

# The ARTSI Alliance: Recruiting Underrepresented Students to Computer Science and Robotics to Improve Society

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## Abstract

African American students are underrepresented in computer science in general and more specifically in robotics. Often African American students are motivated to choose a particular field, such as medicine or law, by their desire to improve society. However, African Americans are seldom aware of the tremendous benefits computer science and robotics can make to society in general and to the African American community in particular. We describe an ambitious and innovative alliance centered around educational and research robotics projects, ARTSI: Advancing Robotics Technology for Societal Impact. ARTSI seeks to attract underrepresented students to computer science through robotics curricula and projects that advance society, concentrating on the areas of healthcare, arts and film, and entrepreneurship. The ARTSI Alliance involves seven Research I (R1) institutions, eight historically black colleges and universities (HBCUs), and a number of industry partners.

## Introduction

Technology literacy and access is a unique challenge within the United States among college students but even more so among minority first-generation college students [1]. African American student communities lack exposure to practical computer science and engineering disciplines such as robotics and their associated research areas. Often, their only exposure to robots comes in the form of science fiction movies such as *I, Robot*, *The Matrix*, or *Star Wars*, or video games such as *Halo 3*. One of the major aims of the ARTSI project is to facilitate early and tangible exposure to robotics technologies to ensure African American students possess the necessary skills to see the

potential positive impact of robotics research on our society. By combining practical and theoretical research as part of an undergraduate robotics curriculum, this intervention can motivate students to pursue a computer science concentration in graduate school and possibly advance robotics research. The ARTSI Alliance seeks to accomplish this through Projects that Engage Educational Robotics (P.E.E.R.) Teams involving healthcare, arts/film, and entrepreneurship. ARTSI has several activities that seek to increase the number of African American students who go on to study computer science and robotics in graduate school.

## ARTSI Goals

A major goal of ARTSI is to increase the number of African American students who study computer science and robotics in college and go on to pursue graduate studies in these areas. Another goal is to increase the number of HBCU faculty who educate students in robotics and involve students in robotics research. ARTSI also seeks to attract middle school and high school students to study computer science and robotics.

## ARTSI Activities

ARTSI activities designed to increase the number of African American students who study computer science in college and graduate school include: (1) summer research experiences for undergraduate students in robotics; (2) collaborative, interdisciplinary robotics projects in the arts and health; (3) instruction in technical film production, with student virtual film festivals; (4) an annual robotics conference; and (5) instruction in entrepreneurship for computer science. ARTSI will assist HBCU faculty in developing robotics curricula and involve them in robotics research through faculty mentoring, summer research

experiences for underrepresented faculty at R1 robotics labs, robotics summer faculty workshops, and development and dissemination of robotics educational material through a web-based portal. The alliance will reach out to the larger community to encourage middle school and high school students to study computer science and robotics in college, through activities such as K-12 community activities using robotics and art, robotics roadshows for high school students and teachers, and a robotics educational film online repository. ARTSI will be an available resource for K-12 teachers who wish to develop robotics projects in their schools. High schools will be encouraged to collaborate with an ARTSI HBCU to organize robotics clubs or workshops. These partnerships can result in the high school participating in a robotics competition such as FIRST robotics.

As an example of an HBCU contribution to ARTSI, the University of Arkansas at Pine Bluff (UAPB), has developed an introductory program to introduce students within computer science to tangible artificial intelligence artifacts such as robots, software agents, and knowledge mining applications. The program is designed to provide students with a basic understanding of the field of artificial intelligence and the specialization of robotics. The program not only increases the student's knowledge of robotics technology but also helps to eliminate their deficiencies with respect to practical computer science research and broadens their understanding of how computer science concepts can be used to solve real-world problems (Nelson et al. 2001).

The R1 partners contribute to ARTSI in three ways. (1) The faculty summer workshop program introduces HBCU faculty to new platforms and curriculum materials they can use in their classrooms. (2) A summer REU (Research Experience for Undergraduates) program brings HBCU students to R1 labs to work with faculty and graduate students. (3) R1 faculty can participate as advisors in P.E.E.R. Team projects to maintain an ongoing working relationship with HBCU faculty and students.

### **Cognitive Robotics**

A key component of ARTSI's educational approach is an emphasis on high level robot programming which we call "cognitive Robotics". Cognitive robotics seeks to develop primitives for perception and manipulation that draw inspiration from ideas in cognitive science. Rather than writing simple reactive programs that input raw sensor values and respond by turning motors on and off, students are provided with primitives for vision (shape recognition, perspective transforms), map building, localization, and navigation (Touretzky et al. 2007). They can use these primitives to solve more complex and interesting problems than would otherwise be possible.

An undergraduate curriculum in cognitive robotics developed by Touretzky and Tira-Thompson at Carnegie Mellon has been used at several ARTSI Alliance schools. The curriculum is based on a software development

framework for mobile robots called Tekkotsu, available for free at Tekkotsu.org. Tekkotsu was originally created for the Sony AIBO, but has since been extended to support a variety of different platforms (Tira-Thompson et al., in press). Spelman's robot soccer team, the SpelBots, has used Tekkotsu to compete in several RoboCup events.

### **ARTSI Alliance Members and Partners**

The current investigators in ARTSI include Andrew B. Williams, Spelman College; David Touretzky and Illah Nourbakhsh, Carnegie Mellon; LaVonne Manning, UDC; Thorna Humphries and Mona Rizvi, Norfolk State University; Ayanna Howard and Carl DiSalvo, Georgia Tech; Dieter Fox, University of Washington; Clement Allen, Florida A&M; Jeffrey Forbes, Duke University; Chutima Boonthum and Solomon Isekeije, Hampton University; Keith Hargrove, Morgan State University; Elva Jones and Rebecca Caldwell, Winston-Salem State University; Jessie Walker, University of Arkansas-Pine Bluff; Chad Jenkins, Brown University; and Monica Anderson, University of Alabama. Industry Partners include Juxtopia, iRobot, Seagate, and Microsoft Research. Academic partners include the Center for Healthcare Robotics, the Quality of Life Technology (QoLT) Center, The Florida-Georgia Louis Stokes Alliance for Minority Participation, and the Computer Science Teachers Association.

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