



Infusing Cybersecurity in Two-Year Programs – ACM Curriculum Guidelines and Other Efforts

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Outline

- ACM Curriculum Guidelines
- CTransfer2017
- CSEC2Y
- Infusing Cybersecurity – Examples from Virginia

ACM – Association for Computing Machinery

- World's largest educational and scientific computing society
- Members include educators, researchers, professionals, students



**Association for
Computing Machinery**

Advancing Computing as a Science & Profession



ACM Curriculum Guidelines for Undergraduate Programs

CC2005 – Computing Curricula 2005: The Overview Report

- Computer Engineering – CE2016
- Computer Science – CS2013
- Information Systems – IS2010
- Information Technology – IT2017
- Software Engineering – SE2014

New

- Cybersecurity – CSEC2017

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Under Development

- Data Mining

ACM CCECC

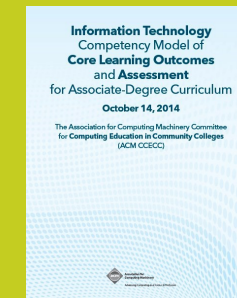
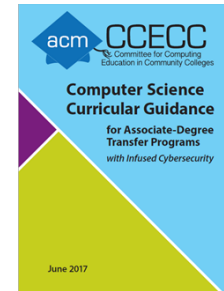
Global Mission

Serve and support community and technical college educators in all aspects of computing education

- **Committee for Computing Education in Community Colleges**
 - 40++ years of service to computing education
 - Standing committee of the ACM Education board for 25+ years
- Engage in curriculum and assessment development, community building, and advocacy in service to this sector of higher education

ACM Curriculum Guidelines for Associate Degree Programs

- Computer Science – CTransfer2017
 - Guidelines for A.S. / transfer programs
 - Infused with cybersecurity
- Information Technology – IT Competency Model 2014
 - Guidelines for the core of A.A.S. / career programs
 - Infused with cybersecurity



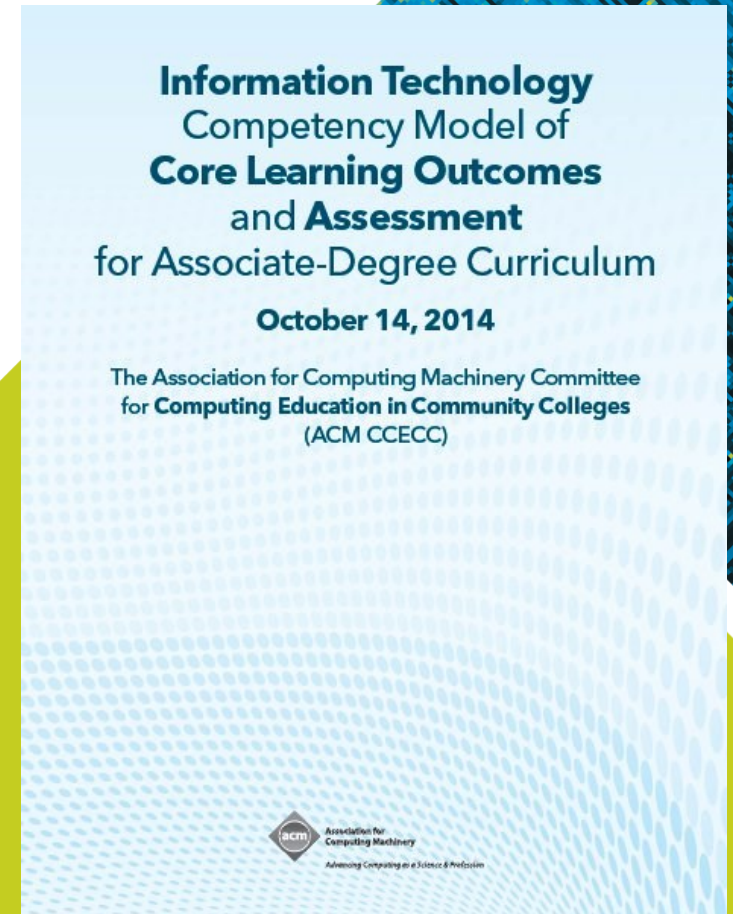
Current Projects

- Cybersecurity – CSEC2Y
- IT Transfer

IT Competency Model 2014

- *Information Technology Competency Model of Core Learning Outcomes and Assessment for Associate-Degree Curriculum*
- Includes 50 core IT learning outcomes
- Includes assessment metrics for each learning outcome
- 7 of the 50 learning outcomes focus on cybersecurity

