DOI:10.1145/3372122

Data on CS graduation rates among six academic institutions in NC traces the demographics of those participating (or not) in the discipline.

BY FAY COBB PAYTON AND ALEXA BUSCH

Examining Undergraduate Computer Science Participation in North Carolina

FORMER U.S. PRESIDENT Obama put forth the initiative ‘CSForAll’ in order to prepare all students to learn computer science (CS) skills and be prepared for the digital economy. The ‘ForAll’ portion of the title emphasizes the importance of inclusion in computing via the participation and creation of tools by and for diverse populations in order to “avoid the consequences of narrowly focused AI (computing and other) applications, including the risk of biases in developing algorithms, by taking advantage of a broader spectrum of experience, backgrounds, and opinions.”¹⁰ Throughout this report, the Obama administration highlighted the number one priority, and challenge, of the field of CS: to equip the next generation with CS knowledge and skills equitably in preparation for the currency of the digital economy.

An increase in government funding is part of the initiative for CSForAll. Of the \$4 billion pledged in state funding, only \$100 million is sent directly to the K–12 school system.¹⁷ The rest of the funding is set aside for research and initiatives involving policymakers to help expand CS opportunities. In just one year, the National Science Foundation (NSF) and Corporation for National and Community Service (CNCS) were called to make \$135 million in CS funding available.¹⁷ The initiative also called for “expanding access to prior NSF supported programs and professional learning communities through their CS10k that led to the creation of more inclusive and accessible CS education curriculum including “Exploring CS and Advanced Placement (AP) CS Principles.” According to Smith,¹⁷ more than 30 school districts began expanding their CS programs at the start of this initiative. A majority of this federal funding for research, such as from the NSF, is awarded to higher education.¹¹

The potential benefit in funding higher education institutions to contribute to CSForAll lends itself to research. Researchers show that engaging students in CS at the K–12 level will not solve the shortage problem if CS programs at the university level cannot scale.^{8,9} Broadening Participation in Computing (BPC) Alliances, originally comprised of 10 (now 8) initiatives, connect educational institutions of different levels, backgrounds, and resources with the collective mission to broaden participation in the CS systems and

» key insights

- NC CS trends offer insights into undergraduate enrollment and completion among female, Black, Hispanic and Native American students.
- Minority serving institutions and smaller PWIs can serve as models to broadening participation.
- There is a need for intersectional data collection to improve our understanding of enrollment and graduation trends.

PHOTO BY SEVENTYFOUR

workforce. Some BPC Alliances work toward this goal through reforming statewide systems. For example, Georgia Computes! connected the University of Georgia with the state's middle schools to recruit students for high school and college CS courses by training high school teachers to teach CS courses (including APCS), and by training college faculty to conduct summer camps and teach high school retention curricula.³ As of 2010, the state of Georgia experienced a 68% increase in high school

APCS course offerings, a 57% increase of women and a 300% increase of Hispanic students taking the APCS exam since Georgia Computes first began.³ Similarly, Into the Loop connects UCLA with Los Angeles Unified School District (one of the largest and most diverse in the U.S.) in order to focus on developing curricula and teacher training for broadening participation in CS.⁷

The Alliance for the Advancement of African American Researchers in Computing (A4RC) and Advancing

Robotics Technology for Societal Impact (ARTSI) were two partnerships created to connect students at Historically Black Colleges and Universities (HBCUs) with the resources of R1 institutions. We note these two alliances no longer exist.³ They served an important purpose to further enable and support students to successfully complete CS undergraduate programs at HBCUs and facilitated their matriculation in graduate school at other institutions. A4RC united the two types of institutions to connect students and faculty in year-round research collaborations, including methods courses, spring visits, and summer research opportunities. ARTSI had a similar yet more specific focus on robotics.³

