Programming Abstractions

CS106B

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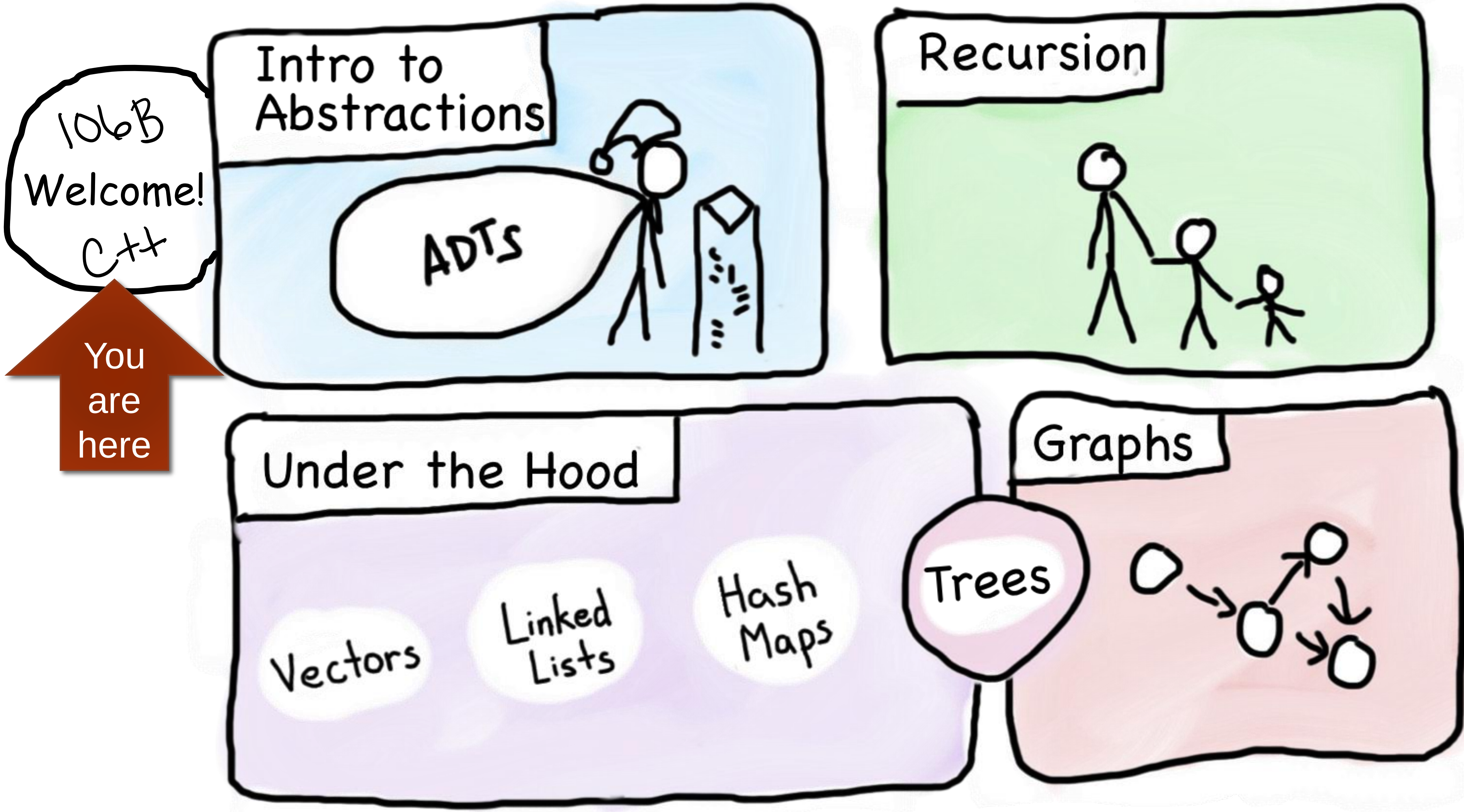
Today's Topics

Introducing C++ from the Java Programmer's Perspective

- firstprogram.cpp
  - Function prototypes
  - <iostream> and cout
  - "simpio.h" and getLine()
- Hamilton example
  - C++ strings and streams


106B
Welcome!
C++
You are here
Intro to Abstractions
ADTs
Recursion
Under the Hood
Vectors
Linked Lists
Hash Maps
Trees
Graphs

C++ from the Java Programmer's Perspective

(But it's ok if you don't know java!)

A first C++ program (Error)

firstprogram.cpp

```
#include <iostream>
#include "console.h"
using namespace std;

int main(){
    cout << "|-5| = "
      << absoluteValue(-5)
      << endl;
    return 0;
}
```

```
int absoluteValue(int n) {
    if (n<0){
        return -n;
    }
    return n;
}
```

A first C++ program (Fixed #1)

firstprogram.cpp

```
#include <iostream>
#include "console.h"
using namespace std;

int absoluteValue(int n) {
    if (n<0){
        return -n;
    }
    return n;
}
```

```
int main(){
    cout << "|-5| = "
      << absoluteValue(-5)
      << endl;
    return 0;
}
```

A first C++ program (Fixed #2)

firstprogram.cpp

```
#include <iostream>
#include "console.h"
using namespace std;

int absoluteValue(int n);

int main(){
    cout << "|-5| = "
      << absoluteValue(-5)
      << endl;
    return 0;
}
```

```
int absoluteValue(int n) {
    if (n<0){
        return -n;
    }
    return n;
}
```

Design Question: Why does C++ have the function prototype syntax?

In other words, why not just have a rule that you must set up the ordering so you define your functions before using them, as in the "FIXED 1" example?

A. C++ could have done that, but such a rule would be *too cumbersome* for programmers to follow.

B. C++ could have done that, but good programming *style* dictates "top-down" approach that logically puts main() first and helper functions it calls to follow.

C. C++ could *not* have done that, because sometimes there is *no way* to order the functions so that all functions are defined before being used.

D. Other/none/more than one of the above

All of the above!

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Which code comes first, the chicken or the egg?

(this code is just for fun, for now—we'll cover recursion in depth in a few weeks!)

```
#include<iostream>
#include "console.h"
using namespace std;

void go();
void stanford();

int main(){
    go();
    return 0;
}
```

```
void go() {
    cout << "Go!" << endl;
    stanford();
}

void stanford() {
    cout << "Stanford!" << endl;
    go();
}
```

What does this code do??

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Streams in C++

Hamilton Example
iostream (C++ Standard)
simpio (Stanford)

HamDaDaDa Code Demo:
What essential skills did we just see?

- You can read and write input/output with:
  - `cout`, `cin` (`<iostream>`)
  - `getInteger()`, `getLine()`, etc (`"simpio.h"`) print a message before waiting for input
- cin and cout use the >> and << operators, respectively
  - Remember: the arrows point in the way the data is “flowing”
  - These aren’t like HTML tags <b> or Java/C++ parentheses () or curly braces {} in that they don’t need to “match”
- Good style: “`static const int`” to make int constants
  - No “magic numbers”!
  - Works for other types too (`"static const double"`)

Strings in C++

String literal vs string class

Concatenation

String class methods

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Using cout and strings

```
int main(){
   int n = absoluteValue(-5);
   string s = "|-5|";
   s += " = ";
   cout << s << n << endl;
   return 0;
}
int absoluteValue(int n) {
   if (n < 0){
      n = -n;
   }
   return n;
}
```

- This prints |-5| = 5
- The + operator concatenates strings, and += works in the way you'd expect.

Using cout and strings

```
int main(){
   int n = absoluteValue(-5);
   string s = "|-5|" + " = ";
   cout << s << n << endl;
   return 0;
}

int absoluteValue(int n) {
   if (n<0){
      n = -n;
   }
   return n;
}
```

But SURPRISE!…this one doesn’t work.

C++ string objects and string literals

- In this class, we will interact with two types of strings:
  - String <u>literals</u> are just hard-coded string values:
    - `"hello!"  "1234"  "#nailedit"`
    - They have <u>no methods</u> that do things for us
    - Think of them like integer literals: you can't do `"4.add(5);" //no`
  - String <u>objects</u> are objects with lots of helpful methods and operators:
    - `string s;`
    - `string piece = s.substr(0,3); //yes`
    - `s.append(t);                     //or, equivalently: s+= t;`

String object member functions (3.2)

Member function name	Description
s`.append(`***str***`)`	add text to the end of a string
s`.compare(`***str***`)`	return -1, 0, or 1 depending on relative ordering
s`.erase(`***index, length***`)`	delete text from a string starting at given index
s`.find(`***str***`)` ***s***`.rfind(`***str***`)`	first or last index where the start of ***str*** appears in this string (returns `string::npos` if not found)
s`.insert(`***index, str***`)`	add text into a string at a given index
s`.length()` or ***s***`.size()`	number of characters in this string
s`.replace(`***index, len, str***`)`	replaces *len* chars at given index with new text
s`.substr(`***start, length***`)` or ***s***`.substr(`***start***`)`	the next *length* characters beginning at *start* (inclusive); if *length* omitted, grabs till end of string

```
string name = "Donald Knuth";
if (name.find("Knu") != string::npos) {
    name.erase(7, 5);               // "Donald"
}
```

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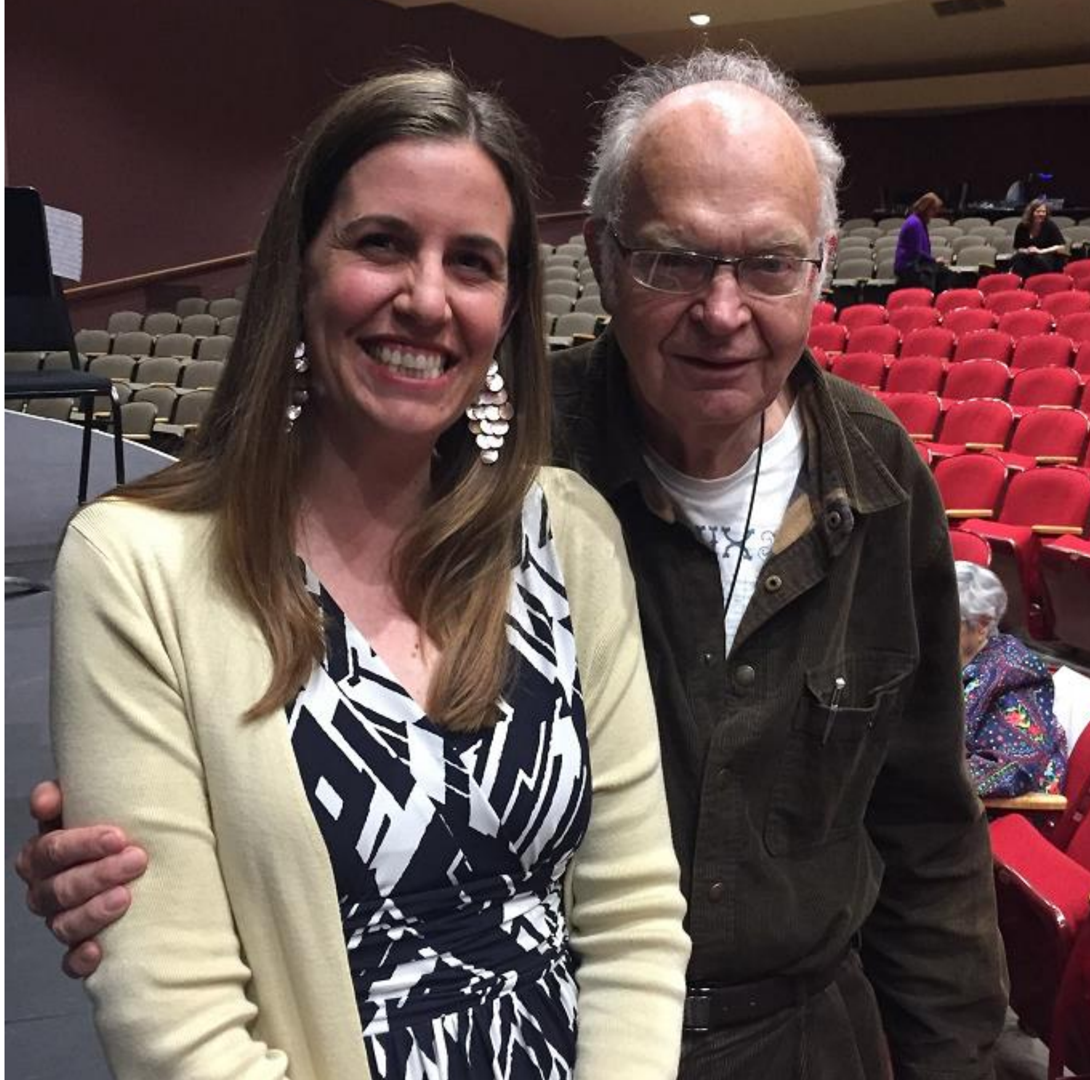
Aside: Donald Knuth

Emeritus (*i.e.*, retired) faculty in our dept.

Legend of computer science

If you're lucky, you'll still see him around campus from time to time!



Recap: C++ string objects and string literals

- Even though they are different types, you can mix them as long as there is a string object around to be the "brains" of the operation:
  - Yes:

```
string s;
s = "hello!"    //string knows how to convert literal
s = s + "1234"; //string has + defined as concatenation
char ch = ‘A’;  //a single ASCII character with ‘ not "
s += ch;        //string knows how to interact with char
s += ‘A’;       //and char literal
```

  - No:

```
"hello!" + " " + "bye!"; //literal not 'smart' enough to
                         //do concat with +
"hello!".substr(0);      //literal has no methods
```

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Practice: C++ strings

```
int main(){
    string s = "1776. ";
    s += "Aaron ";
    s += s + "Burr, " + "sir. ";
    s.append("Sure, ");
    s.append("sir.");
    cout << s + 'A' << endl;
    cout << "1776" + 'B' << endl;
    return 0;
}
```

How many of these lines would NOT work?

A. 0
B. 1
C. 2
D. 3
E. More than 3

When discussing:

- Make sure you agree not only on how many but which
- Talk about the "why" for each

Stanford library (3.7)

```
#include "strlib.h"
```

- Unlike the previous ones, these take the string as a parameter.

Function name	Description

`endsWith(`***`str, suffix`***`)`
`startsWith(`***`str, prefix`***`)`
	returns true if the given string begins or ends with the given prefix/suffix text

`integerToString(`***`int`***`)`
`realToString(`***`double`***`)`
`stringToInteger(`***`str`***`)`
`stringToReal(`***`str`***`)`
	returns a conversion between numbers and strings

`equalsIgnoreCase(`***`s1, s2`***`)`	true if s1 and s2 have same chars, ignoring casing

`toLowerCase(`***`str`***`)`
`toUpperCase(`***`str`***`)`
	returns an upper/lowercase version of a string

`trim(`***`str`***`)`	returns string with surrounding whitespace removed

```
if (startsWith(name, "Mr.")) {
    name += integerToString(age) + " years old";
}
```