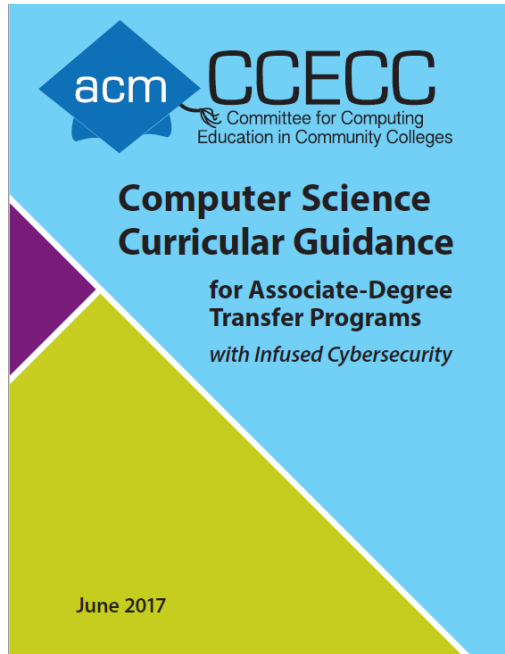
ccecc.acm.org/ITreport



IT Transfer

- Guidelines for Associate-Degree ***transfer*** programs in IT
- Based on IT2017
- Expected release Summer 2019
- Task Group with representation from both 2-year and 4-year programs

CSTransfer2017 Curricular Guidance



- Updates Computing Curricula 2009: Guidelines for Associate-Degree Transfer Curriculum in Computer Science
- Uses Computer Science Curricula 2013 as the base to facilitate transfer
- Includes contemporary cybersecurity concepts

ccecc.acm.org/CSTransfer2017

CSTransfer2017 Background

- **Mar 2015:** BoF @ SIGCSE: Perspectives on How CS 2013 Influences Two-Year College Programs – Standing room only!
- **Nov 2015:** CSTransfer2017 Task Group formed
- For each CS2013 knowledge unit (KU): Appropriate for associate-degree level?
- Draft learning outcomes for each KU
 - Sources: CS 2013, NSA CAE2Y, NICE Framework, IT 2017 v0.51, Bloom's Taxonomy
- **Jun 2016:** StrawDog released; 2 surveys for input
 - Over 50 feedback responses from 8 different countries
- **Oct 2016:** IronDog released
- **Jun 2017:** Final version published

