LEHIGH UNIVERSITY
Computer Science &
Engineering

Computer Science at Lehigh

Jeff Trinkle

Professor and Chair

Department of Computer Science and Engineering

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https://engineering.lehigh.edu/cse

Agenda of CSE Information Session

- (5 min) Overview Department and Job Prospects
  - CSE Chair Prof Jeff Trinkle

- (15 min) Overview of Degree Requirements and Faculty Research
  - CSE Associate Chair Prof Mooi Choo Chuah

- (25 min) Q&A

- (15 min) Robotics Video Presentation
  - CSE Professor of Practice Corey Montella

CSE Degrees At Lehigh

- B.S. in Computer Science
  - Programming, system design, theory, and advanced applications
  - ABET accredited
  - Offered through either Engineering or Arts & Sciences college
- B.S. in Computer Science and Business
  - Full CS degree + full accredited business degree
  - ABET accredited and AACSB accredited
  - Our most popular major
- B.A. in Computer Science
  - For students who want a stronger liberal arts background
  - A little less math and a little less computer science
- Minors in Computer Science and Data Science
  - For students in different majors who want a CS foundation

Evolving Innovative Curriculum

A sampling of elective courses:

- CSE 160 - Intro to Data Science
- CSE 297 - Blockchain Algorithms and Systems
- CSE 264 - Web Applications
- CSE 298 - Mobile Apps (Android)
- CSE 320 - Biomedical Imaging
- CSE 325 - Natural Language Processing
- CSE 326 - Fundamentals of Machine Learning
- CSE 327 - Artificial Intelligence Theory and Practice
- CSE 343 - Network Security
- CSE 347 - Data Mining
- CSE 360 - Mobile Robotics
- CSE 398 - Big Data Analytics

The Attention You Deserve

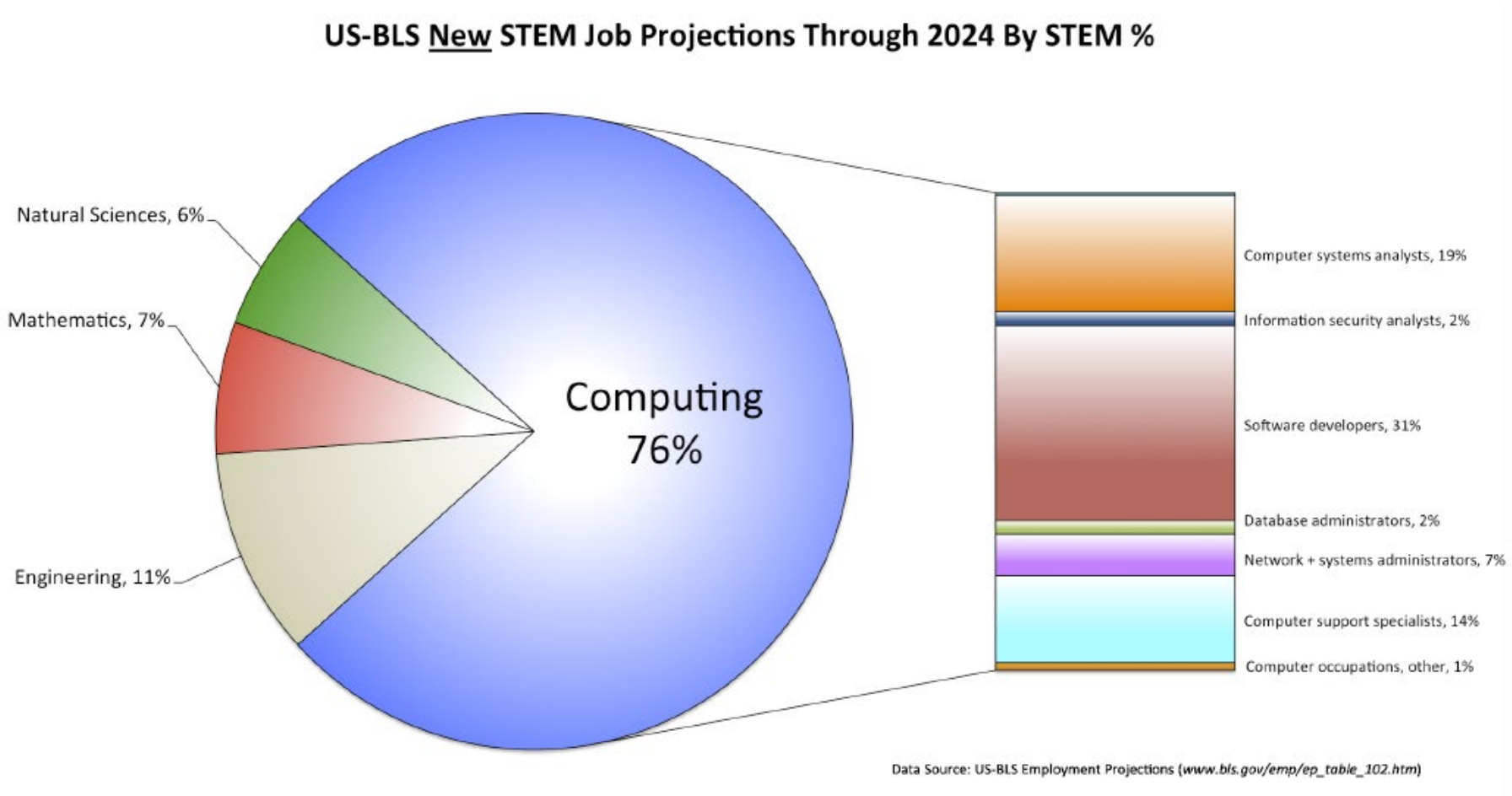
- We hire only the best to be CSE professors. They must:
  - Demonstrate excellence in research
  - Demonstrate excellence in teaching
  - Demonstrate a commitment to students
- Every student in CSE is assigned an advisor:
  - CSE professor who helps with details of registration and course selection; internships; and career planning
  - Students meet as often as they want (at least 2x/year)
- Enrollments up, faculty hiring up:
  - Doing our best to keep class sizes reasonable
  - Hired seven new faculty last year
  - Hiring more new faculty this year
  - Students can always get the help they need

