What is Computer Science and why should you care?

CSE 91 First Lecture
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Outline

• 1.0 CSE 91: Goals and administration
• 2.0 About myself
• 3.0 What is Computer Science and why should you care?
• 4.0 Why study Computer Science at UCSD
CSE 91 Goals

• **Essence:** To convince you that Computer Science is not just programming but *creatively* solving the world’s *problems* using *computers*

• **Careers:** To show there are exciting career options that can change the world

• **UCSD CSE:** To show you that UCSD CSE has a number of cool professors doing cool work

• **Startups:** To give you a glimpse of how CSE ideas can convert to business opportunities

• **Students:** To showcase students like you
Course Mechanics

• **Lectures:** showcase a cool problem (e.g., Search) and a little peek “under the hood”.

• **Homework:** about once a week based on a lecture to allow you to engage with lecture.

• **Effort:** HWs should take no more than 1 hour. Upload instructions on web page

• **Mechanics:** Do in groups of 2. Choose your group or work alone. TA: Jacob Lyles

• **Attendance:** compulsory, must sign, protocol
2.0 Why Computer Science (CSE)?

• CSE Content is cool
• CSE people are cool
• CSE jobs are cool
CSE Stereotypes

- Type, type, program, program, CSE = Java
  - No: about solving problems creatively using computers
- Got to love computers as its all about ‘em
  - No: just as astronomy is not merely about telescopes
- Got to sit behind a desk in a dark room all day
  - No: lots of work outdoors as with sensors
- Work by yourself; interact only with machines
  - No: very much a social process today, lots of schmoozing
- Jobs mostly writing games, no world impact
  - No: huge variety – robotics, bioinformatics, helping blind
- No intellectual challenge
  - No: very hard problems: vision, AI, P = NP problem
CSE and Problem Solving

• If you like solving problems in creative and better ways –
  – you may like Computer Science
  – even if you never programmed in High School. Honest!
  – I never did, and I am still bad at programming . . .

• CSE people solve problems
  – by specifying a recipe (algorithm), often a social process
  – that is then programmed (possibly by others) using a computer as a tool
  – Examples: Mapping Human DNA, making the Roomba, searching information worldwide, stock trading
Problems Computers are good at

- **Boring** work humans do not like
  - Example: Walmart’s inventory system
- **Large** problems humans cannot solve at all
  - Example: Human Genome sequencing
- Problems humans cannot solve **fast**
  - Example: Google versus library search
- **Transcending** human limitations
  - Example: Facebook, blind reading machines
What makes computers **useful**?

- **Ubiquitous:** Everywhere, even in 3rd world
- **Flexible:** limited only by imagination
- **Powerful:** Lots of computation, cheap
  - 1 Million instructions per second for < $10
- **Cooperative:** Can talk via wireless, Internet
- **Physical:** Can sense and respond to world
Consider the iPhone

- **Ubiquitous**: 17 million sold in 2 years
- **Flexible**: 25,000 iPhone Apps and counting
- **Powerful**: 60 Million instructions per second
- **Cooperative**: via Bluetooth, WiFi and Cell
- **Physical**: Camera, Accelerometer, sound, mike
We’ve come a long way, baby

ENIAC, 1946, room, $500,000

iPhone, 2007, pocket, $200
A few CSE Artifacts
Roomba: Cleaning the World’s Dirt

• **Problem:** vacuuming, 2-4 hrs/week/home?
• Biologically inspired, < $200, Angle, Greiner, Brooks
• **Solution:** No mapping, search: spirals, wall-following, random angle-changing after bumping obstacle
Google: organizing the world’s information

- **Problem:** Tons of information on web sites, much of it junk. How to search and rank by computer?
- **Solution:** (2 Stanford students): Count links to you as votes and display sites with keyword and most votes
- **Second problem:** How to make this pay? Adwords and democratizing advertising.
Genomics: mapping the world’s genes

