# A Shifting Research Agenda: Historically Black Colleges and Universities Must Prepare Students for Careers in Computing, Informatics, and Engineering

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## ABSTRACT

This paper describes the founding principles upon which historically Black colleges and universities (HBCU) are built and examines their role in the high-tech economy. It examines and discusses the diversity issues that have led many to posit that HBCUs should embrace computing, informatics, and engineering as focal areas, and partner with Silicon Valley tech companies to ensure their graduates have the skills necessary for gainful employment. The Howard-West partnership of Howard University (an HBCU) with Google LLC and an enterprise architecture framework are presented as conceptual examples of how colleges and universities such as Howard University, can work together and with industry to introduce students to computing, regardless of major, to prepare them for the modern workforce. A conceptual framework is presented, guided by the outcomes of the social cognitive career theory. The theoretical orientation of this proposed work focuses on the intersection between individual, environmental, and behavioral attributes, and describes formative and summative evaluation criteria in support of the research and educational goals. HBCUs can be better served by prioritizing the very areas in which they are currently "overproducing" graduates—computing, informatics, and engineering. The proposed model can be adopted, modified, and integrated by HBCUs, and other universities and colleges, that suffer from a lack of disciplinary integration in their computing programs. The potential outcome of the work would be to attract and retain students to computing majors, which could have an impact on the technology workforce.

**Keywords:** Historically Black college and university, Inclusion, Computing, Informatics, Diversity

## 1. INTRODUCTION

Computing is a career field experiencing rapid growth—triple the rate of the larger economy (Rothwell, 2013). According to the Brookings Institution, 20 percent of American jobs now require specialized technical knowledge, and individuals with a bachelor's degree working in a STEM field, including computing, informatics, and engineering, earn 14 percent more than peers in non-STEM jobs with similar educational requirements (Bayer Corporation, 2010; Rothwell, 2013). Moreover, Landiver (2013) reports that African Americans employed in STEM earn about $17,000 more per year than their peers trained in but not employed in STEM.

### 1.1 Historically Black Colleges and Universities

The term Historically Black Colleges and Universities (HBCU) was a product of the Civil Rights Act of 1964 (Kvasny et al., 2016). These were institutions of higher education with the primary goal of serving African Americans who were barred from attending Predominately White Institutions (PWIs) due to segregation (Kvasny et al., 2016). Since the founding of Cheyney University of Pennsylvania, the first HBCU, in 1837, HBCUs have been instrumental to the education and success of African American students. While HBCUs make up just 3

percent of the country's institutions of higher education, they issue 16 percent of all undergraduate degrees awarded to African Americans (Kvasny et al., 2016). In the United States, a disproportionate number (22 percent) of undergraduate degrees in science, technology, engineering, and mathematics (STEM) are earned by African American students (Margolis et al., 2008). In recent years, over 25 percent of all African Americans graduating with undergraduate degrees in Computer Science have matriculated through HBCUs (Lazowska et al., 2013; Owens et al., 2012; Perna et al., 2009). And research has shown that graduates of HBCUs are more likely to attend graduate or professional schools than African American graduates from non-HBCUs (Kvasny et al., 2016; Postsecondary National Policy Institute, 2015).

At one point, HBCUs were the only option allowing African Americans to pursue higher education, but today HBCUs compete for African American students with each other, PWIs, community colleges, and for-profit colleges. Additionally, like other institutions, HBCUs are faced with declining financial support from local, state, and national governments, changes to the federal student loan system that disproportionately impact minority students, increasing competition for resources and faculty, declining enrollments, retention, and graduation rates. On average, HBCUs' average

retention and graduate rates are 66 and 30 percent, respectively (Kvasny et al., 2016). Additionally, HBCUs operate in only 19 states and the District of Columbia. Between 1976 and 2011, enrollment at HBCUs grew to 324,000 students, representing a 45-percent increase. Of all African Americans enrolled at HBCUs in 2011, 61 percent were women. This is an 8 percent increase since 1976. However, the proportion of African American men enrolled in HBCUs has declined steadily, as has the percentage of undergraduate degrees awarded to African Americans at HBCUs, from 35 percent in 1976-1977 to 16 percent in 2010-2011. According to Lee and Keys (2015), the vast majority (83 percent) of students attending HBCUs are first-generation students from low-income households, making one of the greatest hurdles for HBCU administrators' proposition of maintaining affordable rates while ensuring access, retention, and graduation.

Supporting academic success while preparing students for meaningful careers is critically important, especially when one of the factors in a higher education environment is that an undergraduate may be saddled with a national average of $28,400 in student loan debt (TICAS, 2014). To increase the value of their degree programs, a significant number of HBCUs are reevaluating their institutional missions, primarily in terms of their program offerings. According to the Association of Governing Boards of Universities and Colleges (AGB, 2014), such change is significant because the program offerings at most institutions are tied to their mission. Thus, programmatic changes, such as expanding information technology (IT) majors and online programs, is an integral step in rebranding HBCUs as producers of graduates with skills necessary for the workforce of the 21st century (Kvasny et al., 2016).

