Computer Science Education: Challenges and Directions

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CE21 Advisory Board Meeting

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Overview and Welcome

- Challenges in Computer Science Education
  (and what weṽre trying to do about it...)
  - Broadening the classroom view of CS
  - Broadening the diversity of CS students
  - Broadening the pool of qualified CS teachers
  - Broadening access to CS education through curricular reform

- Recommendations for Action

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CS Education: A National Crisis

- We need many trained computer scientists
    - There will be more new jobs in computing than in *all other areas of STEM combined*

- We are not producing enough computer scientists
    - Enrollment in computing majors dropped dramatically in the 2000s
    - Recently, enrollments have increased, but not nearly enough

- Our pool of computer scientists is not sufficiently diverse
    - Women, African-Americans, and other ethnic minorities choose CS at a much lower rate than white males

- We don̦t have enough highly qualified K-12 CS teachers

- We don̦t have a strong K-12 CS curriculum

Lack of Gender Diversity in CS*

- In 2008, women earned:
    - 57% of all BachelorＡs degrees
    - 61% of MasterＡs degrees
    - 51% of Doctoral degrees

- But in 2008, women earned:
    - 12% of BachelorＡs degrees   *in CS (the lowest percentage ever recorded)*
    - 26% of MS degrees in CS
    - 21% of PhD degrees in CS

- *Women are underrepresented in CS by a factor of more than 2 at the grad level, and by a factor of more than 4 at the undergrad level!*

* Statistics for CS, CE, and IS combined
Source: CRA Taulbee Survey

Lack of Racial Diversity in CS

- In 2008, of BachelorẠs degrees in CS:
  - 4.9% went to African-Americans (9.8% of all BachelorẠs)
  - 6.8% to Hispanics (7.9% of all BachelorẠs)

- In 2008, of MasterẠs degrees in CS:
  - 2.7% went to African-Americans (10% of all MasterẠs)
  - 2.4% went to Hispanics (5.9% of all MasterẠs)

- In 2008, of PhD degrees in CS:
  - 1.6% went to African-Americans (6.1% of all PhDs)
  - 1% to Hispanics (3.6% of all PhDs)

- *Minorities are underrepresented by a factor of 4 at the grad level*

Source: CRA Taulbee Survey

Challenges in Teacher Preparation

- In most states (including Maryland!!):
    - Certification requirements are unclear
    - Current certifications do not meet the needs of the discipline
    - Teachers without CS certification are often asked to teach CS classes (often due to a lack of certified/qualified teachers)
    - There is inadequate in-service professional development to keep teachers abreast of new trends and knowledge

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Challenges in K-12 Curriculum

- In most states (including Maryland!):
  - Very few of the CSTA-identified K-12 CS standards are part of the standard curriculum*
  - Computer science classes are not required for graduation, and in most cases donȦt count towards any graduation requirement
  - Many schools donȦt offer computing courses beyond the level of keyboarding schools, and even fewer offer college preparatory CS courses

* CSTA data on Maryland standards:
31 out of 35 Level I standards; 3 out of 10 Level II standards; 1 out of 10 Level III standards.
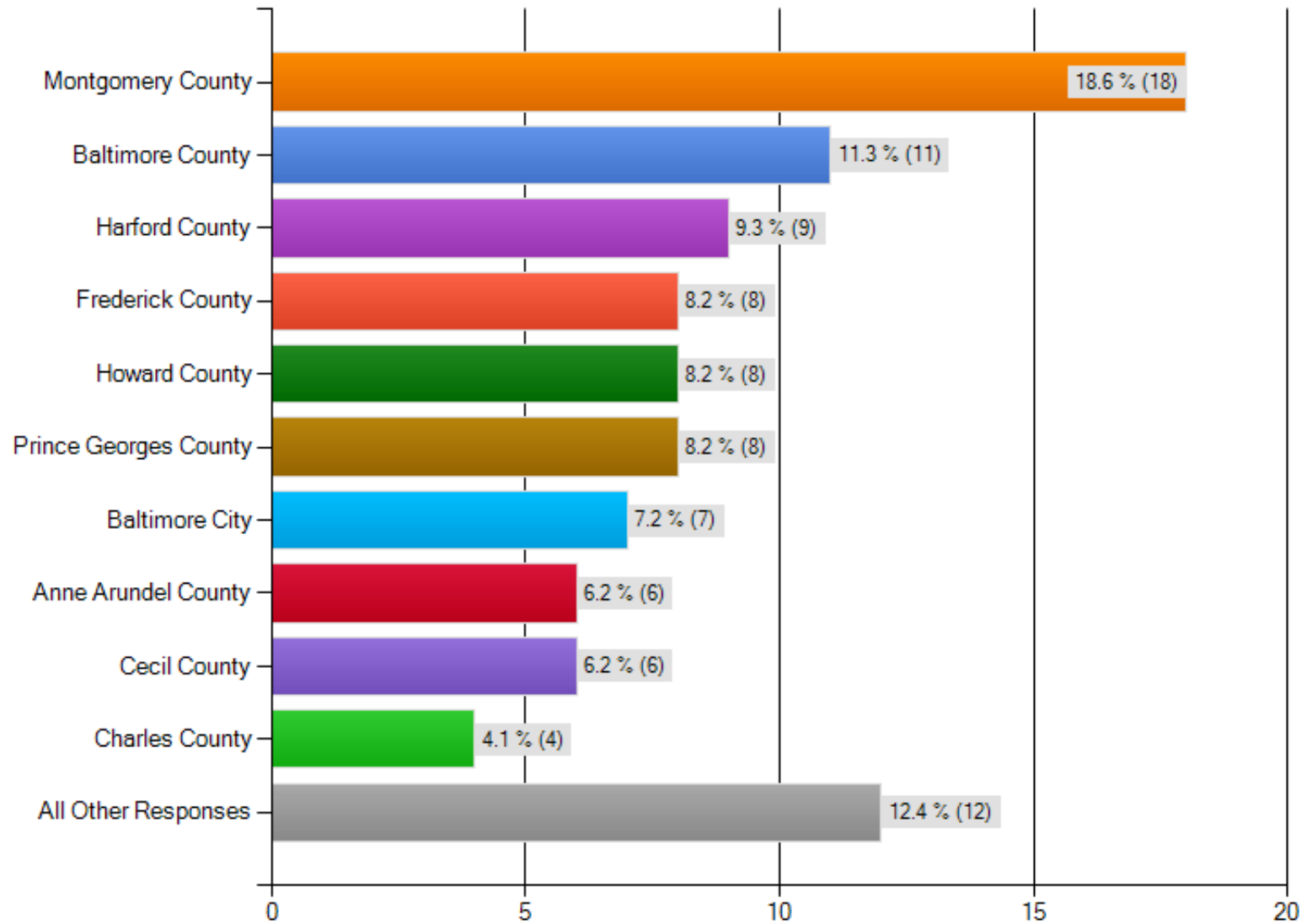
Teacher Survey: What We Learned

- WhoẠs teaching?

