RSACONFERENCE2014

FEBRUARY 24 – 28 | MOSCONE CENTER | SAN FRANCISCO

Share.
Learn.
Secure.

Capitalizing on
Collective Intelligence

Security Education for the new Generation

SESSION ID: MASH-W02
Wednesday, Feb 26, 9:20 AM @ WEST|3018

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HP Enterprise Security Products

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University of California, Davis

A Message from Matt

Sorry I cannot be here!

Jacob and I prepared the slides together, and have known each other for years.

This talk represents our views.

Defining security

State of play today

Opportunities

Existing resources

Conclusion

Security Stuff vs. *Secure* Stuff

Security Stuff

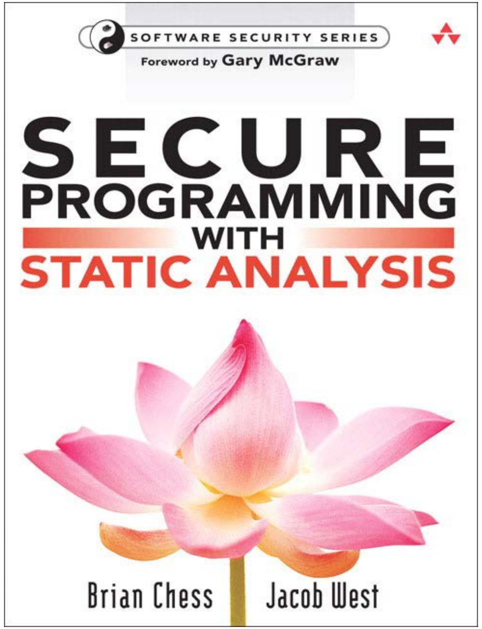
- Responsible for security
- Focus on security activities
- Opportunities for apprenticeship
- Clear career path for the motivated

Doing Stuff Securely

- Responsible for stuff
- Impact on security, but not focus
- Few opportunities to learn
- Hard to map interest to career

What Are We Talking About?

- Robust programming
  - Programming that prevents abnormal termination or unexpected actions
- A “secure” program conforms to a security policy
  - And implicitly requires robustness, but robust programming does not require such conformance
- Here, “secure” is used in the sense of “robust”



Why This Matters

Example:

Exploit a buffer overflow to force a program to do things it should not

- Definitely non-robust
  - Does not handle invalid input properly
- Is it non-secure? That depends if one can…
  - Use the buffer overflow to do things that the security policy disallows (**yes**)
  - Use the buffer overflow to do only things that I could already do (**no**)

