Our Vision: every school every student opportunity
Our Mission:

educate

advocate

celebrate
Topics

1. Q and A
2. Key Messages about CS
3. K-12 CS Framework
4. National Perspective
5. Curriculum and Policy Resources
6. Q and A
Questions?
Misconception 1:
The purpose of CS is to get a coding job

Computer Science is foundational
CS is foundational

**Contribution to total growth in science and engineering occupations, 2010-2020**

(Bureau of Labor Statistics)

Computer Occupations 62%

Architects, Surveyors, and Cartographers 4%

Mathematical Science Occupations 1%

Engineers 13%

Life Scientists 5%

Social Scientists and Related Workers 5%

Physical Scientists 3%

Drafters, Engineering Technicians, and Mapping Technicians 4%

**The value of a computer science education**

- $0.58M lifetime earnings of a high school graduate*
- $1.19M lifetime earnings of a college graduate*
- $1.67M lifetime earnings of a computer science major*

A computer science major can earn 40% more than the college average.

*Net present value today
CS is foundational
Misconception 2:
Computer science is coding

Computer Science is more than coding
CS is more than coding

Systems

Internet

Data

Algorithms

Impact

Programming
CS is more than coding
CS is more than coding
Video

K12 Computer Science Framework
K-12 CS Framework

Concepts & Practices

Guidance

• Ch. 7: Standards Development
• Ch. 8: Curriculum, Courses, Certification, Preservice, PD
• Ch. 9: Early Childhood
• Ch. 10: Research
Highlights

SAMPLE K-12 COMPUTER SCIENCE PATHWAYS

**Elementary School**
- Broad & Deep Exposure
  - Independent special (similar to Science, Music, Art, K to 5)
- Moderate Exposure
  - Integrated into the general classroom
- Basic Exposure
  - Integrated into the general classroom

**Middle School**
- Integrated into math, science, other subjects
  - Independent course at a particular grade level

**High School**
- Introductory course
  - AP Computer Science
  - Specialized courses
- Introductory course
  - Integrated into math, science, other subjects

[Diagram showing Venn diagram with CS, MATH, and SCIENCE]
Highlights

**FRAMEWORK:** KNOW, DO

**STANDARDS:** KNOW AND DO

**PRACTICE**
Recognizing and Defining Computational Problems

*Evaluate whether it is appropriate and feasible to solve a problem computationally.*

**CONCEPT**
Data and Analysis

*By the end of 5th grade...*

Different software tools used to access data may store the data differently. The type of data being stored and the level of detail represented by that data affect the storage requirements.

**STANDARD**
Data and Analysis (5th grade)

*Evaluate the appropriateness of different ways to store data computationally based on the type of data and level of detail.*
Who was involved?

• 14 states: AR, CA, GA, ID, IN, IA, MD, MA, NE, NV, NJ, NC, UT, WA. Districts: NYC, SF, Chicago
• 27 writers, 25 advisors
• Industry: Google, Amazon, Microsoft, Apple...
• Organizations: College Board, PLTW, ISTE
• CT: Jennifer Michalek, Chinma Uche, etc.
The National Scene
## Policies

<table>
<thead>
<tr>
<th>Policy</th>
<th>States</th>
<th>Connecticut?</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-12 Standards</td>
<td>7</td>
<td>No</td>
</tr>
<tr>
<td>Require HS to offer CS</td>
<td>4</td>
<td>Kinda</td>
</tr>
<tr>
<td>Funding</td>
<td>9</td>
<td>No</td>
</tr>
<tr>
<td>Certification</td>
<td>29</td>
<td>No</td>
</tr>
<tr>
<td>Allowing CS to count as core</td>
<td>32</td>
<td>unclear</td>
</tr>
<tr>
<td>Higher Ed Admissions</td>
<td>6</td>
<td>No</td>
</tr>
<tr>
<td>State Plan</td>
<td>2</td>
<td>Today!</td>
</tr>
</tbody>
</table>
Resources and Next Steps
Code.org’s K-12 Curriculum
Resources

• Curriculum Inventories
  – Code.org’s Third Party Resources
  – CSforAll.org
  – LeadCS.org

• Policy and Advocacy Resources
  – Making CS Fundamental: 9 Policy Ideas
  – CS and ESSA
  – Rethinking Perkins
  – Teacher Pathways (coming soon)
  – Advocacy stats, research, reports, presentations
Suggested Next Steps

Principles:
• Plan holistically
• Measurable (ex: A teacher in every ES, MS, HS)

