Welcome to the Bachelor of Science in Computer Science and Software Engineering Option

Open House
October 24, 2009

Computer and Information Science Department
http://www.umassd.edu/engineering/cis

Dr. Boleslaw Mikolajczak, Chair
Overview

- Landscape of Computing
- Computer scientists – Who they are? What they do?
- Career decision-making
- Professions of Computer Science & Software Engineering
- Employment for Computer Science & Software Engineering graduates
- BS in Computer Science and Software Engineering Option at UMass Dartmouth
Landscape of Contemporary Computing

Academic BS/MS degrees exist in the following areas:

- **Computer Science** – at CIS Department
- **Software Engineering** – at CIS Department
- **Computer Engineering**
- **Information Systems** (BIS, MIS, AIS)
- **Information Technology**
Computer Scientists - 1

- **Computer scientists** study algorithms, computers and systems around computers.
- **Computer scientists** write software to control these systems and work on applications that use computers.
- **Computer algorithms/applications** solve problems across all spectra of society; computer scientists work with all aspects of these applications.
Computer Scientists - 2

• **Innovation** is at the center of computer scientist’s profession – in algorithms and computer systems.

• CS gives framework on "**why and how to do things**" and for presenting knowledge in terms of precise processes - algorithms.

• “**A solution is a rule telling** the decision maker what to do; a policy or a recipe”  R. Bellman

• “**A person does not really understand a subject until he has tried to teach it to a computer**- that is, until one has expressed it in terms of algorithms”, D. Knuth
Many disciplines are influenced by Computer Science: machine learning algorithms, computational science, understanding of the human brain, humanities and social sciences.

The algorithmic method is one of the best ways not to miss the wagon for the future.

Develop new ways of solving problems on computers and improve existing ways of solving problems.
Computer Scientists - 4

- Analyze the performance of computer algorithms
- Write and present scholarly and technical papers on computer related topics
- Create new programming languages and new computer systems architectures
- Determine which architecture to use for a given computational problem
What Computer Scientists do?

• Determine what programming language to use for a given problem
• **Estimate the effort to create a solution** for a given problem
• Develop software designs and software programs, document and maintain software
• Design computer systems that are **more energy-efficient** and **user-friendly**
What do Software Engineers do?

- Elucidate **software specification** from customers
- **Model specification to represent structure and behavior** and to allow verification of software design
- **Select implementation** hardware and software platform
- Use **formal methods** to provide quality assurance for mission-critical and complex software systems
- **Encode, test, and maintain** software systems

Computer and Information Science Department
Career decision making

1. Do you have genuine **interest** in solving societal problems using algorithmic techniques and computers? **YES**

2. Are you ready to participate in **innovation**’s excitement of computing and to take a **challenge** of the computing profession? **YES**

3. What are **employment predictions**:
   a). **growth of job market in computing professions** **Excellent**
   b). **frequency of job offerings in computing professions** **High**
   c). **starting salaries for graduates with BS in CS/SE** **>$50K**
Software - a market product

• **Software** - market product of the global economy that interacts with humans and machines

• **Computers Science** - provides knowledge and skills that allow to develop software that is functional and maintainable

• **Innovation of Computing** – developing software that solves important problem for a client is exciting and rewarding; solving problems on time and budget contributes to professional and personal discipline

• **A good life** – computing leads to well-paying jobs and these lead to a good life; your good life contributes to improvement of larger community
Professions of Computer Science and Software Engineering


- Computer Scientists, and Database Administrators - ocos042.htm
- Computer Programmers - ocos110.htm
- Computer Software Engineers - ocos267.htm
- Computer Support Specialists and System Administrators - ocos268.htm
- Computer Systems Analysts - ocos268.htm
# Projections of Computer Science Employment in the US Industry for 2006-2016

