

CSCI 0150

(also known as CS15)

A Gateway to Computer Science



Computer Science (1/2)

- CS15 is a start to understanding computer science
 - for your own intellectual interest
 - for its enrichment of other fields
 - for its combination of scientific, engineering, art and design concepts and practices, and as a “mode of thought” – “computational thinking”

Computer Science (2/2)

- IT, or information technology, including CS, is key to the “knowledge economy”
- Omnipresent in a breadth of various applications and fields

Stunning Special Effects



Pixar's "Toy Story 4"



Disney's "The Lion King"



Immersive Virtual Reality

- Researchers can create fully immersive 3D environments via head-tracked stereo glasses, enabling realistic “field geology” on Mars!
- A state-of-the-art “Cave,” the YURT (YURT Ultimate Reality Theater), at 180 George Street
 - much higher quality (e.g., 100Mpixels) and much more comfortable than Oculus Rift, VALVE Vive and other VR headsets
 - but way more expensive!



Augmented Reality

- Creates virtual elements “on top of” the real world, blending a digital reality with an existing one!
- Smartphone apps, e.g., Pokéémon Go
- Microsoft HoloLens
 - special glasses with built-in head tracker that create a mixed reality
 - still in development



The Internet and Social Networks

- Facebook, Inc. – July 2019
 - 2.7 billion active users worldwide
 - 83 million fake profiles
 - 510,000 comments are posted,
293,000 statuses are updated,
and 136,000 photos are
uploaded every minute
 - 300 million photo uploads per
day



Opportunities/Threats of the Digital Age (1/4)

- Machines continue to replace human labor and decision-making
 - machines have increased human productivity while reducing demand for routine, repetitive jobs
 - as middle-skilled, task-intensive jobs disappear, income gap (“income inequality”) widens
 - but new jobs are being created, old jobs “upskilled” to be more interesting
 - impacting not just blue collar jobs such as factory work or driving, x-ray reading, tax advising, news reporting...
- **Education is key to economic survival**



Andries van Dam © 2019 09/05/19

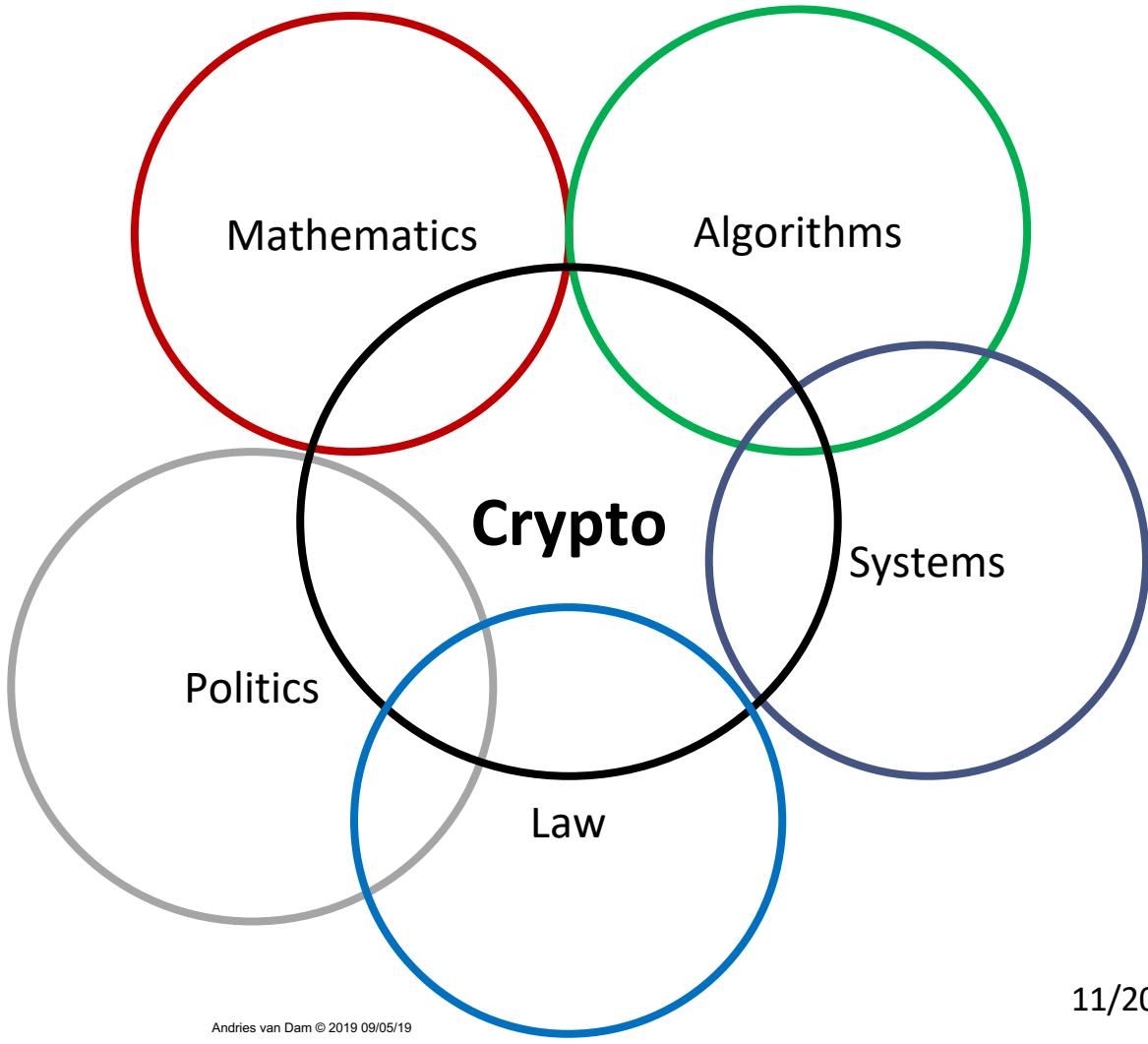
- Should there be a “robot tax”?
- Should there be a “guaranteed minimum income,” also called Universal Basic Income?
- “What is the future of work?”

