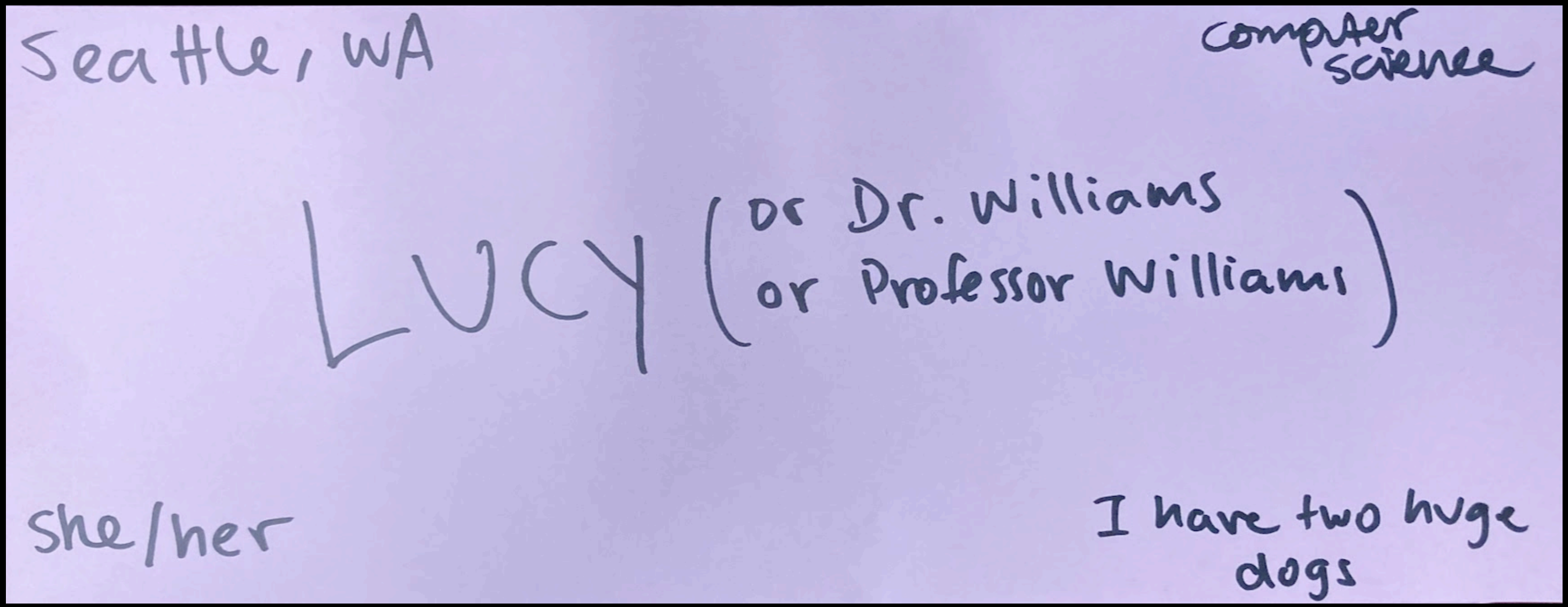
CSCI 332: Advanced Algorithms & Data Structures

After you sit down, please fold your paper hot dog style and write:

- What you'd like to be called
- Your hometown
- Your pronouns
- Your major/concentration
- A fun fact about you



Seattle, WA

computer science

LUCY (or Dr. Williams or Professor Williams)

she/her

I have two huge dogs

Introduce yourself to your neighbors!

Algorithm definition

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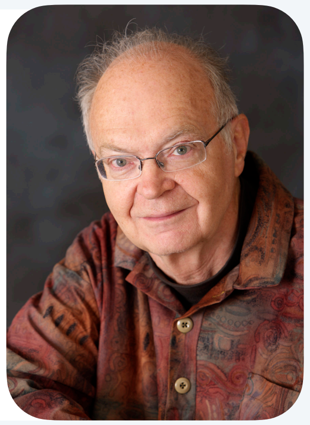
" An algorithm is a finite, definite, effective procedure, with some input and some output. "

— Donald Knuth



But...

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"*Algorithmic problems form the heart of computer science, but they rarely arrive as cleanly packaged, mathematically precise questions. Rather, they tend to come bundled together with lots of messy, application-specific detail, some of it essential, some of it extraneous.*"

— *Kleinberg & Tardos*

CSCI 232 vs. CSCI 332

What were the focuses of CSCI 232?

CSCI 232 vs. CSCI 332

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- String processing.

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- Sorting.
- Searching.
- Graph algorithms.
- String processing.
- Compression.

```
private static void sort(double[] a, int lo, int hi)  {
  if (hi <= lo) return;
  int lt = lo, gt = hi;
  int i = lo;
  while (i <= gt) {
    if      (a[i] < a[lo]) swap(a, lt++, i++);
    else if (a[i] > a[lo]) swap(a, i, gt--);
    else                   i++;
  }

  sort(a, lo, lt - 1);
  sort(a, gt + 1, hi);
}
```

Emphasizes critical thinking, problem-solving, and code.

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$$\begin{aligned}
\sum_{i=1}^{n} \sum_{j=i+1}^{n} \frac{2}{j-i-1} &= 2\sum_{i=1}^{n} \sum_{j=2}^{n-i+1} \frac{1}{j} \\
&\leq 2n \sum_{j=1}^{n} \frac{1}{j} \\
&\sim 2n \int_{x=1}^{n} \frac{1}{x} dx \\
&= 2n \ln n
\end{aligned}$$

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Emphasizes critical thinking, problem-solving, and both open-ended problems and rigorous analysis.

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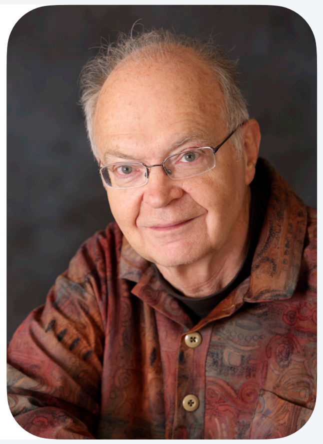
Why study algorithms?

" *Algorithms are the life-blood of computer science… the common denominator that underlies and unifies the different branches.* " — *Donald Knuth*



Course logistics

In table groups, try to complete the syllabus quiz. Some of the questions are open-ended and may not have one single answer!

If your group comes up with a question you can’t answer (not necessarily one on the quiz), post it in #questions in Discord.

Matching med-school students to hospitals

How to match? What should we think about when designing an algorithm for this problem?

Matching med-school students to hospitals

Input: a set of preferences among hospitals and med-school students

favorite ↓ least favorite ↓

	1st	2nd	3rd
Atlanta	Xavier	Yolanda	Zeus
Boston	Yolanda	Xavier	Zeus
Chicago	Xavier	Yolanda	Zeus

hospitals' preference lists

favorite ↓ least favorite ↓

	1st	2nd	3rd
Xavier	Boston	Atlanta	Chicago
Yolanda	Atlanta	Boston	Chicago
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students' preference lists

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Output: a (perfect) matching of hospitals to students…

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students' preference lists

Output: a (perfect) matching of hospitals to students…

{ Atlanta–Zeus, Boston–Yolanda, Chicago–Xavier }

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…that is self-reinforcing: no mutually beneficial side deals!

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With your table: can any hospitals/students that are not currently matched make a mutually beneficial deal?

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On your syllabus quiz, tally up how many at your table think:

1) a stable matching always exists
2) there is an optimally efficient algorithm for this problem