COS 116: The Computational Universe

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- Preceptors:
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- Labs will be held in (Friend 005)
  - Mon 7-10, Tues 7-10, Wed 1:30-4:20
- This week: Take-home lab
Ancient dream of man: “Breathe life into matter”

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<tr>
<th>Golem (Jewish mythology)</th>
<th>“Automata”, (South Germany or Spain, c. 1560)</th>
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<td>Also, chess automata</td>
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<th>Frankenstein (Mary Shelley, 1818)</th>
<th>Robot (Karel Capek, 1921)</th>
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<td><img src="image" alt="Frankenstein" /></td>
<td><img src="image" alt="Robot" /></td>
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“Breathe life into matter” – another perspective
“Breathe life into matter” – A 20th century perspective

- “Matter”: Atoms, molecules, quantum mechanics, relativity …

- “Life”: Cells, nucleus, DNA, RNA, …

- “Breath life into matter”: Computation

One interpretation: Make matter do useful, interesting things on its own
Computational Universe
Some important distinctions

Computer Science vs. Computer Programming (Java, C++, etc.)

Notion of computation vs. Concrete Implementations of Computation (Silicon chips, robots, Xbox, etc.)
No programming in this course!

- Not necessary for conceptual understanding

- Gives us more time for a broader coverage of computer science (broader than COS126!)

- No advantage to those who have prior programming experience
Brief history of computers / computation

- Technological:
  - Clocks
  - Clockwork “Automata”
  - Mechanized looms, steam engines
  - Vacuum tubes, electronic calculators (1910-1930’s)
  - ENIAC (1945)
  - von Neumann Computer (1949, Princeton)
Brief history of computers / computation (cont’d)

Intellectual

- Ancient Greeks, philosophers (“How to formalize thought?”)
- Boolean logic (G. Boole, 1815-1864)
- Crisis in math
  - Hilbert: Call to axiomatize math
  - Gödel: Incompleteness theorem
- Lambda calculus (A. Church, 1936)
- Turing machines (A. Turing, 1937)

Both at Princeton;
First clear notion of “What is computation?”
Computer Science:
A new way of looking at the world
Example 1:
Example 2: Public closed-ballot elections

- Hold an election in this room
  - Everyone can speak publicly (i.e. no computers, email, etc.)
  - At the end everyone must agree on who won and by what margin
  - No one should know which way anyone else voted

- Is this possible?
  - Yes! (A. Yao, Princeton)
Example 3: Computational Biology

Old Biology

New Biology

Microarrays

Pathways
COS 116 : Course structure

- First 10 lectures:
  - Cool things computers do and how

- Next 8 lectures:
  - What’s inside computers, Internet, silicon chips

- Last 6 lectures:
  - Complexity, cryptography, viruses, search engines, artificial intelligence
This week's lab: Blogs & HTML

(Take-home Lab; pick up “manual” today)
Lab in Weeks 2 and 3: Scribbler. What determines its behavior?

(Each student gets one robot)
Bureaucratic details

- 3 hour lab sessions:
  - M 7-10, Tu 7-10, W 1:30-4:30
  - Not assigned a session yet? Come see us today after class!

- 1 hour “optional” precept:
  - No new material, will explain lecture, help with HW/labs
  - Time will be decided today

- This week’s lab is take-home: Start your blog
Grading

- Final (in-class): 35%
- Lab reports (including answering questions): 35%
- Participation (in class, on blog): 15%
- Midterm (take-home): 15%

Attendance at lectures is expected:
- Homeworks / lab assignments are handed out and due in lecture