The purpose of this project is to understand, synthesize, document, highlight, and transform the experiences of Black students in computing at Howard University and to introduce an introductory computing course that is valuable for all majors at the university. The overarching research questions that will guide the project are:

**Research Question 1:** (Self-efficacy) Do students studying technology at HBCUs believe that they are qualified to work in the high-tech industry (before they declare their major, throughout their time in the major, and post-graduation)?

**Research Question 1.1:** Are there specific factors that impact students' belief or disbelief that they are qualified to work in the high-tech industry?

**Research Question 2:** (Outcome expectations) After participating in classes that include problem-based learning and coding exercises, do students at HBCUs feel qualified to work in the high-tech industry?

**Research Question 2.1:** Do students have out-of-class experiences that contribute to the belief or disbelief that they are qualified to work in the high-tech industry?

**Research Question 3:** (Goals) Do minority students at HBCUs who study technology aspire to work in the high-tech industry/Silicon Valley?

**Research Question 3.1:** Does this perspective change after participating in a problem-based course?

Addressing these research questions will provide insights into how Black students thrive in computing, technology, and engineering fields.

Howard University, an HBCU, is among the premiere research universities in the nation and is one of the country's largest producers of African American STEM practitioners and leaders for public service and industry. Based on the Integrated Postsecondary Education Data System (Ginder et al., 2018), African Americans account for 85% of students enrolled at Howard University by race/ethnicity, while nonresident alien, Asian, White, and Hispanic/Latino students account for 8%, 3%, 3%, and 1%, respectively. In fact, during 2008-2012, Howard University ranked 1st among HBCUs in awarding BS degrees to African Americans and 6th among all universities in the US in the same category (Ginder et al., 2018). Howard University awarded a total of 3,114 (68%) STEM degrees to African American women, and 1,415 (31%) to African American men from 2005-2019.

The project described in this manuscript is expected to improve retention and result in the improved graduation rate of minority students in STEM disciplines at Howard University. This is aligned with the *2019-2024 Howard Forward* strategic plan outlined by Howard University (2018) that aims to "enhance academic excellence by supporting faculty, research and student development, academic rigor and retention through strategic recruitment and continuous improvement of academic programs." In turn, this will help Howard to sustain its leadership among the top universities in the nation in awarding BS degrees to African Americans. The potential institutional impact of the proposed project will be to broaden the pool of students exposed to technology in computing. Based on the outcomes of this project, we anticipate that an undergraduate research experience will become the norm for all STEM students and be fully integrated into the undergraduate curriculum. By preparing African American undergraduates for IT jobs, and linking them to companies seeking talented IT workers, HBCUs can better demonstrate their value proposition to parents, students, national and state governments, employers, and other stakeholders. This project specifically focuses on African American men, "the other STEM minority" (Bidwell, 2015), because their rate of enrollment in HBCUs is lower than that of their female counterparts. In addition, African American men are one of the only minority groups not currently making progress in their representation in STEM (Bidwell, 2015; Cain, 2021a). Given the number of computing, informatics, and engineering students graduated by HBCUs, and the lack of diversity in Silicon Valley, an academic-industry partnership is of interest to both parties.

**1.2 Silicon Valley**

Technology companies have a diverse user-base, although their staffs remain overwhelmingly white and male (Bass, 2017; Harkinson, 2015). For instance, Google, Apple, and eBay increased their ratio of non-white employees by only 1% in 2016 (Figure 1) (Quick & Tomasevic, 2017). Many companies have diversity programs and release their diversity metrics with a commitment to improving each year. However, progress has been slow due to some of the hiring practices, such as the technical interview, and issues related to company culture and "fit," for which HBCU students may not have been prepared (Frizell & Nave, 2008).

Tech companies in Silicon Valley have employed several strategies to improve the number of underrepresented employees (Kang & Frankel, 2015). One of these strategies is the immersion of technical employees at minority-serving institutions (MSIs) to teach computer science classes (Mejias et al., 2018). After more than five years embedded at a few of these institutions, tech companies have reported that students

graduating from HBCUs do not have the prerequisite skills to perform well in the field (Baker et al., 2015). One approach to address the perceived lack of preparedness is to embed HBCU

