Making Computer-Science Education Universal for All Students

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DAY ONE PROJECT

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Summary

The next administration should establish a national initiative to accelerate the implementation of rigorous computer science (CS) education for preschool through 12th grade (P–12) students in the United States. The initiative should include investments in evidence-based education pathways that incorporate computational thinking, computer programming (coding), cybersecurity, data science, social impacts of computing, and ethics. CS curricula should prepare students for future careers working with technologies such as artificial intelligence (AI), machine learning, virtual/augmented reality, autonomous vehicles, automation, cybersecurity, and other emerging and future technologies. This initiative will enhance the United States' global competitiveness, economic growth, and technological innovation, and will better prepare the nation to address pressing challenges such as healthcare, social mobility, climate change, and national security in an increasingly technology-driven and innovation-based world.

1. Background

The United States is facing a talent crisis in computing and information technology (IT). There are currently tens of thousands of open positions—in both the public and private sectors—related to information technology (IT), computing, and cybersecurity,[1,2] but not enough workers with the skills to fill them. The (ISC)², a cybersecurity professional organization, estimates that there is currently a shortage of 500,000 cybersecurity workers in the United States and a shortage of almost 3 million globally. Such gaps are likely to increase. The U.S. Department of Labor projects that there will be 3.5 million computing-related jobs in the United States by 2026. Yet our country's current educational system will only prepare enough trained CS professionals to meet 19% of the demand.[3] While 67% of projected STEM jobs are related to computing, only 10% of STEM degrees earned by U.S. students are in computing fields.[4] In 2015, international students earned the majority of graduate degrees in mathematics and CS at U.S. universities.[5]

Preparing students in CS and related subjects is vital for the future of the United States workforce and economy. CS has applications in virtually all industries, including transportation, healthcare, education, entertainment, manufacturing, and financial services. There is also rapidly increasing demand for CS skills in growing areas such as

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[1] U.S. Office of Personnel Management, "USAJOBS", n.d., https://www.usajobs.gov/.
[2] Indeed.com. (2020). "Information Technology Jobs", query results obtained January 5, 2020, https://www.indeed.com/jobs?q=information+technology&l=.
[3] National Center for Women & Information Technology (NCWIT), "By the Numbers", May 9, 2019, https://www.ncwit.org/resources/numbers.
[4] U.S. Bureau of Labor Statistics, "Employment by detailed occupation", September 4, 2019, https://www.bls.gov/emp/tables/emp-by-detailed-occupation.htm.
[5] National Science Board, *2018 Science and Engineering Indicators*, National Science Foundation (2018).

cybersecurity, advanced defense technologies, and machine learning and AI. As such, recent years have seen parents, teachers, states, districts, and the private sector lead a growing movement to expand P–12 CS education. The Obama administration responded in 2016 by launching Computer Science for All (CSforAll), a national effort to increase student access to CS both in and out of school. CSforAll included investment of more than $135 million of existing federal funds into CS education, as well as a fiscal year (FY) 2017 budget request to Congress for more than $4 billion for states and school districts to build on federal investments at the sub-national level.[6]

Yet while CS education enjoys broad bipartisan support and aligns with national goals for economic growth and workforce development, federal leadership, investment, and accountability on this front are still insufficient. Congress has not appropriated adequate funding to support development and implementation of rigorous and equitable CS education for P–12 students nationwide. As a result, access to quality CS education is often limited to affluent schools and students. This places low-income, minority, and rural communities at risk of being left behind. It also means that we as a nation are realizing neither the full potential of all students in the U.S. talent pool nor the global competitive advantage that the diversity of the U.S. population can contribute to technology and innovation. The next administration should address this issue by championing an ambitious, evidence-based, comprehensive, and inclusive CS education initiative. Such an initiative would rapidly and significantly upskill and grow the U.S. technical workforce, increase equity of opportunity and career readiness for millions of youth and their communities, and contribute to a computationally literate and cybersecurity-aware populace.