- What are they teaching?

- Who are they teaching?

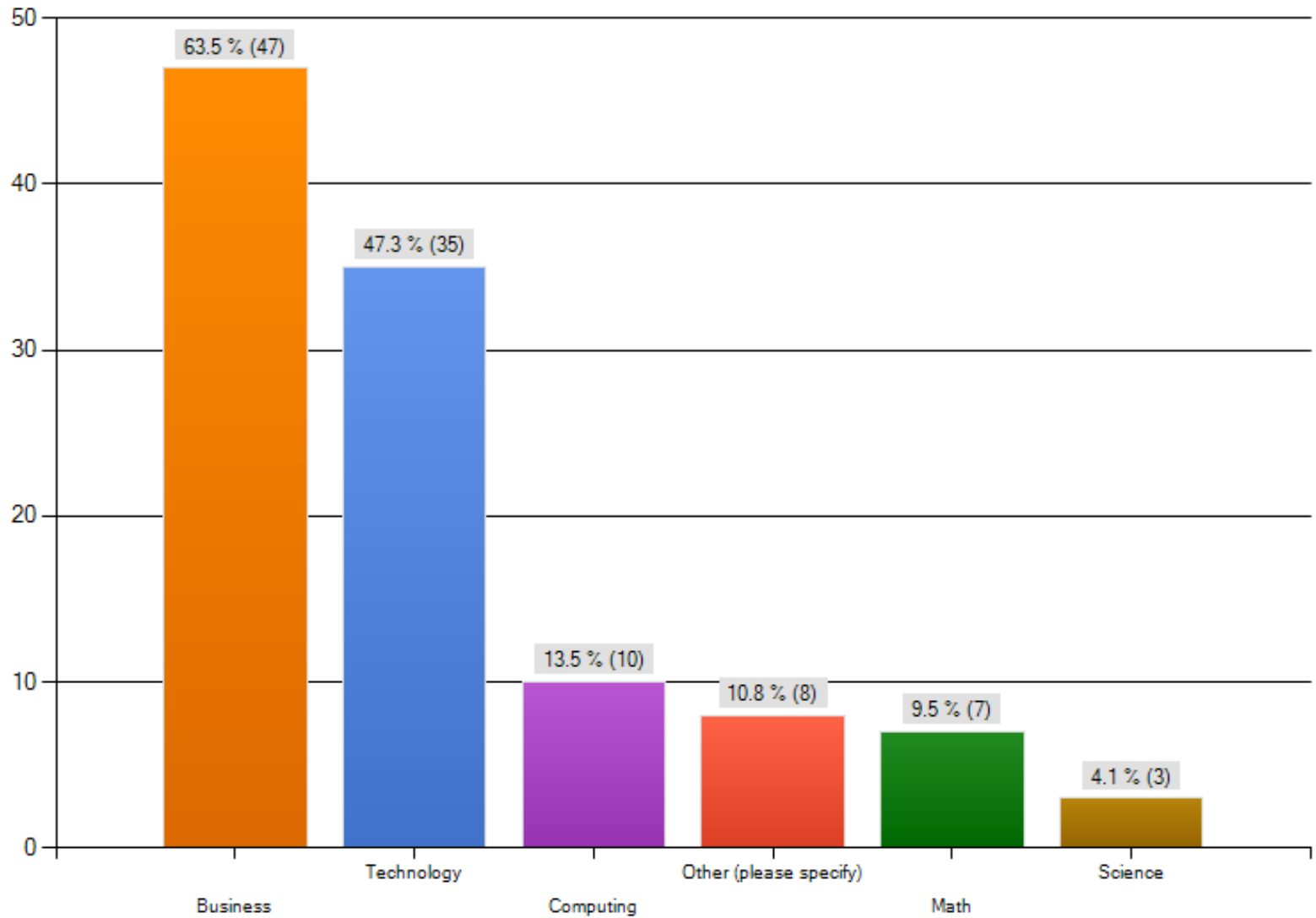- What are their challenges?

- What do they need?

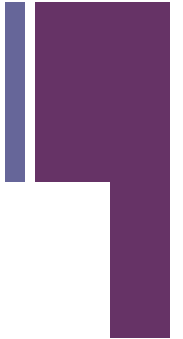# In which Maryland public school district is your high school located?

District	Percentage (Count)
Montgomery County	18.6 % (18)
Baltimore County	11.3 % (11)
Harford County	9.3 % (9)
Frederick County	8.2 % (8)
Howard County	8.2 % (8)
Prince Georges County	8.2 % (8)
Baltimore City	7.2 % (7)
Anne Arundel County	6.2 % (6)
Cecil County	6.2 % (6)
Charles County	4.1 % (4)
All Other Responses	12.4 % (12)

Under what department(s) is CS offered in your school? (Check all that apply.)

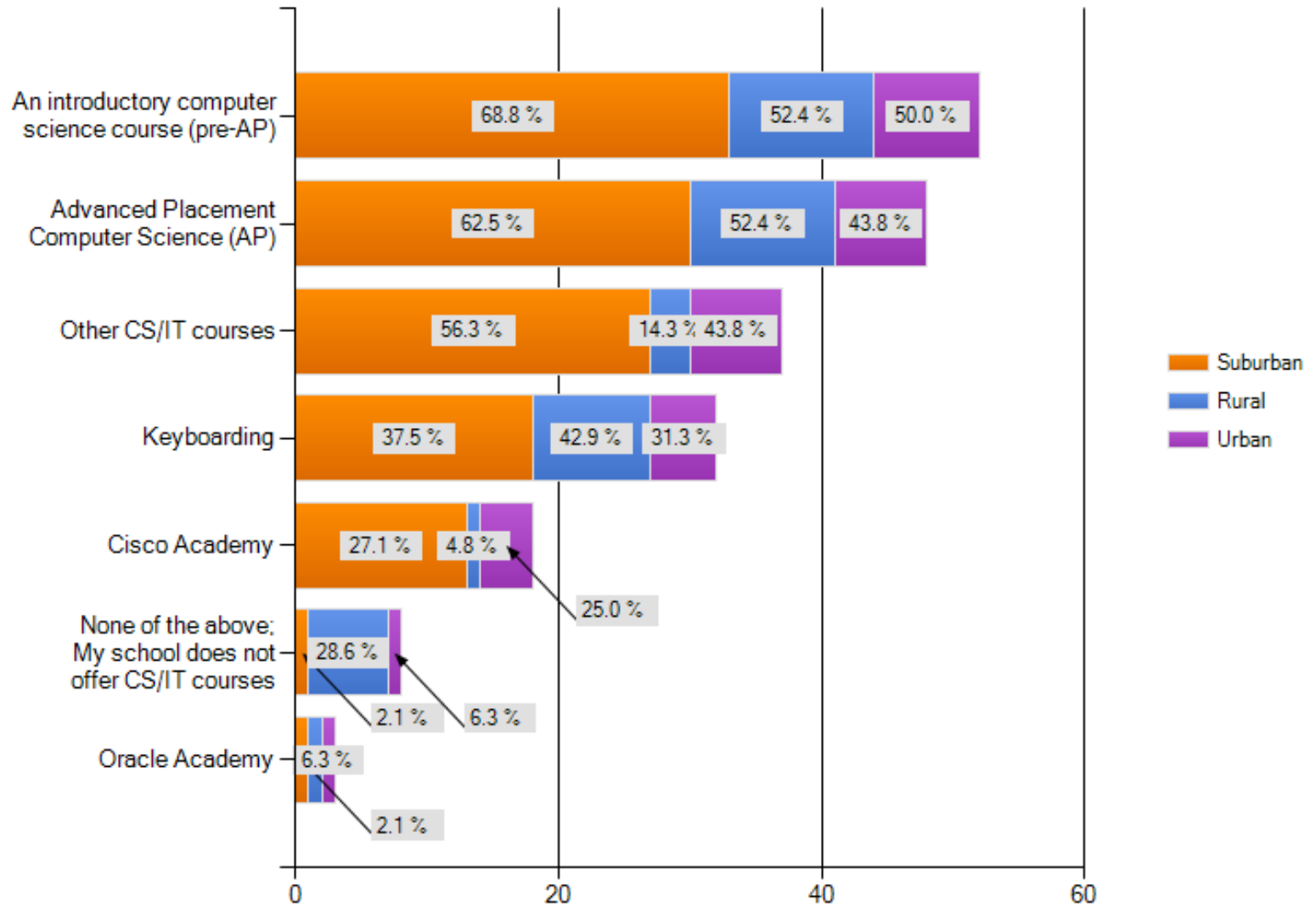| Department	Percentage
Business	63.5 % (47)
Technology	47.3 % (35)
Computing	13.5 % (10)
Other (please specify)	10.8 % (8)
Math	9.5 % (7)
Science	4.1 % (3)