LLC with the goal of increasing the number of HBCU graduates employed as software engineers at Google and other tech companies in Silicon Valley. Additionally, the Howard-West
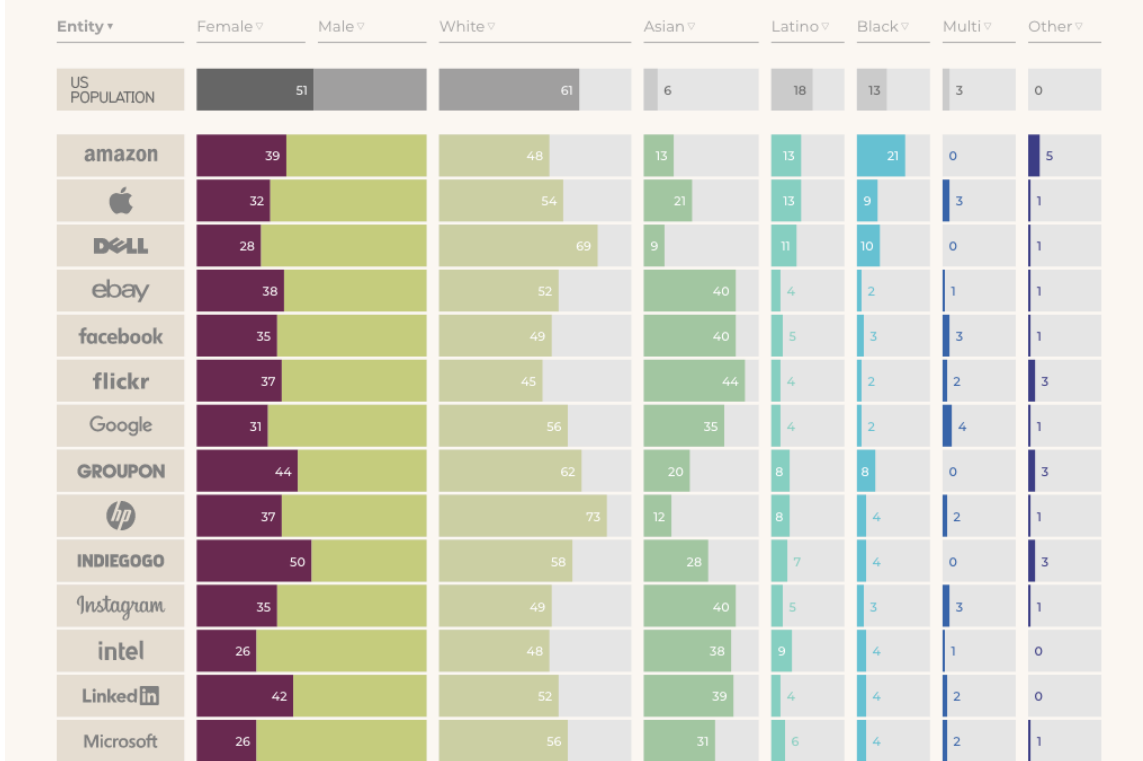
| Entity | Female | Male | White | Asian | Latino | Black | Multi | Other |
|---|---|---|---|---|---|---|---|---|
| US POPULATION | 51 | | 61 | 6 | 18 | 13 | 3 | 0 |
| amazon | 39 | | 48 | 13 | 13 | 21 | 0 | 5 |
| Apple | 32 | | 54 | 21 | 13 | 9 | 3 | 1 |
| DELL | 28 | | 69 | 9 | 11 | 10 | 0 | 1 |
| ebay | 38 | | 52 | 40 | 4 | 2 | 1 | 1 |
| facebook | 35 | | 49 | 40 | 5 | 3 | 3 | 1 |
| flickr | 37 | | 45 | 44 | 4 | 2 | 2 | 3 |
| Google | 31 | | 56 | 35 | 4 | 2 | 4 | 1 |
| GROUPON | 44 | | 62 | 20 | 8 | 8 | 0 | 3 |
| hp | 37 | | 73 | 12 | 8 | 4 | 2 | 1 |
| INDIEGOGO | 50 | | 58 | 28 | 7 | 4 | 0 | 3 |
| Instagram | 35 | | 49 | 40 | 5 | 3 | 3 | 1 |
| intel | 26 | | 48 | 38 | 9 | 4 | 1 | 0 |
| LinkedIn | 42 | | 52 | 39 | 4 | 4 | 2 | 0 |
| Microsoft | 26 | | 56 | 31 | 6 | 4 | 2 | 1 |

**Figure 1. Workforce diversity at major Silicon Valley firms (Quick & Tomasevic, 2017)**

faculty within companies with the goal of them transferring knowledge to their student population (e.g., the Google Faculty in Residence Program). Another approach is to have a tech employee partner with HBCU faculty to teach a course at the HBCU (e.g., the Google in Residence Program). Other companies, such as Facebook, have similar programs for HBCU faculty. However, these approaches do not address the cultural and demographic issues that many tech companies face.

Given the significant role that tech companies play in society, many HBCU students want to work for popular companies like Apple, Facebook, and Google, but encounter roadblocks that they may be ill equipped to navigate. If tech companies are serious about their commitment to diversifying their workforce with the competent, talented, and motivated students that HBCUs attract, then a HBCU-Silicon Valley partnership would be advantageous to all parties. Such a partnership could diversify the Silicon Valley workforce and drive enrollment in technology, computing, and informatics at HBCUs (Cain, 2021b).

One such academic–industry partnership is Howard-West, a partnership endorsed by the Board of Trustees and President of Howard University. A pilot program was conducted in the summer of 2017, and a full academic-year trial conducted during the 2017-2018 academic year. Faculty from the departments of computer science, information systems, education, sociology, and psychology at Howard were part of a larger team involved in the planning of the program. Howard-West was specifically created in collaboration with Google

project is directed toward upperclassmen, particularly juniors and seniors, who will soon graduate and enter the workforce.

The STEM partnership framework (Cain et al., 2018) is an enterprise architecture model that depicts how areas of STEM majors and courses, and schools and colleges, overlap with potential fields of employment. Using this framework, a class can be created that introduces technology to students early in their academic careers and addresses roadblocks concerning cultural fit at technology companies and technical interviewing skills using a module-based teaching pedagogy.