Job Prospects

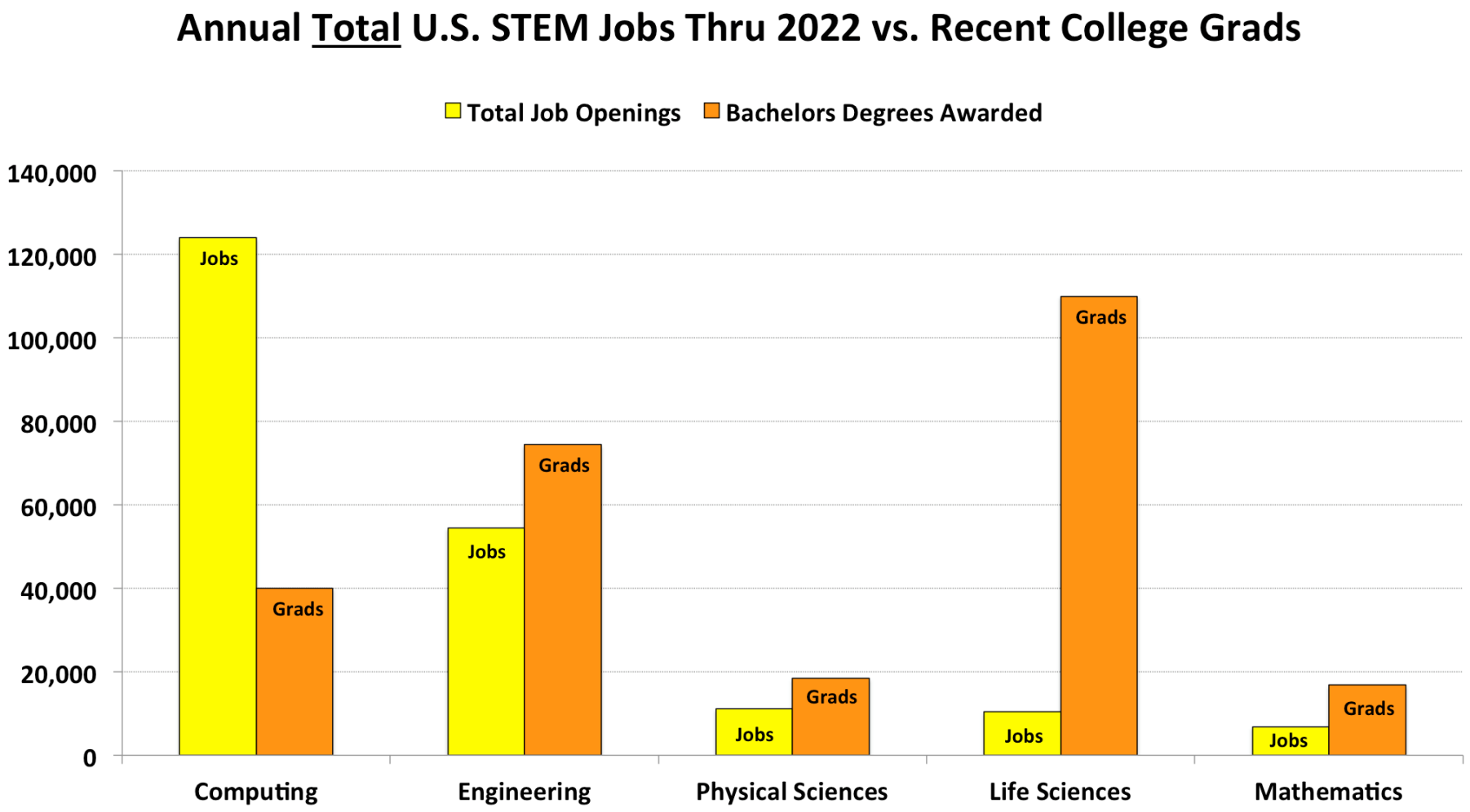
- CS is the fastest-growing STEM field:
  - 100,000 job shortfall, few of which can be outsourced
  - National crisis to produce enough qualified CS professionals
  - Now among the most popular majors on campus
- You can't go wrong majoring in CS:
  - As long as you love problem solving and don't fear technology or discrete math, you can succeed
- Students of all backgrounds are able to flourish:
  - From those who have been programming since they were 10, to those who didn't take a CS class until they were sophomores (half of our students didn't take programming in high school)

US Bureau of Labor Statistics Projections

Computing is 3x bigger than all other STEM areas combined!



US Bureau of Labor Statistics Projections



Data Sources: US-BLS Employment Projections, 2012-2022 (*www.bls.gov/emp/ep_table_102.htm*)
National Science Foundation NCSES (*www.nsf.gov/statistics/nsf13327/pdf/tab26.pdf, tab33.pdf, tab34.pdf, tab35.pdf, tab46.pdf*)

http://cs.calvin.edu/documents/computing_careers

CSE Graduates are Well Paid …

Class of 2019 Engineering Majors: Ave Starting Salaries

$59,200	Bioengineering
$66,892	Chemical Engineering
$64,351	Civil Engineering
$72,154	Computer Engineering
$88,427	**Computer Science & Business (CSB)**
$84,162	**Computer Science**
$77,000	Electrical Engineering
$64,500	Environmental Engineering
$70,091	Industrial & Systems Engineering
$65,929	Materials Science & Engineering
$68,309	Mechanical Engineering

