CompSci 100e
Prog Design and Analysis II

Computer Duke **Fun** Interesting
Knowledge Science University **Work**

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Did you mean: *computer science*

January 13, 2011

Prof. Rodger

Announcements

- Labs start this week on Wed (is Mon) and Fri!
  - Bring laptops to lab
- See prelab work and Resources page
  - Install Java, Eclipse, and Ambient
- Read Chapter 1.1-1.4 for next class
  - Java data types, conditions, loops, arrays
- Today is about introductions, the class and getting started

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What is Computer Science?

- Computer science is no more about computers than astronomy is about telescopes.   - Edsger Dijkstra

- Computer science is not as old as physics; it lags by a couple hundred years. However this does not mean that there is significantly less on the computer scientist's plate than on the physicist's: younger it may be, but it has had a far more intense upbringing!   - Richard Feynman

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Scientists and Engineers

- Scientists build to learn, engineers learn to build.   - Fred Brooks

  ▪ Duke alum
  ▪ Chair of UNC's Computer Science Department
  ▪ Turing Award Winner

Computer Science is a young discipline

- First computer science department formed in 1962

PURDUE UNIVERSITY

1962

Samuel D. Conte
Professor emeritus of computer science and mathematics was the founding department head of the nation's first computer science program. October 1962.

What Is Computer Science?

- What is it that distinguishes it from the separate subjects with which it is related? What is the linking thread which gathers these disparate branches into a single discipline? My answer to these questions is simple --- *it is the art of programming a computer*. It is the art of designing efficient and elegant methods of getting a computer to solve problems, theoretical or practical, small or large, simple or complex.

C.A.R. (Tony) Hoare

C.A.R. (Tony) Hoare

- Turing Award Winner
- Knighted by Queen Elizabeth

What is Computer Science?

- Artificial Intelligence

Roomba

Spirit, Mars Rover

CMU's Sandstorm

What is Computer Science?

- Animation

What is Computer Science?

- Medicine, Genomics
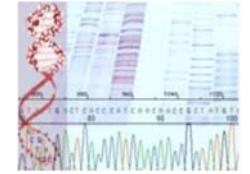
What is Computer Science?

- Devices

Computer Science in a Nutshell

What is this class about?

- The Organization of Data, and Searching

Efficient *design, programs, code*

Using the language: Java (or C++, or Python, or …), its idioms, its idiosyncracies	Object-oriented design and patterns. Software design principles transcend language, but …
Know data structures and algorithms. Trees, hashing, binary search, sorting, priority queues, greedy methods, graphs …	Engineer, scientist: what toolkits do you bring to programming? Mathematics, design patterns, libraries --- standard and others…

Tradeoffs

|	
Programming, design, algorithmic, data-structural	Simple, elegant, quick, efficient: what are our goals in programming? What does XP say about simplicity? Einstein?
Fast programs, small programs, run anywhere-at-all programs. Runtime, space-time, your time, CPU time…	How do we decide what tradeoffs are important? Tension between generality, simplicity, elegance, …

What's in Compsci 100/100E?

- Understanding tradeoffs: reasoning, analyzing, describing…
  - Algorithms
  - Data Structures
  - Programming
  - Design
- Programming using Java -
  - Tools: Eclipse, JDK, Libraries, …
  - Ideas: Design Patterns, OOP
  - Engineering and analyzing designs and programs
  - Using mathematical and scientific techniques
  - Scaling solutions

Course Web Page

www.cs.duke.edu/courses/cps100e/spring11/rodger/
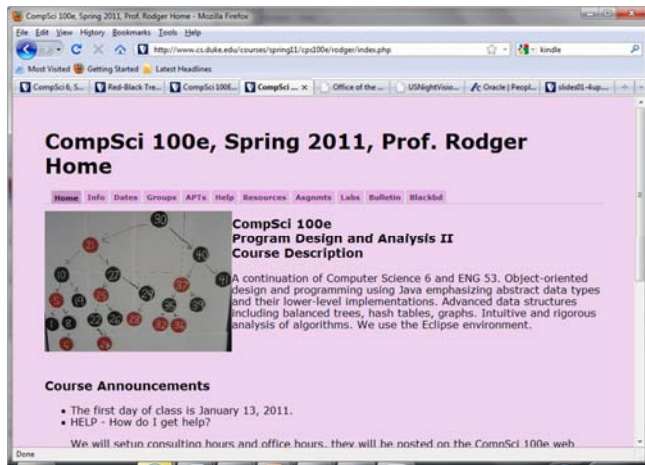
Course Overview

- Course Web Page has details
  - APTs: Algorithmic Problem-solving and Testing
    - Weekly small programming assignments, tested online
  - Programming assignments

- Who is Prof. Rodger?
  - What does she know and not know?

- Should you come to class/lab?
  - Meet people, learn things, participate in a community
  - Active classwork
  - We code together

Environment we will use

- Eclipse – an Integrated Development Environment

  - Editor
  - Compiler
  - An output console
  - Visualization of files and folders
  - Submission of programs (Ambient)

- See CompSci 100e Resources page for installing Java, Eclipse and Ambient on your computer

Am I in the right course (100/100E)?