## 2. SUMMARY OF GOALS AND OBJECTIVES

The research objective is to understand, synthesize, document, and highlight the computing experiences of African American students in computing at Howard University, and to introduce an introductory computing and informatics course that employs a module-based teaching pedagogy that counts toward the degree requirement for all undergraduate students, regardless of major. Specific research and education goals and objectives for the project are listed below and expanded upon in later sections.

### 2.1 Research Goals
**Goal:** Identify and examine the experiences (i.e., barriers and successes) facing students studying technology in relation to future employment in the tech industry.

**Objective 1:** Collect empirical data to understand the factors that influence technology success.

**Objective 2:** Collect empirical data to understand how aspirations for careers in computing are actualized and cultivated.

**2.2 Education Goals**
**Goal 1:** Broaden the participation of students at HBCUs in computing and informatics.
   **Objective 1:** Strengthen links among students and with technology through the development and implementation of an introductory course in computing for all students at the university.
   **Objective 2:** Facilitate the participation of undergraduate students in problem-based courses.
   **Goal 2:** Disseminate the results broadly.
   **Objective 1:** Share results with educators, department chairs, and deans.

One aspect where this project and Howard-West differ is the target population. This project is not concerned about which field of computing students enter but is instead designed to increase the use of technology and informatics across the entire student body of Howard University, regardless of major. This program seeks to increase the number of underrepresented minority students in computing, technology, informatics, and engineering by: (1) providing learning activities that immerse students in similar projects and use the problem-based teaching and learning modules that were utilized in Howard-West, and (2) helping students develop their problem-solving and coding skills while showing them that computing will be an integral part of their lives regardless of their chosen profession.

The motivating hypothesis is that immersing students in technology at the time of their enrollment in the university can help grow the computing and informatics majors. The project's immersive learning approach will inform the pedagogy of computer science and informatics faculty.

**3. THEORETICAL FRAMEWORK AND EVALUATION**

Social cognitive career theory (SCCT) serves as the theoretical orientation for this project. In seminal work by Lent et al. (1994), SCCT, which was developed partially based on Bandura's (1986) general social cognitive theory, was also created to address three elements of career development: first, how interest in educational and career pursuits develop; second, the manner in which decisions about academic and career choice are made or enacted; and third, how success is defined within the academic or career environment. Importantly, all SCCT models (Figure 2) assume that "self-efficacy beliefs and

outcome expectations are informed by four primary sources of information: mastery experiences, vicarious learning, social persuasion, and physiological and affective states" (Lent & Brown, 2019), which correspond to the educational experiences this project seeks to deliver.

SCCT has been used to better understand and evaluate career and academic choices in a number of settings. Of specific interest to this project are studies that have used it as a framework to investigate academic or career choices, and the choices of minority populations. Regarding academic choices, Alshahrani et al. (2018) used SCCT to identify factors that might lead a university student to study computer science. The findings of that study were that social support, including support from teachers and family members, were of great importance, along with the diversity of career paths offered by the degree. Other studies (e.g., Flores et al., 2014; Navarro et al., 2014) have found that self-efficacy around engineering skills and goal-related factors were solid predictors of academic satisfaction among students studying engineering.

Research that uses SCCT as the theoretical orientation has also focused on ethnic minorities. According to Fouad and Santana (2017), "SCCT has continued to be the major theoretical framework investigating factors that have contributed to the underrepresentation of women and racial-ethnic minorities in STEM fields." For instance, a study by Alliman-Brissett and Turner (2010) evaluated math-based career interests among African American adolescents and found that perceived racism affected both self-efficacy and outcome expectations—and in turn, math and science interest among that population. Dickinson et al. (2017) examined the applicability of SCCT for a population of African American college students and found the theory to be appropriate for understanding their career development. Importantly, they found that African American college students' "self-efficacy beliefs play a more vital role in the formation of positive outcome expectations in comparison to the direct development of interests and choice goals."

Additional research has utilized SCCT and focused on the differences between minorities and genders and the career choices and development of women (Flores & O'Brien, 2002; Rollins & Valdez, 2006). A study of the career expectations of adolescents showed that both boys and girls report higher self-efficacy and interest in jobs that they believe employ a great number of individuals of their same gender (Ji et al., 2004). The constructs of SCCT lend themselves to understanding both the personal and the environmental influences that students are impacted by as they make both academic and career choices
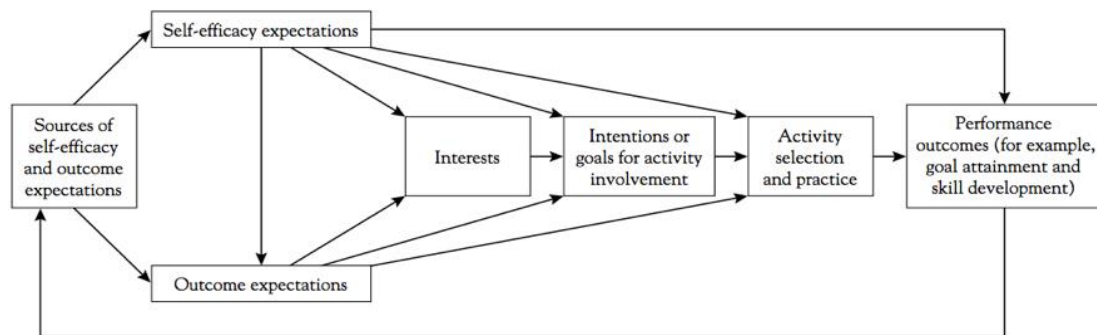
**Figure 2. Social Cognitive Career Theory: How Basic Career Interests Develop Over Time (Lent & Brown, 2019)**

