Public Interest Technology Capacity Building Guide: A Case Study of Coding to Learn

Introduction **2**

Background **2**

Creating Community **3**

- Meet-ups 3
- Social Network 4
- Partners 4
  - Student Organizations 4
  - Schools 4
  - University and School Support Organizations 5

Scholarships & Internships **5**

- Selecting scholarship recipients 5
- Finding internship projects 6
- Matching students/faculty/staff 6
- Monitoring & Support 6

STEM and non-STEM **6**

- “How To” Project Tutorials (by Major) 6
- Peer-instructors 7

Other Tips for Success **7**

Acknowledgements **7**

Introduction

Coding offers students the opportunity to solve problems or create opportunities through computational tools. From using R to analyze data or Javascript for creating a web app, to Python for natural language processing, coding skills can be a valuable asset for students in any major or discipline. Yet few institutions have been successful in creating a campus culture where students (regardless of their major) take advantage of coding in their educational experiences. The shift in perspective from one focused on coding as a course that students take (i.e., learn-to-code) to the view that coding is a fundamental tool for learning (i.e., code-to-learn) is fundamental to modernizing the cultures at colleges and universities.

The following "Guide" is intended to share the lessons we have learned thus far in our journey in Public Interest Technology (PIT) capacity building at GWU. Given our unique context, our capacity building focus is on using coding as a foundational skill set for applying technology for the public good. From building a community to implementing an internship program, the guidance based on our experiences may help you determine an appropriate path for developing a coding culture at your school. While our journey at GWU is certainly not over, we are already starting to see the benefits of our efforts over the past two years of capacity building.

Computational tools (largely accessible only through coding skills) are now routinely found in most academic disciplines – from chemistry and physics to history and international affairs. From natural language processing and machine learning based on Shakespeare's texts to Fourier transformations of EEG data, the application of computational tools offers students and faculty new opportunities to learn and do research. Machine learning, for example, allows for asking and answering predictive questions that were previously not available in the classroom or research lab. Students with computational skills having the capacity to investigate these questions, benefit in their educational experience. And faculty, likewise, have new opportunities to ask research questions, seek grants, collaborate with colleagues.

Gaining these benefits does not just happen; it requires deliberate effort to increase the coding capacity of students and faculty and to nurture a culture of valuing computational skills (i.e., coding) so that students and faculty are ready when the time comes (and so that they have a supportive community to go to when they have questions or want to broaden their networks). Especially for students, the development of computational skills and networking offered in a collaborative environment can prepare them for future job opportunities.

Background

GW Coders is an initiative at GWU to engage students beyond their coding courses by providing a social community through which students can apply the coding and data analytics skills they develop in the classroom to real research projects ongoing across the campus and region. The organization facilitated a grant from the Public Interest Technology University Network (PITUN) to create a "PIT Scholarship & Internship" program in 2021 and 2022. The

program provides (a) scholarships to students from underrepresented groups to take introductory coding and data analytics courses, and (b) stipends to students who provide coding and data analytics support to faculty or graduate student research projects that have a PIT focus.

The GW Coders group facilitated matching between ongoing PIT-related research projects with students, and the PITUN funds supported the student as they develop and apply specific skills that will be used to advance the research. Students were then supported through the GW Coders' network and social events to collaboratively develop and improve their coding and data analytics skills to meet the requirement of real-world research while building their interest in applying their newly developed skills for the public good.

You can learn more about GW Coders at: https://go.gwu.edu/gwcoders

Creating a Community

Building capacity and nurturing a culture starts with community. Prior to GW Coders, GWU had number of groups and resources that tangentially brought together students who were interested in coding, such as, a student organization focused on business analytics, a group that routinely held public health hack-a-thons, an engineering innovation lab, and a campus-wide office for innovation and entrepreneurship. Each of these are successful initiatives on their own, but none had a goal of creating a university-wide culture promoting the use of coding in learning and research.

1. Meet-ups

In response, GW Coders began with informal weekly (then moving to bi-weekly) meet-ups. The meet-ups focus on informal sharing and networking, and are attended primarily to GW students (undergraduate or graduate), faculty, researchers, staff and alumni – though people not affiliated with GW are also welcome and encouraged. During COVID-19, the meet-ups were moved online, and even though campus is again open we continue to offer the meet-ups as a hybrid of online and on-campus. Recordings of the meet-ups are also available on YouTube. The meet-ups are held at lunch time, and pizza is provided for the on-campus participants when resources are available.

Each meet-up includes roughly 10 minutes for announcements, 30 to 40 minutes for a presentation on a coding related topic (e.g., using Regular Expressions in code, using Arrow for large datasets, manipulating audio with Python), and 10 minutes for discussion. Sample videos of meet-up sessions are available on YouTube: https://gwcoders.github.io/studyGroup/#events

Code for automating the meet-up schedule, sending out reminder notices, and pulling member email addresses from Slack can be found at: https://github.com/orgs/GWCoders/repositories

2. Social Network

The capacity to connect students, faculty, and others who are interested in PIT related topics, and in coding (for our case), is important for creating community beyond the classroom and meet-up opportunities. We selected Slack as our networking platform since several coding classes at GWU already use Slack to connect students. Though other platforms could be used, Slack works well for sharing announcements, events, jobs, and offering a coding help hotline. Slack also offers an API which allows it to be connected to other services (such as our automated event reminder systems in Google Apps Script).

The GW Libraries coding workshop team also uses the GW Coders Slack group for announcements and sharing content. This partnership has been beneficial to both groups since we have a community of students and faculty who are already interested in the coding workshops offered by the GW Libraries, and participants in coding workshops get added to the Slack group by the workshop instructors – allowing us to routinely expand our community reach.

