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

Disney’s “Soul”

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 headsets (Oculus Rift S, VALVE HTC Vive Pro, and other VR) 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., Pokémon Go
- Microsoft HoloLens 2
  - special glasses with built-in head tracker that create a mixed reality
The Internet and Social Networks

- Facebook, Inc. – October 2020
  - 3.21 billion use Facebook, Instagram, WhatsApp monthly
  - 500 million use Instagram Stories daily
  - 10+ million active Facebook groups
  - Facebook removed 3.2 billion fake profiles in the first half of 2020
CS15 is Not Just About Learning to Program

- Introduces some fundamental concepts in CS
- Introduces some of the societal context and implications of our field
  - “IT in the News”
  - “Socially Responsible Computing” in the Department and in CS15: Shira Abramovich and Ellie Madsen as our STAs
Opportunities/Threats of the Digital Age (1/5)

- Machines continue to replace human labor and decision-making
  - machines have increased human productivity while reducing demand for routine, repetitive, and dangerous jobs (factory work, coal mining,…)
  - 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

  - Should there be a ”robot tax”?
  - Should there be a “guaranteed minimum income,” also called Universal Basic Income? (Andrew Yang ‘96)
  - “What is the future of work?”
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 (facial recognition, mortgage lending, job placement…)

Opportunities/Threats of the Digital Age (2/5)
Opportunities/Threats of the Digital Age (3/5)

- Cyberfraud, Cybercrime, Cyberwarfare
  - culpability of social media in spreading mis- and dis-information thereby causing polarization and distrust (e.g., 2020 election, COVID-19, organizing the insurrection)
  - belated banning of Trump and Parler, post-riot
  - we keep experiencing huge data breaches
    - Russia’s hack of SolarWinds, a major information technology firm, infiltrated over 18,000 clients’ systems
    - impacted clients included Fortune500 companies and many gov’t agencies (Pentagon, National Nuclear Security Administration, State Department, etc.)
  - 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 (4/5)

- **Big Data**
  - “data mining,” “machine learning,” “deep learning,” “reinforcement learning”…
    - statistics-based algorithms for detecting patterns, anomalies, etc.
  - search
  - real-time language translation
  - facial 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”?!?
Opportunities/Threats of the Digital Age (5/5)

- 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, Facebook, Apple… and their data collection and use of that data – our digital footprint is permanent, and we have no control over how it is used
    - Sun Microsystem’s Scott McNealy – “privacy is dead, get over it!”
    - When Apps are free, YOU are the product
- “Free speech” vs. (appropriate) censorship
  - hate speech, terrorism, violence
  - government-induced censorship (e.g., China, Saudi Arabia, Pakistan,…)
  - are social media content-neutral platforms or publishers, and what laws should apply to them?
- Need an educated government, citizenry
  - pass realistic laws to govern behavior
CS: So Much More Than Programming!

• Computers are our only universal machine, through the magic of software…
  o 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?
Computer Science at Brown Works on Hard Questions (3/3)

• How can AI understand the intricacies of human language the way humans do?
Other Areas of Research at Brown

• **Algorithms and Theory** (Lorenzo De Stefani, Pedro Felzenszwalb, Sorin Istrail, Philip Klein, Tim Nelson, 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, Ellie Pavlick, Stan Zdonik)

• **Machine Learning** (Stephen Bach, Eugene Charniak, Lorenzo De Stefani, George Konidaris, Michael Littman, Daniel Ritchie, Ritambhara Singh, 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, John Hughes, David Laidlaw, Barbara Meier, Daniel Ritchie, James Tompkin, Srinath Sridhar)

• And more…[http://cs.brown.edu/research/areas.html](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 exciting and impactful jobs in established companies, start-ups, research labs, and academia