- **Problem**: Personalized medicine instead of 1-size fits all? Need to map all our genes and see differences.
- **Solution**: Machines cut DNA in small pieces with errors. Big jigsaw puzzle to reassemble. Celera
- **First fruits**: Go to 23andMe, pay $300, spit into kit and get a genetic evaluation
Stereotypes of CSE People

• Meant for people with no social skills
  – No: good communicators are required

• Much better suited for men
  – No: great for women, flexible, fulfilling, no barriers

• Meant for geeks who don’t have a life.
  – No: many are musicians, writers, sportsmen

• Meant for people who want to make tools, not for people who want to nurture or are artistic
  – No: great enabler in solving societal problems in medicine, and development, and today even art and music
CSE Cool Dude: Exhibit A

- Masi Oka plays Hiro on TV Show “Heroes”
- Graduated as CSE Major from Brown
- First job: software to create water effects for ILM (George Lucas’s company that created Star Wars)
- Still Works at ILM 3 days a week as software director
• Erik Brewer, CSE Professor co-founded Inktomi
• **Current research:** cheap and sustainable network technology for developing world (India, Africa)
• Selected as World Leader for Tomorrow by World Economic Forum
CSE Cool Dude: Exhibit C

- Raymond Kurzweil: inventor, MIT CSE 1970
- Built first reading machine for blind
- Inspired by Stevie Wonder, built terrific music synthesizers (e.g., Kurzweil K250)
Cool UCSD CSE Alum: Exhibit D

- Angelina Lee: UCSD CSE 2003
- Ph.D. candidate at MIT under Charles Leiserson
- Parallel processing that can handle errors well
Cool UCSD CSE Alum: Exhibit E

- Khwaja Shams: UCSD CSE 2006
- Works at NASA Jet Propulsion Lab
- Software for rovers and landers on MARS
Cool UCSD CSE Alum: Exhibit F

• Lindsey De Salvo: UCSD CSE 2005
• Software engineer, Amazon
• Academic coordinator Tau Beta Pi, volunteered for San Diego Rescue Mission
CSE Jobs

• So its exciting, but are there good jobs? Yes!
  – 80,000 new CSE jobs in California, more than any other degree (CA Labor Market Analysis 2007)
  – 59% of all new job openings 2004-2014 vs life science 4% (US Bureau of Labor, 2005)
  – Median salary $70,000 (labor statistics) 2nd highest
  – Unemployment 3% is low versus US average 6%
  91% of employers report shortage
UCSD Engineering Starting Salaries

2007 Starting Salaries Greater Than $56,000

- Structural Engineering
- Bioengineering
- Electrical Engineering
- Mechanical/Aerospace
- Computer Science
2.0 Why CSE@UCSD

• Great program
• Great students
• Great faculty
• Great location
CSE Program: Unique Combination

CSE ranked 12th in US News, UCSD 7th best public university but more specifically has:

• Great courses (as in small teaching schools):
• Great opportunities (as in great research universities)
• Great community spirit
CSE Courses

• Introductory courses taught by full-time, award-winning teachers supported by tutors in the lab
• Rich electives taught by leading researchers: e.g.
  – Multiplayer Games (project: design and build game)
  – Rendering (Project: render a butterfly)
  – Internet systems (Project: build Napster)
  – Robotics (Project: program underwater robot)
  – Mobile Computing (Project: program cell phone)
Great opportunities in CSE

• **Degrees:** Multidisciplinary work via BA program, 5 years BS/MS; BS in CE for hardware interest
• **Research:** research in CSE, CALIT, and San Diego Supercomputer Center with leaders in field
• **Tutors:** many jobs as tutors at approx $15/hour
• **Jobs:** 3 full-time campus job fairs; internships and jobs at the best places (Google, Intuit etc)
• **TIES:** Socially relevant computing projects (e.g. software for hospitals) Gordon engineering leaders
• **Community:** ACM game nights, Women in Computing
For the **Entrepreneurial** Student