Acknowledgements

Team Leaders

Prof. Lambros Piskopos, Wilbur Wright College, IL

Dr. Christian Servin, El Paso Community College, TX

Prof. Teresa T. Moore, Volunteer State Community College, TN

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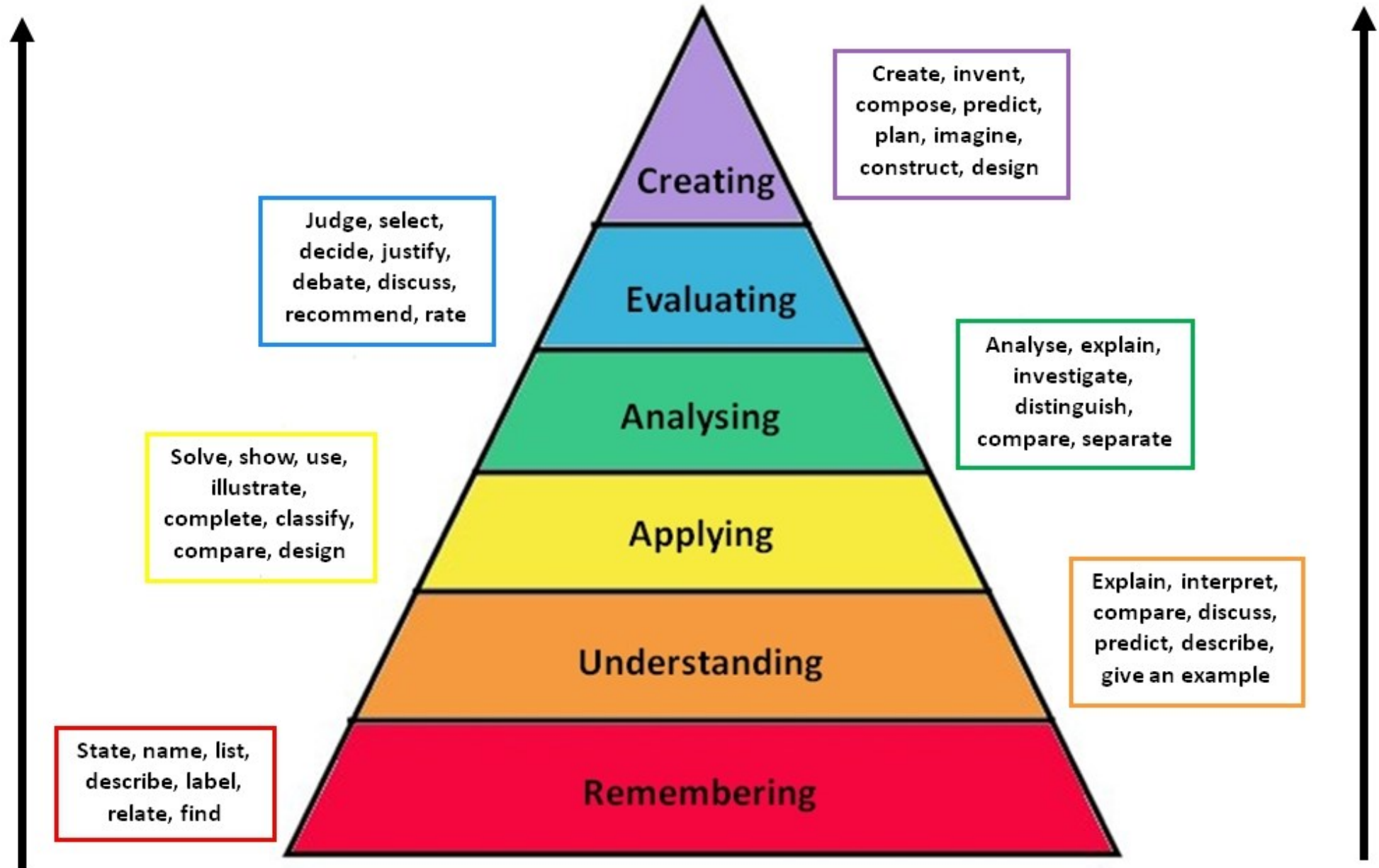
Prof. Barry Sullens, Ivy Tech Community College, IN

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Why Learning Outcomes Approach?

- Focus is on **student achievement**
- Supports modification of existing courses (easier to add outcomes than entire courses)
- Also supports development of new courses
- Avoids traditional body of knowledge focus on topics and contact hours that can grow unbounded as new technologies emerge
- What topics are eliminated to make room for the new? (food fight)

Bloom's Taxonomy



CSTransfer2017 Body of Knowledge

- 17 knowledge areas
- 214 learning outcomes with assessment metrics
 - Updated from CS2013 utilizing Bloom's Revised Taxonomy
- 64 learning outcomes specific to cybersecurity
 - 25 in CYB knowledge area
 - 39 in other KAs
- No topics