Steps (in parallel)
• Allow CS to count
• Standards + certification
• Professional learning
• Funding
Questions?
ECEP & Connecticut’s Landscape Study

Renee Fall
Co-PI, ECEP
University of Massachusetts
Amherst
rfall@cs.umass.edu

Seth Freeman
ECEP CT Co-Lead
Professor, Comp Info Systems
Capital Community College
sfreeman@capitalcc.edu
Expanding Computing Education Pathways Alliance

• National Science Foundation funded
• “Broadening Participation in Computing” program: alliance
• Collaborative grants to UMass Amherst and Georgia Tech
• 2012-2017
STEM Careers are Computing Careers

Of the more than 9 million STEM jobs available in the next decade, half will require computing experience.

Source: Bureau of Labor Statistics
Who is part of this workforce?

The Diversity Challenge

Percentage of Computer Science Majors Who Were Women

- 1985: 37%
- 2009: 18%
- 2012: 18%

Source: Department of Education

Percentage of Today's Software Workforces

- Male: 80%
- Female: 20%
- Asian: 29%
- Hispanic: 5%
- Black: 4%

Source: Bureau of Labor Statistics
Broadening Participation in Computing (BPC)

Focus on groups traditionally under-represented in computing:

• Women
• persons with disabilities
• African Americans
• Hispanics
• Native Americans
• indigenous peoples

= 70% of the population
Why focus on these groups?

Without their participation, talents, and creativity, our Nation cannot meet its imperative for a globally competitive, computationally savvy workforce and we cannot hope to achieve the appropriate scientific, technological and economic innovations that will serve our highly diverse society.

http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503593
• Goal: to increase the number and diversity of students in the pipeline to computing and computing-intensive degrees by promoting state-level computer science education reform
  – Refine and integrate 2 state-based projects CAITE (Massachusetts) & Georgia Computes!
  – Interventions and practices in K-12 and higher ed.
  – Expand to other states & regions
17 ECEP States & U.S. Territories
Expanding Computing Education Pathways
ECEP provides its members with

• Community
  – Virtual meetings w/ topics & experts (monthly)
  – Annual meetings & summits
  – Listserv
  – Collaborative website w/ resources

• Services
  – Mini-grants (for landscape reports, summits, meetings, special projects with systemic impact)
  – Summer computing camp model, workshop & seed grants
  – Train-the-trainers to develop teacher PD leaders
  – Experts Bureau
  – NCWIT resources (materials for public awareness & promising practices)

• Interventions & models
  – Rise Up 4 CS – program to help students pass AP-CS A exam
  – Artbotics curriculum & workshops
  – Evaluation models
  – How to Change a State model
State Membership

• Requires leader(s) who will participate in ECEP
• Multi-stakeholder group to work with leaders
• Participation in meetings, share with other states
States work on . . .

• Developing strategic plans
• Educational policy – state level and/or districts
  – Graduation requirements
  – College admission requirements
  – Standards/frameworks
  – Curricula
  – Teacher credentialing
  – Teacher pre-service training
  – Teacher professional development
• Raising public awareness
• Raising resources, partners
ECEP’s 4-step model

HOW TO CHANGE A STATE (1.0)

1. Find your leaders and change agents
2. Understand your state’s computing education landscape and identify key issues/policies for change
3. Gather and organize your allies
4. Get initial funding to support change
Connecticut at work in ECEP
ECEP – CT Chapter

• CT joined ECEP as a partnering state in 2015 through CSDE CS Advisory Committee

• Current State Leads and Co-PI's for Landscape Study

<table>
<thead>
<tr>
<th>Seth Freeman</th>
<th>Dr. Chinma Uche</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor, Comp Info</td>
<td>President, CTCSTA</td>
</tr>
<tr>
<td>Systems</td>
<td>Math &amp; CS Teacher</td>
</tr>
<tr>
<td>Capital Community College</td>
<td>CREC Academy of Aerospace and Engineering HS</td>
</tr>
<tr>
<td><a href="mailto:sfreeman@capitalcc.edu">sfreeman@capitalcc.edu</a></td>
<td><a href="mailto:cuche@crec.org">cuche@crec.org</a></td>
</tr>
</tbody>
</table>

• Additional Co-PI

<table>
<thead>
<tr>
<th>Jackie Corricelli</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Science Teacher</td>
</tr>
<tr>
<td>Conard High School</td>
</tr>
<tr>
<td><a href="mailto:jcorricelli@whps.org">jcorricelli@whps.org</a></td>
</tr>
</tbody>
</table>
Landscape Study – CS for CT

