CompSci 201, First Day

Website: http://bit.ly/201spring2020
DO NOT SIT IN THE LAST 4 ROWS

Come closer …..
Course Information Online


• Sakai
Respect

• Unplug from electronics
  • Laptops, phones only for WOTOS, taking notes
• Not for
A is for ...

• **Algorithm**
  • This course is: Data Structures + Algorithms

• **API**
  • Using Libraries is the future
PFTD: Plan For the Day

• Be able to articulate why 201 is the right course for you, in terms of being able to complete it with understanding
  • What are pre-requisites?
• Be able to explain what work is expected, collaboration policies, exams, discussions, assignments, APTs
  • Why are you taking Compsci 201?
PFTD: Part II

• Be able to read some Java programs and to analyze them by applying your knowledge of programming to Java programs
  • Analyze for understanding and prediction

• Know what work you should complete before January 13, 15, and 16
  • What is due, when is it due
What is Computer Science?

“Our species needs, and deserves, a citizenry with minds wide awake and a basic understanding of how the world works.”

-Carl Sagan
Algorithms and Data Structures

keys

hash function

buckets

John Smith
Lisa Smith
Sandra Dee

00
01
02
03
...
13
14
15

521-8976
521-1234
521-9655
Course Staff

• Teaching Associate:
  • Kate O'Hanlon
• Teaching Assistants:
  • Yongxin Tan, Carol Yang
• Head UTAs:
  • Belanie Nagiel, Megan Phibbons, Charles Lyu, Daniel Hwang

• 26 UTAs: see course website
How do you keep your sanity?
What is Computer Science?

- **Groups** of 2-4, Do NOT use a search engine

- How is this relevant to Compsci 201?
  - Tradeoffs in scaling Data Structures/Algorithms
  - WOTO
What is Computer Science?

3.5 billion snaps/day or 40,000 second
350 million photos to FB/day
100 million Instagram updates/day
5.6 billion Google searches/day
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
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C.A.R. (Tony) Hoare

He invented quicksort!
What is Computer Science?

- It is the study of automating algorithmic processes that scale
  - Long Division?
  - Updating Search Engine information?
  - Adding up a column of numbers?
  - Sending $$ via Venmo?
  - Updating your LinkedIn page?
Some Goals for 201

• Given a problem statement & a real data source, design, develop, debug, and test a Java program that uses appropriate standard libraries to efficiently solve the problem.

• Write programs that effectively implement and use data structures such as: arrays, maps, linked lists, stacks, queues, trees, and graphs.
More Goals for 201

• Evaluate the **time** and **space** complexity of *algorithms*, especially algorithms that scale, using **empirical** and **mathematical analysis**.

• Apply basic **object-oriented** design and programming principles in developing software
Who are you?
Who are you?
Who are you?
Who are you?

Photo mosaic
What class are you?

- Class of 2023: 66.2%
- Class of 2022: 25.1%
- Class of 2021: (small portion)
- Class of 2020: (small portion)
- Undergrad not listed: (small portion)
- Graduate student: (small portion)
- Non-degree student (taking class as professional development): (small portion)
What CompSci Studied?

- 48.1% Haven't taken a formal course
- 21.2% Took an online course and not at Duke
- 12.1% Took APCS A in high school
- Took a non AP compsci course
- Took CompSci 101 at Duke
- Took CompSci 116 at Duke
- Took EGR 103 at Duke
- Took Math 290 Python Progr...
How Comfortable with Java Experience?

- 52.4% haven't read or written any Java
- 32% have read, but never written Java
- 10.8% have some experience with Java, e.g., have taken AP Computer Science
- 5% have more than some experience, have written lots of Java
Why Taking 201?

- 84% Considering a compsci major or a minor
- 11.7% Requirements, but major is doubtful
- 5% Want to learn more, don't have to take this, major/minor doubtful
- 5% I have a friend taking it
How Anxious/nervous?
1 – anxious to 5 - not at all

1: 6 (2.6%)
2: 36 (15.6%)
3: 94 (40.7%)
4: 72 (31.2%)
5: 23 (10%)
Latanya Sweeney

I am a computer scientist with a long history of weaving technology and policy together to remove stakeholder barriers to technology adoption. My focus is on "computational policy" and I term myself a "computer (cross) policy" scientist. I have enjoyed success at creating technology that weaves with policy to resolve real-world technology-privacy clashes.

http://latanyasweeney.org/

Identify 87% of US population using (dob,zip,gender). Prof. Government and Technology @ Harvard, instrumental in HIPAA because if de-identification work. Former CTO of the FTC.
Code Interlude

• First 201 Java program – maybe first ever!
  • Use what you know
  • Make informed assumptions
  • When more time? Book, Internet, Friends, Brain

• All code online: website and GitLab
  • Browse, fork, clone, critique, …
This may be true, but …

Here is my secret.
It is very simple:
It is only with the heart that one can see rightly;
what is essential is invisible to the eye.

