.1 Introduction to Files (Optional)

(This is a good exercise for those needing a review of basic file operations) Retrieve program files.cpp from the Lab 12 folder. The code is as follows:

// This program uses hours, pay rate, state tax and fed tax to determine gross

// and net pay.

#include <fstream> #include <iostream> #include <iomanip> using namespace std;

int main()

{

**// Fill in the code to define payfile as an input file**

float gross; float net; float hours; float payRate; float stateTax; float fedTax;

*continues*

cout << fixed << setprecision(2) << showpoint;

**// Fill in the code to open payfile and attach it to the physical file**

**// named payroll.dat**

**// Fill in code to write a conditional statement to check if payfile**

**// does not exist.**

{

cout << "Error opening file. \n";

cout << "It may not exist where indicated" << endl; return 1;

}

cout << "Payrate Hours Gross Pay Net Pay"

<< endl << endl;

**// Fill in code to prime the read for the payfile file.**

**// Fill in code to write a loop condition to run while payfile has more**

**// data to process.**

{

payfile >> payRate >> stateTax >> fedTax; gross = payRate \* hours;

net = gross - (gross \* stateTax) - (gross \* fedTax); cout << payRate << setw(15) << hours << setw(12) << gross

<< setw(12) << net << endl;

payfile >> **// Fill in the code to finish this with the appropriate**

**// variable to be input**

}

payfile.close(); return 0;

}

*Exercise 1:* Assume that the data file has hours, payRate, stateTax, and fedTax on one line for each employee. stateTax and fedTax are given as decimals (5% would be .05). Complete this program by filling in the code (places in bold).

*Exercise 2:* Run the program. Note: the data file does not exist so you should get the error message:

Error opening file.

It may not exist where indicated.

*Exercise 3:* Create a data file with the following information:

|  |  |  |  |
| --- | --- | --- | --- |
| 40 | 15.00 | .05 | .12 |
| 50 | 10 | .05 | .11 |
| 60 | 12.50 | .05 | .13 |

Save it in the same folder as the .cpp file. What should the data file name be?

*Exercise 4:* Run the program. Record the output here:

*Exercise 5:* Change the program so that the output goes to an output file called pay.out and run the program. You can use any logical internal name you wish for the output file.

## Lab 12.2 Files as Parameters and Character Data

Retrieve program Grades.cpp and the data file graderoll.dat from the Lab 12 folder. The code is as follows:

#include **// FILL IN DIRECTIVE FOR FILES**

#include <iostream> #include <iomanip> using namespace std;

// This program reads records from a file. The file contains the

// following: student’s name, two test grades and final exam grade.

// It then prints this information to the screen.

const int NAMESIZE = 15; const int MAXRECORDS = 50;

struct Grades // declares a structure

{

char name[NAMESIZE + 1]; int test1;

int test2; int final;

};

typedef Grades gradeType[MAXRECORDS];

// This makes gradeType a data type

// that holds MAXRECORDS

// Grades structures.

**// FIll IN THE CODE FOR THE PROTOTYPE OF THE FUNCTION ReadIt**

**// WHERE THE FIRST ARGUMENT IS AN INPUT FILE, THE SECOND IS THE**

**// ARRAY OF RECORDS, AND THE THIRD WILL HOLD THE NUMBER OF RECORDS**

**// CURRENTLY IN THE ARRAY.**

*continues*

int main()

{

ifstream indata; indata.open("graderoll.dat");

int numRecord; // number of records read in gradeType studentRecord;

if(!indata)

{

cout << "Error opening file. \n";

cout << "It may not exist where indicated" << endl; return 1;

}

**// FILL IN THE CODE TO CALL THE FUNCTION ReadIt.**

// output the information

for (int count = 0; count < numRecord; count++)

{

cout << studentRecord[count].name << setw(10)

<< studentRecord[count].test1

<< setw(10) << studentRecord[count].test2;

cout << setw(10) << studentRecord[count].final << endl;

}

return 0;