Currently, eight NSF Alliances (that is, Access Computing, CAHSI, ECEP, iAAMCS, Exploring Computer Science, NCWIT, STARS and CRA-WP) exist to broadening participation in computing. Based in North Carolina, the Students & Technology in Academia, Research, and Service (STARS) Alliance includes universities, K-12 school districts, and community colleges. The goal of STARS is to pool resources and energy while propagating effective practices of broadening participation for underrepresented groups at the local level.³

The STARS Alliance includes North Carolina State University, UNC Charlotte, North Carolina A&T University, Duke University, and UNC Greensboro. Because of North Carolina's reputation and involvement in BPC, we expect undergraduate CS programs in NC to be some of the best equipped to broaden participation at both the undergraduate and K-12 levels. Therefore, we turn to several of these higher education institutions (that is, North Carolina A&T, NC State, UNC Charlotte, and Duke University) who have partnered with STARS and compare them to other, similar NC institutions with CS programs (Wake Forest University and UNC Chapel Hill) to inform the field if and how access to CS can be broadened at the college level. Specifically, we examine the demographics of students completing undergraduate CS degrees from 2007-2017 to see the trends over the 10-year horizon.

Table 1. Institution type and degrees offered by institution.

Institution	Institution Type			Degrees Offered		
	Public	Private	HBCU	PhD	M.S./A.	B.S./A.
Duke		+		+	+	+
NC A&T	+		+	+	+	+
NCSU	+			+	+	+
UNC, Chapel Hill	+			+	+	+
UNC, Charlotte	+			+	+	+
Wake Forest		+			+	+

Note. += descriptive of institution

Table 2. Participation in BPC initiatives by institution.

Institution	BP Alliance Partner?	Alliance(s)
Duke	Yes	ARTSI
NC A&T	Yes	ARTSI, A4RC, STARS
NCSU	Yes	STARS
UNC, Chapel Hill	No	
UNC, Charlotte	Yes	STARS
Wake Forest	No	

Note. += descriptive of institution

Figure 1. Number of students completing CS bachelor's degrees between 2007 to 2017.

**Number of Students Completing CS Bachelor's Degree
2007-2017**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Duke University	23	9	22	12	0	0	28	52	67	93	112
North Carolina A&T State University	26	16	31	36	24	39	43	48	33	34	30
North Carolina State University at Raleigh	113	130	111	102	128	110	169	153	171	193	174
University of North Carolina at Chapel Hill	40	38	48	43	24	45	54	80	105	124	175
University of North Carolina at Charlotte	80	93	76	87	123	135	165	220	206	281	294
Wake Forest University	10	8	9	15	0	17	9	9	25	33	22

Background:

Broadening Participation

Prior studies^{1,2,4,11,12,16} offer evidence regarding both the importance and challenges associated with broadening participation in computing. Creating firm foundations to the path of CS at the undergraduate level undoubtedly rests on social/psychological, structural, and systemic barriers. The *structural barriers* include disparities in access to and availability of rigorous computer science curricula, lack of access to peer networks/mentors/sponsors, and bias in selection processes and coursework. *Social/psychological barriers* include perceptions of who should (should not) participate, lack of cultural hooks and relevance to engage and retain students, and misconceptions about what computing is. Lastly, the *systemic barriers* are policies, practices or procedures that preclude equity in access and/or diverse pathways to computing.¹

Work by Gates and her colleagues⁴ in the context of the Hispanic population indicates that peer-led learning and affinity research group models have been successful interventions. These methods focus on academic preparation and peer-driven activities to create agency and resilience among students. In addition, culturally relevant and responsive pedagogy includes interventions, such as aligned curricula, a multi-CS course sequence, exposure to diverse CS role models, peers and instructors, and in-school and out-of-school leadership growth opportunities and equally.¹⁶

Withstanding these barriers and myriad of interventions, computing acumen² can be an equalizer to workforce opportunities in the broader society. To be an equalizer, however, broadening participation efforts must recognize the preparatory privilege associated with families that could provide parental knowledge, guidance, summer camp opportunities, in-home computers, software, even private tutoring.⁷