<table>
<thead>
<tr>
<th>Profession</th>
<th>2006 Employment</th>
<th>2016 Employment</th>
<th>Percentage Growth</th>
<th>Growth in thousands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network systems and data communication analysts</td>
<td>262</td>
<td>402</td>
<td>53.4%</td>
<td>140</td>
</tr>
<tr>
<td>Network and computer systems administrators</td>
<td>309</td>
<td>393</td>
<td>26.9%</td>
<td>83</td>
</tr>
<tr>
<td>Computer software engineers, applications</td>
<td>507</td>
<td>733</td>
<td>44.6%</td>
<td>226</td>
</tr>
<tr>
<td>Computer software engineers, systems software</td>
<td>350</td>
<td>449</td>
<td>28.2%</td>
<td>99</td>
</tr>
<tr>
<td>Database Administrators</td>
<td>119</td>
<td>154</td>
<td>28.6%</td>
<td>34</td>
</tr>
<tr>
<td>Computer Systems Analysts</td>
<td>504</td>
<td>650</td>
<td>29%</td>
<td>146</td>
</tr>
<tr>
<td>Computer and Information scientists, research</td>
<td>25</td>
<td>31</td>
<td>21.5%</td>
<td>6</td>
</tr>
<tr>
<td>Computer Support Specialists</td>
<td>552</td>
<td>624</td>
<td>12.9%</td>
<td>71</td>
</tr>
<tr>
<td>Computer specialists, all other</td>
<td>136</td>
<td>157</td>
<td>15.1%</td>
<td>21</td>
</tr>
<tr>
<td>Computer Programmers</td>
<td>435</td>
<td>417</td>
<td>-4%</td>
<td>-18</td>
</tr>
</tbody>
</table>
Employment for Computer Science and Software Engineering graduates

- **Job growth** in Computer Science occupations during 2006-2016 by circa 800 thousands NEW jobs or 80 thousands new jobs per year on average
- US universities graduate annually circa 30 thousands graduates in computing
- **Foreign nationals** make the difference of 50 thousands every year
- The numbers do not count **job replacements** needed due to retirements and other decisions to leave the market place
- Computer industry is a **growth industry** as opposed to replacement industry
UMass Dartmouth Graduates of BS in Computer Science program work at

- **EMC**² - Hopkington, MA
- **Raytheon** - Portsmouth, RI; Bedford, MA
- **General Dynamics** - Taunton, MA
- **Martin Lockheed** - various places
- **APC** - American Power Conversion, Providence, RI
- **Microsoft, Lucent Technologies** - MA
- **Naval Undersea Warfare Center** - Newport, RI
- **Sun Microsystems** - MA
- **Fidelity Investments, Thompson Investments** - Boston
- **Textron Financial** - Providence; **Goldman Sachs** - NY
- **Meditech** - several places in MA
- **Various software development & consulting houses**
Computer Science vs. Programming

- **Computer Science** is much more than computer programming
- **Computer Programming** means proficient knowledge of a specific programming language
- **Computer Science** uses methodological and technological tools to build complex software/hardware systems that solve challenging problems of the society in all branches of national economy and science
Example #1: VW Phaeton

- 61 electronic control units; 45 different ones
- three coupled bus systems including one optical bus (3860 m cables; 64 kg)
- about 2500 signals in 250 CAN-messages
- 50 MB memory to store software
- **Problem**: complexity
- **Automobile** software requires circa 35 million lines of code
- **iPhone** software requires circa 2 million lines of code
I.2.2 Example: The Denver International Airport Baggage System

The Denver International Airport has a modern, automated baggage-handling system designed by BAE Automated Systems, Inc. (In June, 2003 G & T Conveyor Company, Inc. acquired BAE)

See:
Schlohn, Michael. Analysis of the Denver International Airport baggage system
http://www.csc.calpoly.edu/~dstein/SchlohnProjec t/Csc463.html

Elpe, Rohit. The importance of software architecture: Denver International Airport’s automated baggage handling system: A report

Nice, Karim. How Baggage Handling Works, HowBizWorks
http://biz.howstuffworks.com/baggage-handling.htm
Computational Thinking

- **Solving problems** taking into account resource constraints and operating environment
- Is **approximate solution** good enough?
- Solving problems by **embedding, transformation** or **simulation**
- **Parallel and distributed processing**, will it be correct?
- Program correctness, efficiency, system’s design, simplicity and elegance
- **Abstraction** and decomposition when it comes to designing complex systems
- **Separation of concerns**; using hierarchical approach
- **Modeling** relevant aspects of the problem
Computational Thinking

- Using *heuristic reasoning* to discover a solution
- *Planning, learning, and scheduling*
- Use *massive amount of data* effectively
- Making *tradeoffs* between *time and space resources*
- Focus on *energy efficiency* – designing and localizing
- Using *prefetching* and *caching* in anticipation of future use
- Using *backtracking* to trace back previous actions
- Using *performance modeling*
- Thinking in terms of *prevention, protection, and recovery* from *worst-case scenario* through *redundancy, damage containment, and error correction*
Areas of Innovation in Computer Science

