

Broadening Participation through Information: A Synthesis of Resources for Research and Practice in Computing and Computer Science

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Abstract—Computer science has long been a discipline in which those who are able to participate often come from backgrounds in which they have been afforded exposure, training, and support in computing. In the field of computer science, minoritized students (e.g., persons who identify as African American/Black, Hispanic/Latinx, and/or American Indian/Alaska Native) may experience a variety of barriers such as a lack of support or access to resources. While initiatives and resources that support broadening the participation of minoritized students in computing do exist, they may not be well known or well publicized. Specifically, there is information about several computer science resources and opportunities in computing scattered across different mediums such as websites and social media platforms. However, there is a lack of a synthesis of this information. To address this issue, we propose a Computer Science (CS), Tech, and STEM Mentoring Resources Repository that consists of information about conferences, organizations, programs, scholarships, and more. This resource will help to inform students, especially minoritized students, about opportunities in these highly homogeneous fields. To synthesize this information, we conducted a series of searches for computing and STEM resources, specific to Black students and professionals. The purpose of our work is to provide a collection of CS and STEM resources that exist across several mediums. This work is guided by the question: what resources (e.g., conferences, programs, websites, etc.) exist that support research and practice in computing and computer science? In this paper, we present an overview of interventions and resources related to computing and computer science, and discuss the implications of the use and impact of a resources repository. This work provides information about potential opportunities and resources that can help to inform and increase interest and participation in computing and computer science.

Keywords: Computer Science, Computing, Race/Ethnicity, Resources

Introduction

Computing has been defined as the systematic study of algorithmic processes that describe and transform information: their theory, analysis, design, efficiency, implementation, and application [1]. According to Denning et al., “the fundamental question underlying all of computing is, ‘What can be (efficiently) automated?’ [1].” However, as computing seeks to revolutionize the world by easing the burden of human work through automation, it is important to consider “who” is performing computing and automation activities and what are the implications for various populations. Thus far in history, automation has not proved to be equitable.

Technology often overlooks, denigrates, or reinforces negative biases and stereotypes of minoritized populations such as Black people. For example, in 2015, nascent image recognition software designed by Google and Flickr, prominent tech companies, identified Black people as “gorillas” or “apes” in photo search applications [1]-[5]. Instances like these demonstrate the need for more diverse perspectives in computing to further the automation of society in an equitable manner. However, in 2016, Black/African American people earned 6.0% of all bachelor’s degrees in computer science, a major discipline focusing on certain areas of computing, despite comprising 12.6% of the U.S. population [6]-[8]. Likewise, in 2017, only 3.1% of workers in technical jobs among the eight largest tech companies in the U.S. were Black [9]. Moreover, not only are universities struggling with effectively recruiting

and retaining Black computer science students, top tech companies are disproportionately hiring from existing computing talent [9], [10].

Additional and accessible resources are needed to support Black people looking to enter into computing and computer science. This may include resources for high school students considering computing careers, computer science graduates seeking jobs, or established professionals in other fields looking to enter the growing tech industry. Many such resources already exist; however, they are scattered across the internet. Thus, resources may not be easily identifiable for persons interested in computing and result in a lack of adequate utilization of these resources. Some websites have sought to consolidate some of these resources; however, they usually only focus on one area of resources, such as organizations or scholarships.

To address these issues, the purpose of this work is to provide a synthesis of resources about computing and computer science that exists across several mediums. The guiding research question of this work is: what resources (e.g., conferences, programs, websites, etc.) exist that support research and practice in computing and computer science? As such, we sought to create a resources repository that consolidates information about everything from podcasts to conferences related to computing and computer science that might be of specific interest to Black students and professionals. Our intended audience for the resources repository is Black students and professionals looking to start or expand their education and careers in computing, computer science, and/or tech. This repository provides an easily accessible location of a plethora of resources that may provide Black people interested in computing and computer science with resources and information, and subsequently help to broaden participation of Black people in computing and computer science.