CSTransfer2017 Body of Knowledge

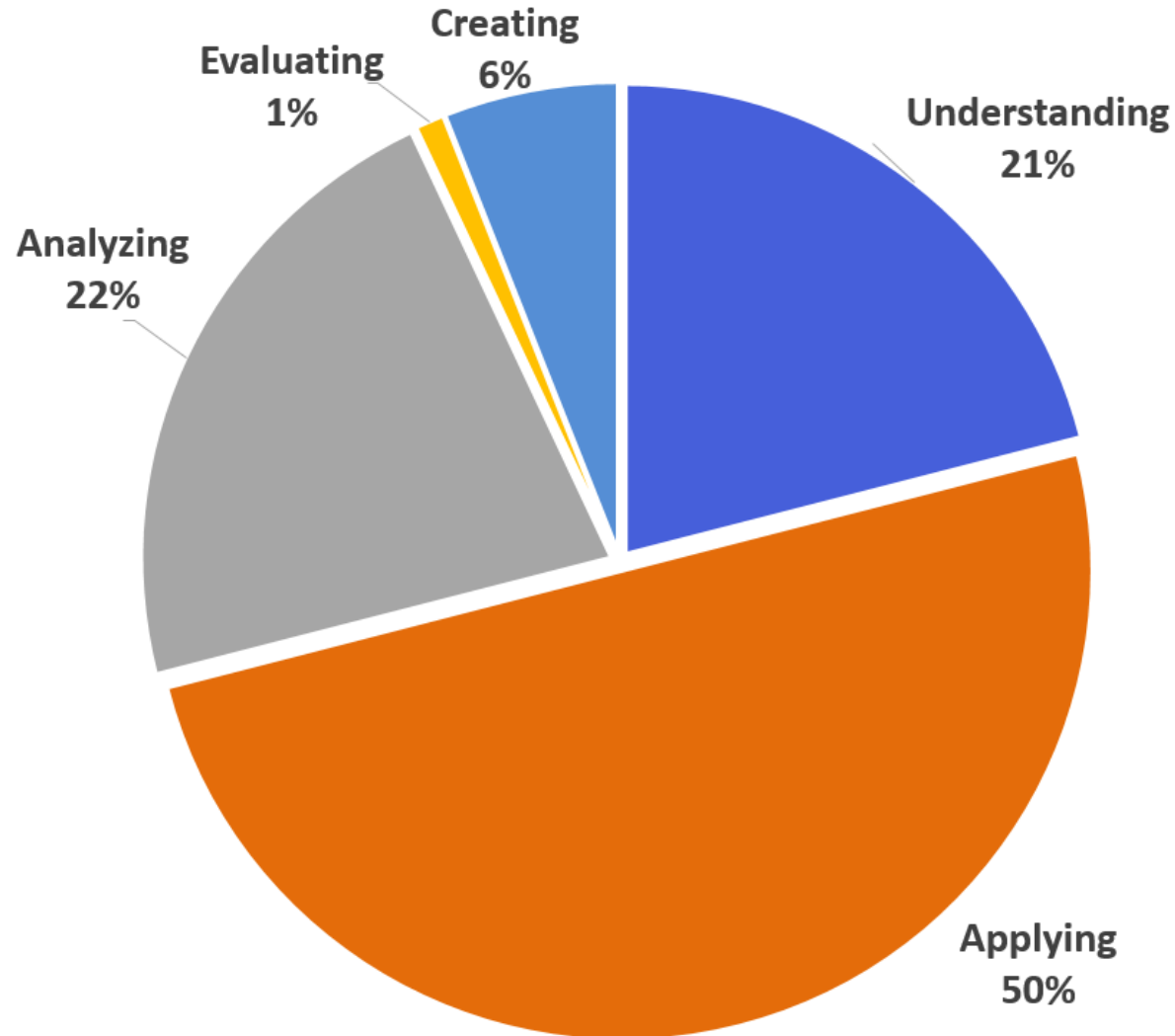
Algorithms and Complexity (AL) – 17 LOs	Architecture and Organization (AR) – 11 LOs
Computational Science (CN) – 3 LOs	Cybersecurity (CYB) – 25 LOs
Discrete Structures (DS) – 34 LOs	Graphics and Visualization (GV) – 5 LOs
Human-Computer Interaction (HCI) – 6 LOs	Information Management (IM) – 13 LOs
Networking and Communications (NC) – 8 LOs	Operating Systems (OS) – 13 LOs
Parallel and Distributed Computing (PD) – 5 LOs	Platform-based Development (PBD) – No LOs
Programming Languages (PL) – 10 LOs	Software Development Fundamentals (SDF) – 19 LOs
Software Engineering (SE) – 14 LOs	System Fundamentals (SF) – 9 LOs
Social Issues and Professional Practice (SP) – 22 LOs	

3-Tiered Assessment Rubric

- Every learning outcome has an assessment rubric

Learning Outcome	Emerging Standard	Developed Standard	Highly Developed Standard
CYB-15. Construct input validation and data sanitization in applications, considering adversarial control of the input channel. [<i>Creating</i>]	Implement simple input validation and data sanitization in applications. [<i>Applying</i>]	Construct input validation and data sanitization in applications, considering adversarial control of the input channel. [<i>Creating</i>]	Develop complex input validation and data sanitization in applications, considering adversarial control of the input channel. [<i>Creating</i>]

CSTransfer2017 Bloom's Levels



Program Examples

Paper at SIGCSE 2018:
*Computer Science Curricular
Guidance for Associate-Degree
Transfer Programs*

- **El Paso Community College, TX**
 - Two-Year **Computer Science Field of Study**
 - Strong concentration in computer programming
- **Bluegrass Community and Technical College, KY**
 - **A.S. Transfer degree in Informatics**
 - Focus on software development and databases
- **Folsom Lake College, CA**
 - **A.S. degree in Computer Science**
 - Comprehensive exposure to Computer Science in preparation for transfer **or** entry level employment