Institutions

In the last 10 years, researchers have acknowledged North Carolina (NC) for taking considerable measures to broaden participation in CS education. Some have recognized NC high

Creating firm foundations to the path of CS at the undergraduate level undoubtedly rests on social/psychological, structural, and systemic barriers.

schools for having a technology literacy requirement for graduation.²¹ The state also prides itself in offering classroom and online courses to all students.⁵ For example, education programs in the fundamentals of CS are available through NC's statewide career technical education programs and North Carolina Virtual Public School.²¹ NC is also recognized as one of 14 states participating in the Southern Regional Education Board (SREB) initiative.¹⁸ Funded by the Gates Foundation, this initiative developed out of SREB's Strengthening Statewide College/Career Readiness Initiative (SSCRI).

North Carolina was also an early adopter as one of only 17 states that permitted an Advanced Placement (AP) computer science course to satisfy a core math or science high school graduation requirement.⁵ This is an important distinction. By allowing AP CS to fulfill high school core requirements, North Carolina sends the message that it prioritizes computer science and recognizes it as an important part of K-12 education curricula. The state showed further support of AP CS courses in 2014 when it began paying for AP examination fees instead of requiring students to do so out-of-pocket. The idea was to cover testing fees for low-income students in order to encourage more students to take AP tests and obtain college credit for high school courses.¹⁵ This is important for AP CS as research has shown that students who take an AP computer science course are 4.5 times more likely to major in CS than those who do not.⁵ By collectively offering graduation credit for AP CS courses and paying for students to take AP exams, North Carolina has arguably taken *initial* steps towards broadening exposure and access to computer science for its students.

Due to their reputable leadership in broadening access at the K-12 level, it may be unsurprising that higher education institutions in NC receive funds to scale their CS programs. For example, Google awarded CS Capacity grants to eight universities across the U.S. in 2015. These grants provided funding for the past three years (concluding in 2018) to assist participating institutions in implementing "innova-

tive, inclusive, and sustainable approaches to address current scaling issues in university CS educational programs.”⁸ Duke University, North Carolina State University, and the University of North Carolina-Chapel Hill were CS Capacity grant recipients.

With this significant recognition and momentum, we examined how NC is actually faring in broadening participation at the undergraduate level. Therefore, we explore how many students have completed CS degrees at the following institutions in the last 10 years: Duke University, North Carolina State University, UNC Chapel Hill, North Carolina A&T University, Wake Forest University, and UNC Charlotte.

We specifically explore the participation of female, Black, Hispanic and Native American students. It should be noted this sample of schools includes two private institutions and an HBCU (see Table 1). The sample also includes those that are involved in BPC initiatives and those that are not (see Table 2). These universities are described in further detail here:

Duke University is a private, non-profit, research university located in Durham, NC. It offers BS, MS, and Ph.D. degrees in CS. Duke’s CS department is housed in their College of Engineering. Their department has participated in one of the original 10 BPC initiatives, ARTSI, which partnered

with HBCUs on the specific topic of robotics. Duke is a member of the STARS Alliance.

North Carolina A&T University is a public, research HBCU located in Greensboro, NC. It offers BS, MS, and Ph.D. degrees in CS. Its CS department is housed in the College of Engineering. NC A&T participated in A4RC and ARTSI and is a current STARS Alliance member.

North Carolina State University (NCSU) is a public research university located in Raleigh, NC. As proudly stated on their website, it is home to one of the nation’s oldest CS departments and offer degrees at the BS, several master’s options, and Ph.D. levels. The CS department at NCSU is housed in its College of Engineering. NCSU is also a partner in STARS, one of the original and still funded BPC Alliances.

The University of North Carolina at Chapel Hill is a public research university located in Chapel Hill, NC. It offers CS degrees at the bachelor’s, master’s, and Ph.D. levels. The CS department at UNC Chapel Hill is housed in their College of Arts and Sciences.