This work is a descriptive paper in which we propose a Computer Science (CS), Tech, and STEM Mentoring Resources Repository that consists of information about conferences, organizations, programs, scholarships, and more. First, we provide a discussion of the theoretical lens and methods we used to conduct searches for information to include in the repository. Then, we discuss our findings in terms of computing and computer science interventions and resources we identified, and provide a brief description of the categories and characteristics of these resources. Finally, we conclude with a discussion about the implications of the resources repository and its potential to support broadening participation in CS.

Theoretical Framing

A social capital lens was used to assist in identifying resources to include in the repository. Social capital can be the intangible networks and relationships that provide social support formed through interactions, exchanges, and supportive measures [11], [12]. Social capital is dependent on the relationships people have with each other and provides advantages through these networks [12], [13]. In addition, social capital may exist as various forms of capital (e.g., intellectual and cultural capital) [14]-[16], actions [17], [18], and resources [19]-[21]. In this work, we identified and examined informative resources that may support the social, intellectual, and cultural capital of Black people interested in computing and computing science.

Methods

To identify resources to include in the repository, we used a multimethod approach. First,

we populated the repository with resources about computing and computer science that we were aware existed. Next, we performed a series of Google searches to identify more resources using the following search terms: “Black in computer science conference,” “Black computer science,” “coding while Black,” “Black in computer science club,” “Black in computer science scholarship,” “Black in tech Twitter,” “Black in computer science Twitter.” We then added resources we found directly from the search or through articles identified in the searches that featured compilations of relevant articles. These resources were analyzed through a social capital lens. More specifically, we added resources that may be relevant or useful to Black people currently in computing or CS, whether research or industry, or Black people considering entering computing or the CS field.

Additionally, we attempted to identify resources from YouTube, the largest public video platform and a place where younger people often go to gather information. The following are the terms and phrases we used to search YouTube: “Black CS,” “Black CS-CSGO,” “African Americans CS,” and “African American computer science.” We searched these four terms and phrases on that website, removing CSGO from the search as it is a popular video game that came up frequently in our results, but was not relevant to our search. From our searches, we found 84 items that we put into categories (e.g., conferences, organizations, podcasts, etc.) in the resources repository (refer to Table 1). We determined that we had reached the point of saturation when we performed new searches and we no longer discovered new resources.

Table 1. Summary of the search and review process

Category	Number Found
Conferences	13
Organizations	22
Podcasts	6
Programs	9
Scholarships	14
Twitter	6
Videos	6
Websites	8
TOTAL:	84

Results: Computing and CS Interventions and Resources

There are several resources that exist that support research and practice in computing and the field of CS, yet these resources are scattered and may be difficult to find. In this paper, we organize and display a variety of resources and opportunities available for students and professionals in computing, CS, and STEM, particularly persons who identify as Black. We present a [Computer Science \(CS\), Tech, and STEM Mentoring Resources Repository](#), which consists of resources that provide mentoring to support computing and STEM (emphasizing computing). A screenshot example of the repository is illustrated in Figure 1. This repository consists of identified resources that are divided into categories labeled as: “Conferences,” “Organizations,” “Podcasts,” “Programs,” “Scholarships,” “Twitter,” “Videos”, and “Websites.” For each resource identified, we provide a short description about what the resource is, who manages the resource, and a direct URL link to the identified resource. In the following paragraphs, we review each category of resources found in our search and briefly

discuss their characteristics.

Computer Science, Tech, and STEM Mentoring Resources Repository

[Table of Contents](#)
[Conferences](#)
[Organizations](#)
[Podcasts](#)
[Programs](#)
[Scholarships](#)
[Twitter](#)
[Videos](#)
[Websites](#)

