Computer Science Principles: Sneak Peek

MSDE Computer Science CTE Program of Study Professional Development
UMBC Training Center
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Today’s Presenters

Curriculum Writers

- **Holly Eckard**, Glenelg High School, Howard County Public Schools (“master teacher”)
- **Chris Morris**, Catonsville High School, Baltimore County Public Schools (“leader teacher”)
- **Jennifer Hoffmann**, Digital Harbor High School, Baltimore City Schools (“master teacher”)
Presentation Overview

Introduction

CS Matters in Maryland Project
AP Computer Science Principles Curriculum
  Learning Objectives
  Performance Tasks
Maryland CS Matters Curriculum
  Development Process
  Curriculum Standards
  Understanding by Design
  Curriculum Overview
CS Matters in Maryland Project
CS Matters in Maryland Leadership Team

- PI: Marie desJardins, UMBC Dept. of CS&EE
- Co-PI: Jan Plane, UMCP Dept. of CS and Maryland Center for Women in Computing (MCWC)
- Leader Teachers:
  - Dianne O'Grady-Cunniff (Westlake High School, Charles County)
  - Joe Greenawalt (La Plata High School, Charles County)
  - Christina Morris (Catonsville High School, Baltimore County)
Project History

- Google CS4HS workshops @ UMBC (2011, 2012, 2013)
- CSTA-Maryland local chapter established (2011)
- NSF-funded CE21-Maryland planning grant (2012-present)
- NSF-funded CS Matters in Maryland – CS10K program (2013-present)
CE21-Maryland

- NSF-funded planning grant
  - CE21: Computing Education for the 21st Century
- Mini-summit (50 attendees) – August 2012
- Create contact database for CS education
  - Currently has ~800 teachers, administrators, faculty, and industry reps
- Landscape survey (~100 Maryland HS teachers) – Spring 2013
- Summit on Computing Education (120 attendees) – May 2013
- Followup survey (~80 Maryland HS teachers) – Spring 2014
CS Education in Maryland

- Maryland has the **highest per capita AP CS** exam rate of any state 😊
- CS is **not a graduation requirement** 😐
  - There is **no computing** in the state **Tech Ed standards** 😐
  - Very recently, the state superintendent recommended that **CS should count** as a fourth math credit towards HS graduation 😊
- There is an **active CS education community** with NSF support
  - Our statewide summit in May 2013 brought 125 teachers, administrators, faculty, and industry professionals to UMBC
- College **enrollments in CS are up** 😊
  - Student **diversity in CS has not increased** 😐
  - **Students are underprepared** to succeed in CS majors 😐

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2012</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS/CE/IS Majors @ UMBC</td>
<td>1,245 (est.)</td>
<td>1,900 (2013)</td>
<td>52%</td>
</tr>
<tr>
<td>CS/CE/IS Majors - US</td>
<td>42,300</td>
<td>67,850</td>
<td>60%</td>
</tr>
<tr>
<td>CS/CE/IS Graduates - US</td>
<td>11,271</td>
<td>15,975</td>
<td>42%</td>
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Sources: UMBC, CRA Taulbee Survey
2012 Maryland Teacher Survey

- 247 high schools in Maryland
  - Reviewed school websites and called schools whose websites were incomplete
  - Created initial database of 347 contacts (≥ 1 per school)
    - (July 2014: database now has 800 contacts)
  - May 2012: Invited by email and postcard to participate in survey
  - Administered survey on surveymonkey
  - 97 respondents (some incomplete)

- Questions related to:
  - Who’s teaching?
  - What are they teaching?
  - Who are they teaching?
  - What are their challenges?
  - What do they need?
Only about half of schools have even an introductory CS class (but the majority of these schools also have AP CS)
Percentage Girls: Intro CS and AP

Fewer than 20% of the students in intro or AP CS are female.
Similarly, fewer than 20% of the students in intro or AP CS are members of an ethnic minority.
CS not being a requirement and budget limitations are the dominant reasons for not offering more CS
What do you perceive as the greatest challenges in teaching CS?
(Please rate each challenge.)

- Lack of student interest/enrollment
- Rapidly changing technology
- Difficult subject matter
- Lack of support/interest by school staff
- Lack of student subject knowledge
- Lack of curriculum resources
- Lack of hardware/software resources
- Lack of teacher subject knowledge

Legend:
- Orange: Great Challenge
- Blue: Moderate challenge
- Purple: Minor/no challenge

0%  20%  40%  60%  80%  100%
2014 Teacher Survey (Initial Findings)

- Caveat: not necessarily the same teachers responding; slightly lower response rate

- Compared to 2012:
  - Fewer keyboarding classes, more pre-AP classes
  - Some movement of CS classes from business departments to technology/mathematics departments
  - More students in CS classes (2012: typically 11-25 students; 2014: typically 51-100 students)
  - More emphasis on graphics, problem solving, and Web applications
  - No apparent increase in percentage of girls or minority students
  - Interest has increased; lack of qualified teachers is a bigger issue
CS Matters in Maryland