CS for CT – Examining the Landscape of Computer Science in Connecticut

• Funded by $25K mini-grant from ECEP
• Leverages prior statewide studies conducted in MD and SC

Goals of the Study:
• Assess the state of computer science education across K-16
• Identify computer science educational leaders and organizations across the state
• Produce baseline and benchmark data to inform statewide policy and form a basis for future action and research
Landscape Study - Questions

• To assess the state of CS education in K-16, study seeks to answer:
  – Who are the leading individuals and organizations promoting CS education?
  – What CS curricular initiatives and educational opportunities are underway in K-12 both in-school and out of school?
  – When are these initiatives offered?
  – Where are these initiatives/programs underway across the state?
  – To whom are these services being provided?
Landscape Study – Focus on Equity

- The focus of this study is to identify where and to what extent CS education has penetrated the state
- Gather concrete data on where CS is being taught and to whom, and where it is not
- Ensure future advocacy, resources, professional development opportunities, etc., are targeted towards students and schools in need
- Aligns with *broadening participation* goals of ECEP
Landscape Study – 4 Components

1. **K-12 School-Based Survey**
   – Short (10-min) survey targeted to K-12 CS teachers, administrators and guidance counselors

2. **College Board Data**
   – Secondary schools offering AP CS A and AP CS Principles

3. **Non-Profits/External Vendors**
   – Data on programs are being offered to whom and where, how many participating students

4. **Undergraduate Data**
   – Demographics of students majoring in CS across the state
K-12 Survey

• Target Audience (K-12), Public and Private Schools
  – Administrators, Guidance Counselors, CS Teachers

• Targeted questions based on grade level
  – Elementary
  – Middle
  – Secondary
K-12 Survey - Background

- **Background Questions**
  - Is computer science offered?
    - If not Why? What are factors preventing your school?
  - About how many teachers teach CS?
  - About how many students are enrolled in CS courses?
  - What percentage of students enrolled in CS courses are female/members of an ethnic minority?
K-12 Survey - Elementary and Middle

- **Survey Questions - Elementary & Middle School**
  - *When* is computer science taught? *(elementary only)*
  - What *topics* (problem-solving, robotics, programming)?
  - What *curriculum resources* are used?
  - What *partnerships* exist?
  - Does your school participate in the Hour of Code?
  - What *challenges* exist to teaching CS?
  - What *prog languages* are used? *(middle only)*
K-12 Survey – Secondary Content

• Survey Questions - Secondary School Content
  – What content is covered in your computer science courses?
  – What programming languages/software tools are used?
  – Do you teach Exploring Computer Science (ECS)?
  – What partnerships exist?
  – Does your school participate in the Hour of Code?
K-12 Survey – Secondary AP Coursework

- **Survey Questions - Secondary School AP Coursework**
  - Which *AP Computer Science Course(s)* are offered?
  - How many students take AP CS courses?
  - What % of students enrolled in AP CS courses are female/minority?
  - Is the % of female/minority students in AP CS courses lower, representative, or higher than the overall population?
K-12 Survey – Secondary Challenges

• Survey Questions - Secondary School Challenges

• Challenges related to Student Participation
  – Scheduling Issues
  – Lack of interest
  – CS is perceived as too difficult/male-dominated

• Challenges related to Teaching CS
  – Lack of resources/teacher knowledge
  – Lack of parental knowledge/encouragement
  – Lack of administrative support/interest
  – Inability to attract minority, female students
K-12 Survey In-Progress

- K-12 Survey currently underway, distributed via email
- Identifying CS teachers through:
  - CTCSTA
  - SDE course codes
  - Curriculum Providers (Code.org, MobileCSP)

- Link to the Survey
  - [https://goo.gl/forms/nCM3HqeOQpWBow5x1](https://goo.gl/forms/nCM3HqeOQpWBow5x1)

Participating Schools through 2/1/17
Landscape Study – CS for CT

Preliminary Data
Advanced Placement Course Offerings in CS

CT Secondary Schools

- Teach AP CSA: 30%
- Don't Teach AP CSA: 70%

- Teach AP CS Principles: 14%
- Don't Teach AP CS Principles: 86%

Source: School Websites/Course Catalogs, June 2016
AP Exam Participation by Year/Subject Area

