BPC-DP: Building a Bridge in Brooklyn – Project Summary

Brooklyn, a sprawling and diverse borough of New York City, characterized by a tightly packed landscape of strongly ethnic neighborhoods, is home to Brooklyn College (BC), one of nineteen institutions that comprise the City University of New York (CUNY). New York is still an active entry-point to the US, and many inhabitants of Brooklyn are first-generation Americans. Many of the students in the public schools are from non-English-speaking homes and poor working-class backgrounds. Brooklyn College is a non-residential campus where the large majority of students live at home with their extended families. They went to high school in Brooklyn and, because of family ties and financial constraints, these students attend college locally. Many of these students are the first in their families to obtain higher education, and many are from exactly those populations that are currently under-represented in STEM fields.

This **demonstration project** focuses on female minority students, primarily Black and Hispanic, who make up the majority of the population at Brooklyn College. The image for the project is the "tree that grows in Brooklyn", illustrating that students can aim high, reaching to meet personal and professional goals, while at the same time, remaining connected to their past, their families, their culture and their roots. Girls are attracted to professions where they feel that they can make a difference, and through this project, they will see that careers in computing *can make a difference* – through advances in computing technology, they can help analyze their grandmother's mammography images, organize the inventory in their uncle's deli or search for legal briefs to help their neighbor's deportment case.

This **Bridging** project will implement and test a series of interventions aimed at students across six critical years – from junior year in high school through senior year in college. By focusing on **preparation**, **recruitment** and **retention**, the project will emphasize the importance of computer science (CS) in a larger context and provide peer mentors and role models. A broad range of activities, at both high school and undergraduate levels, will be pursued: a *Summer Institute* to give high school students a chance to explore context-based computing concepts informally, a *Computing Preparatory Course* to provide high school students with background for college CS classes, *Interdisciplinary Seminars* to afford undergraduates who are undecided about their major an opportunity to examine computing applied to socially relevant areas, *Alternate Pathways into CS* to provide a sequence of tracked, application-based introductory programming courses to new undergraduate majors, and early involvement in *Undergraduate Research* and *Community Outreach* to show students the purpose for the skills they are developing. A strong, multi-faceted *Mentoring Program* will create a continuous support system for participants at all stages of the project and will include *Student Ambassadors* to link BC students to high schools. The expected results will be a collection of proven methods that can be exported to other institutions across New York City and beyond.

The **intellectual merit** of the proposal lies within the project team's proven dedication to teaching and serving under-represented populations. By tailoring successful interventions from institutions with different profiles to an urban, largely minority environment, as well as developing new approaches, particularly community-based activities and student ambassadorships, this **Bridging** project will provide a unique and very exciting suite of tested implementations. Due to the high concentration of diverse ethnicities in the Brooklyn community, the project provides an unusual opportunity to examine at once the effects of interventions in different under-represented groups.

The **broader impacts** of the proposed activities will be realized in new and adapted solutions that work for inner-city students from strong ethnic backgrounds and a deep-seated community base. Results will be widely disseminated in the form of portable context-based curricular modules and replicable community-service oriented mentoring programs. Broadening participation in computing in Brooklyn means building bridges that reach just across the street – yet at the same time, because of its diversity, the population represents a microcosm and an opportunity to learn about how to attract and retain students from varied backgrounds nationwide into the world of computing.

1. Introduction

When broadening participation in computing, one solution does not fit all situations [Galpin 2002] – what works at Carnegie Mellon University (CMU) will not necessarily achieve optimal results at an urban commuter school. One of 19 colleges that comprise the City University of New York (CUNY), Brooklyn College (BC) is a public liberal-arts 4-year college that primarily attracts working-class students, many of whom are the first in their families to attend college and most of whom hold part-time jobs while they go to school. Three-quarters of BC's 15,400[1] students attended Brooklyn high schools. The student body is 60% female; and nearly half the students are ethnic minorities under-represented in computing fields (30.7% African American, 11% Hispanic). Yet despite this diversity on campus, like most institutions in the US, a disproportionate number of the computer science (CS) majors at BC are white males (78%). Of the female CS majors, 18% are African American and 5% Hispanic. In this **demonstration project**, we will examine the factors that contribute to this imbalance and will implement interventions designed to increase the number of female and minority CS majors.

When talking to our CS students, we have found that females do not express the same sense of "not fitting in" that is widely reported elsewhere [Cahoon 20003, Margolis and Fisher 2003], and our statistics support this – the attrition rate for females is no worse than it is for males. However, we see high attrition rates for African American and Hispanic students (50% by the third year), indicating that solutions designed for females will not necessarily work for (male) minorities. Several factors separate BC computer science from CS departments in other schools. We have a relatively large proportion of female full-time faculty (23%). All of our students commute and most do their homework at home, so a strong "geek" culture [Turkle 1984, OTA 1998] does not exist on campus. Yet our department still fails to exceed average enrollment rates for female and minority students, and we cite several reasons. First, lack of preparation at the high school level combined with a feeling that CS is only for students who already know how to program means that relatively few students even consider the major. Second, both male and female students complain that they do not see the reasons for studying computer science until late in the major. Third, instead of female and minority students complaining of being left out of an existing CS community, they lament the lack of any academic community at all.

The purpose of this **Bridging** project is to help under-represented minority and female students to make the transition into computer science and to work within their urban communities as role models, by establishing computing-oriented connections between the university, local public schools and the neighboring community. We will achieve this by focusing on **preparation**, **recruitment** and **retention**, demonstrating the importance of computer science in a larger context and providing peer mentors and role models. The expected result will be a collection of proven methods that can be exported to other institutions across New York City and beyond.

To achieve our goals, we will pursue a broad range of activities. At the high school level, a *Summer Institute* will give students a chance to explore context-based computing concepts in an informal learning environment and a *Computing Preparatory Course* will provide the preparation students need to succeed in college CS classes. At the undergraduate level, *Interdisciplinary Seminars* will afford students who are undecided about their major an opportunity to examine computing applied to socially relevant areas. *Alternate Pathways into CS* will provide a sequence of tracked, application-based introductory programming courses to new undergraduate majors. Early involvement in *Undergraduate Research* and *Community Outreach* will show students the purpose for the skills they are developing. A strong, multi-faceted *Mentoring Program* will create a continuous support system for participants at all stages of the project and will include *Student Ambassadors* to link BC students to high schools. We will evaluate and document the impact of our initiative as it proceeds, so that we may make appropriate changes to improve our approach during the course of the project, to pave the way for

[1] All enrollment data quoted here is from Fall 2004.

future alliances and to provide suitable information for others who wish to follow in our footsteps.

