



COS 116: The Computational Universe

Instructor: Sanjeev Arora

COS 116: The Computational Universe

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- Preceptors:
 - Umar Syed (usyed@cs)
 - David Xiao (dxiao@cs)
- 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”

Golem (Jewish mythology)



“Automata”, (South Germany or Spain, c. 1560)

Also, chess automata



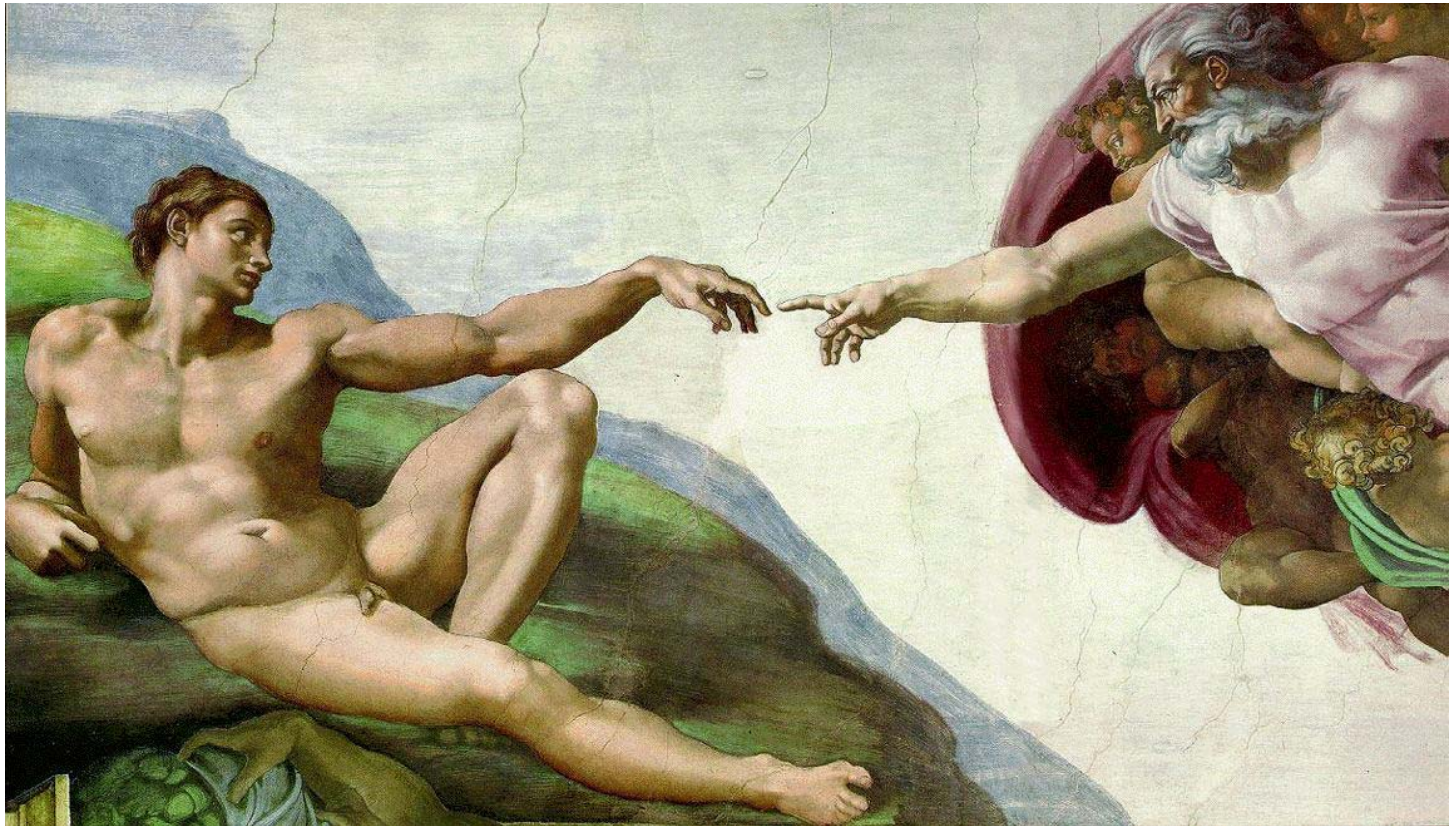
Frankenstein (Mary Shelley, 1818)



Robot (Karel Capek, 1921)

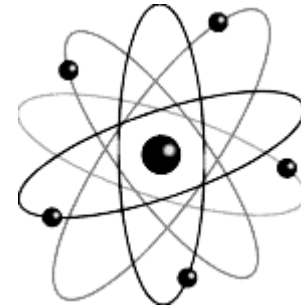


“Breathe life into matter” – Another perspective

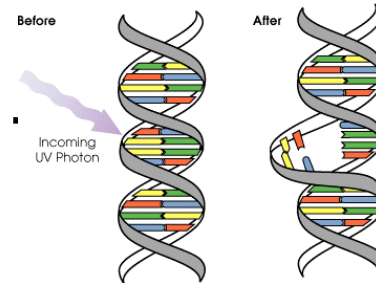


“Breathe life into matter” – A 20th century perspective

- “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**

May 11th, 1997
Computer won world champion of chess
(Deep Blue) (Garry Kasparov)



(Reuters = Kyodo News)



Computational Universe



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Some important distinctions

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

Notion of computation vs. Concrete
Implementations of
Computation (Silicon chips,
robots, Xbox, etc.)