Teacher Certification

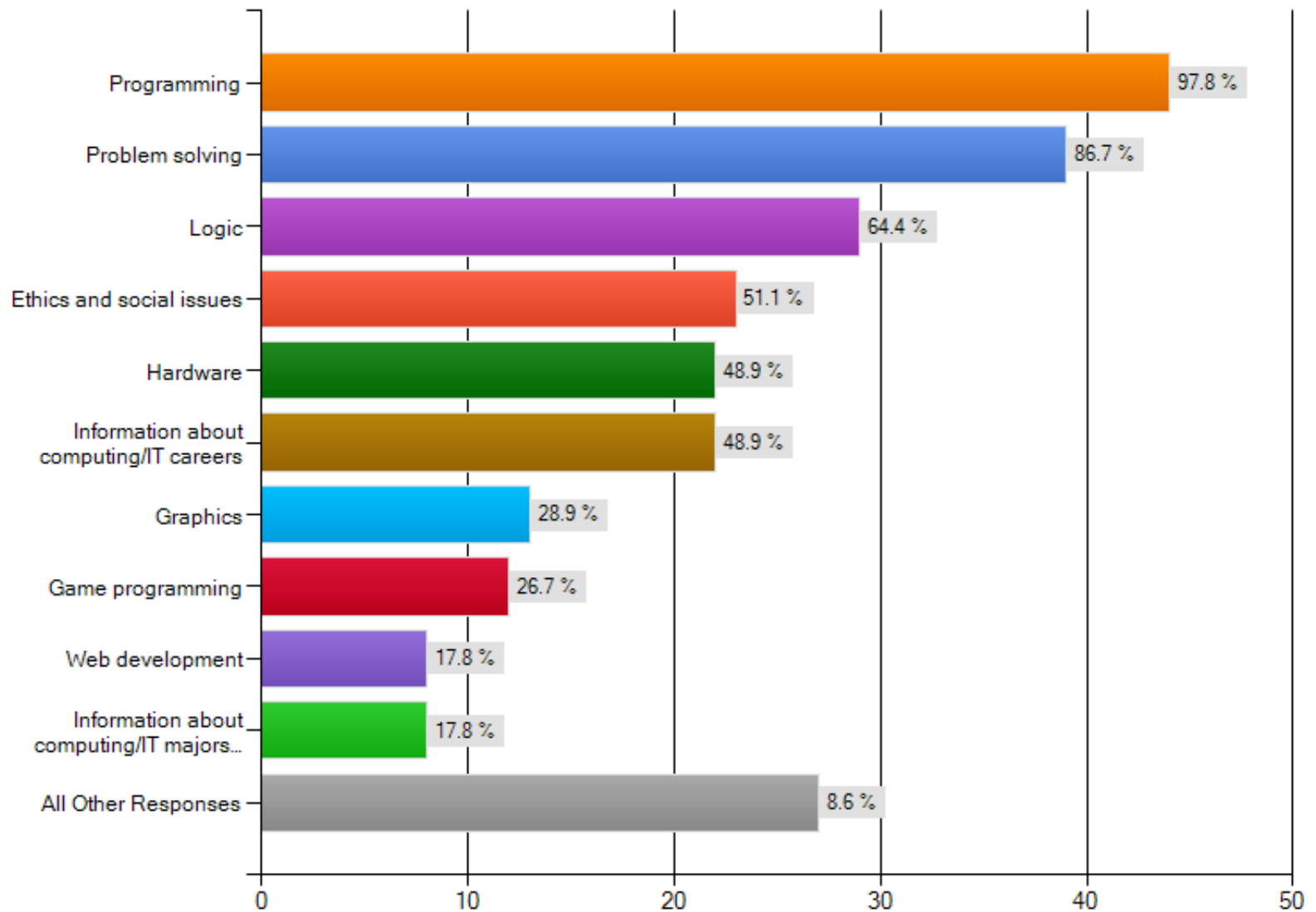In which of the following areas are you certified to teach in Maryland?
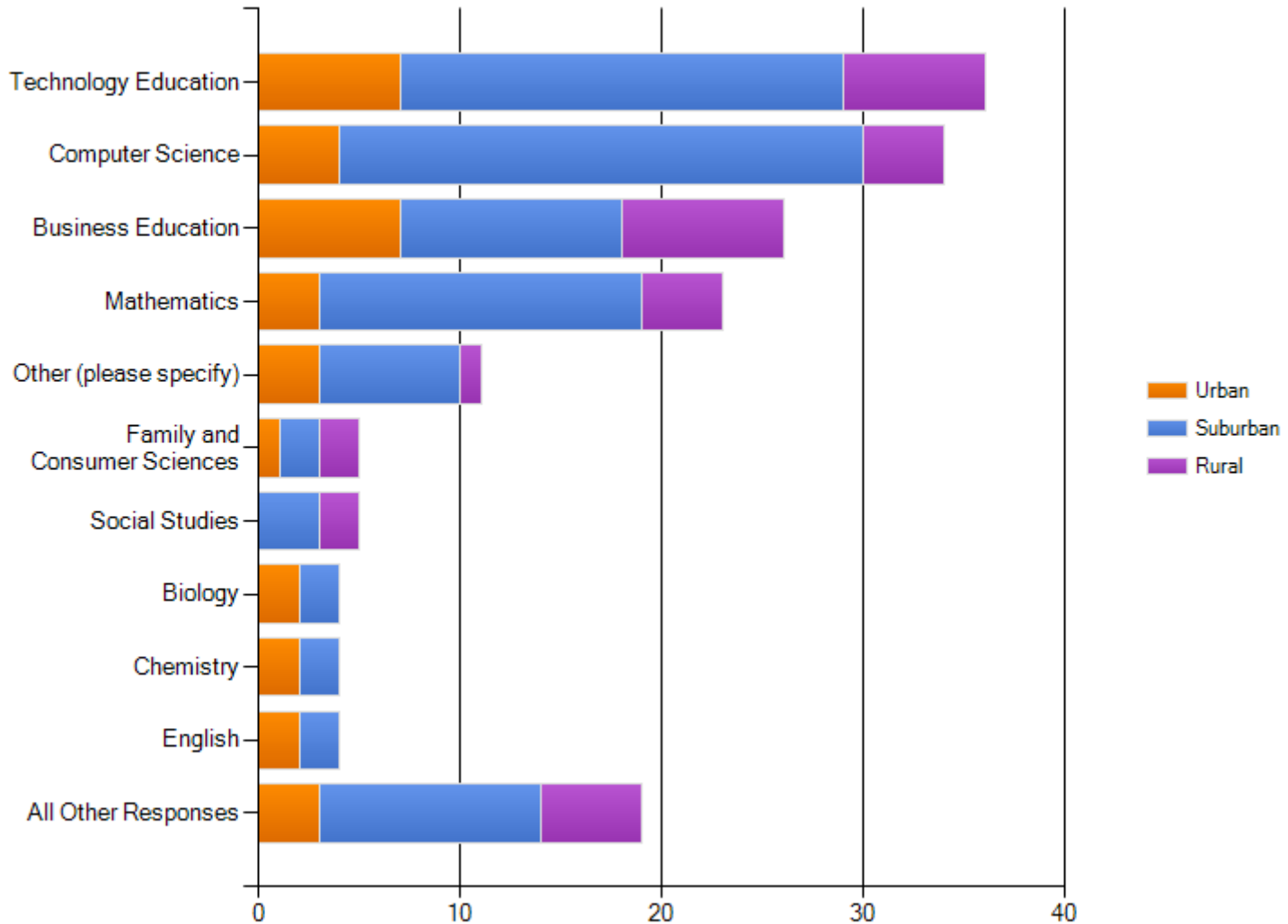
Which of the following are offered at your high school? (Check all that apply.)
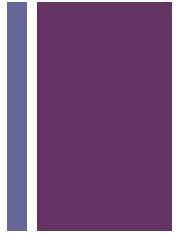
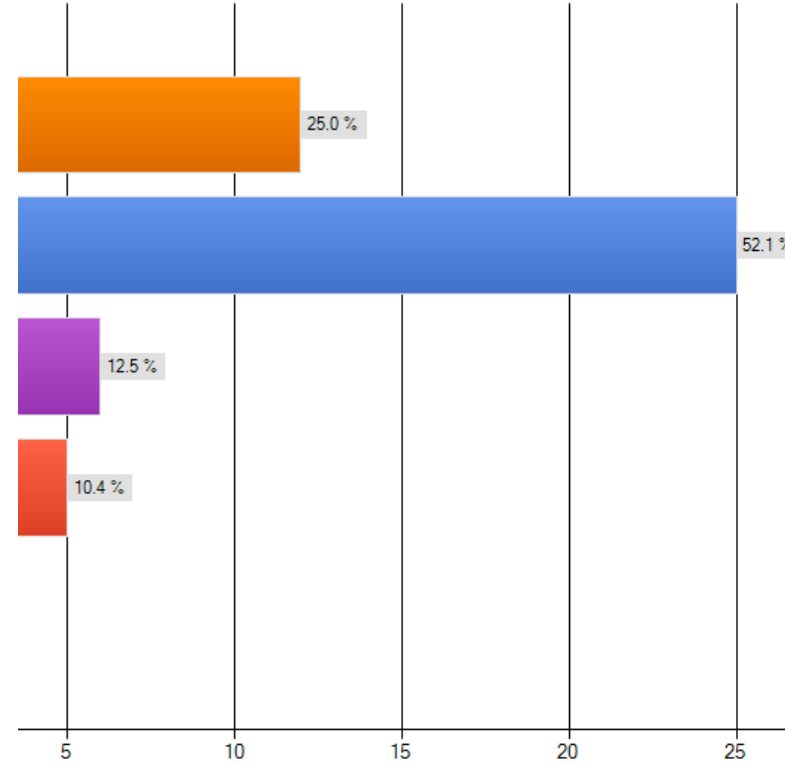# What content is covered in introductory CS? (Check all that apply.)

Content	Percentage
Programming	97.8 %
Problem solving	86.7 %
Logic	64.4 %
Ethics and social issues	51.1 %
Hardware	48.9 %
Information about computing/IT careers	48.9 %
Graphics	28.9 %
Game programming	26.7 %
Web development	17.8 %
Information about computing/IT majors…	17.8 %
All Other Responses	8.6 %

