BROOKLINE EDUCATION FOUNDATION
Collaborative Grant Application for 2017-2018 Academic Year
Project Description Section

Connecting BHS Math Students with the 21st Century through Coding

1. **Project Summary** (1-3 sentences)

This grant will be used to provide professional training for two BHS math teachers (Shoshanna Kostant and Grace Wang) in computer coding (specifically the computer languages SNAP! And Python) as well as the pedagogy of incorporating project-based computer programming into traditional math courses. The training would place in two parts, one over the summer that focuses on pedagogy and some curriculum. The second part would take place during the school year where consultants from TEALS* join our class two to three times a week. These consultants are local professionals currently working in the computer science industry who will share expertise, serve as authentic models for the students interested in computer programming, as well as inspire the class with stories of their own experiences.

* TEALS is an organization that works with schools who are expanding computer programming in their schools.

2. **Need**
Why is this project needed?

This grant allows us to learn the most effective pedagogy of teaching computer science and develop proficiency with relevant computer languages (SNAP! and Python), thereby being more comfortable to support and interact with students who are interested in this field. This is particularly true of Shoshanna who is also the sponsor of the WiSTEM (Women in Science, Technology, Engineering, and Math) club at the high school.   We are excited at the prospect of sharing new practices and skills with members of the department in the hopes that all teachers would want to promote coding in their courses.

The skills necessary for coding require logical reasoning, problem-solving, and perseverance - mathematical practice that our students engage in regularly. By expanding and developing our knowledge of computer programming and pedagogy in problem-based learning we will be able to to enrich our own classes with programming projects and ideas that can be shared with colleagues. Our enthusiasm and excitement at bringing authentic hands-on experiences that connect to the goals of the math department will make us resources for our colleagues.

Additionally, as more and more industries become computerized, the need for the workforce to be able to code has grown dramatically. Currently, the percentage of BHS students who are engaged with coding activity is small. For example, in the current 2016-2017 school year only 8% (144 students) of the student body is enrolled in a computer programming course at the high school. Furthermore, there is a huge racial and gender gap in computer science related fields. That gap is seen at the high school as well - only 26% of the students taking a computer science course are girls and a paltry 2% are African American. This project could be a first step in exposing more

students to coding since all students participate in math classes at the high school. Imagine the ripple effect where small units pass from one course to another or one teacher talks about this fantastic activity they did with their class and another teacher brings that project into their own classroom.

Finally, teaching in a project-based classroom is very different than teaching to a traditional math class.   The training provided by the grant allows us to learn the most effective pedagogy for teaching computer programming. By sharing the pedagogical techniques and programming knowledge with the department, other teachers may embrace computer programming as well. Additionally, having teachers who are currently enhancing their own understanding of computer coding will highlight the frustrations students experience when they are learning to program, debug, or struggle with the precision of syntax. This will help us develop more empathy for the student experience, and also provide insight into making the process less frustrating for students.

3. **Personnel**
a.   In addition to the project leader, who are the participants in this grant? Please include *names, schools, assignments, and email addresses.*

Participants in the training:
Shoshanna Kostant: Brookline High School, 1.0FTE Math, shoshanna_kostant@psbma.org

Grace Wang: Brookline High School, 1.0FTE Math, grace_wang@psbma.org

b. What administrator/principal/headmaster/curriculum coordinator is responsible and accountable for project activities?

Josh Paris: BHS Math Dept. Curriculum Coordinator, joshua_paris@psbma.org

c.   Will the project require additional personnel or reassignment of current staff?

No

4. **Goal Statement**

What are the explicit goals for the project?

1) Learn best-practices for teaching computer programming to students in a project-based setting.

2) Increase teacher knowledge of relevant computer programming languages. One is SNAP!, a block-based introductory programming language that provides a visual, user-friendly interface for introducing coding algorithms. The other language is Python, an object-oriented, high-level programming language that is used to develop applications such as YouTube, Google, Reddit, and Instagram, just to name a few. Having knowledge of an introductory and then a more

advanced language will give us a better understanding of how to differentiate projects across our classes.

3) Foster collaboration among math department teachers as we share the knowledge gained through the training.

4) Expose more students on a regular basis to programming by integrating computer programming activities into math classes. Ideally, this experience will have a snowball effect as other math teachers become inspired to integrate coding activities into their classes as well. The best outcome would be an increase in enrollment in existing computer science courses as more students begin to understand what computer programming entails and why it is important.