(Lent et al., 2010). Thus, its use in this project will support an understanding of the differing influences and impacts that students experience as they seek to persevere in a technical field. It will also be useful in determining if the interventions planned are effective in increasing the number of minority students in technical fields (Patton, 2002).

**3.1 Formative Evaluation**
To provide a coordinated and coherent assessment procedure of the students and the activities in this project, historical information on student performance for the formative evaluation, and historical baseline performance data on student progression, retention, and graduation is examined. The data profile will contain a study of the students' progress, retention, and completion of undergraduate degrees in technology-related fields and any students entering a technology-related area after completing the module-based course (Table 1). Surveys on course engagement will also be given to students and faculty instructors.

Students will complete an evaluation form at the end of each semester that will assess satisfaction and engagement in project activities (e.g., course room instruction).

| Activities | Outputs | Three-year Outcomes | Long-term Outcomes |
|---|---|---|---|
| Recruit undergraduate computing, engineering, and information systems to take the courses. | Students who are active participants in the project each academic year. | Increase in progression and retention of students in computing, information systems, and engineering majors. | Institutionalization of Black computing, engineering, and information systems students with careers at high-tech companies. |
| Prepare student participants with the skill sets to become well-qualified candidates for internships and jobs with high-tech companies. | Students who pursue internships with industrial partners during the summers. | Document the aggregate number students participating in internships and gaining fulltime jobs in industry. | |
| Recruit non-computing majors to take the introductory computing course | Students who pursue internships with industrial partners during the summers | Document the aggregate number students participating in internships and gaining fulltime jobs in industry. | Institutionalization of Black students without computing degrees with knowledge and skills related to computing |

**Table 1. Project Logic Model**

**3.2 Summative Evaluation**
The summative evaluation will determine the extent to which the project has achieved its objectives, and will be guided by the following questions:

(1) To what extent did the project increase participant retention in computing and information systems disciplines?

(2) To what extent did the program increase participants' interest in pursuing information technology, computing, or engineering as their field of study?

(3) To what extent did the employer satisfaction with interns and hiring of computing and information systems graduates improve?

To address these questions, an evaluator will administer baseline and post surveys to students at the beginning and end of each academic year. The evaluator may also convene student and faculty focus groups to assist in analyzing changes from the beginning to the end of the year in objective areas to determine project impact on student's identity in computing, engineering, or information systems. Surveys will include both closed-ended (e.g., Likert-type scales) and open-ended questions. The evaluator will also administer a follow-up survey at the end of each year and request project tracking data, such as participants' enrollment, and GPA to determine whether students are retained and on track to obtain their degrees. Table 2 outlines the data sources, outcomes measured, and timeline of data collection. Analyses will include descriptive statistics, longitudinal comparisons using appropriate inferential statistical tests (e.g., paired samples t-test), and qualitative coding for identified themes.

| Activity | Measure(s) | Timeline |
|---|---|---|
| Baseline annual survey | Interest in pursuing careers in industry | Beginning of academic year for student participants |
| Post-annual survey | Interest and comfort in industry-based careers | End academic year for each student. |
| Follow-up survey | Number of students hired as interns or permanent employees at tech companies | End of academic year for students who have participated in the courses |
| Project tracking data request | Major enrollment GPA (satisfactory academic progress) | End of each academic year |

**Table 2. Summative Evaluation Activities**

## 4. PROPOSED TEACHING MODULES

Module-based learning is a structured practice that allows instructors to select topics that are both strategic in content delivery and important to courses. It guides the course's learning objectives and learning outcomes to support and aid students in mastering content. In module-based teaching schemes, an instructor teams up with other instructors (both academic and professional) to deliver in-class lectures, projects, and other activities to support learning outcomes.

This section outlines the collaboration within academic units at Howard University. One potential course offers a multidisciplinary teaching experience. Outlined below are several content areas that will be taught by different faculty members over the fall and spring semesters in a module- and program-based teaching style. Howard University has an organic partnership framework that has established courses

covering introductory topics in areas including software design, enterprise architecture, and management information systems. The new course implemented by this project will teach foundational principles in support of the project's computing and informatics goals. Students from any department, school, or college within the university can register for the class, which will expose them to topics in IT and enable them to excel at projects, business objectives, and other technology-based activities.

Similar models have been implemented at other institutions; Harvard University and Virginia Commonwealth University have done so at their Graduate School of Education and Executive MBA Programs, respectively (Virginia Commonwealth University, n.d.).