2. Challenge

There has been a sustained national effort over the last four decades to increase access to and participation in STEM disciplines. Yet opportunities for sequenced, rigorous CS education are limited, and compulsory CS classes remain rare in U.S. formal education. In 2019, just 18% of the Department of Education (ED)'s discretionary and research grants in STEM were awarded to CS-focused programs.[7] While this represents a non-trivial dollar amount ($100 million out of $540 million total), it is important to note that ED has only recently begun to invest in P–12 CS education specifically. Compared to the decades of investments that have focused on developing P–12 pedagogy for other STEM disciplines like math, biology, physics and chemistry, investments in CS education are nascent at best.

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[6] Megan Smith, "Computer Science For All", The White House, January 30, 2016, https://obamawhitehouse.archives.gov/blog/2016/01/30/computer-science-all.

[7] U.S. Department of Education, "Science, Technology, Engineering, and Math, including Computer Science", n.d., https://www.ed.gov/STEM.

Moreover, CS has historically been omitted from ED's data-collection efforts, list of core STEM subjects, state educational standards, and teacher certification pathways. This inevitably pushes CS to the bottom of the priority list, especially for resource-constrained schools and districts. Less than half of U.S. high schools offered any CS classes in 2019.[8] Only about 5,000 U.S. high schools offered Advanced Placement (AP) CS, compared to more than 14,000 schools offering AP Calculus and more than 11,500 offering AP Biology.[9] And even in schools that offer CS, participation and success varies widely by demographic group. Of the 166,000 students who took an AP CS exam during the 2018–2019 school year, only 29% were girls and only 22% were African-American or Hispanic.[10] While AP CS scores for White and Asian students averaged 3.20 and 3.50 (out of 5.0) respectively, African American students averaged scores of 2.13, Hispanic students 2.45, and Native American/Alaskan Native students 2.38.[11]

These data are especially troubling given that U.S. public schools have shifted to a majority minority (50.3% in 2019[12]) and majority low-income (52.1% in 2016)[13] student population, and women earn 57% of bachelor's degrees in the U.S.[14] . Despite these demographic shifts in the talent pool, and affirmation by multiple research studies that diverse teams improve innovation, problem solving, and productivity,[15–17] the U.S. tech workforce has remained majority White and Asian, and overwhelmingly male.[18] This failure to include all students and capitalize on the competitive advantage that the unique diversity of the U.S. population adversely affects our nation as a whole. Affluent

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[8] Code.org Advocacy Coalition (CAC), Computer Science Teachers Association (CSTA), and Expanding Computing Education Pathways Alliance (ECEP), *2019 State of Computer Science Education: Equity and Diversity*, 2019.
[9] The College Board, "AP Program Participation and Performance Data 2019", n.d., https://research.collegeboard.org/programs/ap/data/participation/ap-2019.
[10] The College Board, "Program Summary Report", 2019, https://secure-media.collegeboard.org/digitalServices/pdf/research/2019/Program-Summary-Report-2019.pdf.
[11] Scott Jaschik, "More AP Success; Racial Gaps Remain", Inside Higher Ed, February 11, 2019, https://www.insidehighered.com/admissions/article/2019/02/11/more-students-earn-3-advanced-placement-exams-racial-gaps-remain.
[12] National Center for Education Statistics (NCES), "Indicator 6: Elementary and Secondary Enrollment", Institute of Education Sciences (IES), U.S. Department of Education (ED), February 2019, https://nces.ed.gov/programs/raceindicators/indicator_rbb.asp.
[13] NCES, "Table 204.10—Number and percentage of public school students eligible for free or reduced-price lunch, by state: Selected years, 2000-01 through 2015-16", *Digest of Education Statistics,* IES, ED, 2017, https://nces.ed.gov/programs/digest/d17/tables/dt17_204.10.asp.
[14] NCES, "Postsecondary Institutions and Cost of Attendance in 2017-18; Degrees and Other Awards Conferred: 2016-17; and 12-Month Enrollment: 2016-17: First Look (Provisional Data)", IES, ED, 2018, https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2018060REV.
[15] Scott Page, *The Difference: How the power of diversity helps create better groups, firms, schools, and societies*, New Jersey: Princeton University Press (2007).
[16] NCWIT, *What is the Impact of Gender Diversity on Technology Business Performance? Research Summary*, (2014).
[17] Vivian Hunt, Dennis Layton, and Sarah Prince. "Why Diversity Matters", McKinsey & Company, n.d., https://www.mckinsey.com/business-functions/organization/our-insights/why-diversity-matters.
[18] U.S. Equal Opportunity Employment Commission, "2015 Job Patterns for Minorities and Women in Private Industry (EEO-1)", 2015, https://www1.eeoc.gov/eeoc/statistics/employment/jobpat-eeo1/2015/index.cfm#select_label.