Opportunities/Threats of the Digital Age (2/4)

- Dangers of yielding too much control to algorithms, some too complex to be understood by most people
 - instability in the stock market due to trading algorithms
 - autonomous vehicles (autopilot on planes, driverless cars...)
 - nuclear power plants and other infrastructure
 - “bias” in algorithms (mortgage lending, job placement...)
- Cyberfraud, Cybercrime, Cyberwarfare
 - Facebook-Cambridge Analytica data scandal
 - hacking of our democratic machinery (DNC, voting data...)
 - we keep experiencing huge data breaches (Equifax...)
 - offense has the advantage over defense
 - schools in Russia, China, North Korea (at least) teach hacking... we’re well beyond amateur hacking
 - will the next war be fought by drones, and how can they be controlled?
- Brown is strong in cybersecurity technology and policy



Privacy and Security



Opportunities/Threats of the Digital Age (3/4)

- Big Data

- “data mining,” “machine learning,” “deep learning”, “reinforcement learning”...
 - statistics-based algorithms for detecting patterns, anomalies, etc.
- search
- real-time language translation
- face recognition
 - can identify faces in crowd photos
- gesture recognition for user interfaces
- credit card fraud detection
- crime and terrorism anticipation
- but what about privacy in the age of the “surveillance state”?!?



Spielberg's "Minority Report" (2002) with Tom Cruise

Opportunities/Threats of the Digital Age (4/4)

- Big data & personal privacy
 - information now more accessible than ever
 - threat to privacy represented by increasing storage of personally identifiable information – is there any real “anonymous data”?!?
 - Google search results and posting information influencing voter decision-making
 - do hosting companies have the right/duty to ban offensive websites (e.g., Alex Jones, Louis Farrakhan)
 - NSA/Snowden Controversy; what about Google, Facebook, Microsoft and their data collection and use of that data – digital stuff is permanent, and you have no control over how it is used (Sun's Scott McNealy – “privacy is dead, get over it!”)
- **Need an educated government, citizenry**
- “Responsible CS” and Ethics TAs (ETAs)
 - our ETAs are: Kendrick Tan, Rebecca Zuo