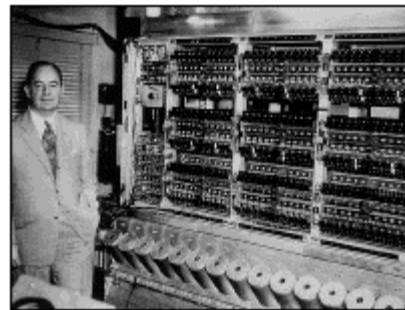
No programming in this course!

- 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:



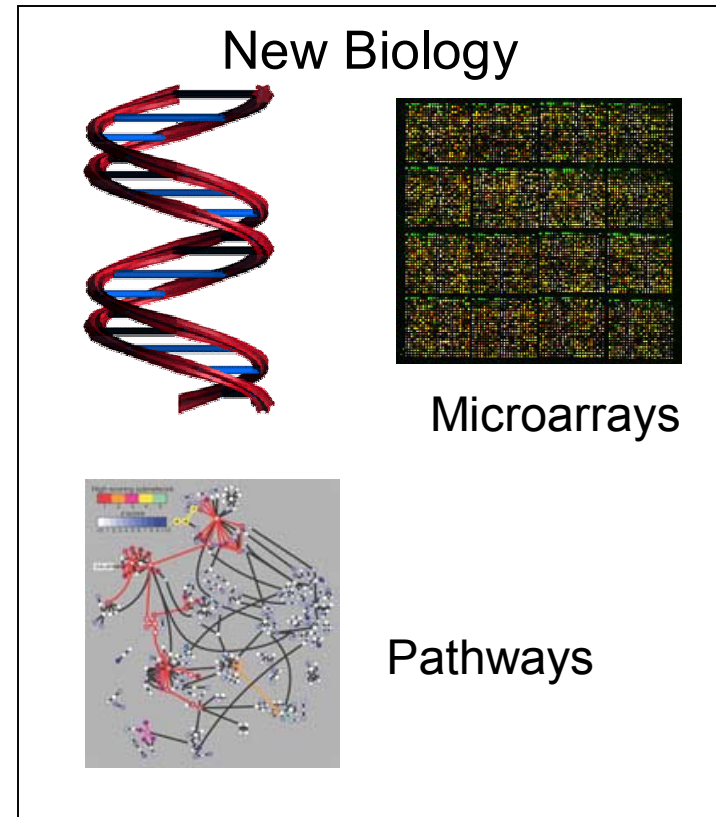
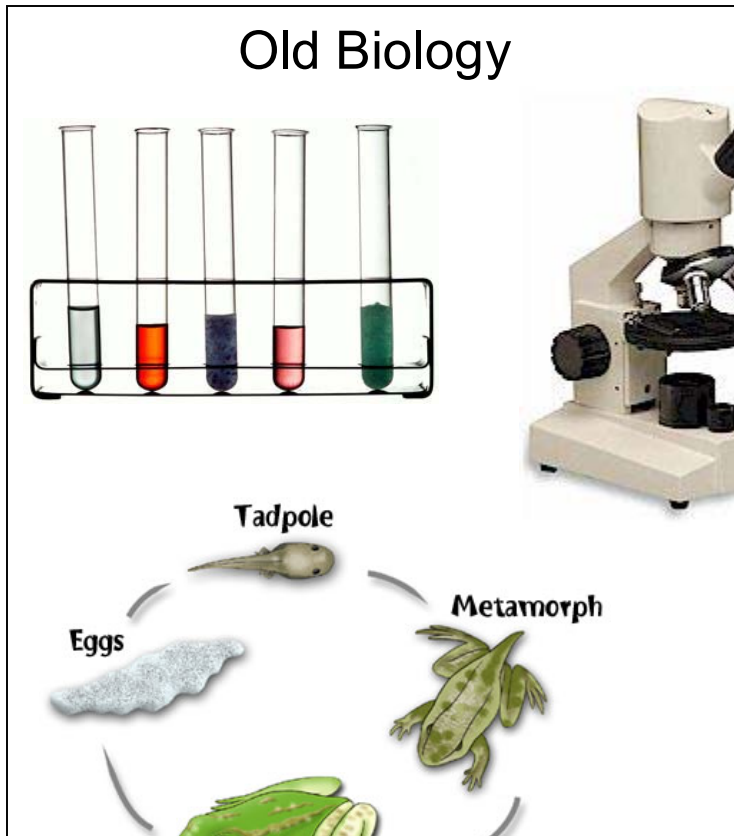
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Example 2: Public closed-ballot elections

- 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

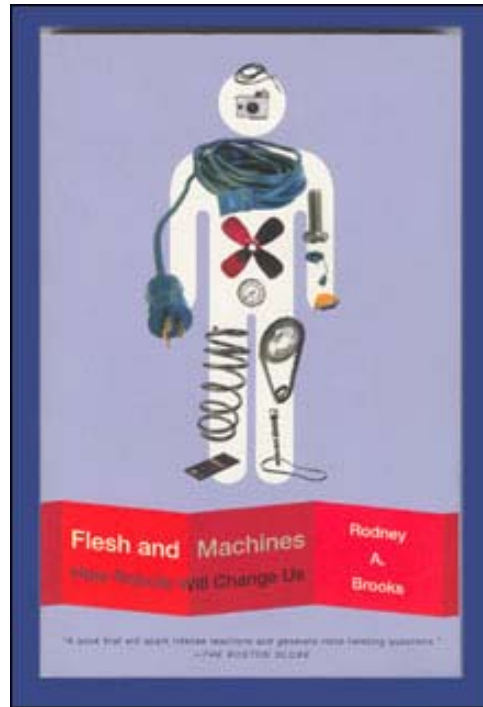




COS 116 : Course structure

- 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

Text



This week:
skim Chapter 1, read
pp 12-21, pp 32-51.

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