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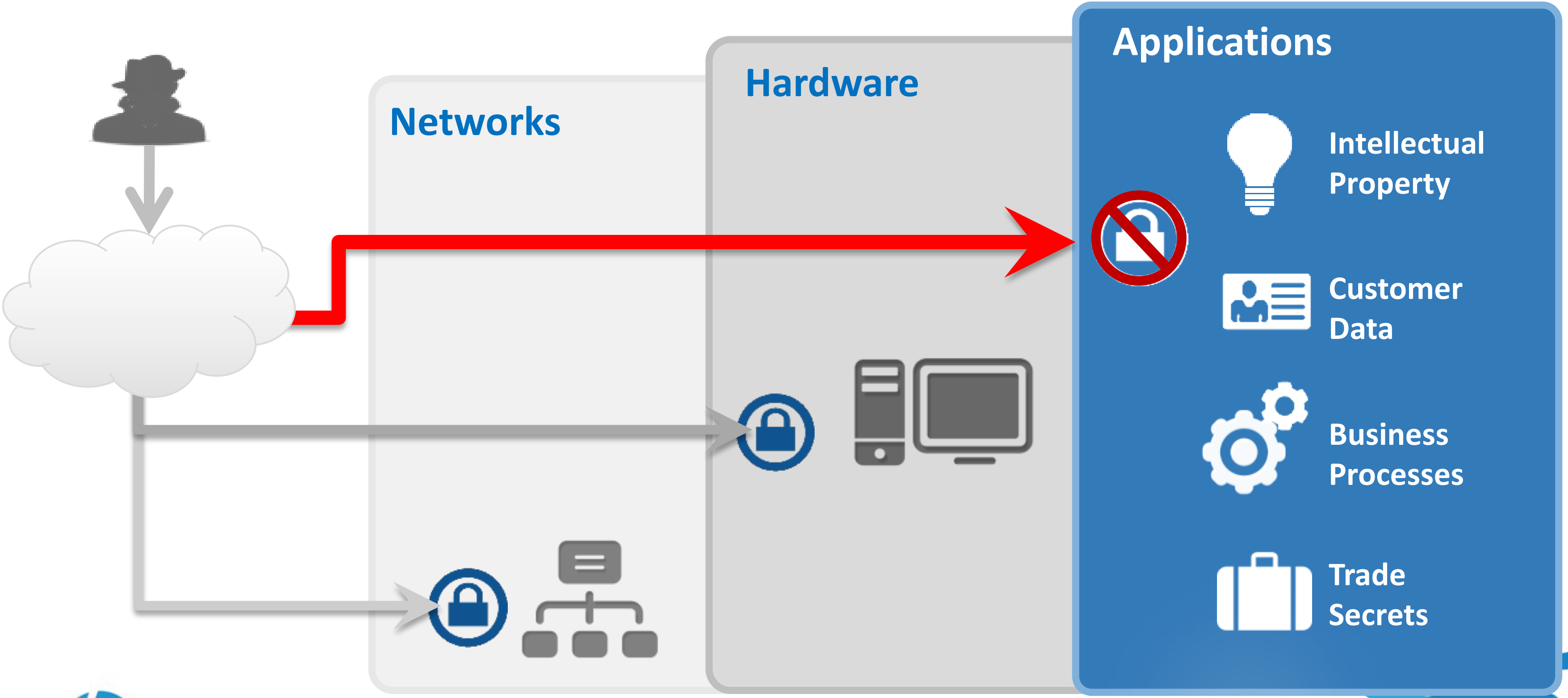
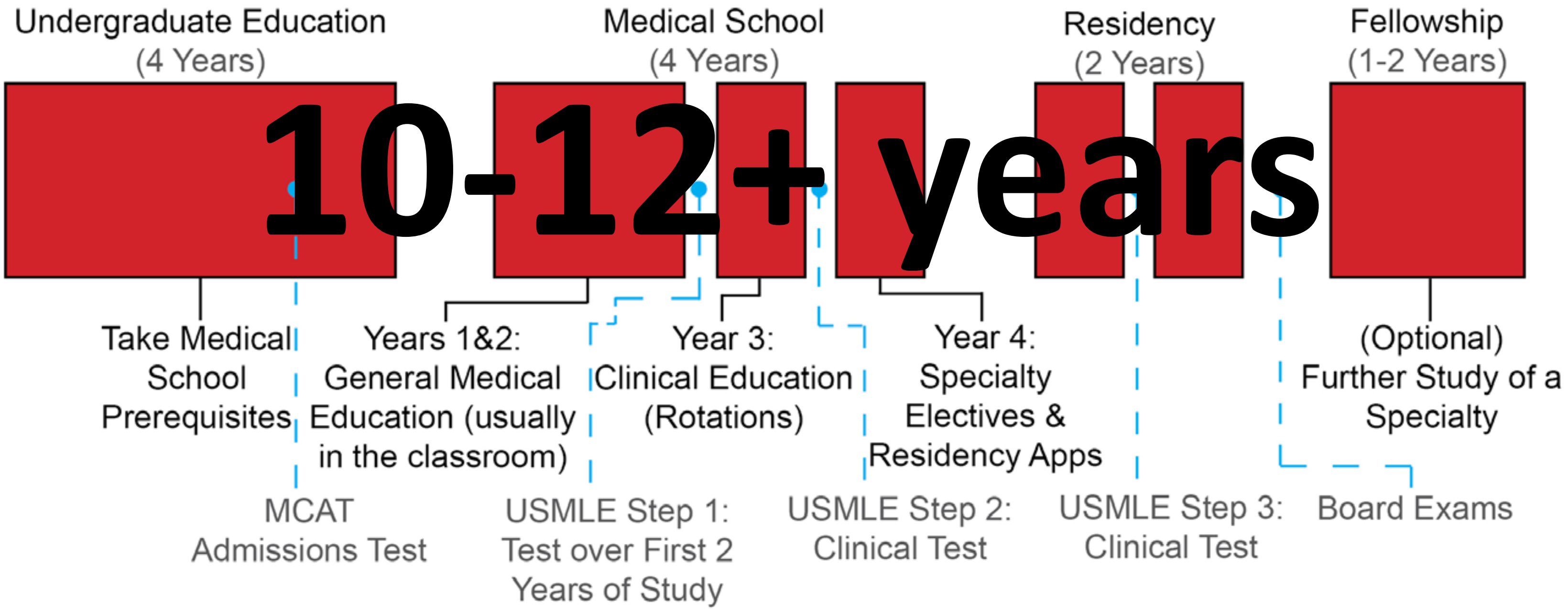
Problem: 84% of Breaches Target Software