Highlight Your College's Computer Science Program

- Submit a program example that correlates your school's degree or certificate with CTransfer2017

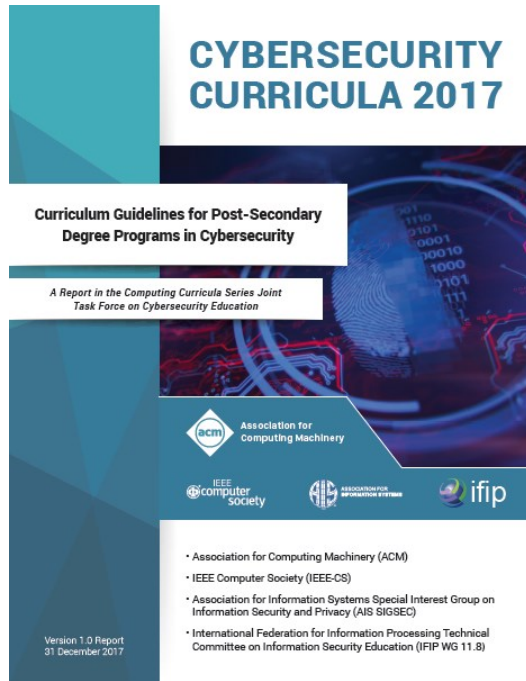
ccecc.acm.org/correlations

CSEC2Y

ccecc.acm.org/guidance/cybersecurity

- Curriculum guidelines for associate degree programs (2 years)
 - Transfer programs (A.S. degree)
 - Career programs (A.A.S. degree)
- Based on CSEC2017
- Updated for currency and appropriateness at the community & technical college level
- Other influences:
 - CAE2Y knowledge units (KUs) – 2019 Foundational + Technical Core
 - Others

CSEC2017



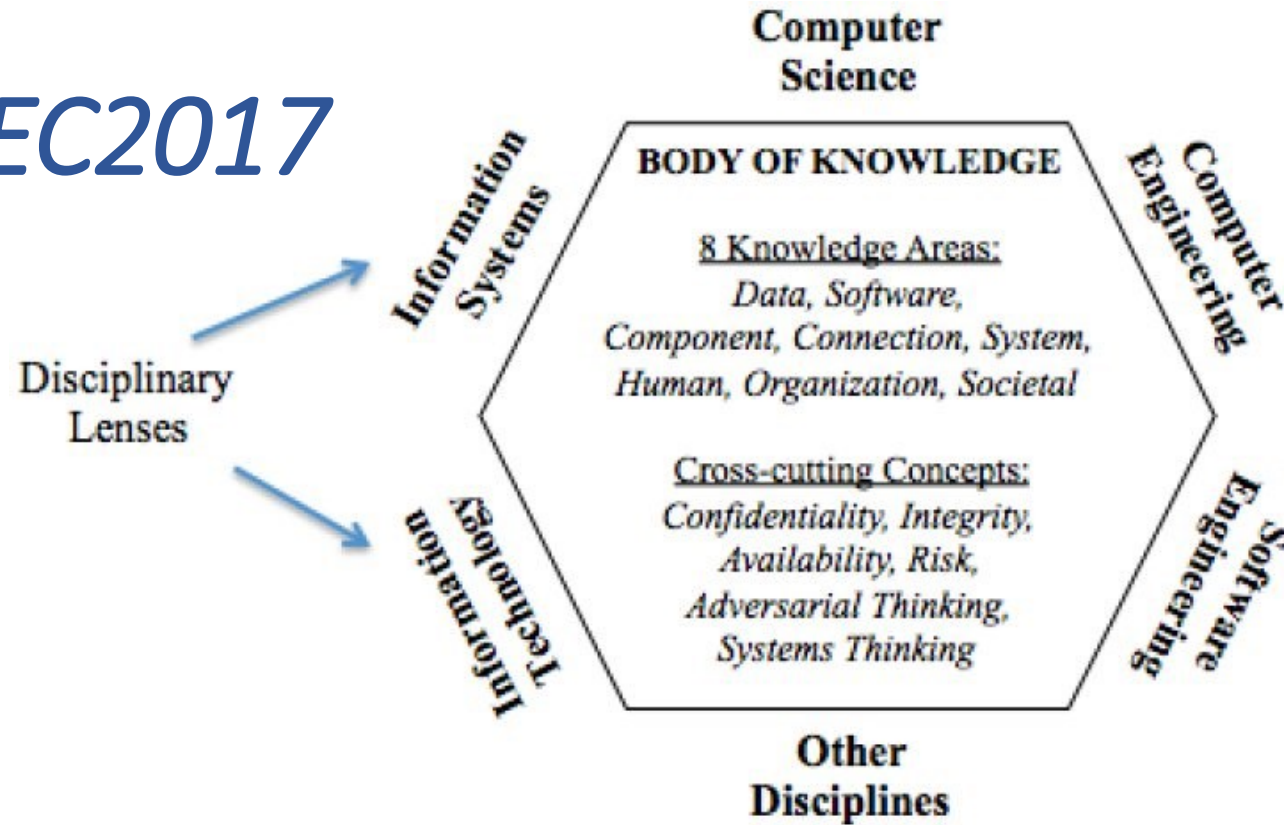
Vision: *The CSEC2017 curricular volume will be the leading resource of comprehensive cybersecurity curricular content for global academic institutions seeking to develop a broad range of cybersecurity offerings at the post-secondary level.*