The **intellectual merit** of this proposal lies in the strength and dedication of the project team combined with our unique environment for learning. The high concentration of diverse ethnicities in the Brooklyn College community and surrounding neighborhoods present an unusual opportunity to examine at once the effects of interventions in different groups – Black and Hispanic students of heritage ranging from Africa to the Caribbean to Mexico – at both high school and undergraduate levels. The team is working in cooperation with four local minority high schools, committed to the success of this program and interested in developing a CS curriculum for their students. The team itself includes computer scientists from a variety of fields with proven track records in research, teaching, mentoring and outreach. Two of the PIs and all the senior personnel (including the Dean of Research and Graduate Studies) are female. Many of their activities have included interdisciplinary projects and community service work, both involving female and minority participants.

The **broader impacts** of the proposal will be realized in new and adapted solutions that work for diverse urban populations with a deep-seated community base. While what works for Women@SCS at CMU will certainly inform our project, one size does not fit all – and we need to design solutions that succeed for inner-city students from strong ethnic backgrounds, students who live at home and feel the pressures of their parents and their heritage on a daily basis. Results will be widely disseminated in the form of portable context-based curricular modules, through our web site and textbook materials, and models of replicable community-service oriented mentoring programs. Broadening participation in computing in Brooklyn means building bridges that reach just across the street – yet at the same time, because of its diversity, the population represents a microcosm and an opportunity to learn about how to attract and retain students from varied backgrounds into the world of computing.

2. Background

According to the Information Technology Association of America (ITAA), between 1996 and 2002 the percentage of women in the IT workforce fell from 41% to 34.9%, and the percentage of African Americans fell from 9.1% to 8.2% [ITAA 2003]. These numbers follow from the numbers of students pursuing IT-related degrees. Women earned only 22% of computer science and engineering undergraduate degrees in 2000. African Americans earned 7%, Hispanics 5%, and Native Americans 1% of degrees. Comparing these figures with the corresponding figures for population shows the extent to which computer science engineering departments as a whole are failing to attract students from these backgrounds. Recent evidence shows that the situation is getting even worse [Foster 2005] with the number of declared computer science majors dropping 32% between 2000 and 2004.

Probably the best known and most comprehensive work on women in computer science is *Unlocking the Clubhouse*, by Margolis and Fisher [2003], which describes CMU's success in increasing female enrollment in CS majors. The book includes vivid stories of women dropping out of a highly aggressive competitive culture that is perceived to typify the CS major. The conclusions of this work closely mirror the major reasons that [AAUW 2000] reported as turning women away from CS: (1) perceived incompatibility of CS with a well-rounded, family life[2]; (2) unacceptability of the competitive rather than collaborative environment in many CS departments; and (3) perception of CS as a solitary major not well integrated into social institutions or interactions. These studies have shown that *the issue is not that women cannot compete, but that they choose not to.*

Relatively few studies have paid any particular attention to these issues among under-represented minority students [AAUW 2004]. However, there is evidence [Simms, et al. 1993] that many of the same factors, such as the lack of social focus [Sleeter and Grant 1987] and antipathy to the way the subject is taught [Shade 1982], have a role, along with some that are minority-specific, such as dealing

[2] This is a problem across all the sciences of course. [Brasselman 2001] reports that 66% of all women scientists marry, compared with 83% of men scientists.

with the social scene on campus [Person and Christensen 1996]. Another major problem [May and Chubin 2003] is the lack of resources during their school careers. Many African American (32%) and Hispanic (25%) students attend inner city schools in poor areas, where schools lack resources [NCES 1999] such as computers and Internet access [Parrish et al. 1995]: in 1999, only 39% of classrooms in high poverty areas had Internet access as opposed to the national average of 63% [Williams 2000]. Furthermore, this aspect of the *digital divide* seems to be growing [Dept. of Commerce 1999, Farrell 2005]. All of these factors mean that minority students arrive as college freshmen with much less preparation in computing than most of their majority peers.

While some of the data suggest that women are rejecting all the sciences [e.g., Seymour and Hewitt, 1997], other data suggests that there may be other psychological factors at work among women at less highly selective schools than CMU. Scragg and Smith [2005] reported that the difference between women and men at a public university (SUNY[3] Geneseo) was not that women dropped out more than men, but that fewer women were entering the major to start with. This is closer to the situation that we face at Brooklyn College. All of Steele's work on stereotype threat (the avoidance of domains where individuals are afraid their poor performance would reinforce negative social stereotypes for members of a group they belong to [e.g., Steele and Aronson 1995]) shows it is unlikely that the strong social stereotypes against women in computing would not affect women's self-concept and self-efficacy. Indeed, other research appears to support this [e.g., Busch 1996, Garvin-Doxas and Barker 2005, Lester and Brown, 2004] on measures of self-efficacy [Bandura 1997, Plaks et al. 2001]. It is worth noting that in most research, the effects of stereotype threat and reduced self-efficacy weigh more heavily on minorities. Careful mentoring is one way to address such social dynamics for women and minorities in similar male-dominated fields [Chesler and Chesler, 2002].

To see how women and minority students cope locally at Brooklyn College, we examined the transcripts of all students who took the introductory computer science course in Fall 2001, in order to track the subsequent development of these students. More than 63% of the students enrolled were taking the class within their first four semesters of entering the college, often in their first or second semester (a good predictor for student retention [Anderson-Rowland 1998]). This means that a new approach early on has a good chance of capturing potential CS majors. However, most of the students taking the introductory course that semester did not go on to major in CS: only 23% of the group went on to become CS majors, and 51% ultimately took other majors (another 23% apparently left school).

Of 409 students, 62% were male and 38% female. Women were less likely to major in CS (24%) than their proportion in this population. African American women again represented only 18% of the female CS majors; there were no Hispanic women who majored in CS in this sample. When looking at course performance, grades in the class were divided into "satisfactory" (at least C-) or "unsatisfactory" (less than C- or did not finish the course); 36% of those who ultimately majored in CS had grades lower than C-. Among all the women taking introductory CS that Fall, 66% overall and 90% of the women of color had unsatisfactory grades. More than 70% of these women ultimately majored in something other than CS, probably because their first experience was not successful.

The genesis of the project described here is to increase the academic success of women taking CS courses. Yet while retention of women in CS is important, attracting new women, particularly women of color, remains for us the best way to really improve on the numbers of females in CS professions. Our **Bridging** project is designed both to increase academic success and retention for women CS majors, and to attract new students to the major by making it more appealing in a variety of ways. Our current data will form the basis for quantitative comparison of the program's impact.

