Computer Science at Lehigh

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

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

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

Computing roles include:
- Computer systems analysts: 19%
- Information security analysts: 2%
- Software developers: 31%
- Database administrators: 2%
- Network + systems administrators: 7%
- Computer support specialists: 14%
- Computer occupations, other: 1%

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


http://cs.calvin.edu/documents/computing_careers
<table>
<thead>
<tr>
<th>Major</th>
<th>Average Starting Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioengineering</td>
<td>$59,200</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>$66,892</td>
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<tr>
<td>Civil Engineering</td>
<td>$64,351</td>
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<tr>
<td>Computer Engineering</td>
<td>$72,154</td>
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<tr>
<td>Computer Science &amp; Business (CSB)</td>
<td>$88,427</td>
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<tr>
<td>Computer Science</td>
<td>$84,162</td>
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<tr>
<td>Electrical Engineering</td>
<td>$77,000</td>
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<tr>
<td>Environmental Engineering</td>
<td>$64,500</td>
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<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>
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.
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

*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.
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