https://www1.lehigh.edu/admissions/undergrad/success

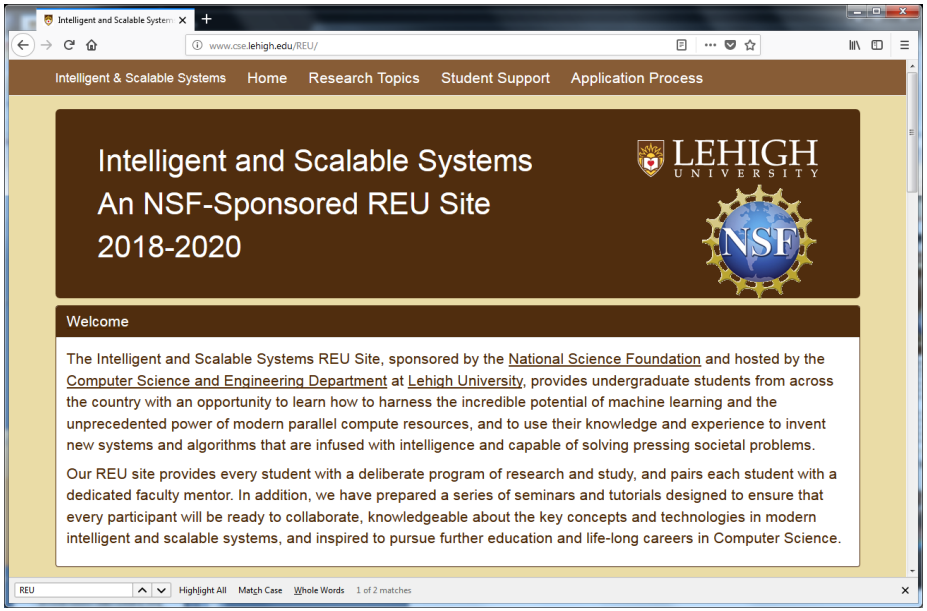
Research Opportunities

- Real benefit of a mid-sized school: research opportunities
  - Goal: distinguish yourself by doing something nobody else has ever done (and get paid to do it)
  - Lehigh: big enough for great research, small enough that grad students don't dominate
  - Funded and unfunded research opportunities for motivated undergraduates to work with faculty, do independent studies, etc.

- National recognition for our students
  - Our students have received NSF Graduate Research Fellowships
  - Finalists and Honorable Mentions in CRA Undergraduate Researcher Award competitions
  - Students regularly accepted into top Ph.D. programs in U.S.

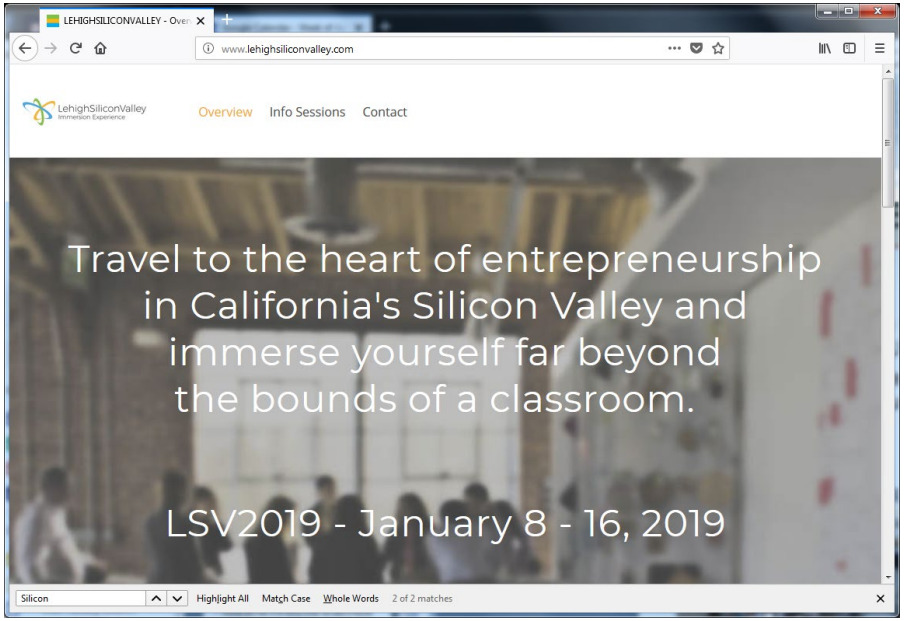
Mountaintop Experiences / Internships

- Research Experience for Undergraduates (REU)
- Dozens of student interns at Mountaintop campus