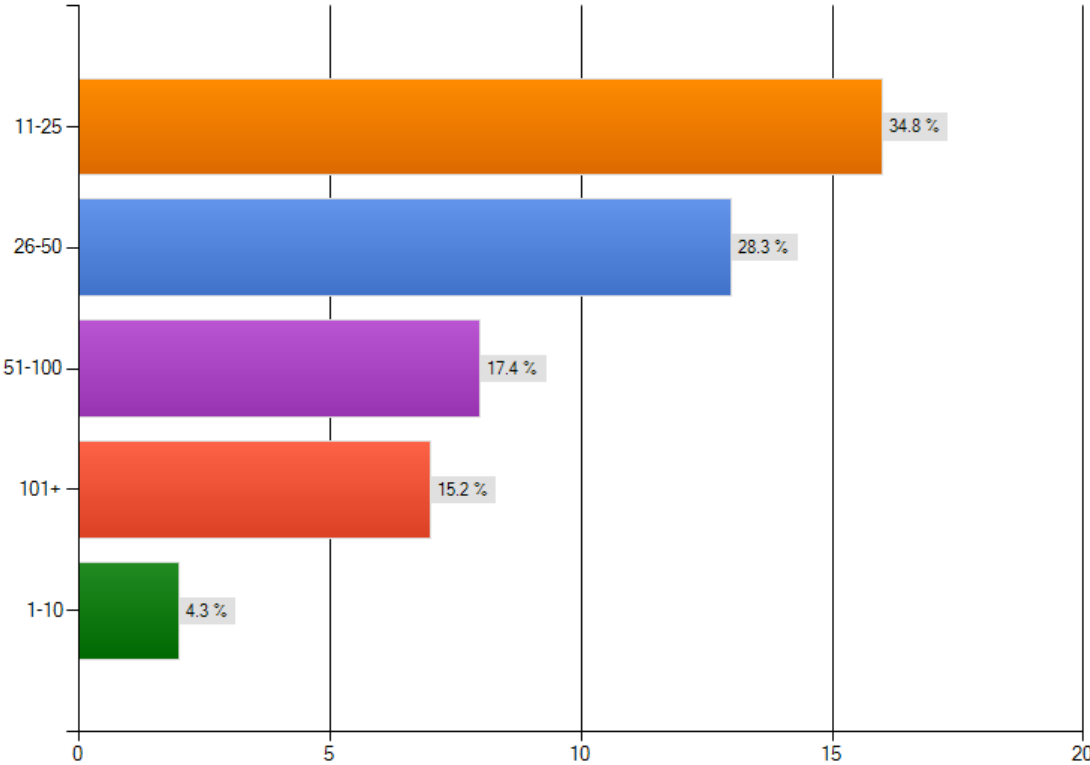# 2011-2012 Enrollment: Intro CS & AP

How many students enrolled in introductory CS this year at your high school?

11-25	34.8 %
26-50	28.3 %
51-100	17.4 %
101+	15.2 %
1-10	4.3 %

How many students take AP CS each year?

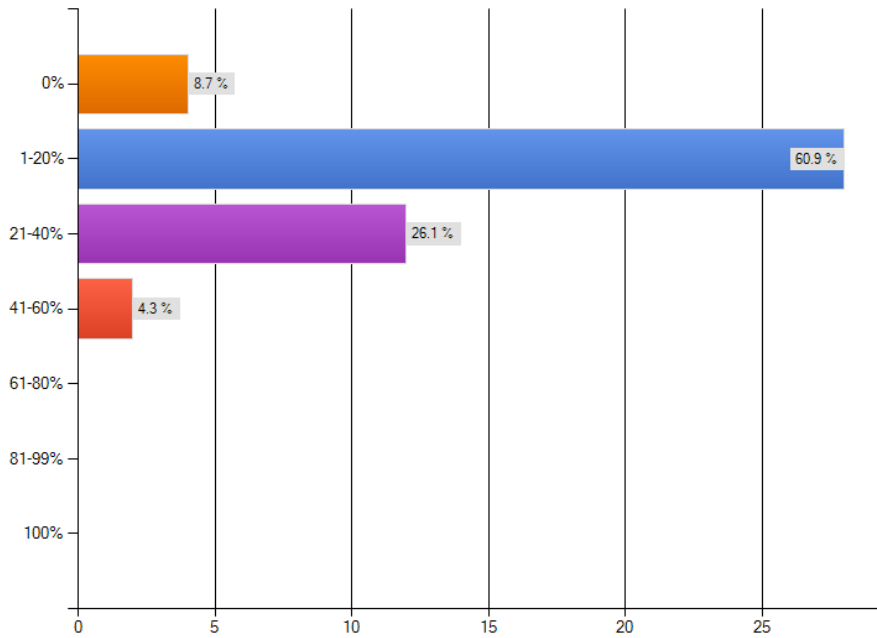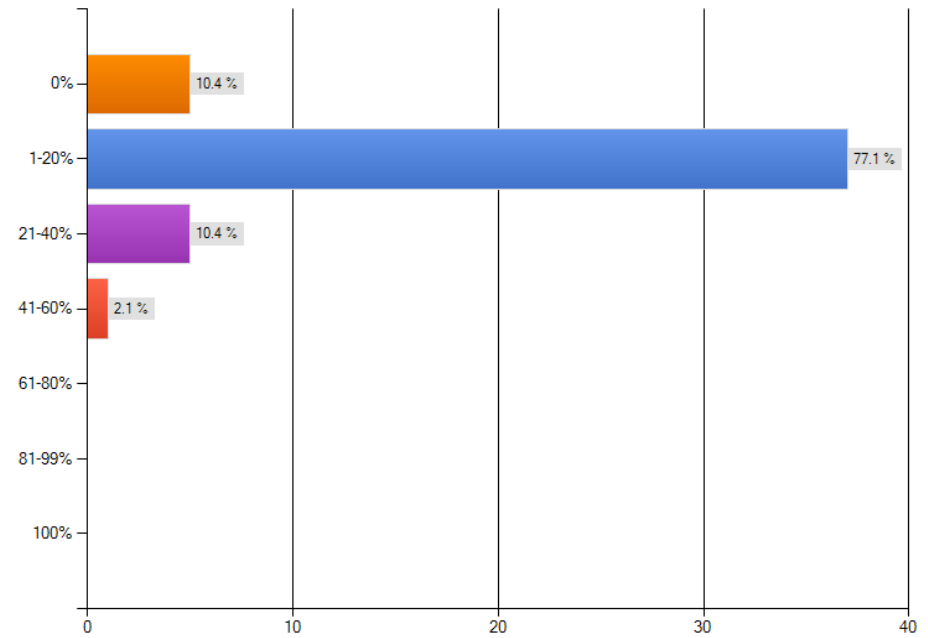|	
11-25	25.0 %
26-50	52.1 %
51-100	12.5 %
101+	10.4 %

Percentage Girls: Intro CS and AP

What approximate percentage of students enrolled in introductory CS are female?

Category	Percentage
0%	8.7 %
1-20%	60.9 %
21-40%	26.1 %
41-60%	4.3 %
61-80%	
81-99%	
100%	

What percentage of students enrolled in AP CS are female?

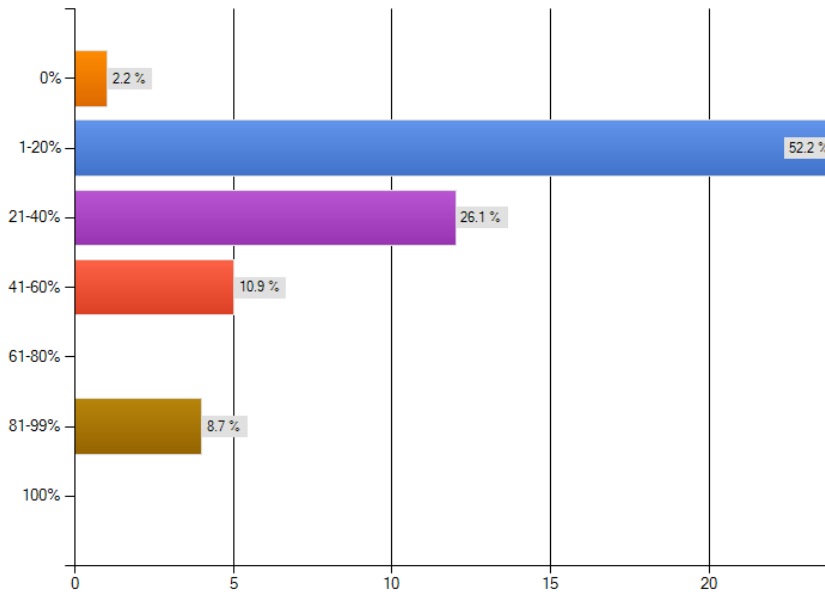| Category	Percentage
0%	10.4 %
1-20%	77.1 %
21-40%	10.4 %
41-60%	2.1 %
61-80%	
81-99%	
100%	

Percentage Minorities: Intro CS & AP

What approximate percentage of students enrolled in introductory CS are members of an ethnic minority?