5) Enrich existing math courses with authentic stories and experiences of the consultants so students can develop a real understanding for the field of software engineering.

5. **Context**
What are the experiences of the participants (inside and/or outside the classroom) that have led you to apply for this grant?

We have tried to implement various calculator programming projects in our Precalculus Advanced course - a course we've both taught for many years. Examples include mini-lessons on the programming functionality of the TI-84 calculators and then asking students to write small programs and read calculator code to give them a sense of programming possibilities. Some students really run with the experience and realize they can program all sorts of formulas into their calculator. We also created a problem set on attractor matrices where students had to create a program to perform a certain set of matrix operations on a triangle. In the end, we want to better integrate programming concepts in all of our classes, not just the advanced level, and program without being limited to just the calculator.

Outside of class, some students already recognize the importance of developing coding skills. Many teachers have been asked to sponsor a computer programming club, but no one within the math department has felt comfortable enough to do so. As a result, a small group of 5-6 students meet after school on their own to pursue interesting projects and teach each other programming skills.

Students in the WiSTEM club have numerous requests for more field trips or activities to learn about this field. In recent years, we have also had a number of students who are heavily involved with the FIRST Robotics competition team. With a background in computer science (having taken courses in college) and many friends who work in the field, Grace has been able to engage in surface-level conversations about the work on the robot. The technology field is a fast-changing field, so her experiences in C++ are now outdated and she would really welcome the opportunity to be trained in a more current language and gain more ideas about ways to expose all her students (she teaches students in grade 10 - 12, standard and advanced) to programming on a regular basis.

The discovery of the TEALS program excites us as we feel it is a good way to dust off and update older computer programming skills while also learning about best teaching practices for the field.

BROOKLINE EDUCATION FOUNDATION
Collaborative Grant Application for 2016-2017 Academic Year
Project Description Section

6. **Project Description**

a. Describe the structure of this grant: what is your time frame, when and where will you be working, with whom will you work? You may include copies of supporting material (e.g., conference brochure, tour itinerary). Links to websites may be used for supporting materials and are preferred, if available.

There are two parts to this project. The first constitutes summer learning and initial training, and the second component consists of hands-on support and training during the 2017-2018 school year.

Summer 2017, 24 hour training with TEALS in pedagogy: We would attend the training session (run by TEALS) where best practices for teaching computer programming will be taught through on-line exercises, and in-person discussions and activities.

School Year 2017-2018, hands-on training with the TEALS consultant: The TEALS program is unique in that the teacher-training by the consultants occurs on-site in the classroom 2-3 times a week. The consultants are on-hand to support us in curriculum delivery, problem-solving, as well as add industry exposure by sharing their personal story with students. The consultant may also help brainstorm new lesson ideas, serve as a guest speaker and act as a resource for information around new technologies.

TEALS program:
http://library.tealsk12.org/schools/2017/TEALS%20Program%20Description%202017-18.pdf

b. Tell us about the collaborative aspect of this grant.

We will be collaborating in a number of ways. First and foremost, for many years the two of us have been teaching two of the same courses (Algebra 2 and Precalculus Advanced). As such, when we collaborate throughout the year on these courses we can utilize our improved understanding of coding to enhance their curricula; to explore how we can modify units by incorporating coding activities into them. In addition, as explained in section 8 below, we will also be collaborating with the other teachers in the math department to share what we learn about how to integrate coding into other math courses. Finally, one of the goals of this project is to increase

the number of African American and Latino students taking computer science courses at BHS. As the number of such students exposed to coding grows we will begin to collaborate with the directors of auxiliary programs such as the Calculus Project and the African American and Latino Scholars Program to explore how coding can be integrated into their programs and to recruit their students to take computer programming courses.

7. **Impact and Evaluation**

a. Describe as specifically as possible the impact of the work you propose:
   • <u>On Yourselves</u> - How do you expect this project will change you as educators? How might this work impact future professional activities?