- **Goal:** “increase the number of rigorous computer science classes offered across the state and the number and diversity of students taking these classes”

- **Activities:**
  - **Year 1:** Recruit 13 master teachers to develop a Maryland-specific curriculum for AP CS Principles, and pilot the course in their home schools in 2014-15
  - **Year 2:** Recruit 30 (less experienced) pilot teachers to be trained on the CS Matters CSP curriculum, and teach the course in 2015-16
  - **Year 3:** Support four workshops around the state to train up to 80 additional teachers on the CS Matters CSP curriculum, and teach the course in 2016-17 (the first year in which the AP exam will be offered)
2014 Master Teachers

- 13 master teachers
- 100+ years of teaching
- Extensive experience with curriculum development
- Public and private schools across the state of Maryland
- Public schools in Washington, D.C.

Maryland districts include:
- Anne Arundel County
- Baltimore City
- Baltimore County
- Charles County
- Garrett County
- Howard County
- Montgomery County
- Queen Anne’s County
- St. Mary’s County
2015 Pilot Teachers

- Currently requesting expressions of interest!
- http://ce21maryland.umbc.edu/events/summer-workshops/
- or Events tab at http://csmatters.org
AP CS Principles
The College Board will offer a new Advanced Placement (AP) exam in Computer Science beginning in May 2017.

The College Board will continue offering the current AP Computer Science A exam.

Reference: http://www.csprinciples.org/

- New exam will include a set of three performance tasks and a multiple choice exam.
- Students develop artifacts and reports for each of the three tasks. These will be submitted to the College Board and represent about 50% of the student’s AP score. The other half of the score will be based on an end of course exam.
Computer Science Principles – Course Content

Computational Thinking Practices

- Connecting computing
- Developing computational artifacts
- Abstracting
- Analyzing problems and artifacts
- Communicating
- Collaborating
Big Ideas

- Computing is a creative activity.
- Abstraction reduces information and detail to facilitate focus on relevant concepts.
- Data and information facilitate the creation of knowledge.
- Algorithms are used to develop and express solutions to computational problems.
- Programming enables problem solving, human expression, and creation of knowledge.
- The Internet pervades modern computing.
- Computing has global impacts.
AP CS Principles Objectives
AP CS Principles Exam

- In-person exam – multiple-choice and free response
  - Content continues to evolve
- Portfolio model – three performance tasks
  - Explore
  - Investigate
  - Create
Explore Performance Task
Investigate Performance Task
Create Performance Task
CS Matters CSP Curriculum
Curriculum Development Process

Proposed Maryland CSP Curriculum Development Workflow

Planning Team

Writing Teams

Writing Team A
- Writers: Marla, Rich
- 4th Grade: Wall
- 3rd Grade: Data Acquisition
- 2nd Grade: PT, Investigate
- 1st Grade: Chris

Writing Team B
- Writers: Jerry, Rich, Adam
  - 4th Grade: Wall
  - 3rd Grade: Data Manipulation
  - 2nd Grade: PT, Explore
  - 1st Grade: Maureen

Writing Team C
- Writers: Jerry, Rich, Adam
  - 4th Grade: Wall
  - 3rd Grade: Data Visualization
  - 2nd Grade: PT, Explore
  - 1st Grade: Maureen

Writing Teams

Curriculum Alignment
- Assistance: Sharon

Programming & Math
- Assistance: Jan

Writing Process

Initial Review

Final Review

Submit

No

Next Edition

Classroom Implementation

Determine Revisions

Major Revisions

Implement Lessons

Collect Data During Implementation

No

Is draft ready for publication?

Submit

Yes

Is draft ready for final editing?

No

Final Review

Submit

Yes
Understanding by Design

worth being familiar with

important to know and do

enduring understanding
CS Principles – Six Main Units

1. Your Virtual World (15 days)
2. Information and the Internet (20 days)
3. Developing Programs (20 days)
4. Data Acquisition (20 days)
5. Data Manipulation (20 days)
6. Data Visualization (20 days)
CS Principles – Programming

Python Programming Language
Version 3.4
PyCharm IDE
Unit 1: Your Virtual World
Unit 2: Information and the Internet
Performance Task:
Explore
Prepare and Submit:
• Artifact
• Written Report
Unit 3: Developing Programs
Unit 4: Data Acquisition
CS Principles – Performance Task 2

Performance Task: Investigate

Prepare and Submit:

- Collaborative Artifact and Reports
- Individual Artifact and Reports
Unit 5: Data Manipulation
Unit 6: Data Visualization
CS Principles – Performance Task 3

**Performance Task:**
Create

Prepare and submit the following:
- Collaborative Artifact and Reports
- Individual Artifact and Reports
Thanks for Listening!
Any Questions?