0%	2.2 %
1-20%	52.2 %
21-40%	26.1 %
41-60%	10.9 %
61-80%	
81-99%	8.7 %
100%	

What percentage of students enrolled in AP CS are members of an ethnic minority?

0%	6.3 %
1-20%	66.7 %
21-40%	12.5 %
41-60%	8.3 %
61-80%	
81-99%	6.3 %
100%	
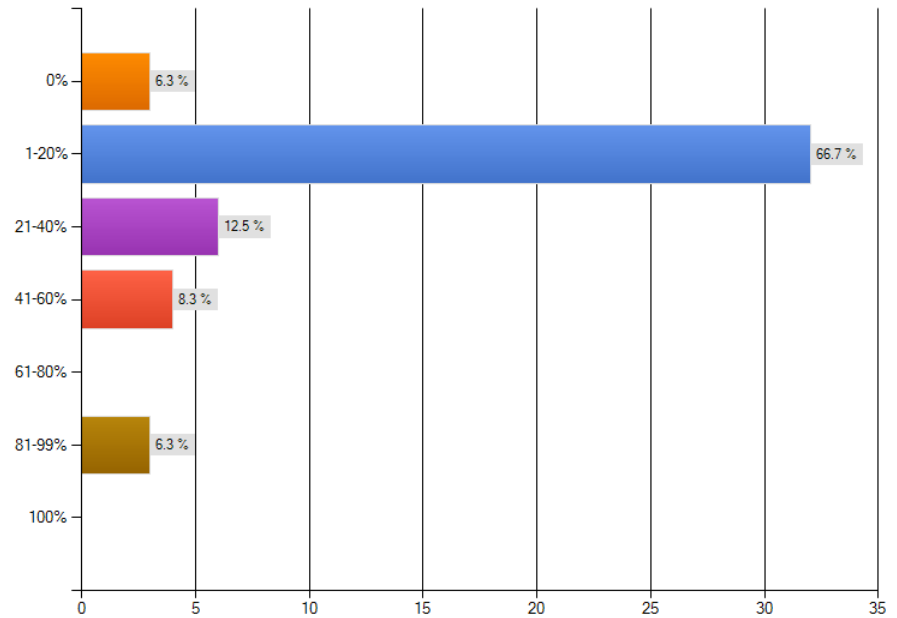
What are some of the reasons why your school does not offer more computer science courses? (Check all that apply.)