}

//\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

// readIt

//

// task: This procedure reads records into an array of

// records from an input file and keeps track of the

// total number of records

// data in: data file containing information to be placed in

// the array

// data out: an array of records and the number of records

//

//\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

void readIt**(// FILL IN THE CODE FOR THE FORMAL PARAMETERS AND THEIR**

**// DATA TYPES.**

**// inData, gradeRec and total are the formal parameters**

**// total is passed by reference)**

{

total = 0;

inData.get(gradeRec[total].name, NAMESIZE); while (inData)

{

**// FILL IN THE CODE TO READ test1**

**// FILL IN THE CODE TO READ test2**

**// FILL IN THE CODE TO READ final**

total++; // add one to total

**// FILL IN THE CODE TO CONSUME THE END OF LINE**

**// FILL IN THE CODE TO READ name**

}

}

*Exercise 1:* Complete the program by filling in the code (areas in bold). This problem requires that you study very carefully the code and the data file already written to prepare you to complete the program. Notice that in the data file the names occupy no more than 15 characters. Why?

*Exercise 2:* Add another field called letter to the record which is a character that holds the letter grade of the student. This is based on the average of the grades as follows: test1 and test2 are each worth 30% of the grade while final is worth 40% of the grade. The letter grade is based on a 10 point spread. The code will have to be expanded to find the average.

|  |  |  |
| --- | --- | --- |
|  | 90–100 | A |
| 80–89 | B |
| 70–79 | C |
| 60–69 | D |
| L E S S O N 12 B | 0–59 | F |

## LAB 12.3 Binary Files and the **write** Function

Retrieve program budget.cpp from the Lab 12 folder. The code is as follows:

// This program reads in from the keyboard a record of financial information

// consisting of a person’s name, income, rent, food costs, utilities and

// miscellaneous expenses. It then determines the net money

// (income minus all expenses)and places that information in a record

// which is then written to an output file.

#include <fstream> #include <iostream> #include <iomanip> using namespace std;

*continues*

const int NAMESIZE = 15;

struct budget //declare a structure to hold name and financial information

{

char name[NAMESIZE+1];

float income; // person's monthly income float rent; // person's monthly rent float food; // person's monthly food bill

float utilities; // person's monthly utility bill float miscell; // person's other bills

float net; // person's net money after bills are paid

};

int main()

{

fstream indata;

ofstream outdata; // output file of

// student. indata.open("income.dat", ios::out | ios::binary); // open file as binary

// output.

outdata.open("student.out"); // output file that we

// will write student

// information to. outdata << left << fixed << setprecision(2); // left indicates left

// justified for fields

budget person; //defines person to be a record

cout << "Enter the following information" << endl; cout << "Person's name: "; cin.getline(person.name, NAMESIZE);

cout << "Income :"; cin >> person.income;

**// FILL IN CODE TO READ IN THE REST OF THE FIELDS:**

**// rent, food, utilities AND miscell TO THE person RECORD**

// find the net field

person.net = **// FILL IN CODE TO DETERMINE NET INCOME (income - expenses)**

// write this record to the file

**// Fill IN CODE TO WRITE THE RECORD TO THE FILE indata (one instruction)**

indata.close();

**// FILL IN THE CODE TO REOPEN THE indata FILE, NOW AS AN INPUT FILE.**

**// FILL IN THE CODE TO READ THE RECORD FROM indata AND PLACE IT IN THE**

**// person RECORD (one instruction)**

// write information to output file

outdata << setw(20) << "Name" << setw(10) << "Income" << setw(10) << "Rent"

<< setw(10) << "Food" << setw(15) << "Utilities" << setw(15)

<< "Miscellaneous" << setw(10) << "Net Money" << endl << endl;

