Recap: the scientific method

- **Question** → **Observations** → **Hypothesis** → **Experiment** → **Predictions**
  - **Falsifiable**
  - **Repeatable**
  - **Data collection and analysis**
  - **Broader theory**

Today

- Discussion: Is computer science science?
- Experiment design and validity: Terminology
  - **Goal**: Collaboratively develop a set of definitions and a common understanding of important terms
  - **TPS**: Think, Pair, Share -> 3 groups (expert panels)
Is computer science science?

Paper discussion:
- CS = science, engineering, and mathematics.
- “CS is a grab bag of tenuously related areas thrown together”
- “CS is not a science, and its ultimate significance has little to do with computers”
- “Computing is not a science because it studies man-made objects”
- “Most scientific fields have saturated”
- “Science will never again yield revelations as monumental as the theory of evolution, general relativity, quantum mechanics, ...”
- “Has computer science already made all the big discoveries it’s going to? Is incremental progress all that remains?”
- CS constantly forms new relationships with other fields => new fields.
- Overclaiming (empty promises) hurts the credibility of CS.
- Is the scientific method applicable to CS?

Is computer science science?

Paper discussion:
- CS = science, engineering, and mathematics.
- Latour defines science-in-the-making as the processes by which scientific facts are proposed, argued, and accepted. A new proposition is argued and studied in publications, conferences, letters, email correspondence, discussions, debates, practice, and repeated experiments. It becomes a “fact” only after it wins many allies among scientists and others using it. To win allies, a proposition must be independently verified by multiple observations and there must be no counterexamples.
- Latour sees science-in-the-making as a messy, political, human process, fraught with emotion and occasional polemics.

Is computer science science?

Today

- Discussion: Is computer science science?
- Experiment design and validity: Terminology
  - Goal: Collaboratively develop a set of definitions and a common understanding of important terms
  - TPS: Think, Pair, Share -> 3 groups (expert panels)
Timeline and goals

1. **Group assignment (Think)**
   - Each group identifies relevant concepts and gives an explanation+example.
   - **Goal:** identify and document relevant concepts related to the group’s focus.

2. **Breakout session (Pair)**
   - Each group identifies relevant concepts and gives an explanation+example.
   - **Goal:** identify and document relevant concepts related to the group’s focus.

3. **Regroup (Share)**
   - Reshuffle groups and each group member explains her/his findings.
   - **Goal:** convey identified concepts and comment on clarity.

4. **Class discussion (next time)**
   - Review the final draft for missing/duplicate information.
   - **Goal:** agree on drafted terminology.

---

**3 Groups: Validity, Variables/Measures, Design**

**Group topics**

**Group 1: Validity**
- What are limitations of an experiment?
- What could possibly invalidate an experiment?
- What measures could improve validity?

**Group 2: Variables/Measures**
- What types of variables exist?
- What variables can we control vs. not?
- What relationships between variables can we observe?

**Group 3: Design**
- What are conceptual differences between experiments?
- What subjects are studied and how?
- What is a good data layout for what experiment design?

---

**Experiments: a systematic approach**

- **Process**
  - **Inputs** → **Controllable characteristics** → **Output** → **Uncontrollable characteristics**

**Two example experiments**

- **Input** → **Controllable characteristics** → **Output** → **Uncontrollable characteristics**
Two example experiments

**High-level research question:**
Does coffee consumption improve programmer productivity and code quality?

<table>
<thead>
<tr>
<th>Experiment 1:</th>
</tr>
</thead>
<tbody>
<tr>
<td>● I program on project 1 for 20 weeks on Mondays with coffee.</td>
</tr>
<tr>
<td>● I program on project 2 for 20 weeks on Fridays without coffee.</td>
</tr>
<tr>
<td>● Code quality: number of defects encountered in each project.</td>
</tr>
<tr>
<td>● Productivity: number of lines of code written.</td>
</tr>
<tr>
<td>● Coffee consumption: dollars spent on coffee (Monday receipts).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Experiment 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td>● 20 participants, randomly assigned to two groups of 10.</td>
</tr>
<tr>
<td>● Each participant gets the same coding assignment.</td>
</tr>
<tr>
<td>● Code quality: number of defects encountered in each project.</td>
</tr>
<tr>
<td>● Productivity: number of lines of code written.</td>
</tr>
<tr>
<td>● Coffee consumption: Participants in group 1 get a free 64oz coffee.</td>
</tr>
</tbody>
</table>