Computer Science Curricular Guidance for Associate-Degree Transfer Programs

SIGCSE, Baltimore, 23 February 2018

ACM CCECC
Cara Tang, Cindy Tucker, Christian Servin, Markus Geissler
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
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
Outline

• CSTransfer2017 Background
• Differences from CS2013
• Body of Knowledge
• Program Examples
CSTransfer2017 Background

• ACM Curricular Guidance – www.acm.org/education
• 2009: Guidelines for Associate-Degree Transfer Curriculum in Computer Science
• 2013: Curriculum Guidelines for Undergraduate Degree Programs in Computer Science – CS 2013
  • New knowledge area: Information Assurance and Security (IAS)
• 2015: BoF @ SIGCSE: Perspectives on How CS 2013 Influences Two-Year College Programs – Standing room only!
• 2015: Joint task force on Cybersecurity Education formed – ACM, IEEE-CS, AIS-SEC, CEP
• 2015: NSF C5 Project – Catalyzing Computing and Cybersecurity in Community Colleges
CSTransfer2017 Background

- **Nov 2015**: CSTransfer2017 Task Group formed
- Divide CS 2013 knowledges areas (KAs) into 3 clusters, form 3 teams
  - Team leads: Teresa Moore, Lambros Piskopos, Christian Servin
- 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
- **Mar 2016**: SIGCSE workshop developing learning outcomes & assessment rubric
- **June 2016**: StrawDog released; 2 surveys for input
  - Over 50 feedback responses from 8 different countries
CSTransfer2017 Background

- **July 2016**: Poster at ITiCSE, Arequipa, Peru
- **Oct 2016**: IronDog released
- **Jan–Feb 2017**: Final input incorporated
- **KAs, KUs, learning outcomes, assessment rubric, and Bloom’s levels reviewed, tweaked, and finalized**
- **Mar 2017**: Pre-release of Final version @ SIGCSE 2017, Seattle
  ACM Education Board Endorsed
- **June 2017**: Final version release @ 3CS 2017
  Available in the ACM Digital Library
## 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

### ACM CCECC Members
- Dr. Elizabeth K. Hawthorne, Union County College, NJ
- Dr. Cara Tang, Portland Community College, OR
- Prof. Cindy S. Tucker, Bluegrass Community and Technical College, KY
- Dr. Christian Servin, El Paso Community College, TX
- Prof. Teresa T. Moore, Volunteer State Community College, TN

### Task Force Members
- Dr. Markus Geissler, Cosumnes River College, CA
- Dr. Anne Apolin, Southern Maine Community College, ME
- Prof. Kimberly Bertschy, Northwest Arkansas Community College, AR
- Prof. Colleen Case, Schoolcraft College, MI
- Prof. Rafael Escalante, El Paso Community College, TX
- Dr. Becky Grasser, Lakeland Community College, OH
- Prof. Charles Hardnett, Gwinnett Technical College, GA
- Prof. Amardeep Kahlon, Austin Community College District, TX
- Prof. James Kolasa, Bluegrass Community and Technical College, KY
- Dr. Shamsi Moussavi, MassBay Community College, MA
- Prof. Pam Schmelz, Ivy Tech Community College, IN
- Prof. Melissa Stange, Lord Fairfax Community College, VA
- Prof. Khallai Taylor, Miami-Dade College, FL
- Prof. Carole Tharnish, Northeast Community College, NB

### Other Contributors
- Prof. Bryce Barrie, Saskatchewan Polytechnic, Canada
- Prof. Michael Bauer, Leeward Community College, HI
- Prof. Paul Dadosky, Ivy Tech Community College, IN
- Prof. Andrea DeMott, Ohio University, OH
- Dean Jamie Edwards, Wytheville Community College, VA
- Dr. Larry Forman, San Diego City College, CA
- Prof. Guy Garrett, Gulf Coast State College, FL
- Prof. Dianne Hill, Jackson College, MI
- Dr. Nancy Jones, Coastline Community College, CA
- Prof. Marc Nester, Wytheville Community College, VA
- Dr. Dean Nevins, Santa Barbara City College, CA
- Dr. Michael Posner, Villanova University, PA
- Prof. Kristopher Roberts, Ivy Tech Community College, IN
- Prof. Barry Sullens, Ivy Tech Community College, IN
- Prof. Robert Surton, Columbia Gorge Community College, OR
Differences from CS2013

• 17 of 18 KAs included
  • 1 KA not included: Intelligent Systems

• 1 KA name change:
  • IAS Information Assurance and Security → CYB Cybersecurity

• Various KUs included for each KA

• Learning Outcomes updated
  • Utilize Bloom’s Revised Taxonomy

• Assessment rubric added for every learning outcome

• No topics
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)
3-Tiered Assessment Rubric

- Every learning outcomes has an assessment rubric

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

- 17 knowledge areas
- 214 learning outcomes with assessment metrics
- 63 learning outcomes specific to cybersecurity
  - 25 in CYB knowledge area
  - 38 in other KAs
## Body of Knowledge