The University of North Carolina at Charlotte is a public research university located in Charlotte, NC. It offers CS degrees at the bachelor’s, master’s, and Ph.D. levels. Their CS department is housed in the College of Computing and Informatics. UNC Charlotte is also a STARS Alliance member.

Wake Forest University is a private research university institution located in Winston-Salem, NC. While it offers CS bachelor’s and master’s degrees, unlike the other institutions in our sample, it does not have a Ph.D. program. Wake Forest has not and does not participate in any of the BPC initiatives. It may also be worth noting its CS program is one of the youngest in our sample.

Current Study

Based on the literature noted here, we explored the following questions:

► In the presence of CS curricula availability at six undergraduate institutions in North Carolina, how can public educational data from the last decade inform the field about CS accessibility among female, Black, His-

Figure 2. Percentage of Black students completing CS bachelor’s degrees between 2007 to 2017.

Figure 3. Percentage of Black females completing CS bachelor’s degrees between 2007 to 2017.

panic or Latino, and Native American students at the undergraduate level?

► How can these trends at the undergraduate level inform the field about CS accessibility among female, Black, Hispanic or Latino, and Native American students at the high school level?

To answer these questions, we downloaded and summarized data from the Integrated Postsecondary Education Data System (IPEDS) data collection. IPEDS data consist of statistics on postsecondary institutions regarding tuition and fees, number and types of degrees and certificates conferred, number of students applying, number of students enrolled, number of employees, financial statistics, graduation rates, student financial aid, and academic libraries. We specifically explored the number of computer science bachelor's degrees conferred by gender and race/ethnicity from 2007–2017.

Trends in the Last Decade

There was a total of 5,025 CS degrees completed from 2007–2017 across all six institutions. Overall, the number of students completing CS degrees has increased from 2007 to 2017 (see Figure 1). Wake Forest and North Carolina A&T had the smallest amount of growth. The largest growth occurred at UNC Charlotte with an increase from 2007 to 2017 of 214 students. While there has been an increase in the number of White and Asian students completing CS degrees in the last 10 years for these schools, little has changed in the number of Black students at any of the schools (see Figure 2).

Here, we show mostly percentage trends with the exception of Figure 1. We include the raw numbers (or absolute numbers) in an online appendix (<http://dl.acm.org/citation.cfm?doid=3372122&picked=formats>), which captures the scope of each institution. This helps to reduce bias in reporting or providing misleading interpretations of the data. Figure 1 shows a general increase in the number of students completing CS undergraduate degrees.

The largest percentage of students completing CS degrees were Black students from North Carolina A&T, aver-

aging an 85.32% completion rate (see Figure 2). The numbers remain small for Black students at all the other schools. In fact, most CS bachelor's degrees completed by Black students at non-HBCUs are less than 20% though the raw data (see online appendix) shows an upward trend at UNC-Charlotte and North Carolina A&T. Across all non-HBCU institutions, more White students completed CS bachelor's degrees than all other ethnicities. However, gender trends remain consistent across all institutions in this study. We found that a total of 215 Black males and 94 Black females completed CS bachelor's degrees at North Carolina A&T between

2007–2017 over the 10-year horizon (see Figure 3). This data shows that Black female completion is somewhat jagged with some spikes to 25 and 26 Black males in more recent years.

The lack of Native American students completing CS bachelor's degrees across these schools is particularly staggering. Despite NC being a state with one of the largest Native American populations,²² almost no Native American students have completed CS degrees across these schools in the last decade. The percentage of Native American students completing CS degrees is below 3.5% across all six institutions. This represents 12 students total over the time horizon as

Figure 4. Native American males completing CS bachelor's degrees between 2007 to 2017.

Figure 5. Percentage of White males completing CS bachelor's degrees between 2007 to 2017.

noted in Figure 4. None of these students are female, meaning zero Native American females completed CS bachelor's degrees across these institutions in the last 10 years.