Lehigh Silicon Valley Software Engineering

- Prof. Lopresti leads Software Engineering Track for highly successful Lehigh Silicon Valley Program (LSV++), in collaboration with the Baker Institute
- For 2018, we visited Lawrence Livermore National Laboratory, OSIsoft, Adobe, Cisco, Google, Plug and Play Tech Center, and Bracket Computing

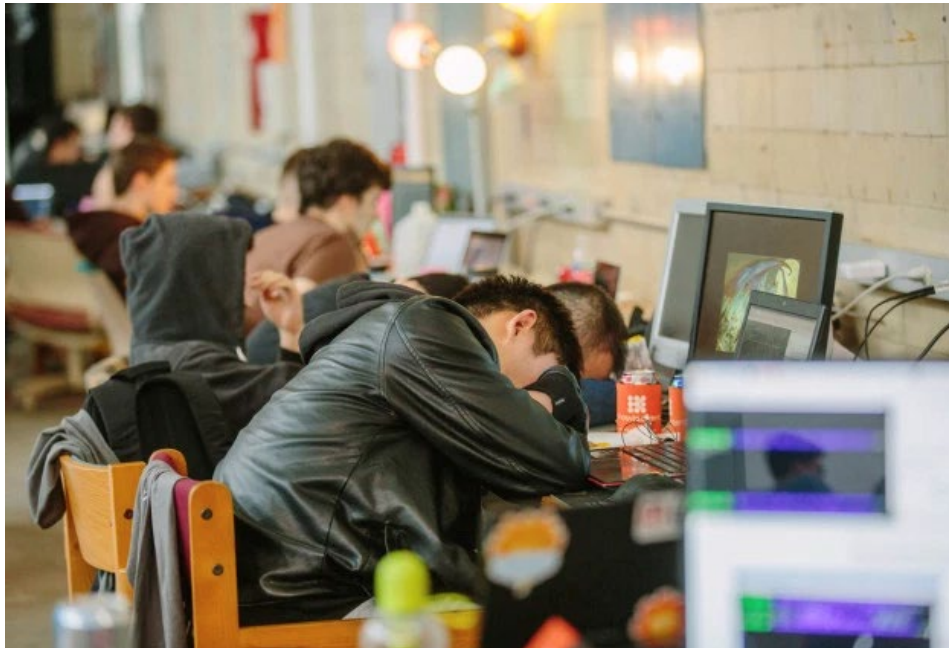


LSV++ students at Adobe HQ in San Jose

LSV++ students at Google HQ in Mountain View

Clubs

- Our Programming Club has 100+ active members
  - Not just a “let’s practice for the annual programming contest” club … service, outreach, and professional development
  - 2 student-run workshops per month; mock job interviews
  - Connect students with tutors; assist students from other departments with start-ups and app development
  - Aid in organizing regional hackathons
- mobiLEHIGH game programming competition
  - 2-months to build a game in a team of up to 4
  - Judges from Microsoft, Yahoo!, Google, Philadelphia Game Lab
  - Also an outreach activity to middle school students



Recent Hackathon on Mountaintop

- LehighHacks! – Hundreds of students, 24 hours

LehighHacks sponsors included IBM, Intel, Qualcomm, Wells Fargo, Microsoft, Thomson Reuters, Lutron…

Internships and Jobs

- Our faculty work hard to help students find the best employment opportunities
  - Google, Microsoft, Yahoo!, Intel, IBM, PWC, KPMG, other “500’s”
  - Smaller companies and start-ups
  - Research internships with faculty at Lehigh, or at other schools


ANY
QUESTIONS
?

CS Related Program

Associate Chair Mooi Choo Chuah

Degree Programs

- B. A. in Computer Science (College of Arts & Sciences)
- B. S. in Computer Science (College of Arts & Sciences)
- B. S. in Computer Science (P.C. Rossin College of Engineering)
- B. S. in Computer Science and Business

Related CSE Programs

- IBE and Computer Science
- IDEAS – CS (Arts) Concentration
- IDEAS – CS (RCEAS) Concentration

Which program is right for me?