Conferences	Details About What it is	Who Manages	Direct URL
ASEE CoNECD Conference*	The vision of the CoNECD conference is to provide a forum for exploring current research and practices to enhance diversity and inclusion of all underrepresented groups in the engineering and computing professions.	ASEE divisions	https://sites.g
BDPA Conference	BDPA is an international organization with a diverse membership of professionals and students at all levels in the fields of information technology, computer science and related S.T.E.M fields. Members are actively engaged in serving the community through outreach and charting the future of the IT industry.	Earl Pace Jr.	https://www.b
blackcomputeHER Conference	blackcomputeHER.org is dedicated to supporting computing+tech education and workforce development for black women and girls. Our aim is to create rich technical programming, lead empirical research, and disseminate information that addresses the lack of inclusive innovation in tech across education and industry.	Dr. Quincy Brown Dr. Jamika Burge Dr. Jakita Thomas	https://blackcc
BlackTech Week Grace Hopper Celebration	Blacktech Week is a week long conference celebrating innovators of color with a mission to accelerate Miami as the gateway to Africa & the Diaspora. World's largest annual gathering of woman technologists, working together to achieve intersectional gender and pay parity in tech.	Derick Pearson AnitaB.org and ACM	http://blacktec https://ghc.an
HBCUHacks	HBCUHacks is a weekend hackathon that gives students at HBCUs the opportunity to flex their coding skills while working together to build mobile apps and web software. During these hackathons, students can also connect with tech companies hiring for open positions. Have been held at the Atlanta University Center Consortium, Howard University, and Morgan State University	Chris Bennett, Hadiyah Mujhid, Nnena Ukuku, Monique Woodard	http://blackfou
NSBC Conference	NSBC stands for the "National Society of Blacks in Computing". In March of 2016, leaders from iAAMCS (the Institute for African-American Mentoring in Computing Sciences) decided to host a conference dedicated to creating a safe space for participants to receive mentorship, increase professional networks, enhance social capital, and plan their career trajectories.	Dr. Kyla McMullen	http://nsbc.org
NSBE Convention* Research in Equity and Sustained Participation in Engineering, Computing, and Technology (RESPECT)	The Annual Convention showcases black students and professionals who have a passion for science, technology, engineering and math (STEM), who are high achievers in these fields and who are channeling their dedication to advance their communities and society at large. #NSBE46 will attract more than 14,000 aspiring and practicing engineers, educators and representatives of more than 250 academic institutions, government agencies, corporations and nonprofit organizations. *While the convention is for anyone within STEM, computing is represented well within the organizations and students that are invited	NSBE	http://convent
	RESPECT is intended to serve a premier venue for peer-reviewed, interdisciplinary research on broadening participation in computing drawing from computer science education, educational leadership, learning sciences, cognitive or social psychology, social sciences, and related disciplines. RESPECT includes several types of presentations to promote collaboration, including research papers, experience reports, panels, posters, and lightning talks. RESPECT is co-located with the ACM Technical Symposium on Computer Science Education (SIGCSE)	Jamie Payton, Tiffany Barnes, Nicki Washington, Christina Gardner-McCune respect2020@eas ychair.org	http://respect

Fig. 1. A Sample of the Computer Science, Tech, and STEM Mentoring Repository displaying Conferences Resources

Conferences

Conferences offer a critical discussion meeting space for students and professionals to share their work with peers in their areas and networks, as well as to engage with academic and industry communities. Specifically, we searched to identify conferences that are dedicated to the support and mentorship of minoritized students in computing and computer science. We initially included conferences that we were professionally aware of, including the [American Society for Engineering Education \(ASEE\) CoNECD](#) conference, the [RESPECT 2021](#) conference, and the [National Society of Black Engineers \(NSBE\) Annual Convention](#). Additional conferences were identified through Google searches that included the phrase “Black in computer science conference.” Conference opportunities found in this category ranged from spaces specifically for computing, as with the [National Society of Blacks in Computing \(NSBC\)](#), to the [Roadmap to Billions Conference](#), initiated by a group of Black women tech founders. These are a few examples of some conferences that may lead to further

opportunities for attendees in the future, whether through networking opportunities, graduate school, or inspiration for new projects.

Organizations

Organizations refers to affiliations or business communities that work together to provide support and opportunities for students and professionals in computing and computer science. In addition to well-known organizations such as the [Association for Computing Machinery \(ACM\)](#), organizations with missions to support Black engineering, technologists, and entrepreneurs are also detailed. These organizations range from ones supporting Black girls and boys in middle and high school ([Black Girls Code](#) and [Black Boys Code](#)) to opportunities for adults in postsecondary education ([The National GEM Consortium](#), [iAAMCS](#)), research ([CIMER](#)), and tech entrepreneurship ([Black Female Founders](#), [Black Founders](#), [The Dream Corps TECH](#)). Each organization's mission focuses on inspiring, encouraging, and supporting minoritized groups in computing, computer science, and technology.