Organization

- Knowledge areas, knowledge units, topics
- Cross-cutting concepts
- Disciplinary lenses

cybered.acm.org

CSEC2017



- Community College Exemplars
 - Curriculum exemplar: Portland Community College, OR
 - 4-Course exemplar: El Paso Community College, TX
 - Course exemplar: Cosumnes River College, CA

CSEC2Y Timeline

- 2018 April: First Task Group Meeting
- 2019 February: StrawDog (SIGCSE)
- 2019 July: IronDog (3CS)
- 2019 December: Final Version

CSEC2Y Task Group

- Cara Tang*, Portland Community College, Portland, OR
- Cindy Tucker*, Bluegrass Community and Technical College, Lexington, KY
- Christian Servin*, El Paso Community College, El Paso, TX
- Markus Geissler*, Cosumnes River College, Sacramento, CA
- Nancy Jones, Coastline Community College, Garden Grove, CA
- James Kolasa, Bluegrass Community and Technical College, Lexington, KY
- Amelia Phillips, Highline College, Des Moines, WA
- Lambros Piskopos, Wilbur Wright College, Chicago, IL
- Pam Schmelz, Ivy Tech Community College, Columbus, IN
- Melissa Stange, Lord Fairfax Community College, Middletown, VA

* Steering committee

CSEC2Y Advisors

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- Phil Helsel, Microsoft
- Sidd Kaza, Towson University
- Sepehr Hejazi Moghadam (Sepi), Google
- Bill Newhouse, NICE (National Initiative for Cybersecurity Education)
- Casey O'Brien, National CyberWatch Center
- Allen Parrish, Mississippi State University
- John Sands, Moraine Valley Community College, CSSIA
- Brian Ventura, SANS Instructor

CSEC2Y Seeking Reviewers

- Help shape the CSEC2Y guidelines by serving as a reviewer
- Approximate timeline for review drafts
 - StrawDog – Feb 2019
 - IronDog – July 2019



Infusing Cybersecurity

- Efforts in Virginia
- Security Injections

Efforts in Virginia

- Lord Fairfax Community College
- Radford University
- Old Dominion University
- James Madison University
- Virginia Commonwealth University
- Shenandoah University
- George Washington University
- Virginia Tech
- K-12 Curriculum Changes
- Virginia Cyber Range

Security Injections

towson.edu/securityinjections

- Hands-on, self-contained modules with security content that can be injected into a variety of computing courses
- Philosophy:

Create a
Security
Mindset

Introduce
Security Early
and Often

Security Injections

towson.edu/securityinjections

- Maps to content in ACM curriculum guidelines
 - CS2013
 - CSTransfer2017
 - IT2017
 - IT Competency Model 2014
- Listed as resource for NSA/DHS CAE program

Security Injections

towson.edu/securityinjections

- 20-30 minutes to complete
- Use in class or as homework
- Common structure
- Certificate of completion
- Topics
 - Big 3 coding errors: integer overflow, buffer overflow, faulty input validation
 - SDLC
 - Passwords, phishing, social networking
 - SQL injection, encryption, network security
 - Security issues in object-oriented design

Questions & Comments

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