Week 3: File I/O and Formatting

Gaddis: 3.7, 3.8, 5.11

CS 1428
Fall 2015

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3.7 Formatting Output

- Formatting: the way a value is printed:
  - spacing
  - decimal points, fractional values, number of digits
  - scientific notation or decimal format
- `cout` has a standard way of formatting values of each data type
- use "stream manipulators" to override this
- they require `#include <iomanip>`

Formatting Output: setw

- setw is a "stream manipulator", like endl
- `setw(n)` specifies the minimum width for the **next** item to be output
  - `cout << setw(6) << age << endl;`
  - print in a field at least 6 spaces wide.
  - value is right justified (padded with spaces on left).
  - if the value is too big to fit in 6 spaces, it is printed in full, using more positions.

setw: examples

- Example with no formatting:

```
cout << 2897 << " " << 5 << " " << 837 << endl;
cout << 34 << " " << 7 << " " << 1623 << endl;
```

```
2897 5 837
34 7 1623
```

Prog 3-12 output in the book is WRONG

- Example using setw:

```
cout << setw(6) << 2897 << setw(6) << 5
     << setw(6) << 837 << endl;
cout << setw(6) << 34 << setw(6) << 7
     << setw(6) << 1623 << endl;
```

```
  2897     5   837
    34     7  1623
```

Formatting Output: setprecision

- `setprecision(n)` specifies the maximum number of **significant** digits to be output for floating point values.
- it remains in effect until it is changed
- the default seems to be 6, and it rounds up

```
cout << 123.45678 << endl;
cout << setprecision(4);
cout << 1.3 << endl;
cout << 123.45678 << endl;
cout << setprecision(2) << 34.21 << endl;
```

```
123.457
1.3
123.5
34
```

Note: We will never use `setprecision` without `fixed`

Formatting Output: fixed

- `fixed` forces floating point values to be output in decimal format, and not scientific notation.
- when used with `setprecision`, the value of `setprecision` is used to determine the number of digits after the decimal

```
cout << 12345678901.23 << endl;
cout << fixed << setprecision(2);
cout << 12345678901.23 << endl;
cout << 123.45678 << endl;
```

```
1.23457e+10
12345678901.23
123.46
```

Note: there is no need for `showpoint` when using `setprecision` with `fixed`

Formatting Output: right and left

- `left` causes all subsequent output to be left justified in its field
- `right` causes all subsequent output to be right justified in its field. This is the default.

```
double x = 146.789, y = 24.2, z = 1.783;
cout << setw(10) << x << endl;
cout << setw(10) << y << endl;
cout << setw(10) << z << endl;
```

```
   146.789
      24.2
     1.783
```

```
double x = 146.789, y = 24.2, z = 1.783;
cout << left << setw(10) << x << endl;
cout << setw(10) << y << endl;
cout << setw(10) << z << endl;
```

```
146.789
24.2
1.783
```


Q1

3.8 Working with characters and `string` objects

- Using the >> operator to input strings (and characters) can cause problems:
- It skips over any leading whitespace chars (spaces, tabs, or line breaks)
- It stops reading strings when it encounters the next whitespace character!

```
string name;
cout << "Please enter your name: ";
cin >> name;
cout << "Your name is " << name << endl;
```

```
Please enter your name: Kate Smith
Your name is Kate
```

Using `getline` to input strings

- To work around this problem, you can use a C++ function named `getline`.
- `getline(cin,var);` reads in an entire line, including all the spaces, and stores it in a string variable.

```
string name;
cout << “Please enter your name: “;
getline(cin, name);
cout << “Your name is “ << name << endl;
```

```
Please enter your name: Kate Smith
Your name is Kate Smith
```


Using `cin.get` to input chars

- To read a single character:
- Can use >>:

```
char ch;
cout << "Press any key to continue";
cin >> ch;
```

  - Problem: will skip over blanks, tabs, newlines to get to the first non-whitespace char.
- Use cin.get():

```
char ch;
cout << "Press any key to continue";
cin.get(ch);
```

  - Will read the next character entered, even whitespace

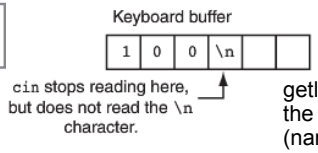
Mixing >> with `getline` and `cin.get`

- Mixing `cin>>x` with `getline(cin,y)` or `cin.get(ch)` in the same program can cause input errors that are VERY hard to detect

```
int number;
string name;
cout << "Enter a number: ";
cin >> number;        // Read an integer
cout << "Enter a name: ";
getline(cin,name);    // Read a string, up to end of line
cout << “Name “ << name << endl;
```

```
Enter a number: 100
Enter a name: Name
```

The program did not allow me to type a name



getline(cin,name) then reads the \n and immediately stops (name is empty)

Using `cin.ignore`

- `cin.ignore(20,'\n')` skips the next 20 characters, or until `'\n'` is encountered.
- Use it before a getline to consume the newline so it will start reading characters from the following line.

```
int number;
string name;
cout << "Enter a number: ";
cin >> number;        // Read an integer
cin.ignore(20,'\n'); // skip the newline
cout << "Enter a name: ";
getline(cin,name);    // Read a string
cout << “Name “ << name << endl;
```

```
Enter a number: 100
Enter a name: Jane Doe
Name Jane Doe
```


Q2

5.11 Using Files for Data Storage

- Variables are stored in Main Memory/RAM
  - values are lost when program is finished executing
- To preserve the values computed by the program: save them to a file
- Files are stored in Secondary Storage
- To have your program manipulate values stored in a file, they must be input into variables first.

File Stream Objects

- File stream data types:
  - ifstream
  - ofstream
- use `#include <fstream>` for these
- objects of type `ofstream` can output (write) values to a file. (like `cout`)
- objects of type `ifstream` can input (read) values from a file. (like `cin`)

Steps to File I/O

- Define a file stream variable.
- Open the file
- Use the file
  - ifstream: read values from the file
  - ofstream: store (write) values to the file
- Close the file

Define and open file stream objects

- To input from a file, declare an ifstream variable and open a file by its name.

```
ifstream fin;
fin.open("mydatafile.txt");
```

  - If the file "mydatafile.txt" does not exist, it will cause an error.
- To output to a file, declare an ofstream variable, and open a file by its name.

```
ofstream fout;
fout.open("myoutputfile.txt");
```

  - If the file "myoutputfile.txt" does not exist, it will be created.
  - If it does exist, it will be overwritten
- The stream variable is associated with the file.

Closing file stream objects

- To close a file stream when you are done reading/writing:

```
fin.close();
fout.close();
```

- Not required, but good practice.

Writing to Files

- Use the stream insertion operator (<<) on the file output stream variable:

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

int main() {
   ofstream fout;
   fout.open("demofile.txt");

   int age;
   cout << "Enter your age: ";
   cin >> age;

   fout << "Age is: " << age << endl;
   fout.close();
   return 0;
}
```

Output demofile.txt:

```
Age is: 20
```


Reading from Files

- Use the stream extraction operator on the file input stream variable to copy data into variable:

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

int main() {
   string name;

   ifstream fin;
   fin.open("Names.txt");
   fin >> name;

   cout << name << endl;
   fin.close();
}
```

Names.txt:

```
Tom
Dick
Harry
```

Screen output:

```
Tom
```


Reading from files

- When opened, file stream's read position points to first character in file.
- stream extraction operator (>>) starts at read position and skips whitespace to read data into the variable.
- The read position then points to whitespace after the value it just read.
- The next extraction (>>) starts from the new read position.
- Just like with cin.

Q3,4,5