- You should already know….
  - How to program – variables, conditional (if), loops (for/while), arrays/lists
  - Prereq: CompSci 6, ENG 53, AP CS A, self-taught….

- You don't need to know Java
  - Be aware, some people will know Java, most won't

- This class will teach you Java for the topics above and then teach you algorithms and data structures such as:
  - Trees, linked lists, sets, maps, queues, stacks, priorityqueues,
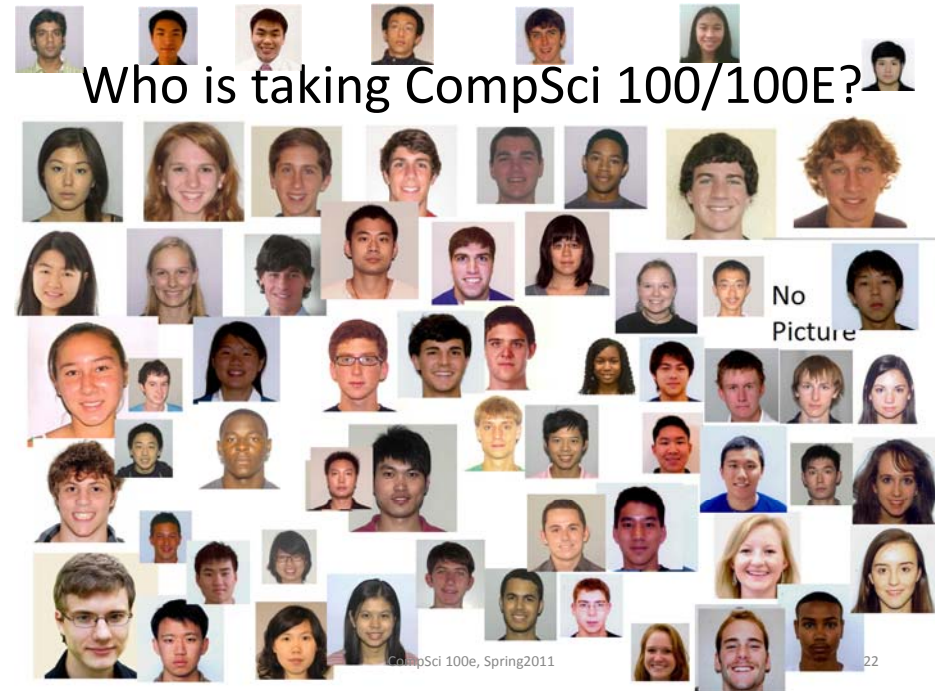
Who has taken Compsci 100/100e?

- Jessica Abroms, Trinity '98
  - Pixar, iPhone, Guitar Hero
- Luis von Ahn, Trinity '00
  - Macarthur, reCaptcha, GWAP
- Rachel Zurer, Trinity '04
  - Americorps, Creative Writing
- Ge Wang, Trinity '00
  - T-Pain, Ocarina, Music
- Jim Bungener, Pratt '99
  - CFD, Team Alinghi
- Ted Hung, Trinity '02
  - Electronic Arts, Lucasarts

Who is taking CompSci 100/100E?

No Picture

Java

- Developed 1995 by Sun
  - James Gosling and Patrick Naughton and team
- Simpler than C++
- Rich and LARGE library
  - We will not learn all of Java!
- Portable – runs on different platforms (this is a big deal!)

Why Java?

- **Java features.**
  - Widely used.
  - Widely available.
  - Embraces full set of modern abstractions.
  - Variety of automatic checks for mistakes in programs.
  - Buzzword-enabled

    "Java is a simple, object-oriented, distributed, interpreted, robust, secure, architecture-neutral, portable, high performance, multi-threaded, and dynamic language"

- **Caveat.** No perfect language.

- **Our approach.**
  - Minimal subset of Java.
  - Develop general programming skills that are applicable to: C, C++, C#, Perl, Python, Ruby, Matlab, Fortran, Fortress, ...

A Rich Subset of the Java Language

Built-In Types	
int	double
long	String
char	boolean

System
System.out.println()
System.out.print()
System.out.printf()

Math Library	
Math.sin()	Math.cos()
Math.log()	Math.exp()
Math.sqrt()	Math.pow()
Math.min()	Math.max()
Math.abs()	Math.PI

Flow Control	
if	else
for	while

Parsing
Integer.parseInt()
Double.parseDouble()

Primitive Numeric Types		
+	-	*
/	%	++
--	>	<
<=	>=	==
!=		

Boolean	
true	false
||	&&
!	