**// FILL IN CODE TO WRITE INDIVIDUAL FIELD INFORMATION OF THE RECORD TO**

**// THE outdata FILE.(several instructions)**

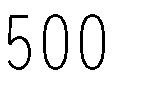
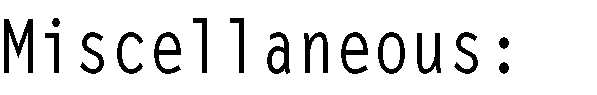
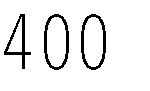
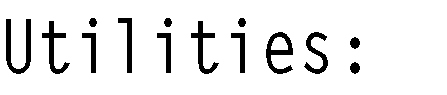
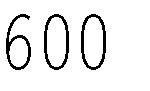
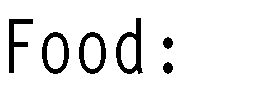
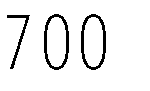
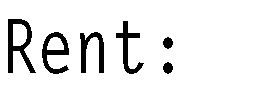
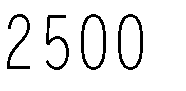
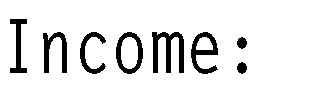
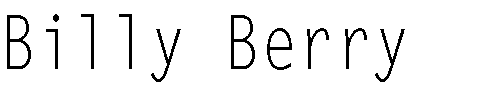
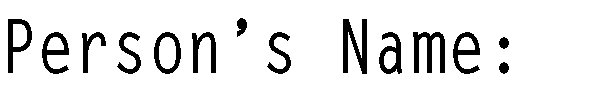
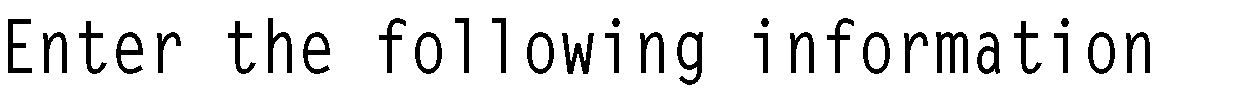
return 0;

}

*Exercise 1:* This program reads in a record with fields name, income, rent, food, utilities, and miscell from the keyboard. The program computes the net (income minus the other fields) and stores this in the net field. The entire record is then written to a binary file (indata). This file is then

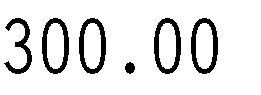
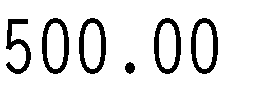
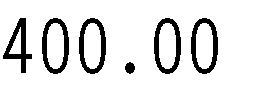
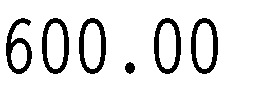
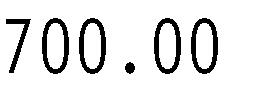
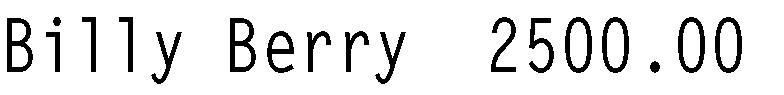
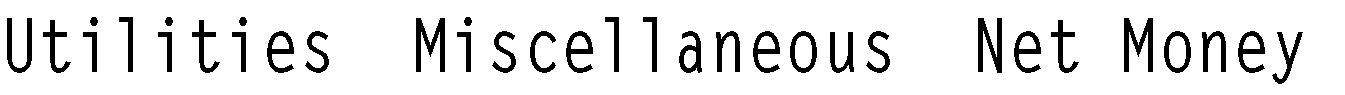
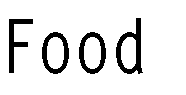
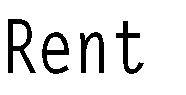
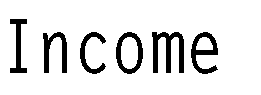
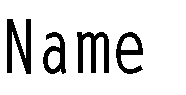
closed and reopened as an input file. Fill in the code as indicated by the comments in bold.