Software Security Today

- The line between secure and insecure is often subtle
  - Many seemingly non-security decisions impact security
- Small problems hurt a lot
  - A single bad line of code can put a company in the news
- Smart people make dumb mistakes
  - As a group, programmers repeat the same security mistakes over and over
- We need non-experts to get security right
  - Security and development are both full time jobs

Becoming a Doctor



Undergraduate Education
(4 Years)
Medical School
(4 Years)
Residency
(2 Years)
Fellowship
(1-2 Years)
10-12+ years
Take Medical School Prerequisites
Years 1&2: General Medical Education (usually in the classroom)
Year 3: Clinical Education (Rotations)
Year 4: Specialty Electives & Residency Apps
(Optional) Further Study of a Specialty
MCAT Admissions Test
USMLE Step 1: Test over First 2 Years of Study
USMLE Step 2: Clinical Test
USMLE Step 3: Clinical Test
Board Exams

Becoming a Programmer

Undergraduate Education
(4 Years)

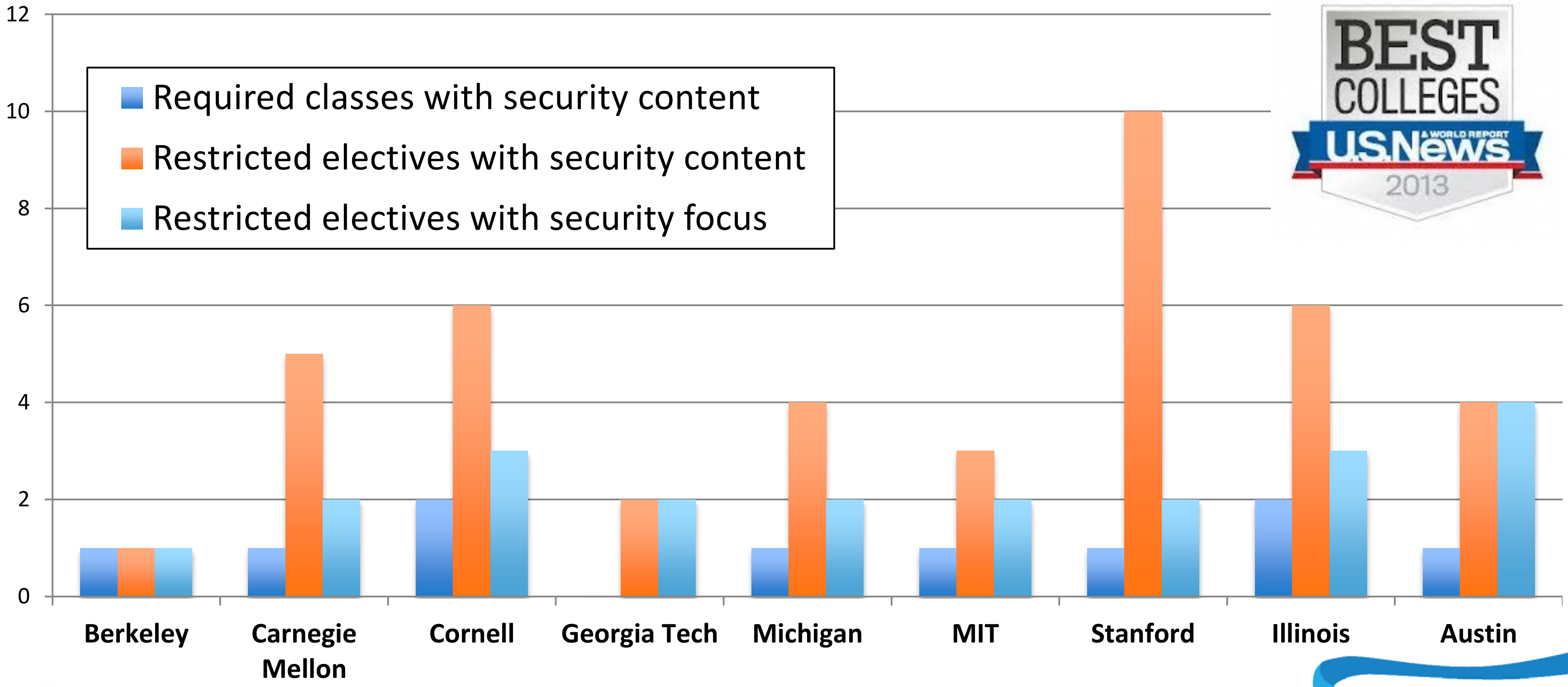
|
Learn
Everything

4 years

Enter Workforce

|
On-the-Job
Training?
Certification?

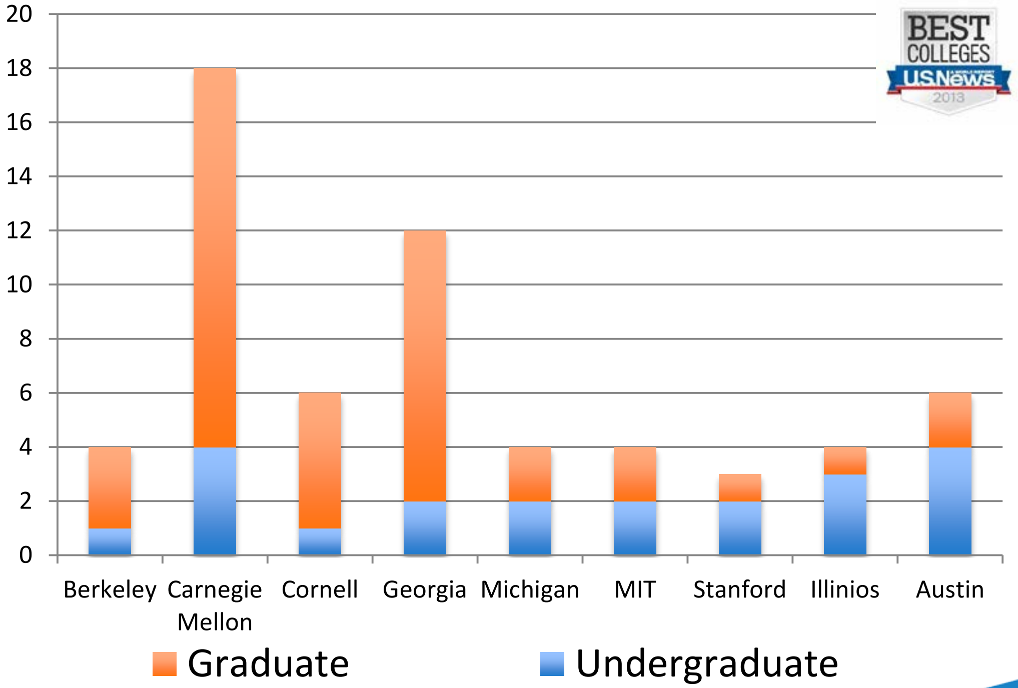
Top 9 Undergraduate Computer Science Programs



