

What is Computer Science and why should you care?

CSE 91 First Lecture

George Varghese

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

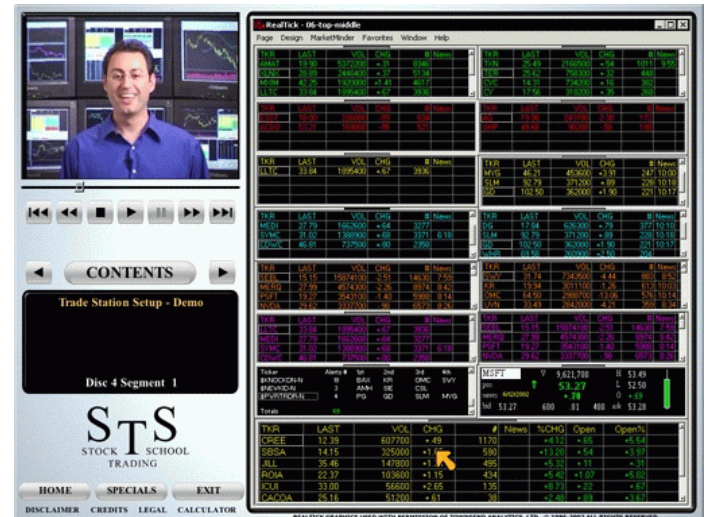
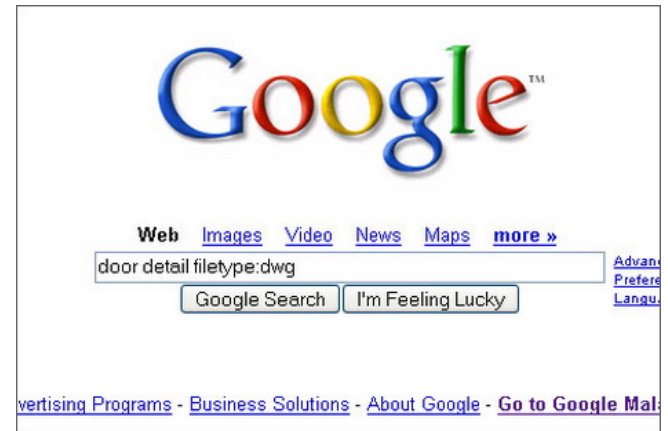
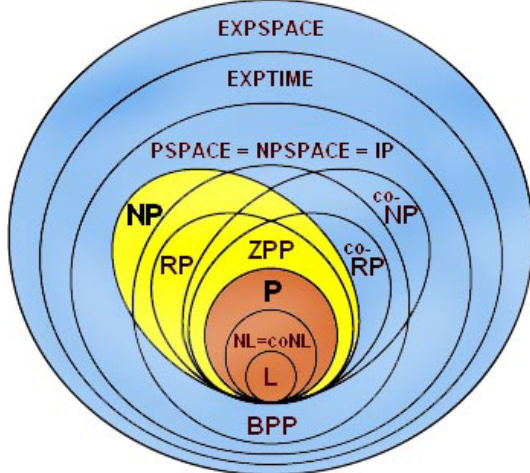


ENIAC, 1946, room, \$500,000



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

CSE Cool Dude: Exhibit B



- 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



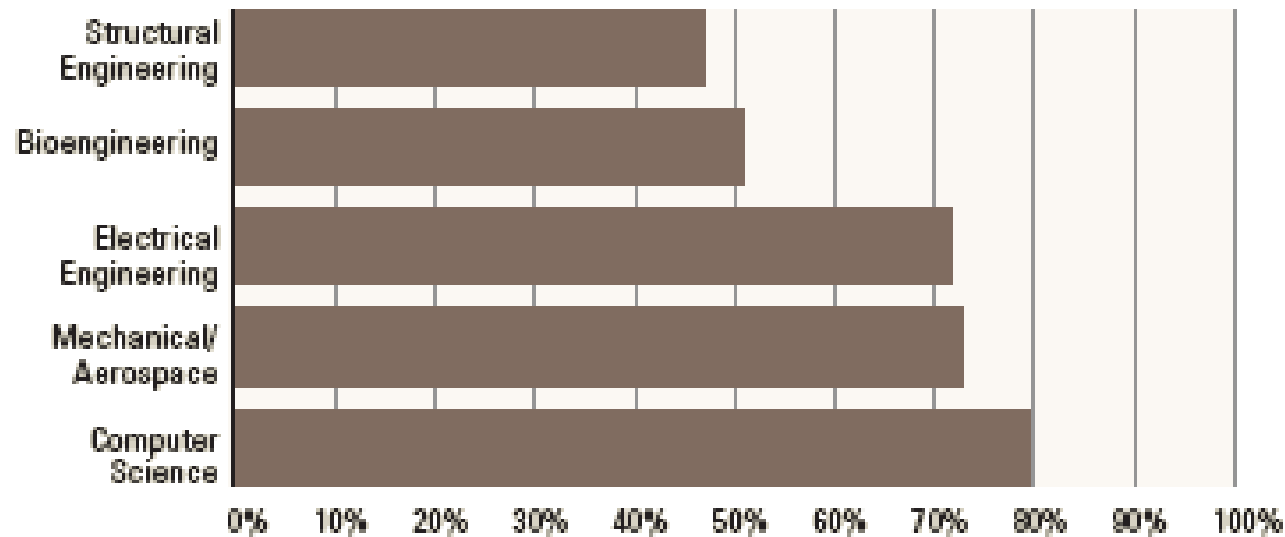
- Lindsey De Salvo: UCSD CSE 2005
- Software engineer, Amazon
- Academic coordinator Tau Beta Pi, volunteered for San Diego Rescue Mission

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)
 - Highest growing market nationally (25%) (US Bureau of Labor Statistics, Nov 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**



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 intriguing 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 . .