- CS is not a graduation requirement — 62.7 %
- Budget restrictions — 52.0 %
- CS is not a priority for the school system — 50.7 %
- Insufficient student interest — 46.7 %
- CS is not a priority for my high school — 42.7 %
- Lack of qualified teachers — 41.3 %
- Other (please specify) — 12.0 %
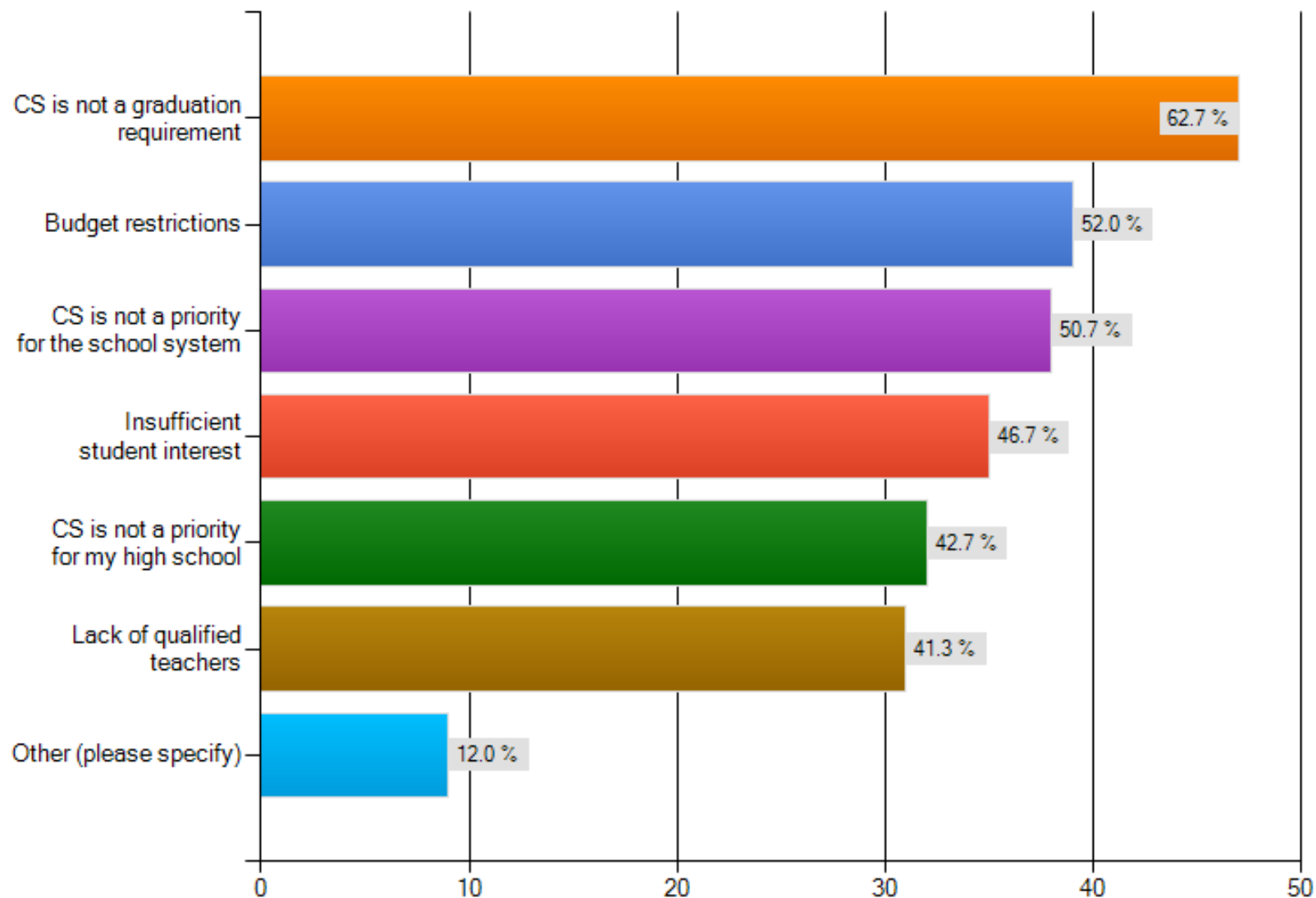
What do you perceive as the greatest challenges in teaching CS?
(Please rate each challenge.)
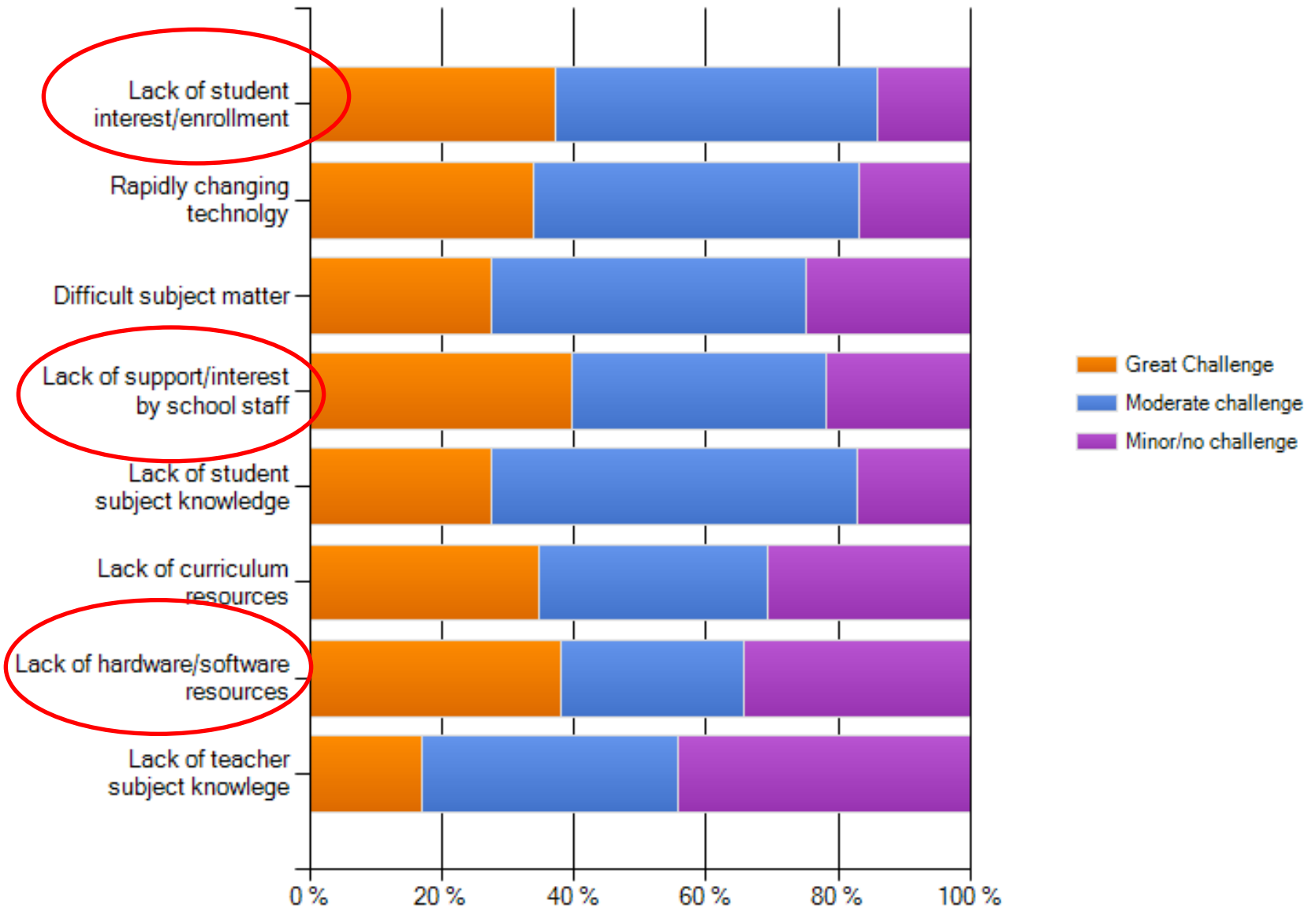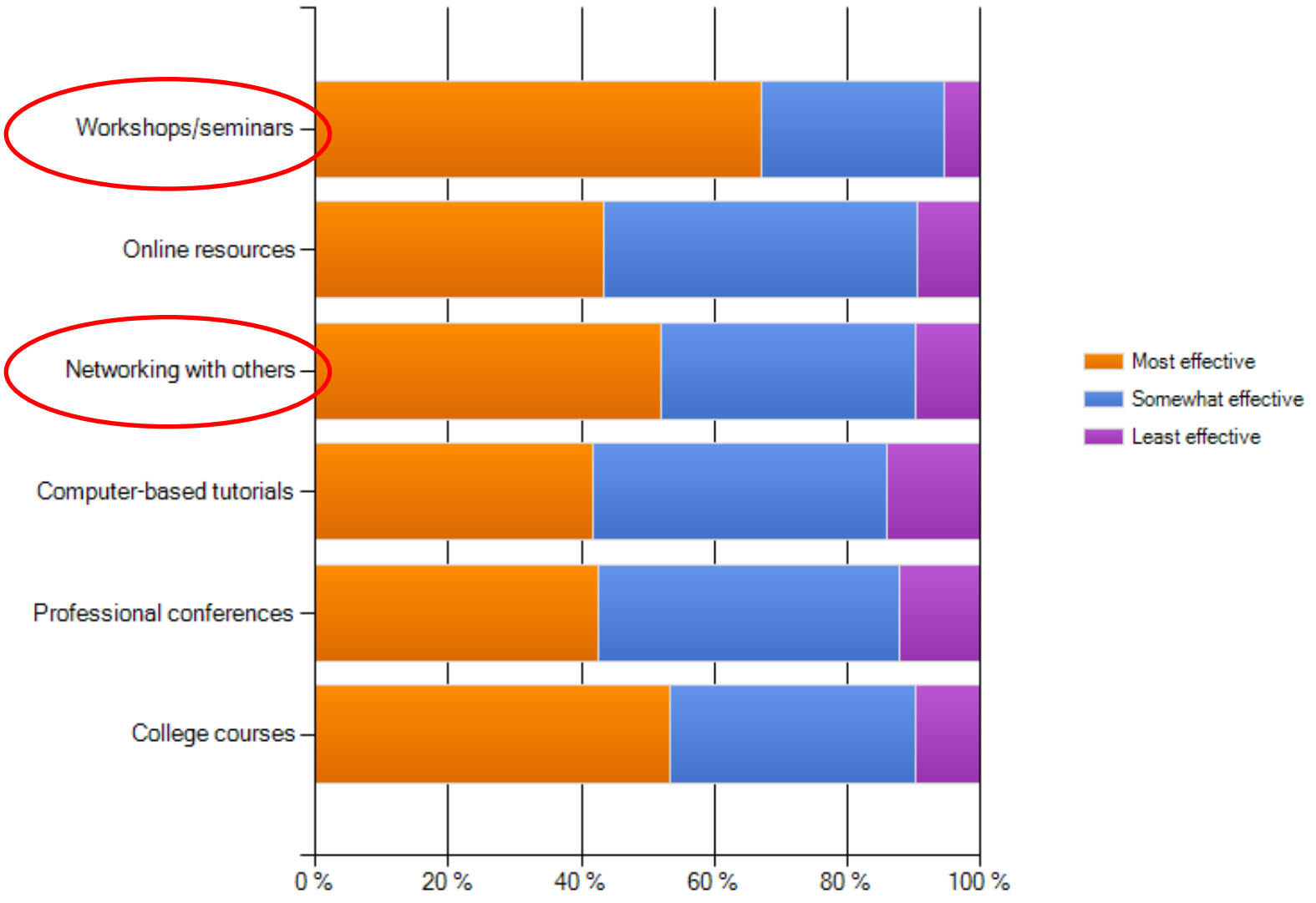
Other Reported Challenges

