Admin

Sections start this week
Section assignments e-mailed, revisit signup page to switch
Compiler installation fun
Any news will post to announcements on class web site
Today's topics
C++ stream classes
C\$106 class library: Scanner, Vector
Reading
Reader Ch. 3, Handout 14 (today & next)

C++ console 1/0

Stream objects cout/cin

- cout is the console output stream, cin for console input
- << is stream insertion, >> is stream extraction #include <iostream>

```
int main()
{
    int x,y;
    cout << "Enter two numbers: ";
    cin >> x >> y;
    cout << "You said: " << x << " and " << y << end];

Safer, easier read from console using our simpio.h
#include "simpio.h"
int main()
{
    int x = GetInteger();
}</pre>
```

Lecture #4

C++ file 1/0

- File streams declared in <fstream>
 - streams are objects, dot notation used
 - ifstream for reading, ofstream for writing #include <fstream>

ifstream in; ofstream out;

Use open to attach stream to file on disk in.open("names.txt"); out.open(filename.c_str()); // requires C-string!

Check status with fail, clear to reset after error if (in.fail()) in.clear();

Stream operations

string answer = GetLine();

Read/write single characters

ch = in.get();
out.put(ch);

- Read/write entire lines getline(in, line); out << line << endl;</p>
- Formatted read/write

in >> num >> str; out << num << str; Use fail to check for error if (in.fail()) ...

Class libraries

- Some libraries provide free functions
- RandomInteger, getline, sqrt etc
- Other libraries provide classes
 - string, stream
- Class = data + operations
- Tight coupling between value and operations that manipulate it
- Class interface describes abstraction
 - Models string/time/ballot/database/etc with appropriate features
- Client use of object
 - Learn the abstraction, use public interface
 - Unconcerned with implementation details

Why is 00 so successful?

♦ Tames complexity

- Large programs become interacting objects
- Each class developed/tested independently
- Clean separation between client & implementer
- Objects can model real-word
 - Time, Ballot, ClassList, etc
 - Build on existing understanding of concepts
- ♦ Facilitates re-use
 - Also easily change/extend class in future

CS106 class library

- Provide common functionality, highly leveraged
 - Scanner
 - Vector, Grid, Stack, Queue, Map, Set
- ♦ Why?
 - Living "higher on the food chain"
 - Efficient, debugged
 - Clean abstraction
- We study as client and later as implementer
 - Why client-first?

CS106 Scanner

- Scanner's job: break apart input string into tokens
 - Mostly divide on white-space
 - ♦ Some logic for recognizing numbers, punctuation, etc.
- Operations
- setInput
- nextToken/hasMoreTokens
- Fancy options available with set/get
- Used for?
 - Handling user input, reading text files, parsing expressions, processing commands, etc.

```
This line contains 10 tokens .
```


Client use of Scanner

```
void CountTokens()
```

ł

}

```
Scanner scanner;
```

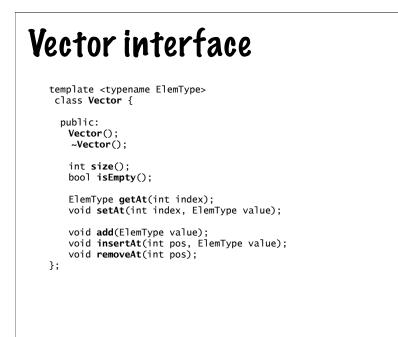
```
cout << "Please enter a sentence: ";
scanner.setInput(GetLine());
int count = 0;
while (scanner.hasMoreTokens()) {
    scanner.nextToken();
    count++;
}
cout << "You entered " << count << " tokens." << end];</pre>
```

Containers

- Most classes in our library are container classes
 - Store data, provide convenient and efficient access
 - ♦ High utility for all types of programs
- C++ has a built-in "raw array"
 - Functional, but serious weaknesses (sizing, safety)
- CS106B Vector class as a "better" array
 - Bounds-checking
 - ♦ Add, insert, remove
 - Memory management, knows its size

Template containers

- C++ templates perfect for container classes
 - Template is pattern with one or more placeholders
 - Client using template fills in placeholder to indicate specific version
- Vector class as template
 - Template class has placeholder for type of element being stored
 - Interface/implementation written using placeholder
 - Client instantiates specific vectors (vector of chars, vector of doubles) as needed



final content of the second seco

Rules for template clients

- Client includes interface file as usual
 - #include "vector.h"
- Client must specialize to fill in the placeholder
 - Cannot use Vector without qualification, must be Vector<char>, Vector<locationT> , ...
 - Applies to declarations (variables, parameters, return types) and calling constructor
- Vector is specialized for its element type
 - Attempt to add locationT into Vector<char> will not compile!

Client use of Vector #include "vector.h" Vector<int> MakeRandomVector(int sz) Ł Vector<int> numbers; for (int i = 0; i < sz; i++) numbers.add(RandomInteger(1, 100)); return numbers: } void PrintVector(Vector<int> &v) { for (int i = 0; i < v.size(); i++) cout << v[i] << " ";</pre> } int main() Ł Vector<int> nums = MakeRandomVector(10); PrintVector(nums); . . .