- **BS in CS – if you are interested in deep study of foundational and practical aspects of computation and information processing.**
- **BA in CS – if you are interested in the study of foundational and practical aspects of computation and information processing but also want to pursue other academic interests e.g. design arts.**
- **I want a computing degree but not sure if I want Computer Engineering or Computer Science degree. What do I do?**
  - **1st year has many common classes. You can choose to declare your major at the end of 1st year.**

https://engineering.lehigh.edu/cse/undergraduate-studies/choosing-right-undergraduate-computing-program-you

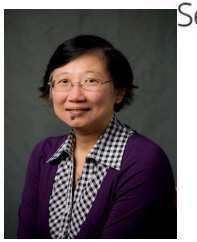
Computer Science Faculty Research
Associate Chair: Mooi Choo Chuah

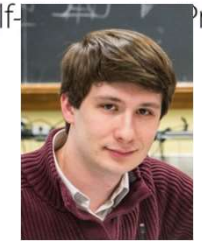
Computer Science is Driving Robot Cars…

- As of May 2017, Waymo has driven over 3 million *autonomous* miles on public roads
- The (arguably) #1 robot car company in the world is a *software* company!
- RePAVE: NSF funded project for building a robust perception system for AVs that can mitigate against malicious attacks and varying environments

Google Self-Project

WAYMO



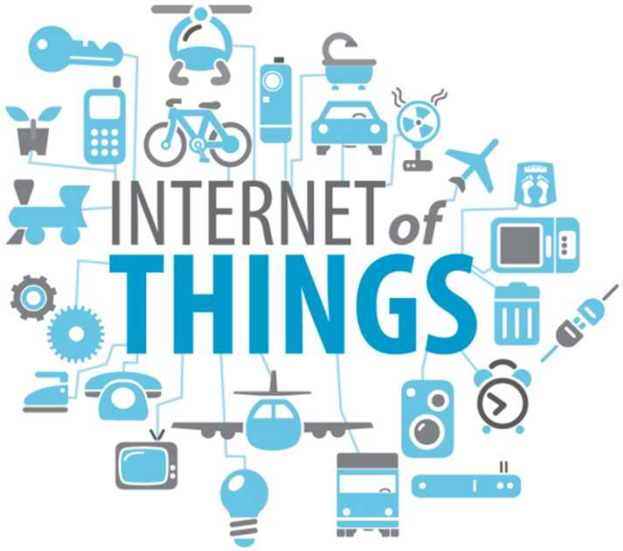


Sensor Networking & Cyber Physical Systems

- Wirelessly preemptive sensing system for quasi-real-time earthquake monitoring of bridges.

Wireless Sensing for Bridge Monitoring
- Courtesy of Dr. Shamim Pakzad

- Wireless signal networks for subsurface modeling and geo-event characterization (e.g., for landslide monitoring, plume tracking, etc.).



Parallel Systems

Mike Spear, Roberto Palmieri, Hank Korth

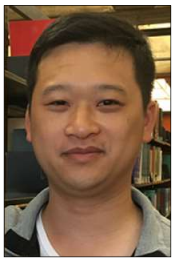


All future CPUs will be multicore: servers, desktops, laptops, game consoles, embedded CPUs.

Multicore programming is a new paradigm:

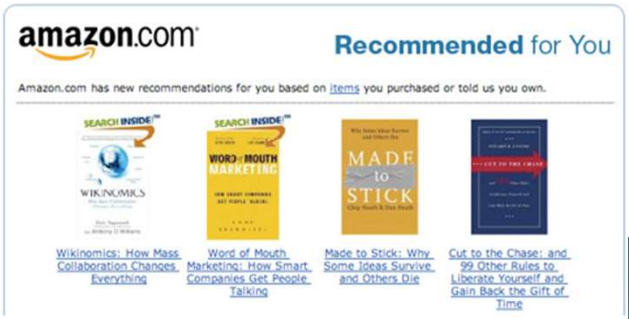
- Scalability matters more than single-thread latency.
- Space efficiency leads to false sharing, slowdown.
- Programmer must find and exploit parallelism.
- Old algorithms are often not parallelizable.
- Data races, deadlock, communication bottlenecks, …