Duke and UNC Chapel Hill had the largest percentage of Asian students completing CS degrees. The raw data indicated that Duke and UNC Chapel Hill, respectively, graduated 122 and 126 Asian students over the 10-year horizon. For all other institutions, less than 15% of students completing CS degrees in the last 10 years were Asian. Also, in the last 10 years, less than 12% of students completing CS degrees identified as Hispanic across all insti-

tutions, with the exception of Wake Forest in 2014. The numbers were considerably worse for women. Women identifying as Hispanic only made up only 4.55% of those who completed CS degrees in each institution.

Across all institutions, males completed more CS degrees than females. While the number of males is increasing, the number of females is not increasing at the same rate. At the majority of schools (with the exception of the one HBCU), CS degrees were completed by White males. White men accounted for 100% of all CS bachelor's degrees completed at Wake Forest University in both 2009 and 2013 (see

Figure 5). While the number of completed CS bachelor's degrees appears to be increasing across these institutions (see Figure 1) in NC, the diversity seems to follow suit as the number of White males decreases as the data illustrates (Figure 5). This diversity, however, is still met with a lack of representation among ethnic groups as the raw data in the online appendix indicates.

In comparison, Figure 6 shows the data for White females. For this group, data were missing for Duke University in 2012 and Wake Forest University in 2011. In 2013, none of the institutions had double-digits percentage completion rates for White females. From North Carolina A&T State University, White females completed CS undergraduates in 2007 (3.85%), 2012 (2.56%) and 2017 (3.33%). The largest one-year percentages for this demographic occurred in 2014 (33.33%) and 2008 (25%) at Wake Forest University. Overall, this data does not show a consistent pattern of sustained growth for the group.

Prior work¹³ indicated that NC was one of the states with the fastest growing Hispanic population. From 2000 to 2010, North Carolina had a 141% change in its Hispanic population. In 2014, North Carolina ranked eleventh in the Hispanic population among all 50 states and the District of Columbia with 890,000.¹³ From the 2018 U.S. Census Bureau,¹³ Hispanic/Latino, Black/African Americans, Native Americans, Whites, and Asians represent 9.5%, 22.2%, 1.6%, 63.1% and 3.1%, respectively, of NC's population.

Given this growing demographic nationally and in NC, we provide Figures 7, 8, and 9 to explore insights on Hispanic CS graduation rates in the state. Figure 7 shows the largest spike in 2014 (22.22%) at Wake Forest University. For a more careful observation of this spike, Figure 10 also shows the raw data with UNCC graduating an increasing number of Hispanic students in CS. The raw data also indicates that 22 Hispanic completed CS degrees from UNCC and two graduated from Wake Forest. The University of North Carolina-Charlotte (UNCC) shows some upward trend in the latter years of the dataset.

Our findings are based on repre-

Figure 6. Percentage of White females completing CS bachelor's degrees between 2007 to 2017.

Figure 7. Percentage of Hispanic students completing CS bachelor's degrees between 2007 to 2017.

sensation. Notably, the composition of a program (demographics) can only change very slowly. Recruitment and retention of students is a slow-moving goal with enrollees from underserved groups with the hopes of translating to significant percentage growth and enrollment. This, however, in the disaggregate creates a false sense of success relative to broadening participation in CS. Hence, students benefitting from preparatory privilege would be more naturally attracted to these careers while other mechanisms should consider alternative approaches to broadening participation.

HBCUs, Hispanic-serving and other minority-serving institutions do seem to be doing well with regards to answering the call to broadening participation. This, however, is not new for these institutions—as institutional culture and mission have driven these efforts to attract and retain underserved and marginalized groups²⁰ as well as prepare them for graduate education and workforce alternatives. This brings to bear if there should be varied types of BPC strategies based on institutional types. This will require thoughtful intention, context, and culturally attuned climates beyond the pure numbers, and the awareness that representation is not inclusion. Our study does not account for critical factors, such as student enrollment/majors, and student/faculty diversity data, which could offer a clearer comparison among the institutions listed in this manuscript.