[3] State University of New York

3. Our Approach

Our approach is to target minorities (Black and Hispanic), with an emphasis on females, implementing many of the elements suggested in the literature both for female [Margolis and Fisher 2003] and minority students [Landis 1991][5]. We will build students' confidence levels and develop their skills through *innovative teaching methods*. For example, Werner et. al [2004] showed that *pair-programming* increases student confidence and reduces attrition rates for women, minorities and even traditional white males. Other studies have shown that *team-based, creative projects* and *mentoring* help attract female students [Moskal et al. 2001, Sklar and Eguchi 2004a, Sklar and Eguchi 2004b]. Our aim is not to filter out students who cannot cope with the picayune details of code syntax but rather to get everyone through the early stages of the program with strong conceptual understanding of the materials [Roberts et al. 2002].

We have chosen a **track** emphasis to attract and motivate students. We recognize that girls are drawn to professions where they feel that they can make a difference, and we will show them that careers in computing *can* make a difference – through advances in computing technology, they can help organize the inventory in their uncle's deli, analyze their grandmother's mammography images, or search for legal briefs to help their neighbor's deportment case. We also recognize that many girls particularly enjoy being creative. One of the main reasons that young women steer away from computer science is that they are not aware of the range of purposeful, practical applications of computing and the necessity for creative thinking and design in order to apply computing principles successfully. Thus, we have chosen five tracks for this demonstration project around which the academic aspects of the project revolve. Each of the project PIs has expertise in one of the areas – *applications:* (1) **business** (Prof Rudowsky), (2) **medicine** (Prof Parsons) and (3) **law** (Prof Chopra); and *creative technologies:* (4) **graphics and multimedia** (Prof Scarlatos) and (5) **robotics and simulation** (Prof Sklar).

This project is not about curriculum development – it is more about *curriculum delivery*. Capitalizing on prior research and teaching experiences of each of the PIs, we will produce portable **modules** for each track that can be used in multiple interventions and can be transferred easily to other institutions. The scope of the project will provide an opportunity for us to evaluate the effectiveness of these modules in different settings (high school vs. college, formal vs. informal) with different populations (male, female, Black, white, Hispanic). The modules will include lecture notes, reading material, code examples, lab exercises and sample assessments.

Our program incorporates seven interventions: (1) a **summer institute** where high school students get a taste of computer science designed to pique their curiosity, (2) a **computing preparatory course** that will ease the transition for high school students into college-level computer science classes, (3) **interdisciplinary seminars** where students who have yet to declare their major can explore specific computing-related fields such as *Bioinformatics*, *Intellectual Property Law* and *Geographical Information Systems*, (4) **alternate pathways into computer science** where students learn the basics of computer programming in application-oriented, project-based courses, (5) **undergraduate research** where students are brought into research labs early on in their academic careers, (6) **community outreach** where students provide practical solutions to computing problems that will help family members, neighbors and friends, and (7) a **continuous mentoring program**, where role models are provided for participants in all stages of the program, support is offered on both academic and social levels, and **student ambassadors** lead the way, from high school to college.

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[4] Note that we will not turn away non-minority females, male minorities, or any students for that matter – though the financial benefits of the program (i.e., student stipends) will be limited to female students. If we find that there are not enough qualified females to receive the funding, then we will step up training and recruitment to provide qualified female students.

[5] These have been shown to have achieve an improvement in minority student performance of up to one letter grade [Triesman 1985, Samms 1997].

4. Implementation plan

From an administrative standpoint, the project activities fall into three categories: (1) **high school**, (2) **undergraduate** and (3) **community building**. Each of these is detailed in this section, followed by a **management** plan and an overall timeline for the project. Though the implementation plan involves a sequential set of activities that could span three years for an individual student, we have designed the sequence for multiple entry-points. Working with a commuting urban population teaches one to be flexible – it simply would be unrealistic to state that we could pick a cohort of students and follow them through three years of the program from start to finish because students frequently move and transfer between schools.

4.1. High School

At the high school level, we will focus our energies on *preparing* and *recruiting* students through two activities (detailed below): a ***Summer Institute*** and a ***Computing Preparatory Course.***

Expected outcomes include increased opportunities for low-income students to work with computers (since many do not have computers in school or at home, simply getting any "keyboard time" is beneficial) and increased interest in CS as a viable career path for these students. Seeing CS undergraduate role models from the same background will help convince high school students that they, too, can succeed in CS. Additionally, by working directly with high schools, we will demonstrate to guidance counselors that CS can be a good career option for many different students.

4.1.1. Summer Institute

We will offer a 2-week summer program at Brooklyn College geared toward students who have completed their junior year in high school. Working with our partner high schools, we will actively recruit 65 students (focusing on Black and Hispanic females) who have high enough math and science grades to support a CS major but feel (before attending the institute) that it is unlikely they will major in CS. Undergraduate student ambassadors (section 4.3.3) will visit the partner high schools to help with recruiting and will later serve as teaching assistants at the summer institute.

The institute will be scheduled over two 4-day weeks. In the first two and a half days, students will attend half-day workshops for each of the five tracks outlined in section 3. For the next five days, students will select one track and work on a focused, meaningful, team-based project in that track. For example, in the *Robotics and Simulation Track*, students will program Lego Mindstorms robots to accomplish a simulated urban search and rescue task [Sklar 2004]. Finally, in the last half-day, students will showcase their projects to each other and to parents and family members. The showcase will extend into the evening of the last day to accommodate working parents.

The purpose of the summer institute is to give students a taste of what they will be able to do after four years of training in computer science. It will emphasize the need for adequate preparation to successfully complete such a program of study. We will draw upon the many successful summer programs that have been implemented at institutions catering to minority and women populations in technical fields [Brahma 1989, Das 1997].

4.1.2. Computing Preparatory Course

After students have completed the summer institute, we will continue to work with them during their senior year by offering a preparatory course, spread over a full year of high school. The course will pick up where the summer institute left off – though we will allow students who did not attend the summer institute, but meet the minimum GPA requirements, to enter the program here.

The course will incorporate the same tracks that play a central role in the summer institute. High school students finishing this course will have acquired a considerable degree of comfort and technical

adeptness before they enter an undergraduate program. Again, the undergraduate student ambassadors will act as teaching assistants.