In learning these coding languages we will be able to incorporate coding activities into our math courses. These activities will then enrich the experiences of the students in our classes as they see firsthand how the content they are learning is connected to the software engineering industry. Additionally, while the first part of the training is specifically for best practices of teaching computer programming, we believe that many of these practices can be carried into any kind of project-based course. The process of developing our own knowledge base and enhancing our skills is exciting. The opportunity to collaborate with a professional in the field of software engineering will no doubt ignite the fire of creativity and spur reflection about our current class projects and activities and how to improve them. Finally, as we grow in comfort with our skills, we will be looking for additional ways to challenge ourselves and use our newfound skills. This could include being part of a team that brings an AP computer science pathway into the math department, or with the help of the consultant, look for additional industry members who might want to take part in a Math-Day that educates students and explores possibilities for math-related careers.

• <u>On Your Colleagues</u> - What impact will your project have on your professional community either directly or indirectly?

   Through the collaboration process described in the next section we will be able to share our learning with our colleagues in the math department. As our department colleagues are able to integrate coding activities into their classes more frequently, more students will be exposed to programming skills.

   • <u>On Your Students</u> - How will your students benefit from this project in the short or long term?

Hopefully, as students are exposed to coding in their math courses they will be inspired to take more computer programming courses at the high school and beyond. The knowledge they learn in these courses could possibly lead to careers in the computer programming industry as well as other professions that require computer programming knowledge. Having real industry references can also open up the possibilities of field-trips to STEM related companies and just give students a sense of the possibilities of software engineering.

b. How will you evaluate the success of this project?

The success of this project will be determined by the extent to which computer programming based activities are integrated into the curriculum of the math courses. As well, we will continue to track how many students (and which students) take computer programming courses at the high school. We hope to see those numbers increase dramatically.

8. Dissemination

How will you share your learning with others in your school and district community? For instance, will you share results in departmental meetings or on departmental wikis, or design other forms of dissemination of your project?

We will share our learning with the math department community in a variety of ways. First, math curriculum teams meet on a weekly basis. We will attend those meetings regularly and work with the teachers who want to integrate coding into the math courses that they teach. As well, we will lead a series of math department meetings throughout the year. At these meetings we will share our learning with our colleagues, lead them in coding activities so that they can begin to learn the computer languages as well, and work to develop a plan for how coding can be coherently introduced into the math department curriculum. Furthermore, as the number of students exposed to coding grows, specifically students of color, we will begin to collaborate with the directors of auxiliary programs such as the Calculus Project and the African American and Latino Scholars Program to explore how coding can be integrated into their programs and to recruit their students to take computer programming courses.

9. **Multi-year projects**
If this application is part of a multi-year project, please put this application in context (to be completed only when applying for a second year of funding).

a. Please evaluate the first year of your grant (see the evaluation form here: [add link]

b.   How does this year build on what was accomplished in the preceding year?

c.   What are the plans and anticipated budget for next year?

BROOKLINE EDUCATION FOUNDATION
Collaborative Grant Application for 2016-2017 Academic Year
Budget and Finances Section

Please provide a **detailed budget**. Be as specific as possible.

Expense	Purpose	Cost
Stipends ($30 per hour per participant)	To work with the consultants (see below) to learn computer programming languages (Snap! And Python). As well, they will learn how to incorporate computer programming projects into math courses.	$1440 (24 hours x 2 teachers x $30/hr)
Consultants (Determined in conjunction with the TEALS program. Specific consultants will be determined later in the Spring and over the Summer. The consulting itself will take place at BHS)	Support us in curriculum delivery of computer programming languages (Snap! And Python) to the two teachers. Train them in the pedagogy of incorporating computer programming projects into math courses.	$5000
Materials and Supplies		
Travel and Accomodations*		
Conference Fee		
Other		
Substitutes **(please indicate days/hours needed)		
TOTAL		$6440

* Single rooms are acceptable if preferred by the applicant.

**The BEF's ability to pay for subs is limited; requests will be considered on a case-by-case basis.

Finances

 a. Will there be additional funding from other sources? No.

b. Are resources needed to continue the work of the project after BEF funding ends? If yes, please describe how these resources will be obtained. If no, please describe how the work of the project will be funded or continued after completion of funding by the BEF.

No additional funds will be needed. The work will continue through the collaboration between the teachers involved in this proposal and the rest of the math department teachers. The ultimate goal is for many more math teachers to be able to integrate computer programming projects into their math courses. As well, as more and more students are exposed to coding in their math courses our hope is that they will be excited to take specific computer programming courses at the high school ultimately finishing with AP Computer Science.

d. Will you be able to complete the project if only partial funding is available? _X__Yes
        ___No
If only partial funding is available, would you be able to redesign the project? ___Yes
        ___No
Please explain: