Welcome to CSci 1113

Introduction to C/C++ Programming for Scientists and Engineers
Instructor (me)

James Parker
Shepherd Laboratories 391

Primary contact:
jparker@cs.umn.edu
TAs

Kshitij Tayal, Brad Fisher, Nikki Kyllonen, Bekka McCoy, Songyu Yan, Tiannan Zhou, Yudi Zhang
Questions?

Direct questions to:
Moodle forum discussion
jparker@cs.umn.edu
CSE Labs account

You need a CSE Labs account to participate in labs in this course

Lab attendance is mandatory (please make an account!)
https://cseit.umn.edu/
https://cseit.umn.edu/

- Classroom Access Form
- CSE Account Authorization Form
- CSE Labs Classroom Reservation Form
CSE Labs Account Creation

CSE Labs accounts no longer closing every term
If you have had a previous CSE Labs account, you do not need to reopen it every term. Accounts will now only be closed after a year of inactivity.

Welcome to the CSE Labs Account Creation Site
Use this site to initiate your CSE Labs account. CSE Labs use is open to any student currently enrolled in the College of Science and Engineering.

If you do not know what your username is, or you are having problems see the U of M Student Internet Account Initiation Form.

Create CSE Labs Account

For further information send email to operator@cselabs.umn.edu or stop by the Systems Staff Office in Keller Hall 1-201.

For a list of our hours see Systems Staff Contact Information and Hours.

Changing your Password
If you want to change your password, you will need to use the U of M Internet Account Options web page.
https://cseit.umn.edu/

Welcome to the Fall2012 CSE Labs Account Creation Form.

Use this form to initiate or change your CSE Labs account for the Fall2012 semester. CSE Labs use is open to any student currently enrolled in the College of Science and Engineering.

Please enter the following information:

- Your student email **username**.
- Your **password** for your general UMN email account. (To verify your eligibility for a CSE Labs account.)

Username: park0580@umn.edu
Password: ***************

If you do not know what your username is, or you are having problems see the U of M Student Internet Account Initiation Form.

For further information send email to operator@cselabs.umn.edu or stop by the Systems Staff Office in Keller Hall 1-213.

For a list of our hours see Systems Staff Contact Information and Hours.

Submit
CSELabs account

CSELabs account used in lab (first lab ensures account working)

Register ASAP

Problems?
Bug operator@cselabs.umn.edu
Class website

www.cs.umn.edu/academics/classes
Or google “umn.edu csci class”

Syllabus, schedule, other goodies

Moodle page will have grades and homework submissions
Class website

Moodle also has a link to the website:

Office Hours

1113 Office Hours

<table>
<thead>
<tr>
<th>Sun 1/15</th>
<th>Mon 1/16</th>
<th>Tue 1/17</th>
<th>Wed 1/18</th>
<th>Thu 1/19</th>
<th>Fri 1/20</th>
<th>Sat 1/21</th>
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CSci 1113: C++ Programming

Schedule
This is an approximate schedule. It will be updated as the class progresses.

<table>
<thead>
<tr>
<th>Week</th>
<th>Week</th>
<th>Topics</th>
<th>Lecture Materials</th>
<th>Readings</th>
<th>Exams</th>
<th>Lab</th>
<th>Due</th>
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<tbody>
<tr>
<td>1</td>
<td>16</td>
<td>Jan.</td>
<td>Introduction, computers, algorithms, programs, compilers</td>
<td>Ch. 1/16</td>
<td>Ch. 1</td>
<td></td>
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<tr>
<td>2</td>
<td>23</td>
<td>Jan.</td>
<td>Variables, expressions, assignment, console I/O, predefined functions</td>
<td>Ch. 2, Section 4.2</td>
<td></td>
<td>Lab 1: Basic C++ programs</td>
<td></td>
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<tr>
<td>3</td>
<td>30</td>
<td>Jan.</td>
<td>Selection, boolean expressions, if-else, multiway-if, switch</td>
<td>Sections 3.1, 3.2</td>
<td></td>
<td>Lab 2: Sequence and Selection</td>
<td>HW 0 due Thursday Feb. 1 at 11:55 P.M.</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>Feb.</td>
<td>Iteration, while loops, for loops, loop paradigms</td>
<td>Sections 3.3, 3.4</td>
<td></td>
<td>Lab 3: Iteration</td>
<td>HW 1, Thursday Feb. 8 at 11:55 P.M.</td>
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<tr>
<td>5</td>
<td>13</td>
<td>Feb.</td>
<td>User-defined functions, procedural abstractions</td>
<td>Ch. 4, 5</td>
<td>Quiz Covers Ch 1-3.2 (up to week 3: if-statements)</td>
<td>Lab 4: User defined functions</td>
<td>HW 2, Thursday Feb. 15 at 11:55 P.M.</td>
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<td>6</td>
<td>20</td>
<td>Feb.</td>
<td>Basic file I/O</td>
<td>Ch. 6</td>
<td></td>
<td>Lab 5: Reference parameters and basic file I/O</td>
<td>HW 3, Thursday Feb. 22 at 11:55 P.M.</td>
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<td>Feb.</td>
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<td>Ch. 7</td>
<td>Midterm 1, Covers</td>
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www.cs.umn.edu
Syllabus