Programs for Higher Education

Programs are short-term activities conducted with the intention of achieving long-term initiatives. Often, programs exist in the form of camps, workshops, or opportunities that occur in a consolidated, focused amount of time. A majority of the programs identified focus on encouraging K-12 students to pursue futures in computing and computer science. Many programs are facilitated through university programming, such as Cornell University's [CATALYST Academy](#), the University of Florida's [Gator Computing Program](#), and Howard University's [Pre-College for Engineering Systems Program](#). Other programs include the [Code2040](#) Early Career Acceleration Program (ECAP) for Black and Latinx tech professionals and their Fellows Program for Black and Latinx college CS students. However, there were more opportunities identified for students generally within STEM rather than specifically for computer science within this resources category. This indicates the need for more programs that encourage exposure and education for minoritized students within computing and computer science at this critical pre-higher education junction in order to improve recruitment and retention at the university level and beyond.

Scholarships

Scholarships offer opportunities for students to pursue higher education and attend conferences in their field. They provide support in one of the most crucial ways to overcome barriers to computing: financial support. We found numerous scholarships for minoritized students in engineering, computing and computer science, and technology. Funding for these scholarships are supported by companies including Apple ([HBCU Scholars Program](#)), Google ([Generation Google Scholarship](#)), and Microsoft ([Blacks at Microsoft: BAM](#)). Others are supported by organizations and foundations like the National GEM Consortium ([GEM Fellowship](#)), the National Action Council for Minorities in Engineering ([NACME](#)), and the National Society of Black Engineers ([NSBE](#)). There are many scholarships available for college-bound high school students and students in undergraduate, graduate, and professional and technology programs who are interested in futures in computing and related fields.

Media: Podcasts, Twitter, Videos, Websites

Media resources provide ways for students and professionals to learn about different

facets of CS and STEM, particularly from the perspectives of minoritized populations. Websites provide details about stories from the past of computing trailblazers, as well as specific information about different networks and projects aimed toward increasing the participation of Black people in computing and computer science. Videos and podcasts feature personal insights from current students and professionals in computing, as well as strategies on how to overcome common struggles in computing such as the impostor syndrome. In addition, Twitter, an online platform that provides a space for people to post short segments of text as well as media, is a space to hear directly from and engage with Black people in technology and computing. Together, these media resources provide opportunities to hear the thoughts and experiences of people in computing and computer science, particularly Black people, and to connect and engage with them, as well as free and easily accessible resources.

Discussion and Conclusion

This work provides a repository of information about resources that has multiple implications for helping to broaden participation in CS and STEM. First, Black people are underrepresented in computing and computer science fields, which can be attributed to a lack of resources and support for entering computing fields [22]-[25]. This repository seeks to help fill that gap by providing an initial synthesis of resources related to: questions about entering computing, videos that address questions about pursuing a career in computing, conferences for established professionals looking to expand their networks, and similar aspects. In synthesizing and providing these resources in a consolidated repository, we provide an informational overview and easier access to resources that help support Black persons interested in computing and CS. As a result, this repository can be used as an assets-based instrument that can be shared to increase awareness about resources and opportunities as well as interest to help broaden participation in computing and CS. In addition to this publication, we plan to disseminate this repository as an information source for a virtual mentoring chatbot created by one of the authors, and also through National Science Foundation reporting.

Second, the compilation of this repository allows us to identify specific gaps in resources to illuminate possible opportunities to help broaden participation in CS and STEM. By compiling available resources in one place, this work makes visible existing gaps in resources for Black computer scientists, particularly in the dearth of available programs and scholarships that are specific to computing and not STEM as a whole. Moreover, it also showcases opportunities for college administrators, researchers, and company hiring managers to work toward developing and implementing resources that can help create equitable opportunities for Black people in computing.

In sum, this work provides a repository of resources specific to Black students and professionals with interests in CS, computing, and STEM. The repository is accessible here: [Computer Science \(CS\), Tech, and STEM Mentoring Resources Repository](#). These resources offer exposure to training, educational, financial, and other support systems for people who are interested in CS and computing.

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