Punctuation	
{	}
(	)
,	;

String	
+	""
length()	compareTo()
charAt()	matches()

Arrays
a[i]
new
a.length

Objects	
class	static
public	private
toString()	equals()
new	main()

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25

Programming in Java

- **Programming in Java.**
  - ➤ **Create** the program by typing it into a text editor, and save it as `HelloWorld.java`

```java
/**********************************************
 * Prints "Hello, World"
 * Everyone's first Java program.
 **********************************************/

public class HelloWorld {
    public static void main(String[] args) {
        System.out.println("Hello, World");
    }
}
```

HelloWorld.java

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Programming in Java

- **Programming in Java.**
  - ➤ **Create** the program by typing it into a text editor, and save it as `HelloWorld.java`
  - ➤ **Compile** it using Eclipse or by typing at the command-line: `javac HelloWorld.java`

command-line →

```
javac HelloWorld.java
```

(or click the Save button in Eclipse)

  - ➤ **This creates a Java bytecode file named: `HelloWorld.class`**

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Java Bytecode

`HelloWorld.class`

```
0000000 312 376 272 276  \0  \0  \0   .  \0 035  \n  \0 006  \0 017  \t
0000020  \0 020  \0 021  \b  \0 022  \n  \0 023  \0 024 007  \0 025 007
0000040  \0 026 001  \0 006   <   i   n   i   t   > 001  \0 003   (   )
0000060   V 001  \0 004   C   o   d   e 001  \0 017   L   i   n   e   N
0000100   u   m   b   e   r   T   a   b   l   e 001  \0 004   m   a   i
0000120   n 001  \0 026   (   [   L   j   a   v   a   /   l   a   n   g
0000140   /   S   t   r   i   n   g   ;   )   V 001  \0  \n   S   o   u
0000160   r   c   e   F   i   l   e 001  \0 017   H   e   l   l   o   W
0000200   o   r   l   d   .   j   a   v   a  \f  \0 007  \0  \b 007  \0
0000220 027  \f  \0 030  \0 031 001  \0  \f   H   e   l   l   o   ,
0000240   W   o   r   l   d 007  \0 032  \f  \0 033  \0 034 001  \0  \n
0000260   H   e   l   l   o   W   o   r   l   d 001  \0 020   j   a   v
0000300   a   /   l   a   n   g   /   O   b   j   e   c   t 001  \0 020
0000320   j   a   v   a   /   l   a   n   g   /   S   y   s   t   e   m
0000340 001  \0 003   o   u   t 001  \0 025   L   j   a   v   a   /   i
0000360   o   /   P   r   i   n   t   S   t   r   e   a   m   ; 001  \0
0000400 023   j   a   v   a   /   i   o   /   P   r   i   n   t   S   t
0000420   r   e   a   m 001  \0 007   p   r   i   n   t   l   n 001  \0
0000440 025   (   L   j   a   v   a   /   l   a   n   g   /   S   t   r
0000460   i   n   g   ;   )   V  \0   !  \0 005  \0 006  \0  \0  \0  \0
0000500  \0 002  \0 001  \0 007  \0  \b  \0 001  \0  \t  \0  \0  \0 035
0000520  \0 001  \0 001  \0  \0  \0 005   * 267  \0 001 261  \0  \0  \0
0000540 001  \0  \n  \0  \0  \0 006  \0 001  \0  \0  \0  \f  \0  \t  \0
0000560 013  \0  \f  \0 001  \0  \t  \0  \0  \0   %  \0 002  \0 001  \0
0000600  \0  \0  \t 262  \0 002 022 003 266  \0 004 261  \0  \0  \0 001
0000620  \0  \n  \0  \0  \0  \n  \0 002  \0  \0  \0 017  \0  \b  \0 020
0000640  \0 001  \0  \r  \0  \0  \0 002  \0 016
0000652
```

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Java Types and Variables

- Every value has a type:

```
int number = 6;
double pi = 3.14;
String month = "January";
FileStream infile;
Color originalColor;
```

- Declare variable (state its type) only the first time it is used

Assignment Statement

```
int numberOfDays;
numberOfDays = 6;
```

- numberOfDays is "assigned" the value 6
- OR 6 is stored in memory location for numberOfDays
- This also illustrates the declaration first time used, and use of a variable.

Identifiers

- Choose meaningful names for variables, methods and classes

```
int x = 60;  // what does x represent?
 // instead of x, use ..
int numberOfDays = 6;
```

- Follow rules for identifiers
- Follow conventions for identifiers
- What is the difference?

A Java Program

```
public class HelloWorld
{
  public static void main(String [] args)
   {
    // display a greeting
    System.out.println("Hello, World!");
   }
}
```

About the Java Program

- What is the name of the class?
- What is the name of the method?
- What is printed?
- What does the ";" mean?
- What does "public static void" mean?
- What is "String [] args"?

Program to Convert Temperature

```java
public class TempConversion
{
  public static void main(String [] args)
   {
    // temp in Fahrenheit
    double temp = 65.0;    // declare, initialize
    double ctemp = (5/9) * (temp - 32);
    System.out.println(temp + "F"+" = "+ ctemp +"C");
   }
}
```

Error in Previous Program

- Output for this program is:

  65.0F = 0.0C

  That is not correct! How do we fix it?

Who is Alan Perlis?

- It is easier to write an incorrect program than to understand a correct one
- Simplicity does not precede complexity, but follows it
- If you have a procedure with ten parameters you probably missed some
- If a listener nods his head when you're explaining your program, wake him up
- Programming is an unnatural act
- Won first Turing award, - when?, what for?
  - 1966, Algol programming language

http://www.cs.yale.edu/homes/perlis-alan/quotes.html