Computer Science at Lehigh

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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

4/10/2020
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)
Computing is 3x bigger than all other STEM areas combined!

US-BLS New STEM Job Projections Through 2024 By STEM %

- Computing: 76%
- Natural Sciences: 6%
- Mathematics: 7%
- Engineering: 11%

Annual Total U.S. STEM Jobs Thru 2022 vs. Recent College Grads

- Computing: Jobs - Grads
- Engineering: Jobs - Grads
- Physical Sciences: Jobs - Grads
- Life Sciences: Jobs
- Mathematics: Jobs - Grads

Data Sources:

http://cs.calvin.edu/documents/computing_careers
CSE Graduates are Well Paid …

<table>
<thead>
<tr>
<th>Major</th>
<th>Ave Starting Salary</th>
</tr>
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<tbody>
<tr>
<td>Bioengineering</td>
<td>$59,200</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>$66,892</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>$64,351</td>
</tr>
<tr>
<td>Computer Engineering</td>
<td>$72,154</td>
</tr>
<tr>
<td>Computer Science &amp; Business (CSB)</td>
<td>$88,427</td>
</tr>
<tr>
<td>Computer Science</td>
<td>$84,162</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>$77,000</td>
</tr>
<tr>
<td>Environmental Engineering</td>
<td>$64,500</td>
</tr>
<tr>
<td>Industrial &amp; Systems Engineering</td>
<td>$70,091</td>
</tr>
<tr>
<td>Materials Science &amp; Engineering</td>
<td>$65,929</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>$68,309</td>
</tr>
</tbody>
</table>

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

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

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

This “drug molecule” fits into the cancer protein and not into the healthy protein.
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

- Knowledge-based Project Planning
- Interactive Entertainment Systems
- Goal-Driven Autonomy
- Domain-Agnostic Dataset
- Healthcare Data Mining
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