Conclusion

We assert that institutions should examine trends in public educational data as leadership and other stakeholders formulate strategies and make decisions around broadening participation. In this study, we used IPEDS data for a 10-year horizon. As noted on the National Center for Education Statistics website, “IPEDS annually gathers information from about 7,000 colleges, universities, and technical and vocational institutions that participate in the federal student aid programs.” This captures a variety of college and university types, allows for institutional comparisons and incorporates the Classification of Instructional Programs (CIP) system tax-

onomy which categorizes a discipline by groupings.

While our work involved analyses from the IPEDS data which has a broader definition of computing based on degree program codes in computer and information sciences, the CIP taxonomy classifications often do not align with the precise names of majors. In the ever-changing field of CS, this can create significant variability in how institutions analyze the data and the decisions that they make. Further, IPEDS is based on self-report, and institutional time burden and resources influence IPEDS data collection which can create additional barriers

to MSIs and community colleges.¹⁴ Alternative datasets, such as ACM’s Survey of Non-Doctoral Granting Departments in Computing, CRA’s Taulbee Survey, and the National Center for Education Statistics, can also provide some comparison of our results. Withstanding the dataset, the role of MSIs and community colleges expertise (both CS domain and inclusive BP acumen) should not be ignored. We are cognizant of the impacts of institutions’ admissions policies, role of academic preparation, curricula access and availability at the K-12 level, broader discipline career fit and biases that can impact this discourse.

Figure 8. Percentage of Hispanic males completing CS bachelor’s degrees between 2007 to 2017.

Figure 9. Percentage of Hispanic females completing CS bachelor’s degrees between 2007 to 2017.

We also contend these decisions should be anchored in an effective, contextualize broadening participation strategy. Engaging students in CS at the K–12 level will not solve the shortage problem if CS programs at the university level cannot scale.^{8,9} To address this question, we observed the following: Of these six institutions, four have participated in at least one BPC project in the last 10 years. Our results indicate that some progress has been made in the last decade across large R1 institutions in our sample. While North Carolina A&T and UNC-Charlotte have shown growth the raw data, these institutions can serve as models for effective strategies for targeting Black and Hispanic students, respectively. The efforts at both institutions can be viewed as part of the organizational culture with some critical mass of faculty committed to integrating broadening participation into research initiatives.

Thirdly, there is a need to disaggregate the numbers and employ *intersectional* (race/ethnicity and gender via those underrepresented in the field) interpretations to get a true picture of who is participating and graduating in CS. Larger predominately white institutions (PWIs), agencies and corporate foundations can stand to learn from HBCUs (in this case North Carolina A&T), minority-serving institutions (MSIs) and other colleges (in this case, UNC-Charlotte) about inclusive excellence to enhance broadening

participation practices, strategies and culture—and provide equitable funding where there are notable results.

Given our results, an examination of North Carolina’s MSIs, community colleges and smaller PWIs is worth exploring. In addition, the definition of computing is broader than CS and can draw from information sciences/technology which can show offer addition insights regarding participation in the field. When aggregated, the numbers appear promising, and the number of students completing CS bachelor’s degrees is increasing. However, it appears to be increasing at much higher rates for White men than for any other group. Some groups have not participated any more or less in the last 10 years. In fact, we found *zero Native American women* to have completed a CS degree in the last decade at any of the six institutions. Though North Carolina is not home to a Hispanic-serving institution despite the state’s growing Hispanic population, has a significant Black demographic and is home to a significant Native American population, IPEDS, and other data sources can be used to (re)formulate decisions associated with CS participation and (re)develop more inclusive programs.

Acknowledgments. This research was funded by NSF grant number, CNS 1740141.