The course will be taught at Brooklyn College, to give students more of a "college experience", to make them feel special and give them a sense of accomplishment. This will contribute to raising participants' profiles in the eyes of their peers and parents and will boost self-confidence. Two sections of the course will be offered: some of our high school partners have agreed to allow their students to come to campus during the school day to attend the class; others are further away where quick travel to and fro is impossible, and so we will offer a second section after school.

4.2. Undergraduate level

At the undergraduate level, we will focus on *recruitment* and *retention* through four activities (detailed below): ***Interdisciplinary Computing Seminars***, ***Alternate Pathways into CS***, ***Undergraduate Research*** and ***Community Outreach***.

4.2.1. Interdisciplinary Computing Seminar

In order to recruit new students into the CS major, we will implement one-semester interdisciplinary seminars that stress computer science as a discipline which is important in many broad contexts and can be used to address problems of social relevance. For each of the five tracks outlined in section 3, we will deliver a high-level interdisciplinary seminar that contains both lecture and laboratory components and provides some hands-on experiences with appropriate computational environments. For example, in the *Medical Track*, students will experiment with a NetLogo[6] [Wilensky 2001] simulation showing how disease can spread through social contact. The seminars will be accessible to students with no experience in computing and, at BC, will satisfy a general "core" requirement that is compulsory for all undergraduates (similar requirements at other liberal arts universities are sometimes labeled "quantitative" or "technical" breadth requirements).

One expected outcome is that many of the minority and female students at Brooklyn College who are undecided about their major will decide that computer science is for them after taking this course. Another expected outcome is that students with little hands-on computing experience will develop basic computer skills in this class.

4.2.2. Alternate Pathways into CS

Like most departments, Brooklyn's computer science department requires all majors to take a sequence of two programming courses, which we will refer to here generically as CS-1 (i.e., "Introductory Programming") and CS-2 (i.e., "Advanced Programming"). Also as in many departments, these two courses represent the greatest attrition rates in the major, and we (like others, e.g., [Stein 1998, Hoit and Ohland 1998, Astrachan et al. 1996, Pattis 1997]) believe that this is because these courses stress the abstract mechanisms of programming and do not relate to concrete, real-world tasks. To address this issue, we will create alternate pathways into the computer science major, one sequence for each of the five tracks discussed in section 3. Innovative teaching methods such as pair-programming, team-based group-work and end-of-term demonstrations will be integrated into the curriculum to help build student confidence and camaraderie.

Since our department offers multiple sections of these classes every semester, we are in a strong position to perform a study comparing traditional and alternate approaches. Each two-course sequence will be taught in consecutive semesters by the same professor (for each topic) and will contain the same students[7]. Expected outcomes of this objective include a decrease in the attrition rate from CS-1

[6] http://ccl.northwestern.edu/netlogo/

[7] While ideally we will have exactly the same cohort of students both semesters, we cannot guarantee this. Our evaluation

to CS-2, particularly for female and minority students.

4.2.3. Undergraduate Research

Early undergraduate participation in enriched research projects will help students feel connected both academically, by understanding how the fundamental materials they are learning as part of the CS major are used, and socially, by developing relationships with research faculty, graduate students and other undergraduates who are involved in research projects. When these relationships are most successful, students stay connected to faculty members throughout their college years (and beyond), continuing to enroll in independent research courses, working in research labs during the summer and participating in exchanges to labs of faculty colleagues – an aspect we will pursue with current collaborators in Australia, Canada, Spain and the UK. Such experiences can inspire students to pursue research careers, subsequently becoming role models for future generations.

While many CS departments offer research options to undergraduates, at Brooklyn College, CS undergraduates are required to work on a major programming project which can be (and often is) guided research with a faculty member. However, this is typically done *after* the non-elective courses for the major are completed. Instead, we will engage the Bridging students in research projects with the PIs early on, just after they have completed CS-2. The expected outcomes are not only that these students will stay enrolled in the major but also that their grades in CS courses will improve due to comfortable relationships with faculty and graduate student mentors, where they can get academic and moral support, and a better sense of where textbook material fits in.

4.2.4. Community Outreach

A significant and unusual component of our Bridging project is a substantial effort toward community outreach. Collaboration will be encouraged, to ensure that the outreach is well-staffed and to give students an opportunity to work together and learn from each other by sharing their expertise. Three types of "practical internships" will be pursued.

First, students will work as **IT Support Interns** in the four partner high schools. Public schools are always understaffed in their IT departments, where technology or computer science (or other) teachers double as system and network administrators for the school. These overworked teachers are called upon not only to install new hardware and software and to upgrade operating systems, but also to fix equipment when it breaks. Extra pairs of hands belonging to eager undergraduates will complement existing school IT staff. Interns will also help high school students prepare for extra-curricular team-based computing activities, such as robotics competitions (e.g., FIRST[8], BotBall[9] or RoboCupJunior[10]). The added benefit of this aspect is that these undergraduates will automatically become mentors and role models as high school students see them in their schools performing IT jobs and offering technical assistance.

Second, we will create a **Community Computing Consultancy**, building up a database of small projects that require technical attention in the immediate neighborhood of the college, and we will assign groups of student "consultants" to undertake appropriate tasks. We will advertise in the community that help is available not only for system administration tasks (as above), but also for software expertise to accomplish straightforward tasks, such as designing web pages or customizing database packages. Student participants may earn independent project credit by working on these jobs

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will take this into account and will produce measures after each semester.

[8] http://www.usfirst.org

[9] http://www.botball.org

[10] http://www.robocupjunior.org

for free or customers may choose to pay a nominal fee for the help[11]. If the demand is great, we will seek additional funding from local companies to support this aspect of the Bridging project[12].

Finally, we will establish a **Community Computing Center** on the BC campus. We will set up a room containing last-generation computers and establish drop-in hours where community members can come for training and Internet access. Bridging students will staff and maintain this space. They will conduct "computer drives" on campus to collect last-generation equipment from departments that are upgrading and use the machines to equip the facility.

Expected outcomes of these activities include increased opportunities for practical, hands-on experiences and an improved view of computing as a desirable career path.

4.3. Mentoring and Community Building

The cornerstone of the Bridging project is a comprehensive mentoring and community-building plan. We have already mentioned the academic aspects of this; the social aspects are outlined below. Expected outcomes include a greater sense of belonging to a community, as well as a feeling of empowerment as students are able to have an impact on what goes on in the CS department and the outlying neighborhoods. We expect that this will, in turn, help to reduce attrition rates.