CT Secondary Schools

AP CS Exams 2014 – 2016

2014: 642  
2015: 648  
2016: 939

AP Exams in 2016

- Calculus: 4489
- Biology: 3967
- Physics: 2766
- Computer Science: 939

Source: College Board
AP Exam Participation/Performance by Ethnicity

CT Students in 2016

# Students Taking AP CS Exam

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th># of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>584</td>
</tr>
<tr>
<td>Asian</td>
<td>197</td>
</tr>
<tr>
<td>Latino</td>
<td>76</td>
</tr>
<tr>
<td>Black</td>
<td>31</td>
</tr>
</tbody>
</table>

AP CS Exam Pass Rate

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Pass Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>70%</td>
</tr>
<tr>
<td>Asian</td>
<td>72%</td>
</tr>
<tr>
<td>Latino</td>
<td>57%</td>
</tr>
<tr>
<td>Black</td>
<td>52%</td>
</tr>
</tbody>
</table>

Passing assumes score of 3 or higher

Source: College Board
AP Exam Participation/Performance by Gender

CT Students in 2016

# Students Taking AP CS Exam

- Male: 723
- Female: 216

AP CS Exam Pass Rate

- Male: 70%
- Female: 64%

Passing assumes score of 3 or higher

Source: College Board

Source: National Center for Education Statistics

Source: National Center for Education Statistics
## Total Degree Completions by State 2002 - 2015

<table>
<thead>
<tr>
<th>State</th>
<th># CS &amp; CIS graduates</th>
<th># Female CS &amp; CIS graduates</th>
<th>% Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH</td>
<td>2,371</td>
<td>407</td>
<td>17%</td>
</tr>
<tr>
<td>CT</td>
<td>2,541</td>
<td>340</td>
<td>13%</td>
</tr>
<tr>
<td>PR</td>
<td>3,848</td>
<td>842</td>
<td>22%</td>
</tr>
<tr>
<td>SC</td>
<td>4,070</td>
<td>861</td>
<td>21%</td>
</tr>
<tr>
<td>MD</td>
<td>11,381</td>
<td>2,112</td>
<td>19%</td>
</tr>
<tr>
<td>MA</td>
<td>14,183</td>
<td>2,582</td>
<td>18%</td>
</tr>
</tbody>
</table>

**Source:** ECEP, National Center for Education Statistics
Landscape Study – Next Steps

• Complete **K-12 Survey** by the end of April 2017
• Collect **Higher Ed** data by end of April 2017
• Conduct **Non-Profit/Vendor** interviews by end of May 2017
• Compile Final Draft by June 2017, share with SDE Advisory Committee
• Distribute final report to CSDE, CTCSTA, ECEP and other stakeholders
Computer Science for All
Connecticut Coalition

CS4CT

Norman K. Sondheimer, Ph.D.
College of Information and Computer Science
University of Massachusetts Amherst
Sondheimer@cs.umass.edu
860-539-9335
K-12 Computer Science Education’s Long and Rich History in Connecticut

Local Organizations
- Connecticut Computer Science Teachers Association
- Random Hacks of Kindness, Jr.
- Girls Who Code

Courses
- Independently Developed Computer Science Course
- AP Computer Science
- Mobile CS Principles

External Entities
- Code.Org
- ECEP Alliance
- White House Commitment to “Computer Science for All”

CS4CT: Computer Science for All
Connecticut Coalition
Advocating for K-12 CS Education in Connecticut

CSDE
Department of Economic and Community Development
Connecticut, its Students and its Businesses need K-12 Computer Science

Connecticut: 6,367 open computing jobs

- 271 CS graduates in 2014; only 16% female [https://code.org/advocacy/state-facts/CT.pdf]
- **Beyond Purely Computer Occupations:** UTC identifies software engineering as a critical skill
- **Beyond College:** Computer Science largest shortfall in vocational-technical occupations [CTDOL “Economic Outlook and Prospects for Vocational-Technical Related Occupations”]

**Computing Occupations**
**The #1 Source of New Wages in America** (Code.Org)

[Image: Connecticut, Department of Economic and Community Development]
Heroic Effort to Overcome the Shortfalls

• Cigna’s IT Department identifies talented HS students, offers internships, and tracks through college just to be competitive with their job offers [https://www.cigna.com/careers/early-career-hiring/leadership-development/tecdp/internships](https://www.cigna.com/careers/early-career-hiring/leadership-development/tecdp/internships)

• Technology Talent Advisory Committee formed with a focus on attracting Computer Science talent to Connecticut PA 16-3, MSS, §§ 10(b)(6) & 23