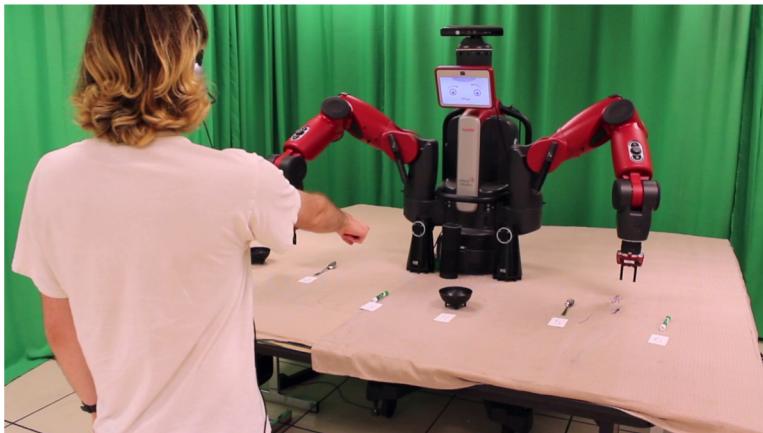


CS: So Much More Than Programming!

- Computers are our only universal machine, through the magic of software...
 - if you can program it, a computer can execute it
- **Programming is a means to an end, much like mathematics is... but they are both also fascinating topics in their own right!**
- Big push to learn how to “code,” but there is no “royal road” to programming or CS – it requires serious, sustained effort

Computer Science at Brown Works on Hard Questions (1/3)

- How can robots understand language to answer questions and hold conversations?



Stefanie Tellex

Computer Science at Brown Works on Hard Questions (2/3)

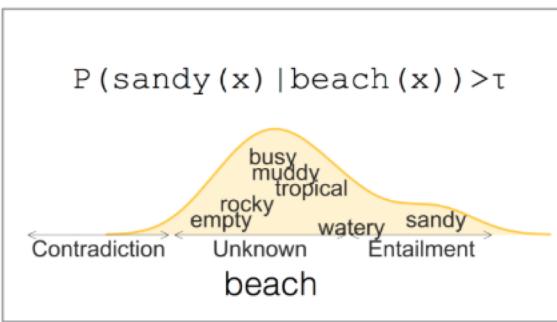
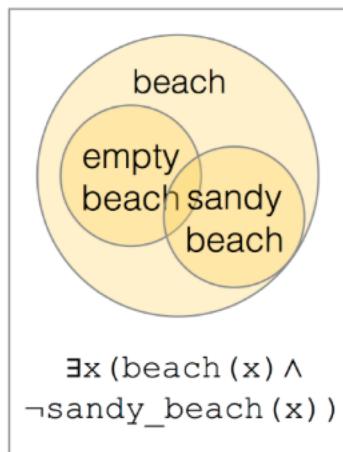
- How can we use encryption to promote privacy?
- How can we analyze the efficiency of algorithms we use in encryption?



Seny Kamara (CS16)

Computer Science at Brown Works on Hard Questions (3/3)

- How can AI understand the intricacies of human language the way humans do?



Does “beach” entail “sandy beach”?