4.3.1. Social and Academic Support

Successful mentoring programs offer social as well as academic support mechanisms. This is particularly crucial for encouraging under-represented individuals to become pioneers, and we will draw upon the resources of programs such as those at New Jersey Institute of Technology (NJIT), a nearby university that deals with a large minority population taking technical courses. We will offer peer-mentoring for undergraduates [Wills et al. 1999] as well as "big sister-little sister" mentoring [Freize and Blum 2002], involving professors [Atkinson et al. 1991], graduate students, undergraduates and high school students. Ties will be established early on, during the *Summer Institute* and *Interdisciplinary Seminars*. Students will be able to call upon the network of mentors to address general academic issues (e.g., time management, exam-taking strategies), Brooklyn-specific academic questions (e.g., course selection, computing environment), course-specific problems (e.g., homework help), and life issues (e.g., having a life while studying CS, talking to parents about computing careers, balancing work and family, appearing attractive to boys despite being a CS major…). Study groups will be established, as well as chat groups for those who prefer to converse on-line and exercise groups to talk and walk, bike, run, dance or do yoga together.

4.3.2. Tea with a Prof

We will sponsor a monthly tea with one of the PIs and discuss a single issue at each session (e.g., "how to talk to your parents about IT careers" or "how to have a life *and* a CS career"). These meetings will foster a sense of community among CS students who currently feel isolated and disconnected from one another, giving students from under-represented groups a chance to meet each other and find common interests and concerns. The teas will instill in students a sense of ownership and importance in the department. Expected outcomes include decreased sense of isolation, increased sense of belonging and improved relationships between students and faculty.

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[11] Since most BC students hold part-time jobs, paid employment as a computing consultant could take the place of current, typically non-academically-oriented positions and give the student more time to dedicate to the project than with an academic-credit based arrangement.

[12] As part of their community service, larger companies would be called upon to support the needs of organizations that could not afford to pay for consulting help (even at nominal rates), such as child-care centers.

4.3.3. Student Ambassadors

We will create a cadre of "student ambassadors" from amongst our current computer science undergraduates from under-represented groups. These students will visit local high schools to recruit students into the Bridging program and help with program activities. Where possible, we will send alumni back to their own high schools. The student ambassadors will fulfill roles as teaching assistants for the *Summer Institute* and the *Computing Preparatory Course*, as system administrators for school IT departments and coaches for extra-curricular teams. The student ambassadors will be carefully selected (women and minorities) and trained as teaching assistants and peer mentors. The expected outcomes will be an increase in students from those groups pursuing CS majors.

4.3.4. Showcase Day

We will organize an annual one-day event for all project participants, to bring people together and to showcase the project's activities. The first half of the day will be for participants to discuss progress of the project. This will include breakout groups and guided exchange about key issues (such as impact on student participants) and will involve all students as well as college faculty and administrators, high school teachers and principals. A distinguished speaker will be invited to address the group. The event will include a public forum for participants to display their research projects and outreach activities for their peers, their parents and families, and community members.

The *Showcase Day* will increase the visibility of collaborative undergraduate research and outreach projects conducted with professors and local organizations. Incentives such as a "best paper" prize and poster sessions where participants can show off their work will encourage students. These types of events have been shown to be more attractive than programming contests [Fitzgerald 1996] and to make minority students feel more welcome [Mitchell and Yarborough 1999, Sedlacek 1987]. Expected outcomes include increased quality of student projects, increased visibility of the Bridging project and the CS department, increased understanding and acceptance by parents of computing careers, and greater interest in computer science among our female and minority students.

4.4. Management Plan

The PI (Scarlatos) will manage the project and keep it on schedule by distributing responsibilities and holding monthly status meetings. Individual PIs will be responsible for managing each of the interventions: Summer Institute (Scarlatos), Computing Preparatory Course (Sklar and Parsons), IT Support Interns (Rudowsky), Community Computing Consultancy (Rudowsky), Community Computing Center (Parsons), Social and Academic Support (Sklar), Tea with a Prof (Scarlatos), Student Ambassadors (Chopra) and Showcase Day (Chopra). Each PI will be responsible for delivering and packaging modules for their designated track (section 3) and will align these tasks with their regular undergraduate teaching duties. Graduate students (female and minority) will deliver the modules in the Computing Preparatory Course. Prof Sklar and Parsons will oversee the graduate students and the course implementation.

The evaluation team (Dean Hainline and Dr Lowes) will coordinate development of surveys, data collection and analysis. Another senior member of the project team (Ms Holder) will act as Community Liaison and will coordinate all activities with the four high schools. This will include the recruitment of high school students for the summer institute and the computing preparatory course. An administrative assistant will take care of all paperwork, schedule meetings, handle data collection, dissemination and maintain the project web site.

The project timeline is shown in Table 1 (on the next page).

4.5. Dissemination

Our interventions will be easily reproducible in other cooperative college-high school settings. We

will offer a general procedure for highlighting the attractions of computing while not minimizing the technical skills required to become a computer scientist. We will draft textbook materials for a high school computing preparatory course and tracked undergraduate CS1-2 sequences.

We plan to disseminate the results of the project primarily through a project website. Although we do intend to present our findings at workshops and in scholarly papers, this on-line repository of project information will allow us to disseminate materials more broadly, including reports, and nuggets for the NSF. Our website will feature the following: descriptions of research and outreach projects, training materials for student ambassadors, course modules (including lecture notes, programming examples, and lab assignments), annual evaluation reports, and links to other NSF BPC projects.

At the end of the grant period, we intend to take steps that will enable us to expand the scope and impact of this project. These steps will include collaborating with other CUNY and SUNY colleges (particularly existing and future NSF GK-12 and NSF BCP projects) to export our interventions; expanding the summer institutes to include more high schools and community colleges; and expanding the scope of our research and outreach projects by building on alliances that we already have with local organizations (including the National Park Service and the New York Hall of Science).