*Sample Run:*



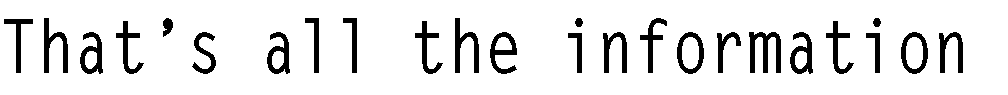
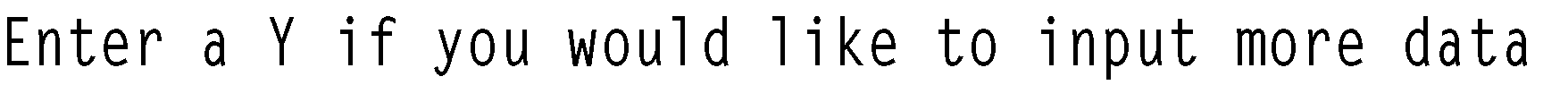
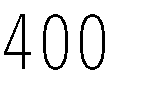
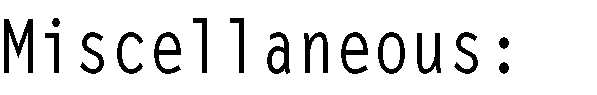
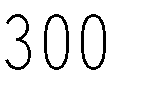
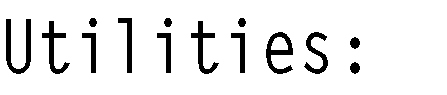
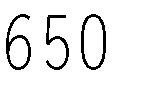
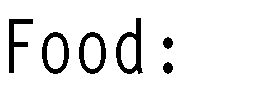
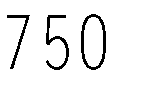
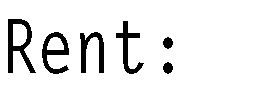
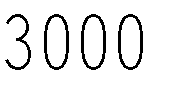
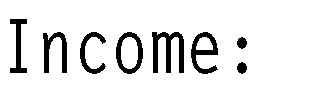
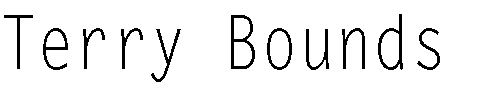
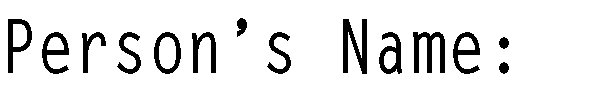
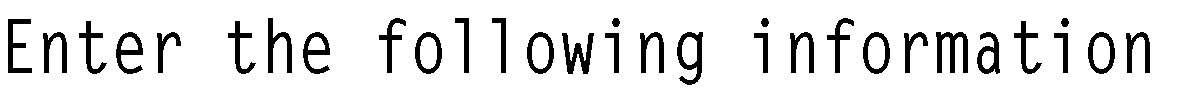
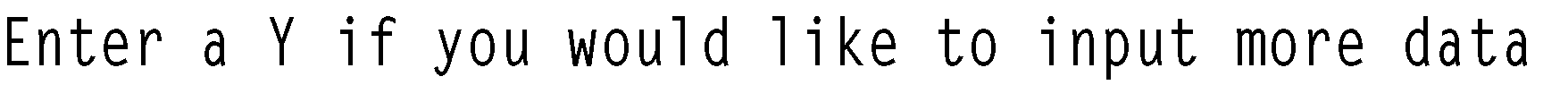
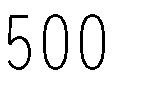
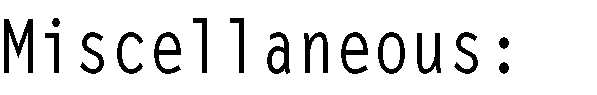
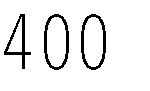
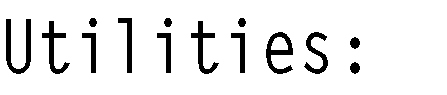
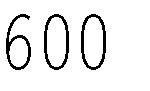
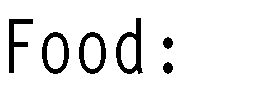
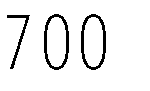
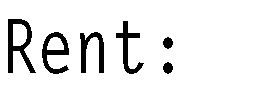
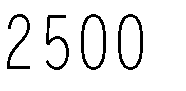
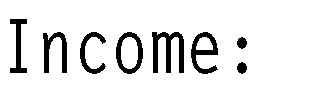
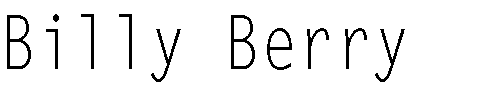
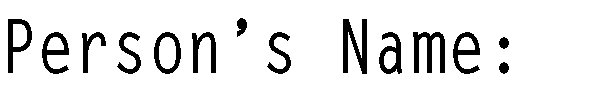
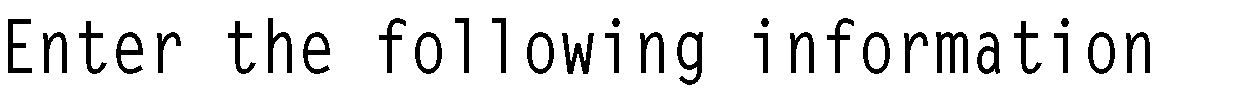
The program should write the following text lines to the output file