Data Mining




Sihong Xie, Brian Davison, Lifang He, Jeff Heflin

- Recommendation / Prediction / Ranking / Filtering / Classification
- Medical Image Processing
- Natural Language Processing
- Semantic Web



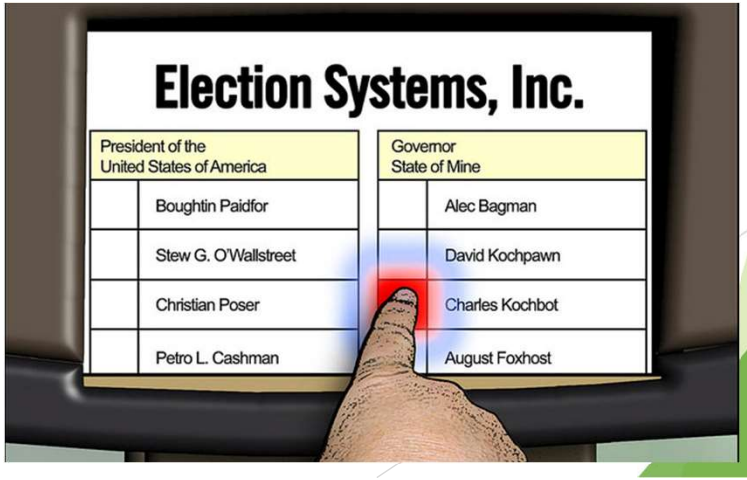
Network and System Security

Mooi Choo Chuah, Dan Lopresti

Motivated by:

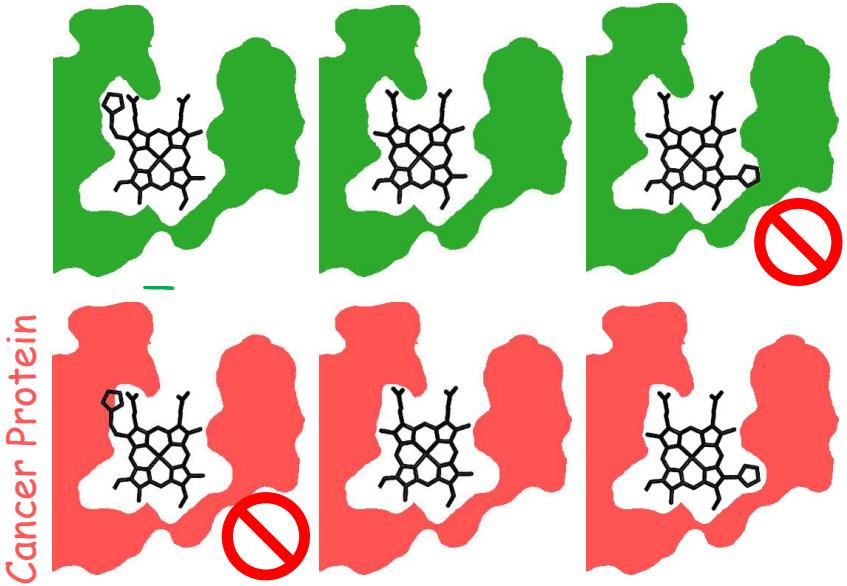
- Ubiquity of critical software systems: e-commerce, e-voting, vehicle control software ("fly by wire"), etc.
- Widespread reports of software failures with big impacts.
- Viruses, internet worms, botnets, rootkits, web site defacement, DDoS, hacked accounts, etc.

Goal: to make systems secure, reliable, and trustworthy.