	Spring 2006	Summer 2006	Fall 2006	Spring 2007	Summer 2007	Fall 2007	Spring 2008	Summer 2008	Fall 2008	Spring 2009	
planning activities:											
recruit and train student ambassadors	x			x			x				Chopra
recruit graduate student instructors	x					x					Sklar,Parsons
recruit high school participants	x			x			x				Holder
plan for summer institute	x			x			x				Scarlatos,Holder
plan for teaching activities	x	x	x	x	x	x	x	x			Scarlatos,Chopra,Rudowsky,Parsons,Sklar
teaching activities:											
summer institute		x			x			x			Scarlatos
computing preparatory course			x	x		x	x		x	x	Sklar, Parsons
interdisciplinary seminar (business applications)			x			x	x				Rudowsky
interdisciplinary seminar (medical applications)			x	x			x				Parsons
interdisciplinary seminar (legal applications)				x		x			x		Chopra
interdisciplinary seminar (graphics and multimedia)			x			x			x		Scarlatos
interdisciplinary seminar (robotics and simulations)				x			x		x		Sklar
CS-1 (business applications)	x					x					Rudowsky
CS-1 (medical applications)			x				x				Parsons
CS-1 (legal applications)				x					x		Chopra
CS-1 (graphics and multimedia)			x			x			x		Scarlatos
CS-1 (robotics and simulations)	x			x			x				Sklar
CS-2 (business applications)			x				x				Rudowsky
CS-2 (medical applications)				x					x		Parsons
CS-2 (legal applications)						x				x	Chopra
CS-2 (graphics and multimedia)				x			x			x	Scarlatos
CS-2 (robotics and simulations)			x			x			x		Sklar
community/mentoring activities:											
supervise undergraduate research projects	x	x	x	x	x	x	x	x	x	x	Scarlatos,Chopra,Rudowsky,Parsons,Sklar
supervise IT support interns	x	x	x	x	x	x	x	x	x	x	Rudowsky
supervise community computing consultancy	x	x	x	x	x	x	x	x	x	x	Rudowsky
supervise community computing center	x	x	x	x	x	x	x	x	x	x	Parsons
oversee social and academic mentoring program	x	x	x	x	x	x	x	x	x	x	Sklar
organize tea with a prof	x	x	x	x	x	x	x	x	x	x	Scarlatos
manage student ambassadors	x	x	x	x	x	x	x	x	x	x	Chopra
hold showcase day				x			x			x	Chopra and everyone
evaluation activities:											
create/modify surveys	x			x			x				Lowes
collect data	x	x	x	x	x	x	x	x	x	x	Hainline, Lowes
analyze data	x	x	x	x	x	x	x	x	x	x	Hainline, Lowes
write reports			x			x			x		Scarlatos, Hainline, Lowes
advisory board				x			x			x	everyone

Table 1. Project Timeline.

5. Partnership Plan

5.1. PIs and Senior Personnel

Dr Lori Scarlatos, the PI, is an Associate Professor in the CIS department. Her research interests are primarily in the areas of computer graphics, with a focus on multiple level of detail modeling, and computer-human interaction, with a focus on tangible user interfaces in educational applications. She has supervised teams of undergraduate women on three CREW (Collaborative Research Experience for Women) undergraduate projects, and supervised collaborations between computer science and education students, producing educational applications for classrooms and museums. She is also a member of the Undergraduate Curriculum Committee. In addition to overseeing this project, Dr Scarlatos will be responsible for the **Graphics and Multimedia Track,** the **Summer Institute** and **Tea with a Prof**.

Dr Samir Chopra, Co-PI, is an Assistant Professor in the CIS department. His research involves examination of the political implications of technology and the legal theory of artificial agents. He serves on the department's Undergraduate Curriculum Committee, the BC Bachelor of Liberal Studies Planning committee, as an organizer for the BC Student Summit's Arts of Democracy project and has worked as a peer counselor. He has designed classes on *Computer Ethics* and *Social Implications of Computing* for joint teaching with the Philosophy and Sociology programs, respectively. Dr Chopra will be responsible for the **Legal Applications Track**, the **Student Ambassadors** and the **Showcase Day**.

Dr Simon Parsons, Co-PI, is an Associate Professor in the CIS department, where he has been integrating the use of robotics in teaching computer science since he joined the department in 2002. His research interests span the areas of reasoning under uncertainty, interaction mechanisms in multiagent systems and medical informatics. He also works with Cancer Research UK on decision support techniques and with researchers at the New York Presbyterian Hospital on data mining in medical data. Dr Parsons will be responsible for the **Medical Informatics Track,** the **Computing Preparatory Course** and the **Community Computing Center**.

Dr Ira Rudowsky, Co-PI, is an Associate Professor in the CIS department. His research focuses on proactively improving data quality in databases via the integration of intelligent agents at the point of data entry. Prior to joining Brooklyn College, he worked in industry for over twenty-five years and brings a wealth of practical, hands-on knowledge of the business world to the department. He serves as chair of the department's committee on Long Range Planning, which has identified strengthening the quality of the department's undergraduate and graduate programs as a major goal. Dr Rudowsky will be responsible for the **Business Applications Track**, the **IT Support Interns** and the **Community Computing Consultancy**.

Dr Elizabeth Sklar, Co-PI, is an Assistant Professor in the CIS department. Her research involves interactive learning systems, multiagent simulation of learning environments, interaction in multiagent systems and educational robotics. She has been involved with CRA-W mentorship, NSF GK-12, NSF REU and STEP programs. She also has a wide range of experience with educational robotics, including development of materials, evaluation and teacher-training. She will be responsible for the **Robotics and Simulation Track,** the **Computing Preparatory Course** and the **Social Support** program.

Dr Louise Hainline, Senior Personnel, is a Professor of Psychology and currently Dean of Research and Graduate Studies. In addition to mentoring many students, the majority of them women, in her research, she has been long been active in improving science teaching in higher education and making it more accessible for under-represented minority students, which includes a high proportion of women. She has been the PI or Co-PI on several NSF REU and CCLI projects, on an NSF Institution-wide Reform grant to infuse more quantitative reasoning into our general education curriculum. She

also serves as the Program Director on the College's NIH Minority Access to Research Careers and Research Initiative for Scientific Enhancement programs, as well as our NYS-funded College Science and Technology Enhancement Program, and is the supervisor of our college's part of CUNY's NSF Alliance for Minority Participation project. She is also a co-PI on a new NSF Science Talent Enhancement program to increase majors in the physics, geology, and environmental studies. Dean Hainline also heads the College's team in Project Kaleidoscope's Leadership Initiative. Her role on the project will be to coordinate the project with various administrative offices, to guide the work with the minority students and assist with the design of formative evaluations for project components and the collection of relevant institutional data.

Dr Susan Lowes is Director of Research and Evaluation at the Institute for Learning Technologies (ILT), Teachers College, Columbia University, which has conducted evaluations of projects that develop, test, and implement new pedagogical approaches to education in the university, K-12, and community/after-school environments, including those funded by NSF (IGERT, CCLI, REU, EMSI, GK-12), the Department of Education (PT3, FIPSE, 21st CCLC, ATI, TICG), NIMH, EPA, the New York City Department of Education, and private foundations (Goldman Sachs, JP Morgan, Arthur Vining Davis). Dr Susan Lowes is currently Co-PI on a Track 2 GK-12 project to Columbia University (along with Dr Sklar) and is responsible for university K-12 collaborations. She has conducted evaluations on a wide range of NSF, Dept of Education and Dept of Commerce grants. She has also been involved in many professional development and curriculum projects and has worked extensively with museums, archives, and libraries.