References

1. Abu-El-Haija, L. and Payton, F.C. Computer Science Enrollment in Magnet High Schools: Issues of

- Curricula Clusters, Equity and Pathways. RESPECT. Minneapolis, MN, 2019.
2. Bobb, K. Broadening Participation in Computing: A Critical Perspective. *ACM Inroads* 7, 4 (Dec. 2016), 49–51.
3. Chubin, D.E. and Johnson, R.Y. *Telling the Stories of the BPC Alliances: How one NSF program is changing the face of computing*. American Association for the Advancement of Science. (2010).
4. Gates, A.Q., Thiry, H. and Hug, S. Reflections: The Computing Alliance of Hispanic-Serving Institutions. *ACM Inroads* 7, 4 (Dec. 2016), 69–73.
5. Kaczmarczyk, L. and Doplick, R. and EP Committee. *Rebooting the Pathway to Success: Preparing students for computing workforce needs in the United States*. ACM, New York, NY, 2014.
6. Lehman, K.J., Sax, L.J. and Zimmerman, H.B. Women planning to major in computer science: Who are they and what makes them unique? *Computer Science Education* 26, 4 (2017), 277–298.
7. Margolis, J., Estrella, R., Goode, J., Holmes, J.J. and Nao, K. *Stuck in the Shallow End: Education, Race, and Computing*. MIT Press, Cambridge, MA, 2010.
8. Nager, A. and Atkinson, R. The case for improving U.S. computer science education. (2016).
9. National Academy of Engineering, and Institute of Medicine. *Rising above the gathering storm: Energizing and employing America for a brighter economic future*. The National Academies Press, Washington, D.C. 2007, 1–591.
10. National Science and Technology Council Committee on Technology. *Preparing for the Future of Artificial Intelligence*. Dec. 2016.
11. The National Science Foundation. Survey of federal science and engineering support to universities, colleges, and nonprofit institutions fiscal year 2015; <https://ncsesdata.nsf.gov/fedsupport/2015/>
12. Payton, F.C. and Berki, E. Countering the negative image of women in computing. *Commun. ACM* 62, 5 (2019), 56–63.
13. Pew Research Center—Hispanic Trends. Demographic Profile of Hispanics in North Carolina, 2014; <https://www.pewhispanic.org/states/state/nc/>
14. Powers, K. and Henderson, A.E., eds. *Burden or Benefit: External Data Reporting: New Directions for Institutional Research*. Jossey-Bass Publishing, San Francisco, CA, 2016.
15. Ryoo, J., Goode, J. and Margolis, J. It takes a village: Supporting inquiry- and equity-oriented computer science pedagogy through a professional learning community. *Computer Science Education* 24, 4 (2015), 351–370.
16. Scott, A., Martin, A., McAlear, F., and Koshy, S. Broadening participation in computing: Examining experiences of girls of color. *ACM Inroads* 8, 4 (Dec. 2017), 48–52.
17. Smith, M. Computer Science for All. Blog, Jan. 30, 2016; <http://bit.ly/38SYAj6>
18. Southern Regional Education Board. *Bridging the Computer Science Education Gap: Five actions states can take*. Report of the SREB Commission on Computer Science and Information Technology. Nov. 2016.
19. U.S. Census Bureau Quick Facts—North Carolina, 2018; <https://www.census.gov/quickfacts/fact/table/NC/PST045218>.
20. Varma, R. Why so few women enroll in computing? Gender and ethnic differences in students’ perception. *Computer Science Education* 20, 4 (2010), 301–316.
21. Wilson, C., Sudol, L.A., Stephenson, C. and Stehlick, M. *Running on Empty: The failure to teach K–12 computer science in the digital age*. ACM and CSTA, 2010.
22. World Atlas. US States with the Largest Native American Populations, 2017; <http://bit.ly/32huH9R>.

The appendix for this article can be found at <http://dl.acm.org/citation.cfm?doid=3372122&picked=formats>

Fay Cobb Payton (fcpayton@ncsu.edu) is a professor and University Scholar of Information Technology/Analytics at North Carolina State University, Raleigh, NC, USA.

Alexa Busch (agbusch@ncsu.edu) received her master’s degree in Operations Research at North Carolina State University, Raleigh, NC, USA.

Figure 10. Hispanic students completing CS bachelor’s degrees between 2007 to 2017.