In the STEM Partnership Framework (Figure 3), courses are structured to employ a team-teaching arrangement, online learning modules, and in-class projects or labs to achieve course outcomes (Cain et al., 2018). Courses will offer instructor-based learning with practitioners to support current/emerging topics in technology like cloud computing and a discussion of the advancement of Amazon Web Services (AWS). Each course will leverage online modules to host macro- and micro-content to support in-class activities, such as a lab that will have students engage in cloud modeling to support a business problem. The online modules will support in-class projects, such as those in which students team up to build a cloud solution to support a business objective. Each module seeks to accelerate topics and expand learning across the entire framework providing participants the opportunity to advance technology learning and academic growth. Figure 3 is color-coded; green represents the School or College; yellow the discipline; pink the corporate domain; and gray the focus of the project. Figure 3 depicts a high-level overview of an Enterprise Architecture perspective across all disciplines at Howard University.
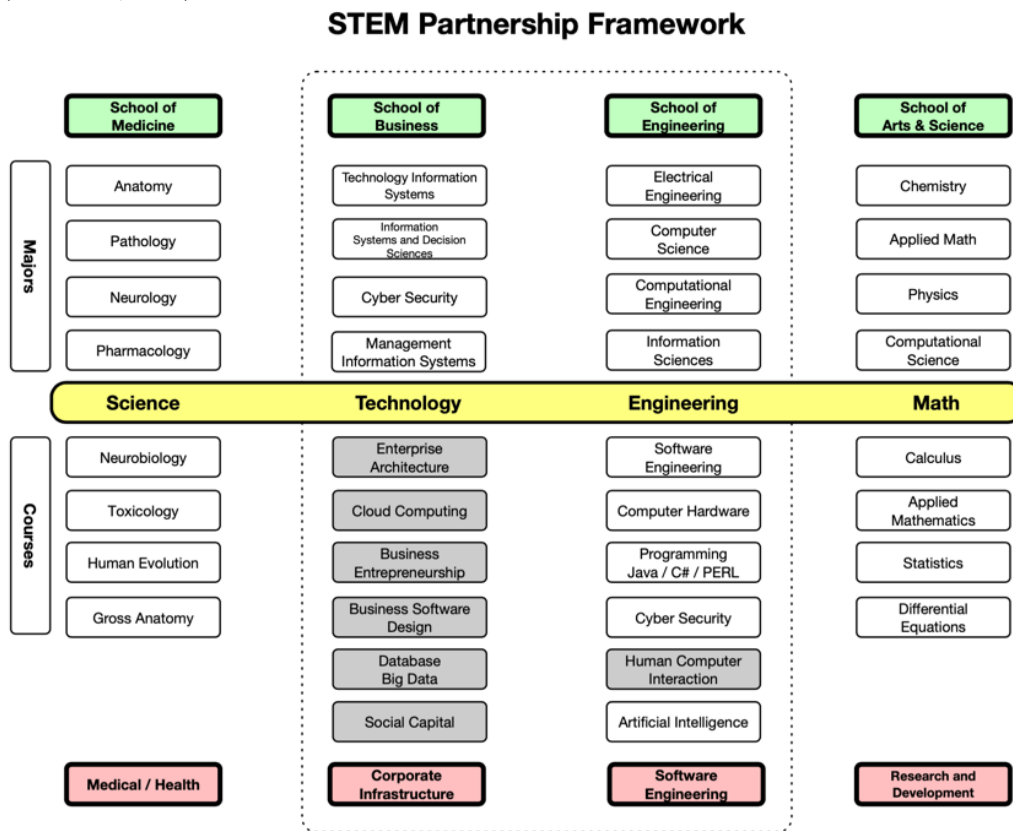


**Figure 3. STEM Partnership Framework**

The Howard University course implemented in this project will utilize modules from seven primary areas, as outlined in the Appendix.

Each of these modules will be refined with insights into workforce expectations gained from corporate partners. The project will engage corporations to provide feedback and input to ensure the projects and topics covered are related to emerging technologies in the field, and representative of real-world problems students would need to solve as professionals in the field. Figure 4 offers a map of some of the schools (in green),

and majors for which the proposed areas of emphasis (in gray) would be applicable.

**5. DISCUSSION**

Despite the financial disparities that cannot be solved with the rollout of any one program or initiative, HBCUs are overproducing graduates in computing, engineering, and informatics. Thus, HBCUs find themselves in a potentially advantageous position. They can build partnerships with corporations to ensure their students are exposed to technology

and the culture of companies. Leveraging the composition of their student body to focus on computing and partnering with