communities are disproportionately able to build robust tech-based local ecosystems—while low-income populations, women, minorities, people with disabilities, and those living in rural areas are excluded from opportunities in technology and innovation and remain sidelined in the global, technology-driven economy. There is a clear need for new approaches to CS education that better serve all populations.

One of the most significant barriers to universal access to P–12 CS education is a lack of qualified CS teachers, especially in rural and tribal schools.[19] To date, most efforts to address the CS teacher shortage have focused on enlisting in-service teachers (often teachers of other STEM subjects like math or science) by providing professional development in CS curricula. This approach is incomplete. Addressing the CS teacher shortage by recruiting existing teachers creates new shortages in other high-need subjects, shortages that are exacerbated by overall attrition of teachers to school administration and to other fields. A comprehensive approach must include preparing a new CS teachers "from the ground up". Yet the number of new CS teachers graduating from teacher-education programs is woefully low, largely due to the fact that teacher certifications in CS remain novel and preparation programs small. As of 2019, 38 states offered a state teacher certification in CS but just 19 states offer state-approved preservice teacher preparation at their institutions of higher education.[20] From 2015–2016, only 36 pre-service teachers in the entire United States were prepared to teach CS. More than 11,000 pre-service teachers were prepared to teach mathematics and science in the same year.[21]

3. Opportunity

Since the Obama administration's launch of CSforAll in 2016, the community-led movement for P–12 CS education movement has made significant progress in raising awareness of the need for CS education, establishing educational standards for CS, developing CS courses and curricula, and implementing CS education policies at the state level.[22] The number of states that count CS towards high-school graduation has grown from 28 to 48 (plus the District of Columbia), and 34 states have adopted CS standards.

The next administration can and should build on this work. The time is ripe for a "second wave" of CS education—one that expands CS education beyond the circle of early

[19] Gallup, "Pioneering Results in The Blueprint Of U.S. K–12 Computer Science Education", n.d., http://csedu.gallup.com/home.aspx.
[20] CAC, CSTA, and ECEP, *2019 State Of Computer Science Education.*
[21] CAC and CSTA, *2018 State of Computer Science Education: Policy and Implementation*, (2018).
[22] Education Development Center, *State of the States Landscape Report: State-Level Policies Supporting Equitable K–12 Computer Science Education*, (March 2017).

adopters and entrenches CS education as a fundamental component of P–12 education nationwide. Making rigorous, inclusive, universal, and comprehensive P–12 CS education a top priority in the next administration will prepare Americans to succeed in an increasingly automated and digital economy, help build a technology-literate society, increase economic mobility and social equity, and contribute to the talent pool needed to support U.S. cybersecurity and national defense.

Achieving these goals will require the next administration to provide visibility, funding, and resources for CS education. Specifically, the next administration should focus on expanding formal and informal CS learning pathways for all students; training and supporting a robust pool of skilled and highly valued CS educators; and emphasizing ongoing development innovative, evidence-based pedagogy for P–12 CS education. The result will be a world where we don't need population-specific outreach programs to expand opportunities in CS…because CS education and achievement will be an expected norm for *all* students, from all walks of life.

4. Proposed action

A national P–12 CS education initiative should include four key components: (1) White House leadership and coordination, (2) federal budget commitments, (3) increased agency participation and use of diverse policy tools, and (4) mobilization of non-federal actors to undertake complementary actions. The following section expands on each.