Heidi Holder will be senior personnel on this project. She is the Director of Pre-College and Collaborative Education Partnerships at Brooklyn College, where she is responsible for bringing together the various pre-college programs at the College, forming meaningful, sustainable partnerships between the College and K-12 schools, and for improving recruitment of students in science and science-related disciplines. She has an extensive background in educational outreach, designing professional development programs for teachers and in designing multicultural and interdisciplinary curricula. She will help design the college-prep training for participating students and will help coordinate efforts with partnering schools for all aspects of the program.

5.2. Brooklyn College

Brooklyn College, a senior college of CUNY, was established in 1930 by the New York City Board of Higher Education. It has provided, from its inception, access to high-quality, low-cost education to the children of the poor and immigrants from Brooklyn, its neighboring boroughs and across the globe. One of the major goals of Brooklyn College's strategic plan is to recruit students of diverse ethnic and cultural backgrounds and retain them. Thus, the administration is highly supportive of this project.

Brooklyn College has a wealth of experience dealing with the non-academic components of ensuring the success and matriculation of under-represented minorities, persons with disabilities and women. The various STEM research programs and internships that the college has instituted include: Minority Access to Research Careers (MARC; NIH funded), Alliance for Minority Participation (AMP; NSF and CUNY funded), Research Initiative for Scientific Enhancement (RISE; NIH funded), STEP (NY state funded), NYS Collegiate Technology Entry Program (CSTEP; NY state funded), FAA Airway Facilities Collegiate Training Initiative Program (FAA funded), Science Talent Enhancement Program (STEP; NSF funded), and Research Experience for Undergraduates (REU; NSF funded).

5.3. Brooklyn High Schools

The borough of Brooklyn contains 81 high schools that prepare students to meet the challenging requirements of a high school diploma. The borough itself has a large minority population, which is reflected in the demographic of schools. Brooklyn high schools run the gamut from nationally recognized stellar academic programs with almost 100% college admission to overcrowded,

underperforming institutions with high dropout rates. While over 90% of schools offer integrated technology programs in which technology is used as a teaching and learning tool, fewer than 10% offer pure or applied CS courses. As part of this project, BC will partner with four high schools:

Brooklyn College Academy (BCA), an alternative 7-12th grade combined middle and high school, is part of a consortium of NYC public high schools and CUNY colleges (that includes Brooklyn College). BCA provides a strong academic environment that forms the foundation for the transition from high school to college. BCA has an enrollment of 556 (54% female, 46% male; 82% Black, 8.3% Hispanic, 8% are white, 2% are Asian or other; 44% of students are eligible for free lunch). BCA offers an integrated technology program with Regents diplomas, but does not offer CS courses.

Midwood High School is a four-year comprehensive high school with an academically challenging curriculum that prepares all students for Regents diplomas and college study. The enrollment is 3745 (50% female, 50% male; 40% Black, 8% Hispanic, 32% White, 20% Asian or other; about 24% of students are eligible for free lunch). Midwood offers a C++ programming class (but not AP CS) and, through collaboration with Polytechnic University, offers a mechatronics/robotics course to gifted and talented students. Note that we will recruit students from Midwood who are not enrolled in C++ and are not part of the mechatronics program (which will give us another basis of comparison for project evaluation).

Samuel J Tilden High School, a four-year comprehensive high school, offers an academic program that features Regents-level courses and skill-based hands-on experiences. The enrollment hovers around 2000 (47% female, 53% male; 93% Black, 5% Hispanic; over 34% of students are eligible for free lunch). Tilden does not offer CS courses and has limited technology integrated into the curriculum.

Science Technology and Research High School (STAR) is a small four-year high school with a specialized integrated curriculum that focuses on science, mathematics and technology and encourages inquiry-based learning, hands-on lessons and activities, and research. STAR is one of 180 Early College Model High Schools and Brooklyn College is their main college partner. STAR has an enrollment of 184 (48% female, 52%; over 80% Black, 12% Hispanic; 52.2% are eligible for free lunch). STAR does not offer any CS classes, but does have an integrated technology program.

5.4. Advisory Board

A panel of experts has agreed to serve on an advisory board for the project: Dr Cornelia Brunner, Associate Director, EDC Center for Children and Technology; Dr Fadi Deek, New Jersey Institute of Technology (NJIT); Prof Mary Flanagan, Dept of Film and Media Studies, Hunter College, City University of New York; Dr Tessa Lau, IBM; and Prof Andrew Williams, Spelman College. The advisory board will meet annually and provide guidance to the project team. Members will also be invited to attend the Showcase Day.

6. Evaluation

The primary goals of this **Bridging** project are to attract more Black and Hispanic women to CS, to prepare them to be successful academically and to retain them in the field by helping them maintain their confidence and interest levels. The project will be evaluated in terms of changes in: (1) enrollment, (2) academic success (grades, persistence), (3) attitudes and perceptions, (4) participation in the various programs, and (5) mentoring.

The college has institutional data on enrollment trends of academic performance (grades, rate of progress), majors, and persistence/retention, and subsets will be extracted for the Bridging project. Some of these data have already been analyzed and were discussed earlier (section 2), but this analysis will be updated to serve as a quantitative baseline for assessment of program impact. For comparison, we will construct a data-matched control sample for each of the Bridging program participants,

matching on demographics, academic performance and course selection. These data-matched controls will be used to track the impact of the program on the participants compared to the controls. We will also compare end-of-course test results and final grades for undergraduates enrolled in our revised sections of CS-1 and CS-2 to those in other sections. Data on high school participants will be collected from the different high school records. Students' consent to have their data included on a confidential/coded basis will be secured in writing. All these datasets will be constructed and analyzed by Dean Hainline, who regularly analyzes institutional data in connection with her involvement in other funded minority programs. These data will permit assessment of the impact in terms of enrollment, persistence, and academic performance.