• Dependence on foreign workers: “Between 2010 and 2012, there were 1,358 requests for H1-B visas for computer professionals in metro Hartford or about 7 percent of the industry”. Robert Clifford, Federal Reserve Bank of Boston, 2014

Independent of Purely Computational Professions
Computational Thinking is an Essential Skill for Today’s Employees
CT K-12 CS Pipeline

• Sample: AP CS A
  – Only 69 CT schools offered the course
  – 2016 CT AP CS A Exams: 939
  – 2016 AP Stat Exams: 3781

• Bureau of Labor Statistics on 10-year job outlook
  – Computer Occupations: 1,080,800
  – Statisticians and Actuaries: 27,100

New CT Grad Req.“(i) four credits in mathematics, including algebra I, geometry and algebra II, or probability and statistics;”
Goal: Ubiquitous K-12 CS Education

Who needs to act to remove barriers:

• The Connecticut General Assembly needs to allow computer science to count for a core graduation requirement.

• The State Department of Education needs to have rigorous computer science standards available across K-12.

• The State Department of Education needs certification pathways for computer science teachers.

• Connecticut's Institutes of Higher Education need to offer a program in computer science for preservice teachers.

• The Computer Science Education Community needs to raise funds for K-12 CS professional development and course support.

We, the Advocates for K-12 Computer Science Education, must reach out to local Boards of Education, Administrators and Teachers.
CS4CT Summit: Launching the Connecticut Computer Science Revolution

- First major statewide gathering
  - Bringing together committed and potential educators and administrators across CT
  - Sharing proven classroom strategies and techniques
  - Sharing effective administrative models K-12
- Goal: Get every district to the Summit
- Proposed Timeframe: October, 2017
- Organizer: CTCSTA
- General Chair: Seth Freeman SFreeman@ccc.commnet.edu, 860-680-9995

Requirement: Official Support and Funding from the Advocates for K-12 CS Education
Strategic Planning

Jennifer Michalek
CSDE Education Consultant

Jennifer.Michalek@ct.gov
We’ll start by reviewing the architecture of the plan

- **Aspiration:**
  - The organization’s overarching ambition and moral imperative. It is the organization’s answer to the question: “What are we trying to do?”

- **Goal:**
  - A specific, measurable, ambitious and realistic, time-bound outcome that will move the organization closer to its aspiration when achieved. It should have clear **metrics, targets, and year** in which it will be achieved.

- **Strategies:**
  - The projects/programs/initiatives that will enable the organization to achieve its goals
Organize the architecture by clarifying what lives at the goal versus strategy level.

A **goal** answers the broad question, what are we trying to achieve? It is often measured by specific metrics or measures of success.

A **strategy** is a coherent set of activities that is designed to maximize impact on your goal metrics.

An **activity** is a discrete action with a defined start and end date.
Goals have been identified, but goal level metrics need to be identified

<table>
<thead>
<tr>
<th>Goal</th>
<th>Computer Science Education K-12</th>
<th>Quality teachers of Computer Science</th>
<th>Computing workforce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal-level metrics</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Once the goals and metrics are completed, it’s time to think about the prioritized strategies we will use to get there.

Strategies are:

- Deliberate and coordinated activities
- Manageable in number
- Designed to help you achieve your goal
- Defined by changing the way your state does business by adding, improving, or removing an existing activity.
Prioritizing strategies using a 2x2

<table>
<thead>
<tr>
<th>Potential impact</th>
<th>Degree of Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>High</td>
</tr>
</tbody>
</table>

Ideally, having impact would be easy

Small strands of work may not warrant their own strategy

But you may need tougher strategies in the mix to achieve your goal

And you may decide some strategies are not worth the required effort
Today we will identify metrics and finalize strategies and next steps will include developing a profile for each strategy.

**Template: Strategy Profile**

<table>
<thead>
<tr>
<th>Name of strategy</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Leadership:</strong> Who is the single person responsible for making sure implementation happens?</td>
<td></td>
</tr>
<tr>
<td><strong>Description:</strong> Describe the strategy in a sentence or two</td>
<td></td>
</tr>
<tr>
<td><strong>Definition of success:</strong> What would success look like for this specific strategy, and by when?</td>
<td></td>
</tr>
<tr>
<td><strong>Activities:</strong> What are the largest component pieces of work within this strategy (no more than five)?</td>
<td></td>
</tr>
</tbody>
</table>