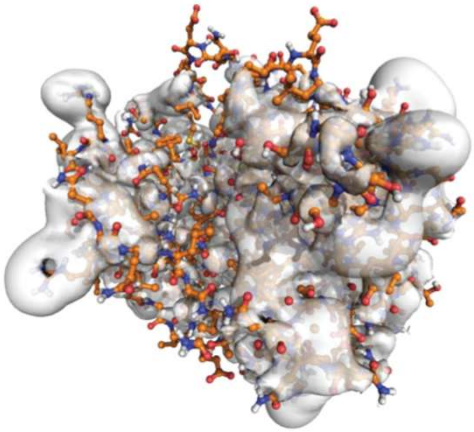


Structural Bioinformatics (Brian Chen, L. He)

Understanding protein binding preferences requires deep analysis of active site shape:



This "drug molecule" fits into the **cancer** protein and not into the **healthy** protein.



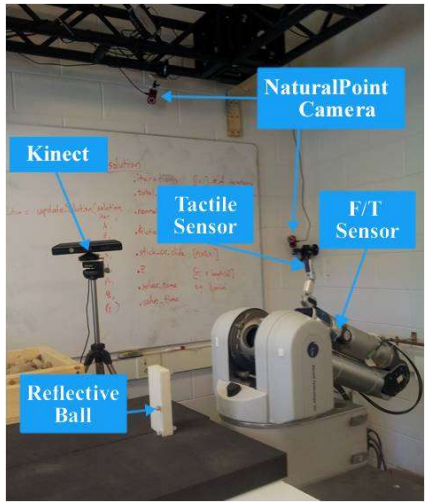
Research on geometric algorithms to help understand relationship between fit and molecular binding.

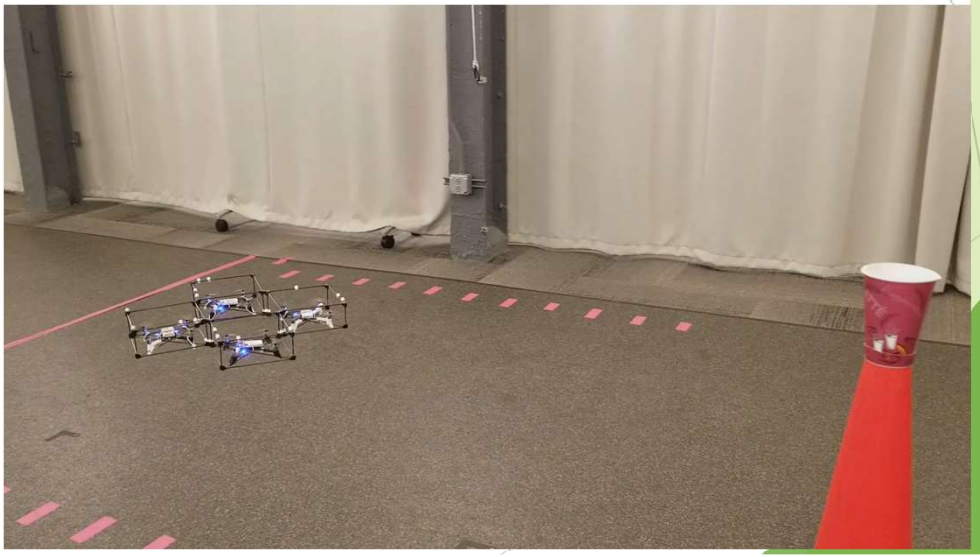
Robotics (D. Saltana, J. Trinkle)



- Modular Aerial System
  - Fast self-adaptation
  - Modular controller based on shape of structure
- Cooperative object transportation
  - Aerial manipulation
  - Cooperative control for autonomous modules
- Robotic Arm Manipulation

http://www.lehighrobotics.org/





Artificial Intelligence




- Interactive Entertainment Systems
- Goal-Driven Autonomy
- Domain-Agnostic Dataset
- Healthcare Data Mining
- Media Forensics
- Computer Vision
- Biometrics

Human Computer Interactions

- Human Centered Algorithm Design
- Technologies for Interpreting Text
- Resistance and Non-use of Technology
- Truman: Social Media Simulation Platform
- CyberBullying Design Interventions
- Robotic Bias on Group Collaboration