15% Labs
30% Homework (due Thursdays)
  5% Quiz (Feb. 14)
10% Midterm 1 (Feb. 28)
15% Midterm 2 (April 11)
25% Final (May 9, 6:30-8:30pm)
Each week there will be either a homework due or a test.

Homework is due Thursdays at 11:55 P.M. on Moodle.

Late homework is not accepted, but we will drop the lowest one.
Labs can be checked off up until a week after the lab

Homework must be coded individually

Don't cheat
Really... don't cheat
Homework

Homework will be both a creative and problem solving endeavor:

Lego example

Build a castle with:
- 4 walls enclosing
- Door
- At least one tower (higher than wall)
Homework
# Syllabus

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<td>93% A</td>
<td>73% C</td>
</tr>
<tr>
<td>90% A-</td>
<td>70% C-</td>
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<tr>
<td>87% B+</td>
<td>67% D+</td>
</tr>
<tr>
<td>83% B</td>
<td>60% D</td>
</tr>
<tr>
<td>80% B-</td>
<td>Below F</td>
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</table>
Syllabus

Any questions?
What can I program?

If you can think of an explicit process (of simple steps) to solve your problem, then it can be programed.
Banana Nut Bread

Directions
1. Preheat the oven to 350°F (175°C).
2. Mix butter into the mashed bananas in a large mixing bowl.
3. Mix in the sugar, egg, and vanilla.
4. Sprinkle the baking soda and salt over the mixture and mix in.
5. Add the flour and nuts last, mix.
6. Pour mixture into a buttered 4x8 inch loaf pan.
Repetitive tasks

Simply move the blue ball with your mouse and avoid the red balls. Easy? Definitely not!
How do you get change for $18.26 with the least amount of bills and coins?
Repetitive tasks

If you feel like a mindless zombie when you do it a lot, you can probably program it.
Repetitive tasks
### Repetitive tasks

<table>
<thead>
<tr>
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<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<tr>
<td>1</td>
<td>Carlos L. Arney</td>
<td>1040 Morgan Street</td>
<td>Pensacola, FL 32507</td>
<td>Username: Herch1955</td>
<td>Password:</td>
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<tr>
<td>2</td>
<td>Randall K. Blackwell</td>
<td>2205 Richson Drive</td>
<td>Canyon Creek, MT 59633</td>
<td>Phone: 406-368-2915</td>
<td>Mother's Maiden name:</td>
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<tr>
<td>3</td>
<td>Ann F. Gibson</td>
<td>294 Briercliff Road</td>
<td>Corona, NY 11368</td>
<td>MasterCard: 5175 0562 3099 3057</td>
<td>Expires:</td>
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<td>4</td>
<td>David J. Woodhouse</td>
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<td>5</td>
<td>Michael J. Smith</td>
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<td>Amarillo, TX 79106</td>
<td>Phone: 806-217-2186</td>
<td>Username:</td>
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<td>6</td>
<td>Mary J. Rasmussen</td>
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<td>7</td>
<td>Martin H. Hughes</td>
<td>2327 Cedar Lane</td>
<td>West Roxbury, MA 02132</td>
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<tr>
<td>8</td>
<td>Melanie D. Mouzon</td>
<td>458 Pursglove Court</td>
<td>Dayton, OH 45410</td>
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<td>9</td>
<td>Christine S. Bonin</td>
<td>2934 Hillview Drive</td>
<td>Columbus, GA 31901</td>
<td>Phone: 706-887-2499</td>
<td>Username:</td>
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<td>10</td>
<td>William G. Holland</td>
<td>2528 Hart Ridge Road</td>
<td>Saginaw, MI 48607</td>
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<td>11</td>
<td>Doyle B. Dye</td>
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<td>Vancouver, WA 98660</td>
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<td>12</td>
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<td>Username:</td>
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<tr>
<td>13</td>
<td>Christine M. Frazier</td>
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<td>14</td>
<td>Nell P. Granberry</td>
<td>888 Cherry Tree Drive</td>
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<td>15</td>
<td>Madeleine D. Daniel</td>
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</tr>
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<td>16</td>
<td>Lillie D. Callenger</td>
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<td>Phone: 904-741-4642</td>
<td>Username:</td>
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<tr>
<td>17</td>
<td>Shoshana J. Falls</td>
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<td>Appleton, WI 54911</td>
<td>Phone: 920-401-7907</td>
<td>Username:</td>
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<tr>
<td>18</td>
<td>Cynthia H. Morgan</td>
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<td>Waukesha, WI 53188</td>
<td>Phone: 414-837-2559</td>
<td>Username:</td>
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<tr>
<td>19</td>
<td>Dorothy R. Reed</td>
<td>1748 Briarwood Street</td>
<td>Waukesha, WI 53186</td>
<td>Phone: 815-472-6115</td>
<td>Username:</td>
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<tr>
<td>20</td>
<td>Tyler M. Pulido</td>
<td>2373 Carriage Lane</td>
<td>Toledo, OH 43609</td>
<td>Phone: 567-472-8284</td>
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<tr>
<td>21</td>
<td>Tommy V. Guzman</td>
<td>370 Fairfax Drive</td>
<td>Fullerton, CA 93632</td>
<td>Phone: 909-262-7466</td>
<td>Username:</td>
</tr>
</tbody>
</table>
Auto leveling?
Software vs Hardware