tech companies can help HBCUs provide their graduates with lucrative tech careers in a competitive environment.
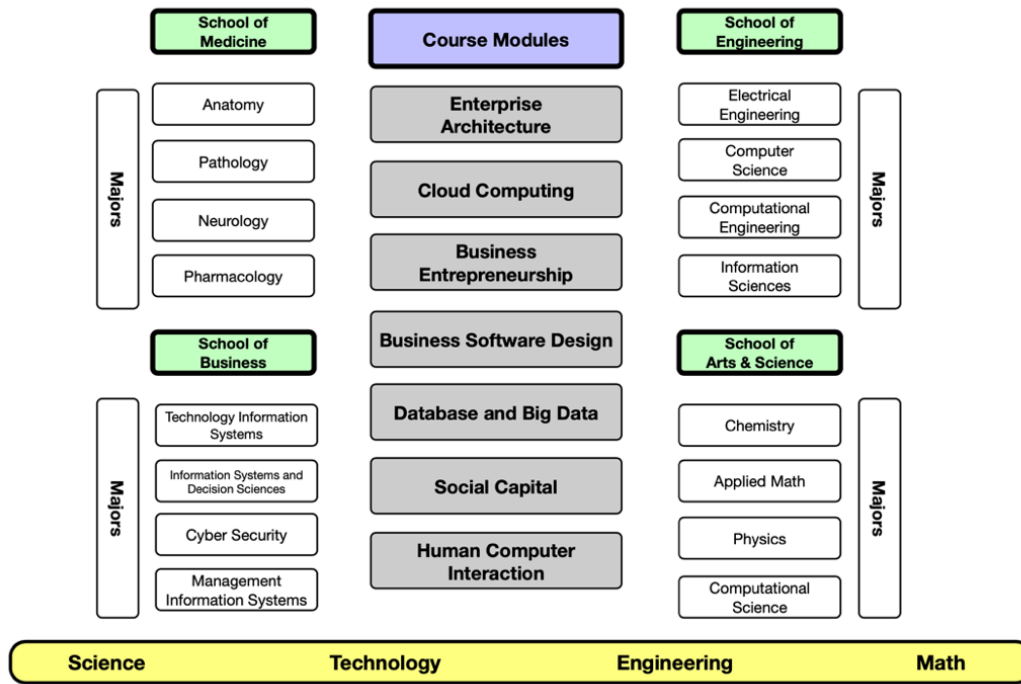


**Figure 4. Map of course modules**

HBCUs can grow their computing majors by implementing a class that introduces aspects of computing to undergraduates early in their academic careers in order to pique their interest in the field and provide insight into how prevalent technology is in society. As the demand for talent in computing fields continues to increase exponentially, the need for diverse perspectives and representation in those areas will also grow. HBCUs are well positioned to take a leadership role in the diversification of the computing workforce. These institutions already benefit from an inclusive culture and a legacy of achievement that makes them an excellent environment to facilitate education in the computing disciplines.

Given that HBCUs already produce a significant amount of STEM majors, it would stand to reason that the student body as a whole would have at least some passing interest in technology and computing. If that is true, then the modular-based curriculum would be well received. As student interest is piqued and cultivated in the proposed class, students would understand how integral technology and computing are to our collective lives and lifestyles, which tangentially translate into other aspects of culture, economics, and technology development. While one goal is to increase the number of students in technology, another is to allow students to gain perspective into how computing is relevant and necessary in nearly any career path.

In theory, enticing industry partners to engage students in meaningful ways at the onset of their collegiate careers should be self-motivating, instead of waiting for summer internship recruitment. Companies are still lacking a diverse ethnic

makeup. A partnership that serves the student in reaching their employment goal, the institution in providing access to capably trained and educated future employees, and the company seeking a diverse employee composition is a recipe that should promote and sell itself. However, that can only be the case when companies seek diversity through actions and deeds rather than words and lip service. The current Wells Fargo CEO, Charlie Scharf, in a June 2020 company memo stated, "While it might sound like an excuse, the unfortunate reality is that there is a very limited pool of Black talent to recruit from with this specific experience, as our industry does not have enough diversity in most senior roles." Mr. Scharf is misinformed, and his rationale is most undoubtedly incorrect and highlights being, knowingly or unknowingly, blind that diversity issues are likely to be present within many organizations. Furthermore, it is an implicit acknowledgment that even the CEO of the world's fourth-largest bank, by market capitalization, does not know how to address issues of a diverse and inclusive workforce tactfully.

Wells Fargo is just one of the latest examples of a company's failure to attract, retain, and promote diverse talent being placed on the very same populations for which it is seeking to attract to fill those positions. Dr. Claudia Rankins, former National Science Foundation Program Director and Hampton University-trained Physicist may have said it best, "There is only one reason we should seek diversity in our organizations, societies, workplaces, schools: it is the socially just and moral thing to do. Talking about how diversity ensures a large enough workforce and makes for better outcomes is self-

serving at best." And yet, here is an entire manuscript dedicated to that goal because it would appear that we need to continuously cloak equality, diversity, and inclusion as anything other than it is morally correct.