<table>
<thead>
<tr>
<th>Category</th>
<th>LOs</th>
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</thead>
<tbody>
<tr>
<td>Algorithms and Complexity (AL)</td>
<td>17</td>
</tr>
<tr>
<td>Architecture and Organization (AR)</td>
<td>11</td>
</tr>
<tr>
<td>Computational Science (CN)</td>
<td>3</td>
</tr>
<tr>
<td>Cybersecurity (CYB)</td>
<td>25</td>
</tr>
<tr>
<td>Discrete Structures (DS)</td>
<td>34</td>
</tr>
<tr>
<td>Graphics and Visualization (GV)</td>
<td>5</td>
</tr>
<tr>
<td>Human-Computer Interaction (HCI)</td>
<td>6</td>
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<tr>
<td>Information Management (IM)</td>
<td>13</td>
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<tr>
<td>Networking and Communications (NC)</td>
<td>8</td>
</tr>
<tr>
<td>Operating Systems (OS)</td>
<td>13</td>
</tr>
<tr>
<td>Parallel and Distributed Computing (PD)</td>
<td>5</td>
</tr>
<tr>
<td>Platform-based Development (PBD)</td>
<td>No</td>
</tr>
<tr>
<td>Programming Languages (PL)</td>
<td>10</td>
</tr>
<tr>
<td>Software Development Fundamentals (SDF)</td>
<td>19</td>
</tr>
<tr>
<td>Social Issues and Professional Practice (SP)</td>
<td>22</td>
</tr>
<tr>
<td>System Fundamentals (SF)</td>
<td>9</td>
</tr>
</tbody>
</table>
Cybersecurity Infused Learning Outcomes
Bloom’s Levels

- Applying: 50%
- Analyzing: 22%
- Understanding: 21%
- Creating: 6%
- Evaluating: 1%
Mapping to Other Curriculum, Frameworks, and Classifications

- College Board AP Computer Science A
- ACM Computer Science 2013 Guidance
- NSA/DHS CAE2Y Knowledge Units
- Others

Percentage of CS Transfer Knowledge Area Learning Outcomes Mapped to Advanced Placement Computer Science A Topics
Program Examples

• El Paso Community College
  • Two-Year Computer Science Field of Study
  • Strong concentration in computer programming

• COSC 1436: Programming Fundamentals I
• COSC 1437: Programming Fundamentals II
• COSC 2336: Programming Fundamentals III
• COSC 2425: Computer Organization and Machine Language
Program Examples

• Bluegrass Community and Technical College
  • A.S. Transfer degree in Informatics
  • Focus on software development and databases

• INF 120: Elementary Programming
• INF 260: Object-Oriented Programming
• INF 282: Introduction to Databases
• CIT 120: Computational Thinking
• CIT 111: Computer Hardware and Software
Program Examples

• Folsom Lake College
  • A.S. degree in Computer Science
  • Comprehensive exposure to Computer Science in preparation for transfer or entry level employment

• CISC 310: Introduction to Computer Information Science
• CISP 300: Algorithm Design / Problem Solving
• CISP 310: Assembly Language Programming for Microcomputers
• CISP 360: Introduction to Structured Programming
• CISP 400 or 401: Object Oriented Programming with C++ or Java
• CISP 430: Data Structures
• CISP 440: Discrete Structures for Computer Science
## Program Examples

<table>
<thead>
<tr>
<th>Knowledge Area</th>
<th>EPCC Computer Science Transfer</th>
<th>BCTC Informatics Transfer</th>
<th>FLC Computer Science Transfer</th>
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<tbody>
<tr>
<td>AL</td>
<td>88.2%</td>
<td>76.5%</td>
<td>94.1%</td>
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<td>AR</td>
<td>100%</td>
<td>63.6%</td>
<td>81.8%</td>
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<td>CN</td>
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<td>66.7%</td>
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<tr>
<td>CYB</td>
<td>72%</td>
<td>72%</td>
<td>88%</td>
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<tr>
<td>DS</td>
<td>48.4%</td>
<td>0%</td>
<td>85.3%</td>
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<tr>
<td>GV</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>HCI</td>
<td>100%</td>
<td>50%</td>
<td>83.3%</td>
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<tr>
<td>IM</td>
<td>46.1%</td>
<td>84.6%</td>
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<td>NC</td>
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<td>OS</td>
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<td>PD</td>
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<td>20%</td>
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<td>80%</td>
<td>100%</td>
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<tr>
<td>SF</td>
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<td>33.3%</td>
<td>33.3%</td>
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<tr>
<td>SP</td>
<td>86.3%</td>
<td>45.5%</td>
<td>40.1%</td>
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</table>
Highlight Your College’s Computer Science Program

• Submit a program example that correlates your school’s degree or certificate with CSTransfer2017

  ccecc.acm.org/correlations
ACM CCECC Events at SIGCSE
Join Us!

- Exhibit Hall Booth #117
- ACM CCECC Community College Reception
  - Friday 7pm, Sharp Street Terrace
- ACM CCECC Community College Breakfast
  - Saturday 7am, 327-328

Sponsored by Intel, the National CyberWatch Center and the C5 project
Computer Science Curricular Guidance for Associate-Degree Transfer Programs with infused Cybersecurity

June 2017

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