Software - the more intangible code on a computer

Hardware - the physical Parts of the computer
Hardware interaction

Input -> CPU -> Output

Input

Memory

Output
Memory addressing

Data is stored in “addresses” inside the memory

Later in this class, we will use these addresses to manipulate and share data
Memory addressing
Object oriented programming

OOP - focus on data and how they interact

To make algorithms for OOP, it is often useful to identify the data you are working with and their relationships before programming.
Object oriented programming

Data for...

Banana nut bread?
ATM?
Ball game?
Object oriented programming

Data for...

Banana nut bread?  Ingredients
ATM?
Ball game?
Object oriented programming

Data for...

Banana nut bread? Ingredients
ATM? Dollars & coins
Ball game?
Object oriented programming

Data for...

Banana nut bread? Ingredients
ATM? Dollars & coins
Ball game? Balls & mouse
Object oriented programming

Data for...

Banana nut bread? Ingredients
ATM? Dollars & coins
Ball game? Balls & mouse

Lots of pixels (tiny color dots)
Break time!

How many programmers does it take to change a light bulb?

None. It's a hardware problem.
Object Oriented

Main focus is on **objects** and how they interact (represented by me as boxes)

Reusable groups of actions (verbs) between objects are called **functions** (squiggly boxes)

These actions can take additional information called **arguments**, (an analogy is ordering at a restaurant; the ordering format is the same, different food)
Object Oriented

One format is:

object.function(argument, argument...);

Example:

James.teaches(CSci 1113);
teach(James, CSci 1113);

The dot (period) shows that “teaching” is an action done by “James”
Banana Nut Bread

Ingredients
* 3 or 4 ripe bananas, smashed
* 1/3 cup melted butter
* 1 cup sugar
* 1 egg, beaten
* 1 teaspoon vanilla
* 1 teaspoon baking soda
* Pinch of salt
* 1 1/2 cups of all-purpose flour
* 1 cup of nuts
Banana Nut Bread

Directions
1. Preheat the oven to 350°F (175°C).
2. Mix butter into the mashed bananas in a large mixing bowl.
3. Mix in the sugar, egg, and vanilla.
4. Sprinkle the baking soda and salt over the mixture and mix in.
5. Add the flour and nuts last, mix.
6. Pour mixture into a buttered 4x8 inch loaf pan.
Banana Nut Bread

Directions
1. Preheat the **oven** to 350°F (175°C).
2. Mix **butter** into the mashed **bananas** in a large mixing **bowl**.
3. Mix in the **sugar**, **egg**, and **vanilla**.
4. Sprinkle the **baking soda** and **salt** over the **mixture** and mix in.
5. Add the **flour** and **nuts** last, mix.
6. Pour **mixture** into a buttered 4x8 inch loaf **pan**.
7. Bake for 1 hour. Cool on a **rack**.
Banana Nut Bread

Directions
1. **Preheat** the **oven** to 350°F (175°C).
2. **Mix** **butter** into the mashed **bananas** in a large mixing **bowl**.
3. **Mix** in the **sugar**, **egg**, and **vanilla**.
4. **Sprinkle** the **baking soda** and **salt** over the **mixture** and mix in.
5. **Add** the **flour** and **nuts** last, mix.
6. **Pour** **mixture** into a buttered 4x8 inch loaf **pan**.
7. **Bake** for 1 hour. **Cool** on a **rack**.
Banana Nut Bread