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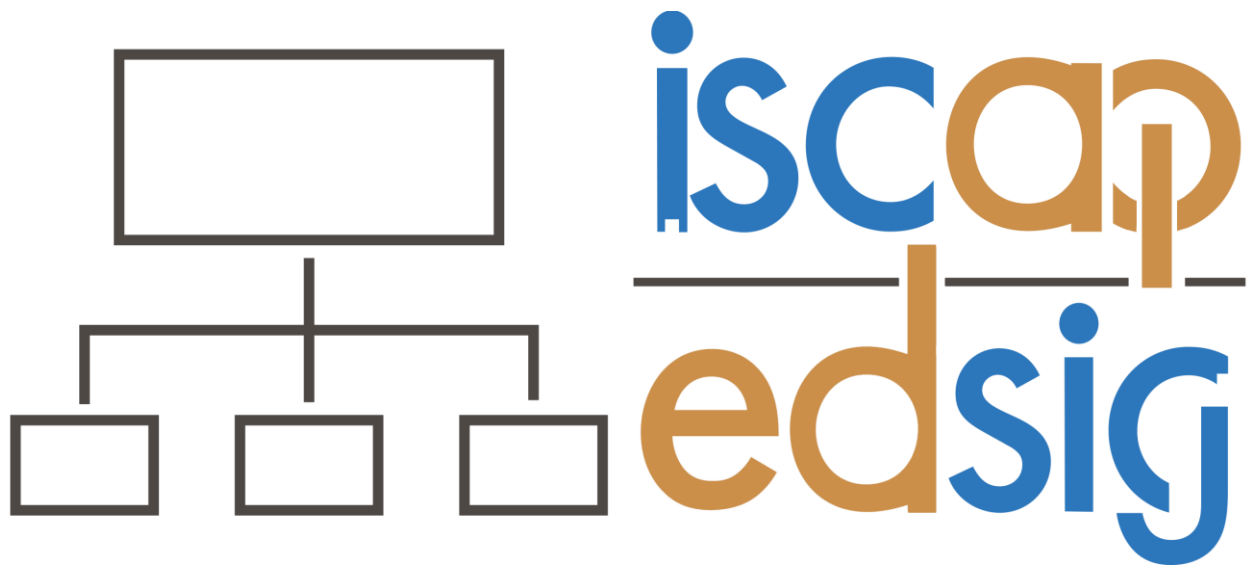**Curtis C. Cain** is an assistant professor in the Department of Information Systems and Supply Chain Management at Howard University and an affiliate professor of computer science in the College of Architecture and Engineering. His research interests over the last 12 years are in Computer Science Education and Broadening Participation in Computing. Specifically, he studies Black people's pathway into computing and engineering to analyze roadblocks and barriers to entry and to sustain success in the field. He has taught several classes at Howard University, and he has taught Software Engineering on Google's Main Campus in Silicon Valley. He received his Ph.D. from the College of Information Sciences and Technology (IST) at The Pennsylvania State University. He received his Master of Science in Computer Science and Software Engineering from Auburn University. He is the recipient of the prestigious NSF CAREER award and has received NSA funding to increase Cybersecurity. Additionally, he has the distinction of having received an Excellence in Teaching award from The Institute for Citizens and Scholars (Woodrow Wilson Foundation). During his Ph.D. studies, he received the National Science Foundation (NSF) Graduate Research Fellowship (GRF) to study Black men's underrepresentation in their pursuit of a computing degree.

**APPENDIX**

**Description of Primary Module Areas**

| Primary Area | Brief Area Summary |
|---|---|
| Enterprise Architecture | Understanding the inner workings of organizations can be a daunting task. This module aims to reflect how a complex system can provide consistency across an organization. Students will learn the fundamentals of refining business procedures, processes, and objectives, and how to align business objectives and missions, creating a standard enterprise language structure. |
| Software Design | The process of becoming an efficient programmer and software engineer begins with design. This module will demonstrate the concepts of structured programming design techniques. Students will develop skills in analyzing business requirements and systematically developing a structured approach using models, charts, pseudocode, object-oriented languages, and other methods used to develop solutions to meet requirements. |
| Management Information Systems | Information technology (IT) is becoming an increasingly significant source of competitive advantage in the business world. Technology alone does not confer a competitive advantage. However, the strategic use of IT to improve key business processes can strengthen a company's competitive position. Market leaders recognize the value of strategic IT management and have made it a core competency. Thus, this module will help students learn about IT and how it can be used productively by individuals, groups, and organizations. |
| Human–Computer Interaction | Interactive technologies are increasingly becoming an integral part of our every day and working lives. Human–Computer Interaction (HCI) is a multidisciplinary area concerned with the design, evaluation, and application of available, productive, and harmonious technologies. Interaction design is a user-centered approach to HCI that takes the interactive character of technologies seriously. This module will introduce students to the techniques, ideas, and models involved in designing and evaluating interactive technologies. Students will study user experience design concepts, processes, and practices, including topics such as user research, personas, heuristic evaluation, information architecture, wireframing, and usability assessment. |
| Social Media and Social Capital | Social media is a communication platform used by millions of people around the world to connect and share stories. This module will introduce students to the main aspects of the communication perspectives used to connect and build social capital. Students will have a basic understanding of social media's technological influences, social outreach, and implication for privacy. |
| Database Systems and Big Data | The impact and influence of data is omnipresent. However, few understand how data is gathered and how it is managed. This module will be designed to give students an overview of the database approach, database management system, Big Data storage, data analytic principles, visualization, cloud computing, and emerging trends in data management. |
| Tech Start-Up/Entrepreneurship | Tech students often want to create a company, but do not know where to start. This module will introduce foundational concepts and terms related to entrepreneurship and innovation, focusing on developing students' understanding of cultivating a business in a diverse, global environment and the dynamics of innovation in the tech industry. |

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