From C to C++

Jyh-Shing Roger Jang (張智星)
CSIE Dept, National Taiwan University

Enhancement of C++

- Some features of C++ that are not part of C
  - Reference types
  - Function/operator overloading
  - Function/class templates
  - Exception handling
  - Default function arguments
  - Object-oriented programming
  - …
- C++ shares C's ability to deal efficiently with hardware at the level of bits, bytes, words, addresses, etc. ➔ C++ has grown to be a complex programming language!

It takes years to be a savvy C/C++ programmer!

Our First Few C++ Programs

- First several examples of C++ programs of this course
  - http://mirlab.org/jang/courses/dsa/example
  - Let's check out some examples…
- More examples via Google
  - Google "c++ example vector unique"
- Choices of compilers
  - Unix/Linux: g++
  - Mac: g++
  - Windows
    - Window's bash (g++)
    - Dev C++ (g++.exe)
    - MS Visual Studio (cl.exe)

Examples are very important!

Pointers and Arrays

- Do you know pointers in C?
  - Very dangerous! (But convenient!)
- What could go wrong?
  - Confusing grammar
    - int* x, y, z; ➔ int *x, y, z;
  - Delete memory that has not been allocated
    - Double deletes are not allowed!
  - Check the availability of allocated memory
  - Memory leak (see next page)
  - Out-of-bound indexing for arrays (example)
    - For efficiency, C/C++ does not perform boundary checking!

Use STL vectors and vec.at() for safe (but inefficient) access.

Memory Leak

Quiz!

- Definition of memory leak
  - A memory leak occurs when you call "new" without calling a corresponding "delete" later.
- How to avoid it?
  - C++: "new" and "delete" must appear in pairs!
  - C: "malloc" (or "calloc", or "realloc") and "free" must appear in pairs!
- Example

Sometimes it's not so obvious!
(See "shallow copy".)

```
int main() {
    // OK
    int * p = new int;
    delete p;

    // Memory leak
    int * q = new int;
    // no delete
}
```

```
void memLeak( )
{
  int *data = new int;
  *data = 15;
}
```

More examples!

How to Tackle Memory Leak?

- Good programming style
  - New/delete pairs should appear in the same scope
    - Do not allocate memory in a function and free it outside.
  - Avoid shallow copy
  - …
- Libraries
  - STL vectors
  - Smart pointers
  - …
- Tools for debugging
  - Windows: Purify
  - Unix/linux: Valgrind

Google “avoid memory leak”…

Online Tutorials for C++

- There are quite a few good online tutorials on C++
  - C++ tutorial at www.cplusplus.com
  - C++ tutorial at www.cprogramming.com
- Do you think you know C/C++ already?
  - Deep C