Antoine de Saint-Exupéry, The Little Prince
What does Code do? WDCD

```java
import java.util.*;
import java.io.*;

public class StaticUniqueWords {
    public static void main(String[] args) throws FileNotFoundException {
        Scanner s = new Scanner(new File(pathname: "data/kjv10.txt"));
        HashSet<String> set = new HashSet<>();
        int wcount = 0;
        double start = System.nanoTime();

        while (s.hasNext()) {
            wcount += 1;
            String word = s.next();
            if (! set.contains(word)) {
                set.add(word);
            }
        }

        double end = System.nanoTime();
        System.out.printf("total #: %d, unique #: %d \n", wcount, set.size());
        System.out.printf("time: %.3g \n", (end - start)/1e9);
        s.close();
    }
}
```
Understanding Repetition

• When does loop terminate?
• What takes time when this code executes?

```java
HashSet<String> set = new HashSet<>();
int wcount = 0;
double start = System.nanoTime();

while (s.hasNext()) {
    wcount += 1;
    String word = s.next();
    if (!set.contains(word)) {
        set.add(word);
    }
}

double end = System.nanoTime();
```
Java Variables and Types

• Variables: name, type, value
  • Primitives: int, double
    • wcount, start, end
  • Object: String, Scanner, HashSet
    • s, set, word

• For reach variable/object: name, type, value
  • What are the operations on these?
Understand and Explain

- "kjv10.txt" with 823,135 words, 34,027 unique
  - About one second to run on rodger laptop

- Double, Triple, Quadruple original file
  - Total # words different, # unique same
  - N words in "kjv10", 2N, 3N, 4N respectively

- Runtimes: 1, 1.5, 2.0, 2.5 -- pattern similar
  - How to justify empirical with analytical analysis?
From Analysis to Code

• How to understand (read) and create (write)
  • Read book, use Google? read book, ask
    • What book? See syllabus
  • Practice, practice, practice

• We will look at a high-level today, more details in Discussion Monday and Lecture Wednesday
  • Pre-discussion work
Java Types and Operations

• What can we do with int and double?
  • +,-,\%/ seen in code, many more
  • Initialize and update

• What can we do with HashSet?
  • .add(..), .contains(..), .size()

• What can we do with Scanner?
  • .hasNext(), .next(), .close()
Java Concepts and Conventions

• Classes and Objects
  • You invoke methods on … call functions on ..
  • Object dot method: `set.add(..)` or `s.hasNext()` or `set.size()` or …

• Variable identifiers begin with lowercase letter
• Class identifiers begin with uppercase letter
• Statements end in semi-colon, statement blocks created by braces: `{..}`
WOTO

Understanding Java and Scale

• Java is an object-oriented language
  • More on classes and objects later
• Primitive types: int, double, char, boolean, …
  • Fast, small, values stored in memory
• Arrays are homogeneous collections
  • Like Python lists, Matlab array/vector
  • Once created, don’t grow, can hold primitives
• ArrayList<> , Set<> , Map<> are collections
  • Dynamic, powerful, scale, no primitives
Analyzing Code, Algorithm

• What file of 1,000,000 strings will result in this code executing most quickly?
  • Characteristics of file? Bottleneck of method?
• What file of 1,000,000 strings will result in this code executing most slowly?
Tradeoffs

• What line is “bottleneck” in this code/algorithm?
  • How can we make this faster?
  • Why is Google so fast when searching?

• Replace `HashSet<>` with `ArrayList<>`
  • Why does code still run?
  • Common API, valuable for programmer!!
Course Logistics

• Please see course website for most material/dates
  • Web:

• For grades
  • Sakai:

• Exams:
  • February 14, April 3, April 30 (final)
Course Logistics

• Please see course website for due dates/grading
  • APT Quizzes, Midterm and Final Exams are assessments
  • Assignments and APTs are where you will practice and learn the material on your own
  • Discussion – practice and think together

• Please note collaboration policies, APT quizzes, late policies, why you should come to class
Succeeding in 201

• Come to class and participate: WOTO
  • Only one in the group fills out the WOTO
  • Put in all netids from the group
• Start work early, get help when needed
• Initial late penalties aren't harsh, on-time doesn't matter, but not doing assignments is a bad idea
  • Ask if you have any reason to ask, any reason
Success in 201 is ...