4.1 White House leadership and coordination

The next administration should work through the White House Office of Science and Technology Policy (OSTP) to oversee and strengthen federal support for universal P–12 CS education in the United States. An OSTP-led Interagency Working Group (IWG) should be established to coordinate relevant federal activities, develop a national strategic action plan, and convene non-federal stakeholders who can contribute through public-private partnerships. Agencies represented on the IWG would help identify offices and programs essential to the success of a national P–12 CS education initiative, and would ensure that federal activities are complementary rather than redundant.

4.2 Federal budget commitments

Federal spending on CS education to date has largely been limited to CS as a component of STEM. This includes research funding through the National Science Foundation (NSF) and ED's Education Innovation and Research (EIR) grant program; discretionary grants from ED that include CS within the STEM designation; and investment by the Department of Defense (DOD) in military-impacted schools through the National Math and Science Initiative (NMSI) College Readiness Program for Military

Families, DOD Education Activity (DODEA) schools, and the recently formed Defense STEM Education Consortium (DSEC).

But it has become apparent that CS often suffers when lumped in with the other STEM disciplines. Because CS is newer than many STEM disciplines, CS proposals often fail to qualify for funding from federal or state STEM programs. The rapidly evolving state of CS means that many CS programs—and the technologies they teach—are too new to qualify for strongly evidence-based programs such as ED's What Works Clearinghouse. Additionally, there is a shortage of professionals with CS backgrounds working in federal funding agencies or serving on funding committees. Further, schools and districts without the resources to start a CS program from scratch are often at a disadvantage in applying for awards from funders that require applicants to meet high baseline requirements (*e.g.*, specific teacher qualifications and certifications, established program history, *etc.*).

To be successful and equitable, a national P–12 CS education initiative must include dedicated funding for CS education distinct from STEM education. Achieving meaningful change would require Congress to invest approximately $4 billion over four years, including funding for:

- **P–12 CS education efforts at the sub-national level.** $2 billion in grants directly to states and $400 million in funding directly to school districts, with priority placed on districts serving youth underrepresented in technology fields.
- **Building the pre-service CS education infrastructure.** $350 million to miscellaneous efforts on this front.
- **Evidence-based approaches to P–12 CS education.** $500 million to the National Science Foundation for relevant research and development projects, with awards emphasizing the importance of pedagogy that keeps pace with new and emerging technologies.
- Assorted federal activities. $750 million to support assorted relevant federal activities such as those described in Section 6.

4.3 Increased agency participation

The two agencies most important to a national P–12 CS education initiative are ED and NSF. However, many other federal agencies, offices, and programs could contribute to such an initiative as well. The next administration should make full use of the federal authorities and policy tools at its disposal. Federal efforts that could be leveraged to support CS education nationwide include:

- Programs that serve and/or impact youth and educators, *e.g.*:

  - The Corporation for National and Community Service (CNCS)'s educator programs.
  - Community education programs in public housing, funded by the U.S. Department of Housing and Urban Development (HUD).
  - The Department of Health and Human Services (HHS)'s Head Start program.
  - Youth programs funded by the U.S. Department of Agriculture (USDA)'s Extension Services, as well as USDA-affiliated youth programs like 4-H.

- A suite of DOD activities, including:
  - DOD programs for children of military personnel.
  - Youth-serving programs like the Junior Reserve Officers' Training Corps (JROTC), Youth Challenge, and STARBASE.
  - Assorted DOD investments in STEM education and outreach.

- The U.S. Department of Labor (DOL)'s youth employment programs (*e.g.*, Job Corps).
- The U.S. Patent and Trade Office (USPTO)'s teacher-education programs.
- STEM outreach supported by the Institute of Museum and Library Sciences (IMLS) and the Smithsonian Institute.
- The GENCyber program, supported by NSF and the National Security Agency (NSA).
- Assorted activities by federal agencies with a science and technology (S&T) focus and/or a significant technical workforce (*e.g.*, the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Department of Energy (DOE), the Department of Homeland Security (DHS), and intelligence agencies such as the NSA, the Federal Bureau of Investigation (FBI), and the Central Intelligence Agency (CIA)).