Lack of parental encouragement for students to take CS	89%
Lack of guidance staff knowledge about importance of CS	88%
Lack of student math preparation	88%
Lack of parental knowledge about the importance of CS	87%
Inability to attract women and minorities to CS classes	75%
Being asked to teach multiple CS related courses in the same classroom at the same time	74%
Lack of support/interest by school leadership	74%
Lack of a professional community of other CS instructors	71%
Lack of internships for students	68%
Lack of professional development opportunities	65%
Creating a curriculum that satisfies district and state	63%
Understanding state curriculum standards	57%

What do you perceive as the greatest professional development needs?

What do you believe to be the most effective methods for delivering professional development to CS teachers? (Please rank each.)

Workshops/seminars
Online resources
Networking with others
Computer-based tutorials
Professional conferences
College courses

Most effective
Somewhat effective
Least effective

0 %   20 %   40 %   60 %   80 %   100 %

Please rank your preference/the convenience of each of the following times for your participation in professional development activities?

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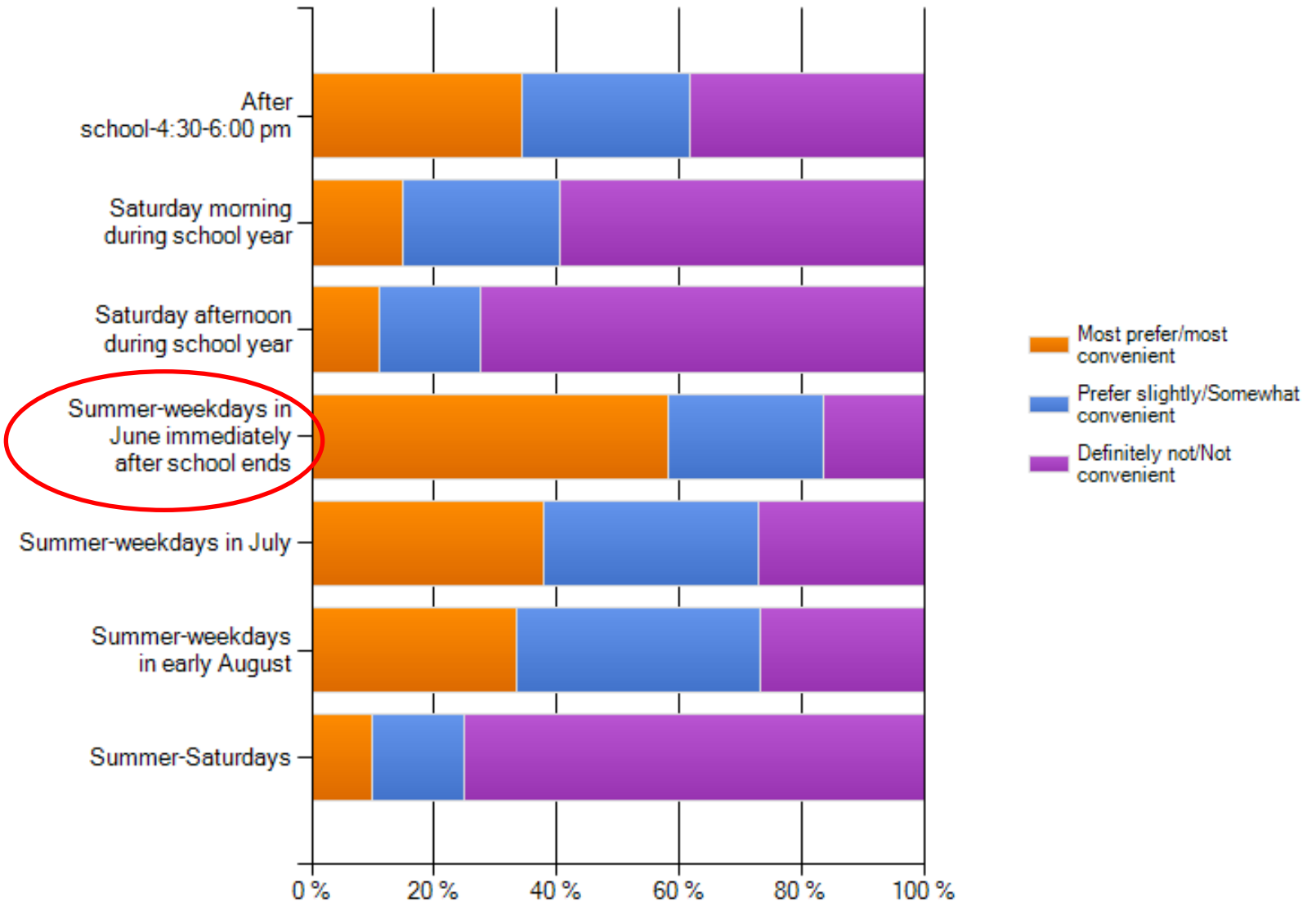
Recommendations

1. Continue to grow the computer science education network in Maryland.

2. Educate the broader community about the CS education crisis.

3. Increase the availability of high-quality CS courses for all Maryland high school students.

4. Provide effective professional development opportunities and develop certification programs to expand the number of highly qualified high school CS teachers.

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Discussion Questions

- Does our snapshot of HS CS education seem accurate and complete?

  - What do we still need to know?

- Do you agree with our recommendations for action?

  - Where should we be headed with regard to HS CS education as a state?

- What should our priorities be?

  - Through September 2013 (the term of the CE21-Maryland project)?

  - Beyond September 2013?