• Internet and Intranet computing
• Computer and Information Security
• Support for Electronic Commerce and Virtual Organizations
• Mobile and Wireless Computing, Mobile Robotics
• Optical and Multimedia Computer Networks
• Agent-based Computing
• Bioinformatics
• Knowledge Discovery through Data and Process Mining, Data and Knowledge Visualization
• Intelligent Information Systems
BS in Computer Science
at UMass Dartmouth

• Accredited by CAC of the ABET since 1988 - www.abet.org
• Program’s **Goals** and **Outcomes**
• Computer Science **Curriculum**
• 230 CS majors = 160 U/ CS + 70 G/ CS
• **Faculty** - 11 full-time tenured/tenure-track faculty
• **Professional Staff** - 1 professional technician + 1 administrative staff + CS student employees
BS in Computer Science - Program Goals

- Graduates who succeed as practicing computer scientists
- Graduates who succeed in advanced study in computer science
- Graduates who adopt and evolve in complex technological environments such as those found in workplace
- Graduates who influence the development of professional, ethical, and legal aspects of computing
BS in Computer Science - Program Outcomes

• Are able to individually solve problems in algorithmic manner with given computer resources and constraints
• Apply their knowledge of mathematics, science, and computer science to solve technical problems
• Apply analytic and empirical techniques to evaluate technical problems and their solutions
• Design system, component, or process to meet specified requirements
• Participate as an effective member of a problem solving team
Program Outcomes, ctnd.

- Identify, formulate, and solve problems encountered when constructing solutions involving IT
- Articulate the social, professional, ethical, and legal aspects of a computing milieu
- Evaluate the impact of computing and IT at the global societal level
- Communicate effectively
- Apply modern skills, techniques, and tools during professional practice
Computer Science Curriculum at UMass Dartmouth

- 120 credit hours to graduate (4 years)
- at least 56 credits in computer science courses:
  - required courses (44 credits) and
  - elective courses (12 credits)
- 17 credits in mathematics (calculus, discrete structures, probability and statistics)
- 14 credits in sciences (choice of PHY, CHM or BIO)
- 9 credits of English (including technical communication skills)
- 15 credits of humanities and social sciences
- 6 credits of FREE electives (may contribute to minor in another discipline)
Software Engineering Option

- Software Quality Assurance and Testing
- Software Architecture and Frameworks
- Software Process and Project Management
- Design of Large Software Systems
- Formal Methods in Software Engineering
- Human Computer Interaction
- Software Engineering Project I & II (Year-long Group Capstone Project)
BS/ MS in Computer Science Option

- **BS and MS degrees in Computer Science in 5 years**
- **Teaching or Research Assistantships** during the 4/5-th years of study
- **Internship opportunities** in industry, esp. in national defense and national security sector
- Industry needs for employees with MS in Computer Science degrees are increasing
- **141 credit hours** with GPA of 3.0 in CS graduate courses
CO-OP and Internships

- Must have 2.75 GPA to start work placement
- Must maintain 2.75 GPA to remain in the program
- A minimum of 3 work placements
- At least 2 work placements must be non-summer
- Two approved internships may substitute a work placement
- CS juniors and seniors are hired as interns by ATMC and computer industry – during summer and semester breaks
BS in Computer Science - program features

- Affordable
- Flexible enough to complete minor in another discipline
- CS=software track+systems track+foundations track
- Intellectual control over systems/software development
- Focus on design
- Object-oriented (Java) and procedural (C) programming
- Group software/systems projects
- Senior group capstone year-long project
- Courses with required and supervised labs
- Quality of lecture/lab instructions
- Faculty active in research and professional development through NSF/DARPA/US Marine Corps/Lockheed Martin grants
Program Features

- CSIAC – Computer Science Industrial Advisory Committee
- effective curricular and career advising process
- comprehensive tutoring system
- balanced integration of professional and general education
- integration of enduring methodologies and evolving technologies
- Windows and Linux computing platforms
- Research labs: mobile robotics, neural and intelligent systems, computer networks, databases, concurrent software engineering, and cluster computing
- Student Computer Game Design Club and Linux Users Club
Faculty Research Specializations

- Software Science and Software Engineering
- Computer Systems and Networking
- Intelligent Information Systems
Thank you for your attention !!!

Questions