4.4 Mobilization of non-federal actors

Engaging non-federal actors is critical to a successful national P–12 CS education initiative. The White House and participating agencies should convene and collaborate with non-federal actors to amplify the impact of such an initiative through public-private partnerships, collaborative campaigns, and co-investments. Key community champions include:

- **Nonprofit organizations** like the Association for Computing Machinery's Special Interest Group on Computer Science Education (ACM SIGCSE), the Afterschool Alliance, CSforALL, Code.org, the Computer Science Teachers Association (CSTA), CS for All Teachers, Girls Who Code, the International Society for Technology in Education (ISTE), National Center for Women & Information

Technology (NCWIT), the National Girls Collaborative Project (NGCP), the College Board, the Computing Research Association (CRA), and the Institute of Electrical and Electronics Engineers (IEEE).

- **Industry partners** like Amazon, Apple, Google, Microsoft, Salesforce, Intel, Raytheon and Oracle, among others.
- **Post-secondary institutions** focusing on both pre-service education and CS education research.
- **Philanthropic organizations** like the Siegel Family Endowment, Pivotal Ventures, the Bill & Melinda Gates Foundation, the Moore Foundation, Schmidt Futures, the Infosys Foundation, and the CS Mott Foundation.

5. Precedents

A national P–12 CS education initiative would expand on the Obama administration's comprehensive CS4All initiative launched in 2016, and would also extend efforts by the Trump Administration to direct ED funding towards STEM and CS. Such an initiative would align with the National Science & Technology Council (NSTC)'s STEM Strategic Plan[23] of 2018, President Trump's 2019 Executive Order on Maintaining American Leadership in Artificial Intelligence,[24] and DOD's science and technology priority areas.[25] Such an initiative also complements established efforts to improve the efficiency of the federal government through technology, efforts such as the Presidential Innovation Fellows and the U.S. Digital Service.

6. Implementation

This section outlines recommended federal actions that should be taken under the next administration to achieve rigorous, inclusive, universal, and comprehensive P–12 CS education in the United States.

6.1 The White House

The next president should sign an executive order launching a national P–12 CS education initiative led by OSTP. OSTP should establish an IWG comprised of federal agency representatives to oversee and coordinate this initiative, including by (1) convening non-federal stakeholders who can contribute through public-private partnerships and (2) developing a strategic national action plan that includes metrics to

[23] Committee on Stem Education, *Charting a Course for Success: America's Strategy for STEM Education*, National Science & Technology Council (December 2018).
[24] "Executive Order 13859 of February 11, 2019, Maintaining American Leadership in Artificial Intelligence", *Code of Federal Regulations*, title 3 (2019): 3967–3972, https://www.govinfo.gov/content/pkg/FR-2019-02-14/pdf/2019-02544.pdf.
[25] Office of the Under Secretary of Defense for Research and Engineering, "Modernization Priorities", U.S. Department of Defense, n.d., https://www.cto.mil/modernization-priorities/.

monitor the initiative's success. The IWG should report regularly to the Executive Office of the President on the initiative's progress.

6.2 Department of Education

The U.S. Department of Education (ED) should:

- Issue a "Dear Colleague" letter affirming that CS is a critical, under-resourced STEM skill that should be prioritized in state funding requests.
- Clarify the importance of CS throughout ED communications, rules, and resources. This includes actively raising awareness of funding opportunities for states, districts, and other actors to implement CS programs.
- Using existing data-collection tools such as the Civil Rights Data Collection survey, investigate and report on the availability of P–12 CS across the United States. ED should also conduct a new study of high-school transcripts study to assess how many students are taking CS courses outside of AP exams.
- Include a question in Title 2 reporting to indicate what programs of study in teacher-preparation programs include CS coursework, and create a special report summarizing the findings.
- Build a pipeline of qualified CS teachers by:
    - Designating CS as a federally recognized teacher-shortage area,[26] thereby allowing teachers certified to teach CS to take advantage of federal and state programs for tuition reimbursement and other benefits.
    - Amending or implementing policies to achieve wider recognition of CS as a high-need area for teachers.
    - Providing incentives for teachers to seek preparation and certification in CS.
    - Developing fast-track pathways to CS teacher certification for ex-military personnel and retiring technical professionals.
- Allocate dedicated funds for the implementation of CS by states and districts, with priority for rural and low-income communities.
- Fund pre-service centers of excellence for CS education at colleges of education to ensure sufficient faculty to prepare pre-service teachers in CS.
- Allocate dedicated funds for and otherwise incentivize CS education in extracurricular programming (*e.g.*, the 21st Century Community Learning Centers program).

[26] U.S. Department of Education, "Teacher Shortage Areas", n.d., https://tsa.ed.gov/.

6.3 National Science Foundation

The National Science Foundation (NSF) should:

- Dedicate funding to the research and development of evidence-based P–12 CS education practices, tools, and curricula.
- Support investigation of rigorous CS education approaches in varying contexts such as in rural and low-income communities, among English language learners, and among students with disabilities and learning differences.
- Support projects that contribute to the integration and alignment of CS and related subjects (*e.g.*, data science, cybersecurity, machine learning, artificial intelligence, artificial/virtual reality, gaming).
- Invest in improved pre-service CS preparation within schools of education.
- Provide scholarships for graduate students in P–12 CS education research.

6.4 Department of Defense

The Department of Defense (DOD) should:

- Prioritize CS education within its multiple STEM outreach programs.
- Prioritize evidence-based CS education (including teacher preparation) within existing programs that serve P–12 students, including the DODEA schools and other schools serving children of military personnel.
- Incorporate CS and cybersecurity education into JROTC program requirements. Support establishment of rigorous CS education programs within JROTC high schools (3,400 schools serving 500,000 students).
- Incorporate CS and cybersecurity education into other DOD youth programs such as STARBASE, Youth Challenge, and branch-led STEM initiatives.

6.5 Department of Labor

The Department of Labor (DOL) should:

- Leverage its Job Corps program and associated 125 training centers to provide job-ready preparation in computer programming and coding for Job Corps-eligible students. This may include:
    - Providing professional development in CS and programming for Job Corps Information Technology (IT) instructors.
    - Adding a computer programming module to the existing career training program for Job Corps IT instructors.
    - Partnering with existing, proven providers of coding "boot camps" to offer intensive training and career-preparation tracks for Job Corps students in software engineering.

- Launch an information campaign through the federal One-Stop employment centers to share up-to-date information on CS-related career preparation and opportunities with communities.
- Modernize the O'NET career exploration database with more accurate descriptions of computing and technology careers. Implement a process to update the database more frequently for fast-moving technology industries.

6.6 Other agencies

Many other agencies can contribute to a national P–12 CS education initiative. For instance:

- The Federal Communications Commission (FCC) should accelerate efforts—including through industry partnerships—to provide access to broadband internet for all U.S. communities and underserved populations, with a focus on rural and tribal communities and schools.
- CNCS should provide AmeriCorps service grants for teachers and educators—including those working in extracurricular programs—who pursue CS professional development and bring CS education to underserved schools and communities.
- HUD should prioritize CS in HUD-funded afterschool and summer-enrichment opportunities, as well as in workforce readiness programs for those living in public housing.
- The Corporation for Public Broadcasting (CPB) should invest in public media and community programs that promote computational thinking, creative problem-solving, and CS exploration for young children, adolescents, and families; accurately portray careers in computing and celebrate the diversity of the people who have them; and highlight the power of computing to understand and improve the world around us.
- HHS should leverage its Head Start program to help teach computational thinking (CT) and CS to low-income pre-kindergarten (Pre-K) youth. This would involve adapting evidence-based Pre-K CT/CS curricula for the Head Start model and providing professional development for Head Start educators.
- USPTO should incorporate CS into its teacher-education and -outreach programs. The office should launch a public outreach campaign that identifies and highlights a diverse set of computing-reliant inventions and inventors.
- IMLS should prioritize grant funding to (1) support innovative initiatives within museums and libraries that engage youth and communities in CS education, and (2) provide resources for creating, exploring, and making with technology.
- USDA should collaborate with 4-H and Future Farmers of America (FFA) on bringing rigorous CS education to youth participants in these programs. USDA should also leverage its summer free lunch program to bring CS education