student.out.



*Exercise 2:* Alter the program to include more than one record as input. Use an array of records.

*Sample Run:*



The output file student.out should then have the following lines of text written to it.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

## Lab 12.4 Random Access Files

Retrieve program randomAccess.cpp and the data file proverb.txt from the Lab 12 folder. The code is as follows:

#include <iostream> #include <fstream> #include <cctype> using namespace std;

int main()

{

fstream inFile("proverb.txt", ios::in); long offset;

char ch; char more;

do

{

**// Fill in the code to write to the screen**

**// the current read position (with label)**

cout << "Enter an offset from the current read position: "; cin >> offset;

**// Fill in the code to move the read position “offset” bytes**

**// from the CURRENT read position.**

**// Fill in the code to get one byte of information from the file**

**// and place it in the variable "ch".**

cout << "The character read is " << ch << endl;

cout << "If you would like to input another offset enter a Y"

<< endl;

cin >> more;

**// Fill in the code to clear the eof flag.**

} while (toupper(more) == 'Y');

inFile.close(); return 0;

}

*Exercise 1:* Fill in the code as indicated by the comments in bold.

The file proverb.txt contains the following information:

Now Is The Time fOr All GoOd Men to come to the aid of their Family

*Sample Run:*

**The read position is currently at byte 0 Enter an offset from the current position: 4 The character read is I**

**If you would like to input another offset enter a Y** y

**The read position is currently at byte 5 Enter an offset from the current position: 2 The character read is T**

**If you would like to input another offset enter a Y** y

**The read position is currently at byte 8 Enter an offset from the current position: 6 The character read is e**

**If you would like to input another offset enter a Y** y

**The read position is currently at byte 15 Enter an offset from the current position: 44 The character read is r**

**If you would like to input another offset enter a Y** y

**The read position is currently at byte 60 Enter an offset from the current position: 8 The character read is r**

**If you would like to input another offset enter a Y** n

*Exercise 2:* Why do you think that the character printed at the last run was another r? What would you have to do to get a different letter after the position is beyond the eof marker?

*Exercise 3:* Change the program so that the read position is calculated from the end of the file. What type of offsets would you need to enter to get characters from the proverb? Do several sample runs with different numbers to test your program.

## LAB 12.5 Student Generated Code Assignments

*Option 1:* Write a program that will: 1) read an array of records from the keyboard, 2) store this information to a binary file, 3) read from the binary file back to the array of records, 4) store this information to a textfile. Left justify the information for each field. Each record will consist of the following fields:

first name 15 characters

last name 15 characters street address 30 characters city 20 characters

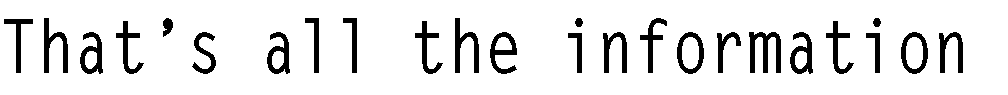
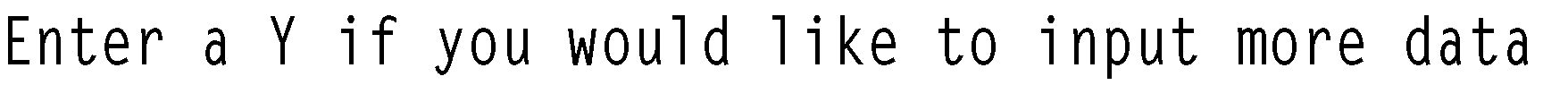
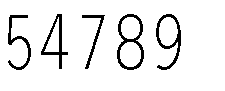
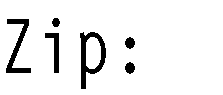
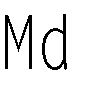
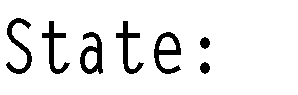
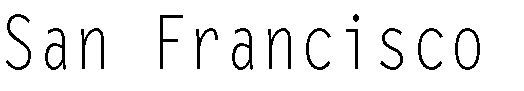
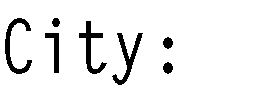
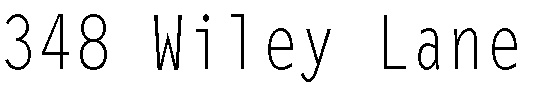
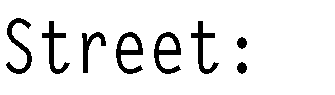
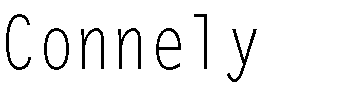
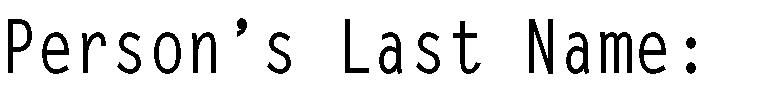
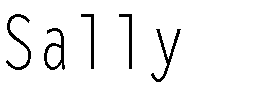
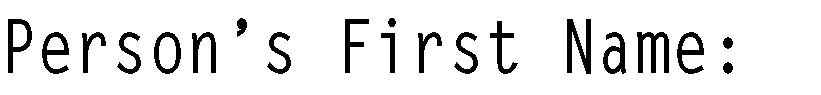
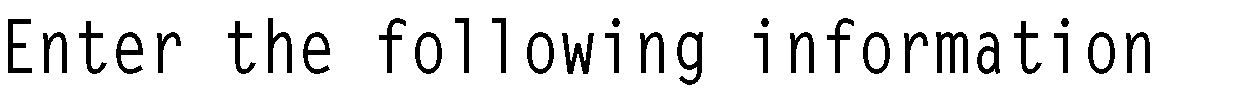
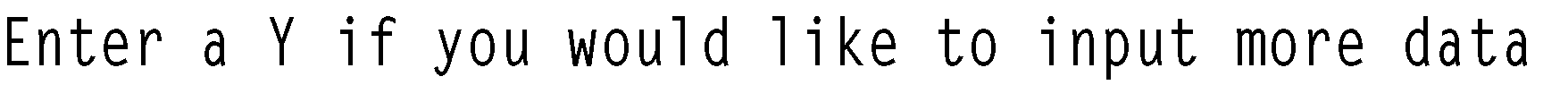
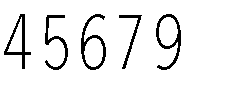
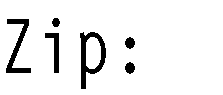
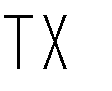
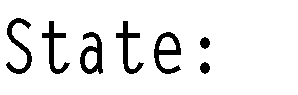
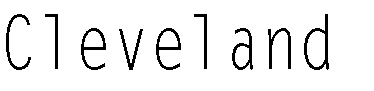
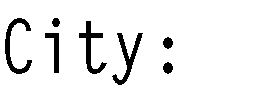
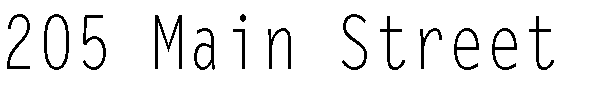
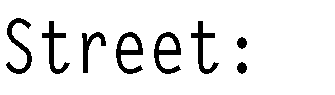
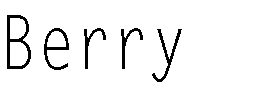
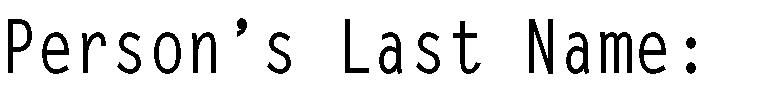
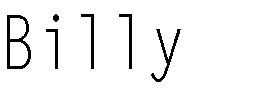
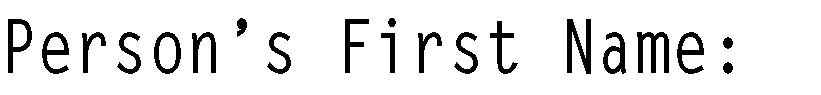
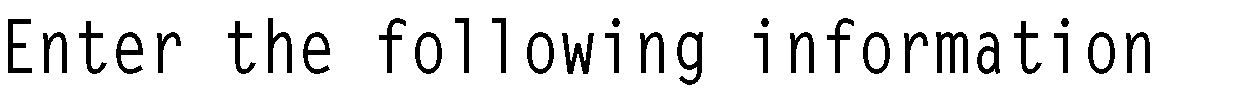
state 5 characters