- Many courses in Business School and Von Liebig Center for Entrepreneurship
- UCSD 50K Business plan contest totally run by undergraduates
- Rich history of faculty starting companies with undergraduates at UCSD
- **Example:** Nadav BenHaim, co-founded license recognition startup after undergrad with UCSD Vision Professor Serge Belongies
Our Students are our Best Product

- Alex Simma (PhD at Berkeley): UCSD CSE allows an undergraduate to pursue their special interests (in my case, learning)
- David Zhang (Microsoft): Recruiting at UCSD is phenomenal. Three career fairs per year . . . I ended up getting 8 interview requests in a day
- Khwaja Sims (JPL): I joined UCSD with no programming skills but the department pulled me in with intruiging courses. Minimal dependencies allowed me to intern at Nokia and Malin Science Systems and do a research project in databases with Prof Yannis.
- Santos Condon (Microsoft): The technical and organizational skills I learned in the large-scale courses at UCSD in Compilers, Architecture, and the Video Games Glass are essential to industry and indispensable for a new hire
Our Students are our Best Product

• **Nick Sha (Microsoft):** I found many of the projects I did in UCSD gave me an insight to how software can help solve many problems... UCSD hosts and organized large career fairs throughout the year, particularly DECaF...

• **Michael Kelly (Google):** The faculty here have good industry connections. I was working on a research project with a faculty member, and he was contacted by a Google recruiter...

• **David Zhang (Microsoft):** Recruiting at UCSD is phenomenal. Three career fairs per year provide graduating students with massive exposure at the fall career fair, I ended up getting 8 interview requests in a day
Great Faculty

• 12 Senior faculty named fellows of either ACM, IEEE, AAAS, or National Academies
• 12 Junior faculty have won NSF Career Awards and 5 are Sloan Fellows
• More than that:
  – Faculty have changed the world
  – Faculty are fun
  – Faculty really do teach undergraduate classes!
World changing Faculty Examples

- Jean Ferrante: Co-invented SSA, a basic representation used by all compilers
- Dean Tullsen: Co-invented SMT a form of multiprocessing common in Intel Chips Today
- Keith Marzullo: Co-invented the algorithm in the Network Time Protocol (NTP) used in the Internet
- Larry Smarr: pioneer, helped create the first Web browser
- Mihir Bellare: co-invented the Security standards
- Pavel Pevzner: fundamental research in showing the similarity of genetic trees in men and mice
- Yoav Freund: co-invented one of the most popular learning algorithms (AdaBoost) for which he shared the Godel Prize
But our faculty are also fun . . . 

- Who is listed in Ripley’s Believe it or Not because he was head of research at AT&T and a great juggler?  RG
- Who accepted an Academy Award presented by Jennifer Garner for work used in Harry Potter?  HJ
- Who beat 2 times Wimbledon winner John Newcombe in tennis doubles?  JP
- Who helped sequence the Human Genome?  VB
- Who does research routines in exotic South Sea Locales like Tahiti?  RK
- Who used research in vision to start a web site (Taaz.com) where women could virtually try out makeup.  DK
UCSD CSE: A night at the Oscars

Henrik Jensen for accurately rendering skin (e.g., in Harry Potter)
Summary

• Choose CSE because
  – The content is intellectually rich, world-impacting, and is a substrate for work in many other fields
  – The people are cool, diverse, and fun
  – The jobs are high paying, plentiful, & enjoyable

• Choose CSE@UCSD because
  – The program has great courses, great opportunities, and is a bargain
  – The faculty are world-changers, cool, and really teach classes
  – Our students are already changing the world

• If you are unsure, try a CSE class at UCSD
  – Try 8A and 8B which teach problem solving via programming by manipulating digital media or CSE 30 (manipulating robots)
  – At the very least, stay in CSE91 and be engaged (i.e., wake up)
Finally

• Various areas of CSE in each lecture and how they can solve the world’s problems

• Think of each lecture as an appetizer:
  – Homework will make you take a few bites
  – Lectures will point to full meal (later courses)

• Take the course, stay the distance, and come change the world with us
You, too, can make the world better...