Pseudo code directions
1. `oven.preheat(350);`
2. `bowl.mix(butter, bananas);`
3. `bowl.mix(sugar, egg, vanilla);`
4. `bowl.sprinkle(baking soda, salt);`
5. `bowl.mix(flour, nuts);`
6. `bowl.pour(pan);`
7. `pan.bake(60);`
8. `pan.cool();`
Banana Nut Bread

Pseudo code directions #2
1. oven.preheat(350);
2. bowl.add(butter, bananas);
3. bowl.mix();
4. bowl.add(sugar, egg, vanilla);
5. bowl.mix();
6. bowl.sprinkle(baking soda, salt);
7. bowl.add(flour, nuts);
8. bowl.mix();
9. pan.pour(bowl);
10. pan.bake(60);
11. pan.cool();
mashedBananas = bananas.mashed();
bowl.add(butter, mashedBananas);

same as:
bowl.add(butter, bananas.mashed());

Kitchen.bowl.add(butter, bananas.mashed());

hand.mix(butter, mashedBananas);
bowl.add(hand.mix(butter, mashedBananas));
Compiling

Converting **code** to binary is called **compiling**

Hi

0101
Compiling

Often this compiled code will not work on other computers.
Compiling
Compiling

C++ is a high level language (human readable)

Compiling changes a high level language into a low level language that is easier for the computer (computer cannot run high level)
Compiling

Your **source code** is the original language you wrote your program in (the C++ code for us)

You must **recompile** the **source code** every time you save a change before running the program again
Compiling tl;dr

directions

cook

directions

meal

cook

meal

eat

satiated

eat

satiated

code

compile

1's and 0's

(program)

run

pretty colors
Compiling

In labs, the computers will come with a program called “geany” (which I will use too)

This program is where you can write code and easily compile simple programs

To run it either click the terminal icon ( ) on the left bar or press Ctrl+Alt+T

Then type:  geany  (enter)
`#include <iostream>
using namespace std;

int main ()
{
    cout << "Hello World! ";
    return 0;
}

(See: helloWorld.cpp)`
MODEL SMALL
IDEAL
STACK 100H

DATASEG
MSG DB 'Hello, World!', 13, '$'

CODESEG
Start:
MOV AX, @data
MOV DS, AX
MOV DX, OFFSET MSG
MOV AH, 09H ; output ascii string
INT 21H
MOV AX, 4C00H
INT 21H
END Start
Ease of use
Why C++?

- Speed
- Control
- Libraries
Not all programming languages need to compile code as C++ (Java, Python).

Compiling can greatly increase speed of a program.
Control

C++ allows you great control over your data (and its interpretation)

This comes with a burden of responsibility to properly manage your data

If you mismanage your data, you are likely to cause an error in your program
C++ is an old language (older than me) and this comes with pros and cons...

Some aspects are quirky to enable backwards compatibility (and are honestly out of date)

Since it has been around for a long time, there are lots of supporting libraries (and the language continues to develop...)
Java vs C++

Java
- Goes anywhere
- Comfy

C++
- Fast
- Fine tuned
Magic 8 ball
Magic 8 ball

What a rip off!
#include <iostream>
using namespace std;

int main()
{
    cout << "Maybe.";
    return 0;
}
Keyboard input

cout << "word"
- prints "word" to the screen

cin >> x
- store what is typed into "x"
  (x is some object or data)

Can also do arithmetic using +, -, / and *
(See: inputOutput.cpp)
Types of errors

Syntax error - code will not compile
e.g.  cout(“hi”);

Runtime error - code crashes after starting
(see: runtimeError.cpp)

Logic error - code runs but doesn't return
the correct answer
(see: logicError.cpp)
Syntax is a fancy word for the “grammar” of programming languages.

The basic English syntax is: (subject) (verb) (noun)
“I eat bananas” not “Bananas I eat”

The computer is VERY picky (and stubborn) about grammar, and will not understand you unless you are absolutely correct!
Avoid errors

To remove your program of bugs, you should try to test your program on a wide range of inputs.

Typically it is useful to start with a small piece of code that works and build up rather than trying to program everything and then debug for hours.
Comments

Comments are ignored pieces of code (computer will pretend they do not exist)

// denotes a single line that is commented // (everything before hitting enter)

/* denotes the beginning of a comment and the end of a comment is denoted by */
Braces denote a block of code \{ \} (belonging to a method, class, etc.)

“White space” is ignored, just as the your brain will ignore the bottom third of this slide (this is why we need a semi-colon)