BEST COLLEGES U.S.News & WORLD REPORT 2013

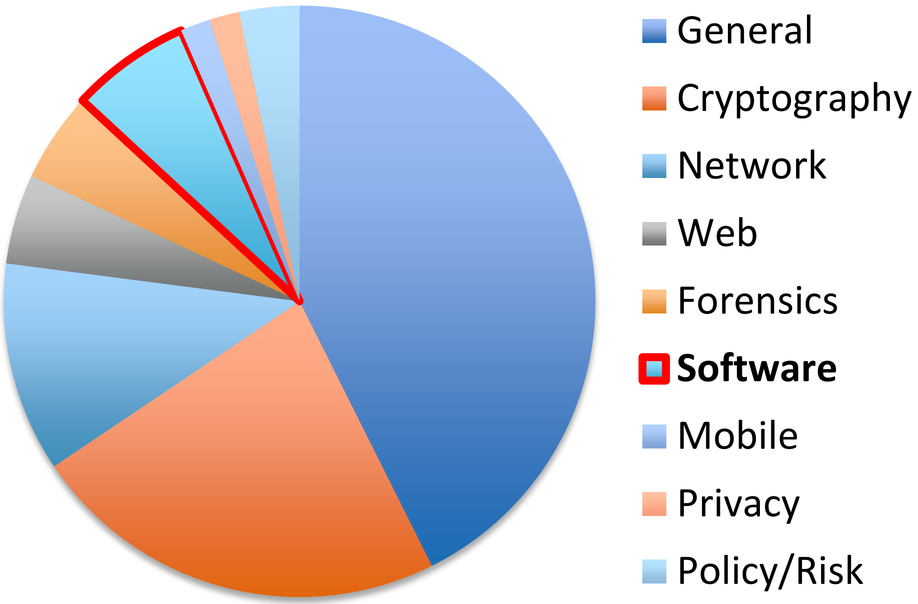
Top 9: Courses with Security as a Focus

- Junior/Seniors specialize
- Only 3 of 9 offer security track
  - Cornell: Security & Trustworthy Systems Track (4 classes)
  - Michigan: Security Track (4 classes)
  - Austin: Information Security Certificate Program (5 classes)



Top 9: Courses Focus on Traditional Security

Software security appears at 3 of 9



The Fundamental Problem

- We don’t write software that is robust
  - Some exceptions in special cases
- We don’t build systems to meet security requirements
- Many different models for developing software

What Will Drive Improvement?

Commercial

- Financial savings
  (avoid cleaning up messes)
- Simpler maintenance
- Improved reputation

- Software liability?

Government

- Financial savings
  (avoid cleaning up messes)
- Simpler maintenance
- National security

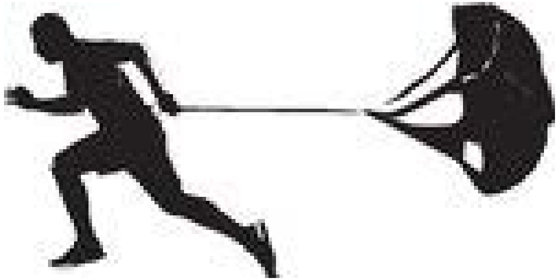
Software Liability

- You can't say "I'm not responsible for anything"
  - Chain of distribution (e.g. supply chain) liability exists now
- You can limit liability somewhat by defining use and environment
  - Then you're liable in that context but (probably) not in others
- It *is* coming . . .
  - EULAs may not be enforceable (*adhesion contracts*)

So What’s Holding Us Back?

Commercial and Government

- Need to spend more money
- Longer time-to-market
- No legal liability for bad software
- Need to pay more attention to installation, maintenance, and use
- Lack of people to write good code



So What's Holding Us Back?

Academia

- Robust coding not seen as integral to programming
  - Textbooks *loaded* with examples of non-robust programming
- Lack of support for *enforcing* and *grading* for robust coding
  - Ties into lack of graders who really know about this
- Lack of faculty who understand robust programming
  - And intimidation factor for those who *know* they don't understand it

Lack of Resources

Assurance costs!

- Industry expected to deliver secure, robust products without resources for the extra effort required to deliver them
- Academia expected to teach *and reinforce* robust programming without resources for the extra effort in supporting this

Lack of People

- Need to teach people how to write robust programming
  - Need to emphasize the *practice*, both in education *and* industry
- Continuous practice is *key* to reinforcing, maintaining, extending skills

Defining security

State of play today

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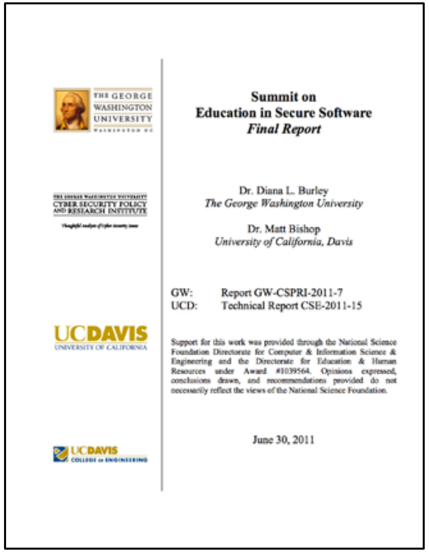
Focus for Rest of Talk

Everyone lacks resources!