zip long integer

You may assume a maximum of 20 records.

This assignment is very similar to the program found in Lab 12.3.

*Sample Run:*



The output file contains the following:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

*Option 2:* Write a program that will read the radii of circles. Use an array of records where each record will have the radius of the circle read from the keyboard and the diameter and area of the circle will be calculated by the program. This information (radius, diameter and area) is stored in a binary file. The information in the binary file is then read back into the records and stored in a text output file. Left justify the information for each field. Each record will consist of the following fields:

radius float

diameter float

area float

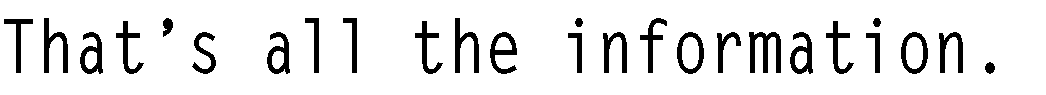
You may assume a maximum of 20 records. You may want to include the

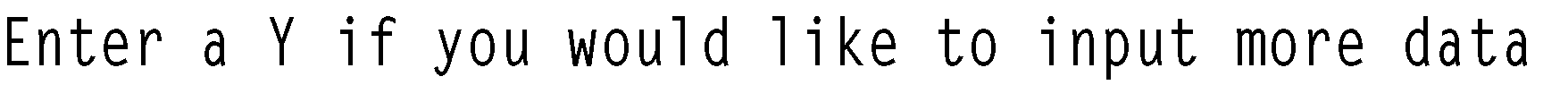
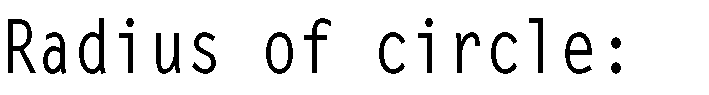
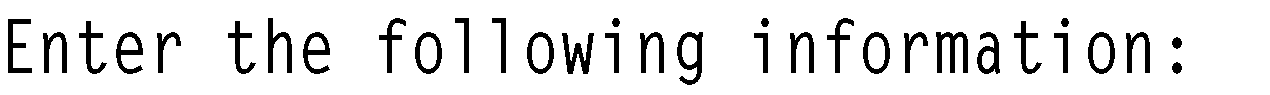
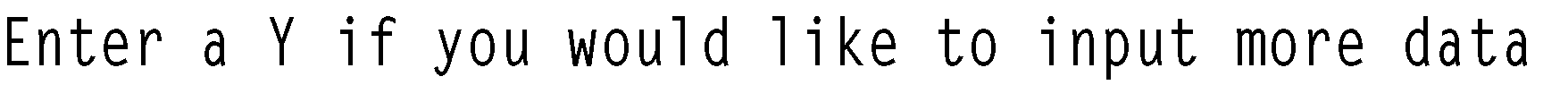
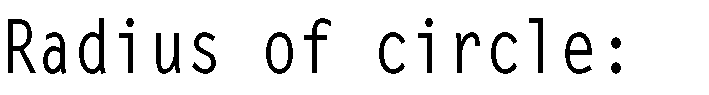
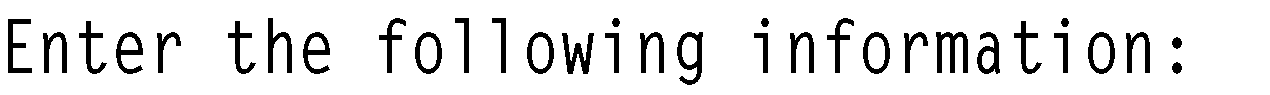
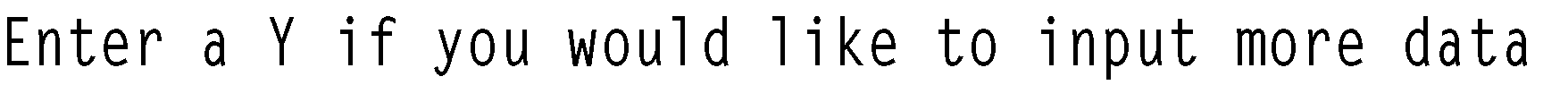
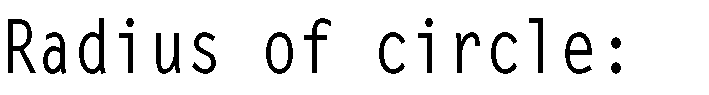
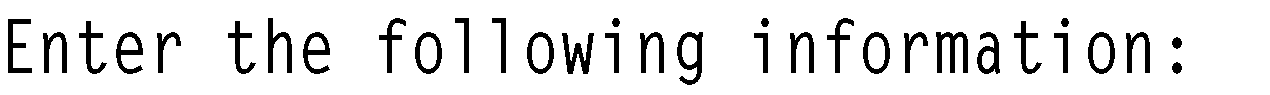