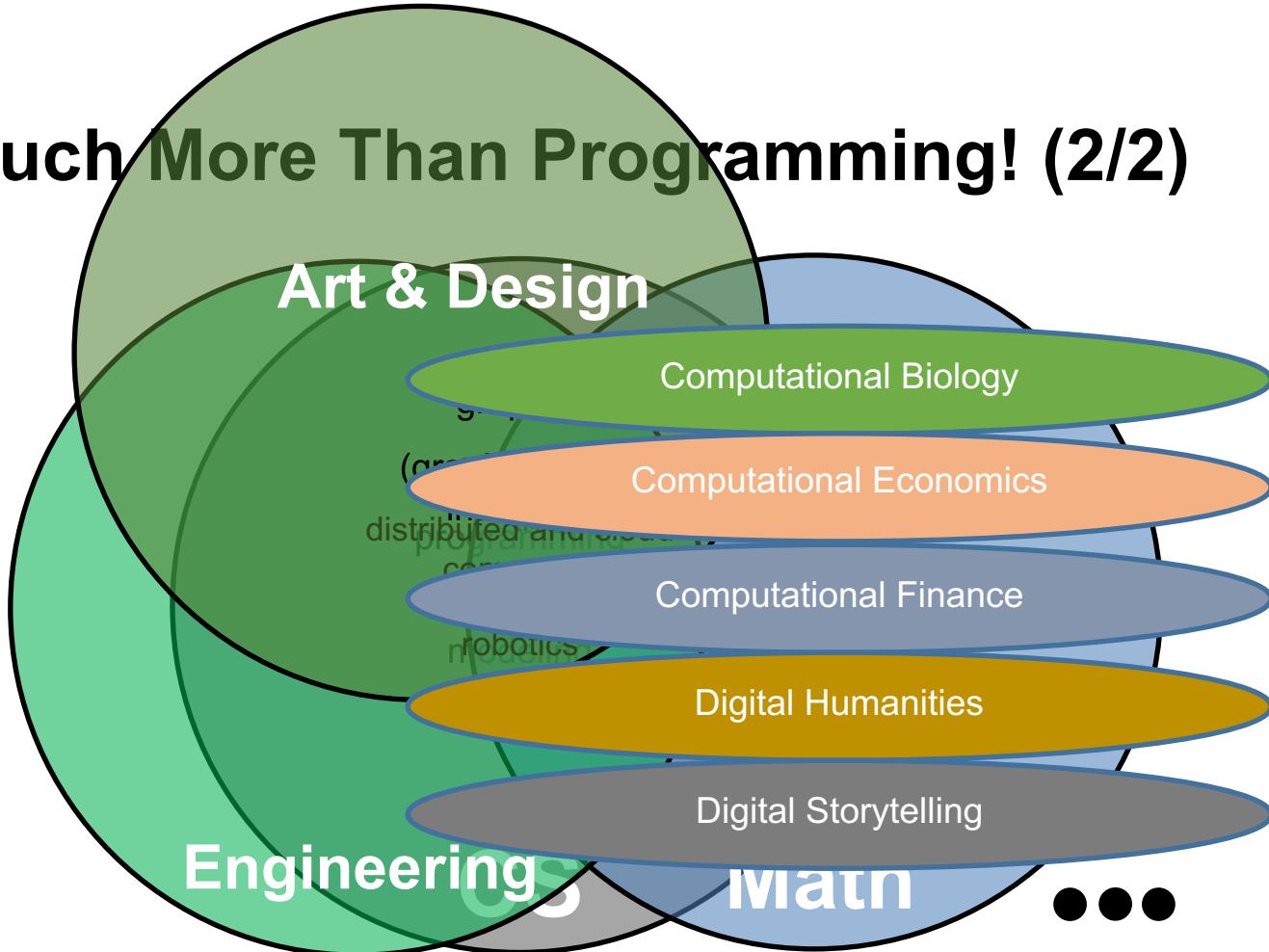


Ellie Pavlick

Other Areas of Research at Brown

- **Algorithms and Theory** (Pedro Felzenszwalb, Sorin Istrail, Philip Klein, John Savage, Roberto Tamassia, Eli Upfal)
- **Artificial Intelligence** (Stephen Bach, Eugene Charniak, Pedro Felzenszwalb, Amy Greenwald, George Konidaris, Michael Littman, Ellie Pavlick, Stefanie Tellex)
- **Comp Bio** (Sorin Istrail, Sohini Ramachandran, Eli Upfal)
- **Data Science** (Ugur Cetintemel, David Laidlaw, Stan Zdonik)
- **Machine Learning** (Stephen Bach, Eugene Charniak, Michael Littman, Daniel Ritchie, James Tompkin, Eli Upfal)
- **Security** (Seny Kamara, Vasileios Kemerlis, Shriram Krishnamurthi, Anna Lysyanskaya, Steve Reiss, John Savage, Roberto Tamassia)
- **Visual Computing** (Andy van Dam, Jeff Huang, David Laidlaw, Barbara Meier, Daniel Ritchie, James Tompkin)
- And more...<http://cs.brown.edu/research/areas.html>

CS: So Much More Than Programming! (2/2)



Why Should You Study Computer Science?

- For fun and intellectual excitement
- Really exciting era is just beginning
 - CS still a young discipline, computers just starting to act intelligently
- Fundamental “mode of thought”
- Increasingly important component of all other fields
- Plenty of enthralling and impactful jobs in established companies, start-ups, research labs, and academia