- How can industry and government work with academia?
  - Carrots, not sticks
  - Security tuned to environment and use
  - What is “secure” varies among companies and government organizations

What Do We Need to Teach Secure Programming?

- *Summit on Education in Secure Software* (SESS)
  - Diana Burley
    The George Washington University
  - Matt Bishop
    University of California at Davis
- Funded by NSF
- 60 participants: academia / industry / government
- nob.cs.ucdavis.edu/~bishop/notes/2011-sess/2011-sess.pdf



Summit on
Education in Secure Software
Final Report

Dr. Diana L. Burley
The George Washington University

Dr. Matt Bishop
University of California, Davis

GW: Report GW-CSPRI-2011-7
UCD: Technical Report CSE-2011-15

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June 30, 2011

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SESS Objectives

- Engage stakeholders from academia, industry, and government to discuss teaching secure programming
- Use discussion as basis for a collaborative effort to develop a comprehensive agenda for secure software education

Recommendations

- Increase faculty who understand the importance of secure coding
  - Establish professional development opportunities for faculty
- Integrate computer security content into existing courses
  - Provide faculty support for the inclusion of security content
- Require at least one computer security course for all college students

Recommendations

- Promote collaborative problem solving and solution sharing
  - Encourage partnerships and collaborative curriculum development
- Use innovative teaching methods to strengthen the foundation of computer security knowledge
  - Develop metrics to assess progress toward meeting educational goals
- Highlight the role that computer security professionals should play in key business decision making processes

Summary

- Holistic view of secure education suggests programmers and non-programmers alike must be educated in the core principles
- Structural enablers
  - Cultural shift among faculty and industry stakeholders that supports the development of a holistic view of software security
  - Identification of measurable objectives and corresponding measurements
  - Development of national licensure programs
  - Alignment of expectations for university education and realistic

What Can Academia Do?

- Include robustness in evaluation of programs and projects
- Create a “secure programming clinic”
  - Like an English clinic, or a writing clinic for law schools
- Provide supplementary material for textbooks, classes
  - These should emphasize robust programming

What Can Industry Do?

- Key is to *show* more than *say* secure development is important
- Make clear that the skills are important for hiring
    - Mention their need in job openings
    - Preference to those with skill in this also helps

Experience
Experience
observing, encour
practical knowledge, skill,
resulted in understanding
of events participated in

Work With Students and Faculty

- Internships
  - Students *love* these; good recruiting tool
  - Tasks requiring robust programming emphasize its importance to students
- Help teach students
  - Review students’ code
  - Team with colleges in senior/capstone projects

What Will This Do?

- Increase student demand
  - If students see it as important, they will ask about it in class, evaluate programs, faculty in part on it
- Increase your visibility
  - Good recruiting tools
  - A corporate “good citizen”

Government Support

- Act like an industry
- Government can also fund programs
  (e.g. DHS and the Software Assurance Curriculum Project)
- Programs should support future faculty (as well as engineers)
  - People willing to commit to teaching
- *Imperative: target funding towards this specific purpose*
  - <u>Require</u> funding to be used for supporting robust programming
  - If done as adjunct, likely to disappear in the main purpose of the funding

Defining <u>security</u>

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Existing Resources

- Industry academic enablement programs
- Tradeshows and conferences
- Competitions and contests
- Training and certification
- Specialized university programs

Industry Academic Enablement Programs

Focused on facilitating university education in security

Notable Programs

- Cisco
- Hewlett-Packard
- IBM
- Microsoft

Delivery Methods

- Direct to students or young professionals with certification programs
- Define a methodology, enlist industry specialists to assist with delivery
- Collaborate with universities and non-profits on research