cmath library.

You need to know the formulas for finding the area and circumference of a circle.

This assignment is very similar to the program in Lab 12.3.

*Sample Run:*





The output file contains the following:

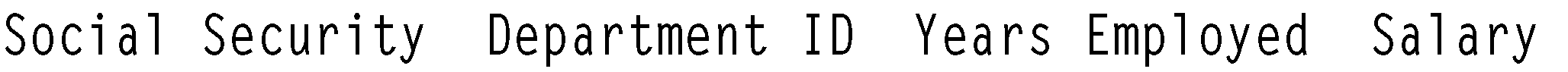
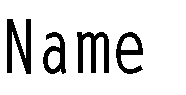
|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

*Option 3:* Bring in the file employee.in from Lab 12 folder. Write a program that will read records from this file and store them in a binary file. That file will then be used as input to create an output file of the information. The data file contains employee information consisting of name, social security, department ID, years employed, and salary. In addition to displaying the information of each record, the program will also calculate the average salary and years employed of all the records. This additional information is stored in the same output file.

*Sample Data File:*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Bill Tarpon | 182460678 | 789 | 8 | 30600 |
| Fred Caldron | 456905434 | 789 | 10 | 40700 |
| Sally Bender | 203932239 | 790 | 8 | 50000 |
| David Kemp | 568903493 | 790 | 9 | 60000 |

The output file should look like this:



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