As part of the formative evaluation of the project, student, faculty, teacher, peer tutor/mentor and parental perceptions of the effectiveness of each of the activities, and of perceptions of Computer Science more generally, will be assessed through a combination of surveys, focus groups and interviews. This aspect of the evaluation will be conducted by Dr Susan Lowes, a researcher from Teachers College/Columbia University who has extensive experience in evaluating projects that bridge high school and university. All project activities will be assessed through short evaluative questionnaires. For the larger undergraduate populations, we will explore using or adapting existing published instruments to measure dimensions such as attitudes toward computers (a 30-item Computer Attitude scale that includes a 10 item computer anxiety scale [Loyd and Loye 1985, Gressard and Loyd 1986, Francis and Jones, 1999]), and computer self-efficacy (several computer self efficacy scales [Murphy et al. 1989, Busch 1995, Cassidy and Eachus 2002, Lester and Brown 2004]), and computer usage [Mitra et al. 2001]; a meta-analysis of a number of these measures can be found in [Whitley 1997] who reports the largest effects for high school students. In our analysis, we will be paying particular attention to correlations with gender and ethnicity, and changes across time as students take part in program activities.

7. Results from Prior NSF Support

Dr Scarlatos is PI on 3 recent NSF awards: (1) “CAREER: Tangible interfaces for collaborative learning environments (TICLE)” (#99-84385, 2000-2004), which demonstrated the feasibility of using tangible user interfaces to foster collaboration and hands-on learning using physical manipulatives and a computer “guide on the side”, and led to the development of a TICLE table (which uses a camera below a table surface to track the positions and orientations of pieces on the table) and several educational applications that use the table to track math manipulatives [Scarlatos 2002, Scarlatos and Landy 2001, Scarlatos et al. 2002a, Scarlatos et al. 2005]; (2) “CRCD: Innovative approaches to computer-human interfaces” (#02-03333, 2002-2005, Co-PI: D. Ferguson), which is researching how multimodal inputs and physical computing can enhance educational applications and has led to successful implementation in two undergraduate classes on two campuses, as well as a series of innovative educational applications that use speech, sensors, and vision [Scarlatos et al. 2003, Scarlatos et al. 2004, Scarlatos and Scarlatos 2005]; and (3) “MRI: Acquisition of CAVE for Experiments in the Creation of Collaborative Learning Environments” (#CNS-04-20996, 2004-2007, Co-PIs: S. Parsons and J. Jannone), which is constructing an augmented reality environment, equipped with a motion-capture system, for the purpose of researching novel ways of using gesture coupled with multimodal inputs for educational applications, control for performance art, and robotics planning.

Dr Sklar is a PI on 6 recent NSF awards, all of which center around learning and interaction, in humans and/or multiagent systems. The key projects include: (1) CEL: “Creating One to One Learning Opportunities across the Internet” (#REC-01-13317, 2002-03, PI J. Pollack), which brings humans together over the Internet to share appropriate learning experiences by participating in multi-player educational activities, interacting with each other and/or software agents [Sklar 2000, Benton and Sklar 2004]; (2) SimEd: “ITR: Evaluating Education -- What are we measuring and how?” (#REC-02-19347, 2002-05, Co-PI S. Parsons), which involves simulating the country's educational system as a

dynamic, multiagent environment in order to experiment with the influences of various factors on human learning [Davies and Sklar 2003, Sklar et al. 2004, Sklar and Davies 2005]; (3) JETT: “Special Projects: Bridging the Gap” (#03-14231, 2003, co-PI's L. Israel and D. Souvaine), which helped train high school teachers in Java and form a community for learning and teaching computer science at the secondary school level – this pilot project grew into the Association for Computing Machinery (ACM)’s national Computer Science Teachers Association (CSTA); (4) “Track 2, GK12: Technology Integration Partnerships” (#DGE-03-38329, 2004-08, PI J. McGourty, Co-PI S. Lowes), which is designed to increase the number of technologically competent teachers in urban environments and heighten the awareness of education issues in engineering graduate students. Over the last five years, Dr Sklar has worked developing materials for and evaluating educational robotics in a variety of settings [Sklar et al., 2000; Sklar et al., 2002, Sklar and Eguchi 2003, Sklar and Eguchi 2004, Goldman et al., 2004, Sklar 2004]. Dr Sklar currently supports and/or advises 3 PhD students, 3 MS students and 1 undergraduate.

Dr Parsons is a PI 4 recent NSF grants, (1) SimEd: ``ITR: Evaluating Education -- What are we measuring and how?'' (with Dr Sklar, see above), in which he has worked on formal models of interactions that can be applied to students and teachers [Parsons et al. 2003a, Parsons et al. 2003b, McBurney and Parsons 2004, Sklar and Parsons 2004, Parsons and Sklar 2005, Parsons and Tang 2004, Tang and Parsons 2005]; (2) MechDesign: ``Tools and techniques for automated mechanism design'' (#IIS 03-29037, 2003-06, Co-PI E. Sklar), which looks at building new kinds of auction-based interactions in a multiagent system and has investigated robustness [Parsons and Klein 2004], learning mechanisms [Phelps et al. 2004, Phelps et al. 2005, Phelps et al. 2003]; (3) REU Supplement to #IIS-03-29037; and (4) CAVE: ``Acquisition of CAVE for Experiments in the Creation of Collaborative Learning Environments'' (with Dr Scarlatos, see above). Dr Parsons currently supports and/or advises 7 PhD students and 2 undergraduates.

8. Summary

This **Bridging** project focuses on **preparation**, **recruitment** and **retention** in computer science of under-represented minority and female students from high school and early college populations within a highly ethnic and strongly connected urban community. The expected result will be a collection of tested methods that can be exported to other urban high school-college cooperatives.

The **intellectual merit** of the proposal lies within the project team’s proven dedication to teaching and serving under-represented populations, locally and beyond. By tailoring successful interventions from institutions with different profiles (e.g., CMU) to our environment (urban, largely minority, non-residential) as well as developing new approaches, particularly community-based activities and student ambassadorships which take advantage of the fact that 75% of our students grew up just around the corner, we will provide a unique and very exciting suite of tested implementations. Due to the high concentration of diverse ethnicities in the Brooklyn College community, this project provides an unusual opportunity to examine at once the effects of interventions in different under-represented groups.

The **broader impacts** of the proposed activities emerge as our tested methods succeed for diverse urban populations with a deep-seated community base. Solutions that work for inner-city students from strong ethnic backgrounds, who live at home and maintain daily contact with parent, will be widely applicable in many settings nationwide. Results will be widely disseminated in the form of portable context-based curricular modules, available on our web site and in textbook materials, and models for replicable community-service oriented mentoring programs.

The image for our project is the “tree that grows in Brooklyn”, illustrating that all students can aim high, reaching to meet personal and professional goals, while at the same time, they can remain connected to their past, their families, their culture and their roots.

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