Tradeshows and Conferences

Notable Conferences

- IEEE Symposium on Security and Privacy
- ACM Computer and Communications Security
- “The Colloquium”
  (Colloquium on Info. System Security Education)
- USENIX Security Symposium

Goals

- Share advancements in research
- Enhance with curricula security-centric topics

Competitions and Contests

Notable Competitions

- CyberPatriot
- National Collegiate Cyber Defense Competition
- UCSB iCTF
- Cyber Security Awareness Week (CSAW)
- DEFCON

CYBERPATRIOT
NATIONAL COLLEGIATE CYBER DEFENSE COMPETITION
CSAW'13
Cyber Security Awareness Week @ NYU-Poly
UNIVERSITY · OF · CALIFORNIA · SANTA BARBARA
LET THERE BE LIGHT
DEFCON

Why Capture-the-Flag?

- Goal-oriented and rewards both participation and success
- Opportunity to network with peers and industry professionals

Training and Certification

Notable Programs

- (ISC)^2
- SANS Institute
- CompTIA

Motivations and Objectives

- Industry effort to develop and ensure baseline skillsets
- Differentiate candidates for human resources and hiring managers
- Validate and recertify relevant security experience

Scholarship Programs

Government Scholarships (for work commitment)

- CyberCorp: Scholarships for Service
- DOD Information Assurance Scholarship Program

Private Scholarships

- (ISC)^2 Scholarships (Community College, Undergrad, Grad)
- Armed Forces Communications and Electronics Association (Community College, Undergrad, Grad)
- National Security Scholars Program (Undergrad)
- Symantec Graduate Fellowship (Grad)
- Applied Computer Security Associates (Undergrad, Grad)

Scholarship for Women Studying Information Security

Support women with a demonstrated interest in security, through coursework, internships or work experience to complete a Bachelors or Masters degree

- Must be entering junior or senior year of Bachelors or first year of Masters
- Administered by *Applied Computer Security Associates* (ACSA) and *Committee on the Status of Women in Computer Research* (CRA-W)
  - Awarded a single $10k scholarship annually pre-2014
- Includes attendance at ACSA, CRAW, as well as internship opportunities

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Many Myths

- Myths about universities confuse how academia can put teaching secure programming into practice
  - *There is no room…*
  - *If students learn to write secure programs…*
  - *Academic institutions are…*
  - *We know what to do…*
- And some questionable ideas don’t help either
  - Testing students knowledge
  - Unsupported mandates

Myth #1

There is no room in curricula for a course on secure programming

- You don’t need a separate course
- Simply check programs submitted during all courses for robustness
  - Make writing robust programs beneficial (through grades or other mechanisms)
  - Provide resources so students can see how to do this, or get help to do it

Myth #2

If students learn to write secure programs, the state of software and system security will dramatically improve

- Will companies accept increased cost, time to market?
- Will customers pay higher prices, endure longer development times?
- Will students be encouraged (required) to practice what they learned?

Myth #3

Academic institutions are hierarchical in organization

- Implication is that deans, provosts, presidents can order this taught
- Learning styles, environments differ
- May not be a 'best' or 'right' way to teach this

Myth #4

We know what to do and how to do it

- We have ideas, but don't know
  - Needed: research on education
  - Needed: funding, people to do this
- The Summit on *Education in Secure Software* suggested ways to do this
  - SESS results are general
  - Approaches must be tailored to various environments

Questionable Idea #1

Testing students' knowledge

- Who creates the tests?
- Who is being tested?
- How do you know that you are testing what is important? (that is, the "right thing")
- Who determines what is an acceptable result?
- Teaching to the test, rather than to learn the material

Questionable Idea #2

Unsupported mandates

- The support has to come from somewhere
  - It’s like a zero-sum game
- What do you want to weaken?
  - If you only have so many resources, something will have to give
  - You don’t want to weaken the core foundation of understanding *why* certain programming paradigms are critical

Conclusion

“We must all hang together, or
we shall all hang separately.”
- Benjamin Franklin

- The state of practice can, and must, change
- Understand that academia is a different environment—completely
- Teaching robust programming, *and nothing more*, will not help
- The marketplace must also change, as must current practice
- The public will be the main driver (unfortunately, probably with lawsuits)

Questions?

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