activities to low-income youth such as low/no cost programs such as csunplugged.org and through partnerships with local CS education providers.

- NASA, NOAA, DOE, DHS, the intelligence agencies (*e.g.*, FBI, CIA, NSA), and all other agencies with a significant technical workforce should collaborate with ED, NSF, and other agencies as appropriate to engage federal technical employees in CS-related outreach and volunteerism.

7. Goals and targets

The initiative described herein will be a success when:

- CS is a normalized, fundamental component of education for all Americans.
- Issues of gender, racial, disability and economic inequity are a thing of the past.
- 100% of publicly funded schools are equipped with the prepared educators and tools needed provide a rigorous P–12 CS education experience for all students.
- CS education is an established and valued part of extracurricular educational experiences.
- Computational thinking and computing are standard aspects of pre-service teacher education.

Quantitative targets that can be used to assess progress towards these goals include:

- Increasing participation in AP CS courses by 400%, thereby matching participation in other AP STEM subjects (*e.g.*, biology and calculus).
- Grow the pool of qualified high-school CS teachers to 50,000, thereby matching the numbers of high-school teachers trained in other STEM disciplines (*e.g.*, physics and math).
- Improve the diversity of post-secondary students in computing to reflect the relative population demographics of U.S. students.

8. Conclusion

The next administration should build on community-led momentum around CS education by launching a national initiative to establish rigorous, inclusive, and comprehensive CS learning as a standard component of P–12 education in and out of school. CS education enjoys broad bipartisan support, supports federal economic-development and workforce goals, and contributes to an educated digital citizenry. Advancing inclusive CS education will increase employability, economic opportunity, and equity for American youth. At the same time, improved CS education will bolster cybersecurity and national defense by preparing Americans to fill critical technical roles in both government and industry, and will foster innovation by the diversifying the technology workforce. Overall, a national P–12 CS education initiative will better prepare

our country and our society to address pressing challenges such as healthcare, social mobility, and climate change in an increasingly technology-driven and innovation-based world.

About the author

Ruthe Farmer is a national advocate for gender equity and diversity in technology, and has focused her efforts on diversity in technology and engineering since 2001. At CSforALL, she serves as Chief Evangelist, working to invite new stakeholders to the CSforALL table—and make the table bigger. Prior to joining CSforALL, Ruthe served as Senior Policy Advisor for Tech Inclusion at the White House Office of Science and Technology Policy focusing on President Obama's call to action for Computer Science for All, led strategy and K-12 programs at the National Center for Women & Information Technology (NCWIT), and implemented national tech and engineering programs at Girl Scouts of the USA. She has launched and scaled multiple national inclusion programs including Aspirations in Computing, TECHNOLOchicas, the AspireIT outreach program, Lego Robotics for Girl Scouts, Intel Design & Discovery and more. She served as 2012 Chair of CSEDWeek, was named a White House Champion of Change for Technology Inclusion in 2013, received the Anita Borg Institute Award for Social Impact in 2014, and the UK Alumni Award for Social Impact in 2015. Ruthe holds a BA from Lewis & Clark College and an MBA focused on Social Entrepreneurship from the University of Oxford Said Business School.

About the Day One Project

The Day One Project is dedicated to democratizing the policymaking process by working with new and expert voices across the science and technology community, helping to develop actionable policies that can improve the lives of all Americans, and readying them for Day One of a future presidential term. For more about the Day One Project, visit dayoneproject.org.