3. Partners

Efforts to develop PIT capacity and a coding culture at GWU have benefited greatly from collaborations among many groups. The groups can extend outreach efforts, offer connections to new communities, and/or provide guidance based on their experiences in getting established at your institution. Partners could include groups in the following categories:

a. Student Organizations

Organizations started and run by students can be valuable partners for getting the word about your PIT capacity building efforts. The *GW Data* student organization, for example, is led primarily by students in business analytics and data science majors; but they also have strong networks with other majors across campus. We were able to partner with them early on in the development of a peer-instructor program, and they also forward announcements to their members. Student organizations frequently change leadership, however, so you have to keep in touch with them routinely in order to coordinate communications.

b. Schools

To encourage students (and faculty) across many disciplines to join in building capacity and creating community around coding, we believe that the leadership of the efforts must also be representative of multiple disciplines to be successful. The GW Coders initiative is co-facilitated by faculty in the School of Engineering and Applied Sciences (SEAS) and the Graduate School of Education and Human Development (GSEHD). The facilitators also actively seek out participation from colleagues and students in other schools and disciplines (such as international affairs, geography, business, and political science).

c. University and School Support Organizations

Beyond schools and academic departments, most institutions have a wide variety of organizations and groups that are tangentially associated with coding. For example, at GWU we have the Office of Innovation & Entrepreneurship (I&E) which sponsors and coordinates a variety of activities and service to engage students and faculty in developing entrepreneurial projects. Many of those projects, as you might expect, have coding elements and often the students (or faculty) with the innovative ideas are looking for partners who can help them create the code to bring the ideas to life.

The GW Libraries and Academic Innovation (LAI) organization has been another vital partner for GW Coders. At GWU, LAI is responsible for student and faculty development in many areas, including coding. From workshops on R to week-long Python camps, the opportunities offered by LAI have been a resource for members of the GW Coders. In addition, we have been able to have the LAI instructor present on coding tools at meet-ups and mentor GW Coder interns as they utilize campus resources (such as the GW social feed manager).

Other organizations, such as the GW Center for Undergraduate Fellowships and Research, the GW Center for Civic Engagement and Public Service, and the SEAS Innovation Center, provide both opportunities for students as well as channels for GW Coders to spread information about our programs.

Working with numerous partners can require organization and some extra time (such as, keeping a list of email contacts and remembering to send announcements/invitations to them). The benefits for growing your community, however, are tremendous.

Scholarships & Internships

Through a 2020 PIT-UN grant, GW Coders was able to offer a number of scholarships (for non-traditional coding students to take their first coding course) and internships (for students who have some coding experience to grow their coding skills). This program was very successful in achieving both goals. What follows are summaries of our experiences at GWU in implementing these programs, including many suggestions for how similar programs could be implemented at other institutions (even with very limited funding).

1. Selecting scholarship recipients

Creating the scholarship program involved three main steps: 1) defining applicant eligibility, 2) recruiting applicants, and 3) helping guide recipients in identifying an appropriate course for their goals. Since our scholarship was designed for non-traditional coding students, we had to first define what this meant. In recruiting applicants for the scholarship program we focused on students “who are female, and/or LBGQT, and/or from a non-STEM major, and/or registered with GW Disability Support Services, and/or member of one or more marginalized racial and ethnic group (Black/African American, Hispanic/Latino/Latina/Latinx, Native American/Alaskan,

and/or Native Hawaiian/Pacific Islanders). Priority will be given to applicants representing multiple groups that are traditionally underrepresented in coding classes, though everyone is encouraged to apply."

Once we defined eligibility, we had to recruit eligible students to apply for the program (see Appendix A for the recruitment email that we shared with colleagues and partner organizations).

Finally, since most applicants had little to no prior coding experience, we discussed their goals with them on a one-on-one basis to help them identify an appropriate course. Since a large university like GW offers multiple versions of introductory programming courses, it is important that students understand the nuanced differences between different courses. For example, an "introduction to Python" course in the Computer Science department might focus on algorithms whereas a course with the same title in a Statistics department might focus on analyzing data. Both courses use Python, but *how* they use it can vary widely.

2. Finding internship projects

Student interns in the program were available to faculty, graduate students, or university centers which had coding projects that would benefit from the assistance of a student intern. The student interns had completed at least an introductory coding course (R, Python, etc.) but routinely the skills required by the projects were a "stretch" for the students, and thus a great opportunity to expand their skills beyond the basics taught in courses. Nevertheless, project sponsors (faculty, graduate students, university staff, etc.) had to also agree that the expectations placed on the student intern were not a replacement for a paid position. In other words, if the project required the work done quickly and without the person learning new skills, then they should just hire a professional coder.

Through GW Coders and our other campus networks, we found sponsors in three categories: (a) those who know what they are looking to get done and were able to guide the student intern closely, (b) those who have data but don't know what to do with it as of yet and they learned along with the student intern as they moved forward on the project, and (c) those who have a vague idea of what they want to do, but not sure how computational tools can help. It was in this last category that the lead faculty supervising the internship program took the most active roles in bringing clarity to the internship tasks.

3. Matching students and projects

The lead faculty typically initially met with the applying sponsor of an internship project to scope the project (i.e., ensure that it was neither too big nor too small) and to set appropriate expectations.

Interested students completed an online form, indicating their current coding skills and what skills they would like to develop through an internship opportunity. The lead faculty would then try to match students to projects proposed by sponsors.

When a potential match was found, the student, project sponsor, lead faculty would meet to discuss the project and Setting appropriate expectations. Sponsors were reminded that an internship is not same a getting paid staff who already has the skills, and students are there to learn and grow their skills. Similarly, students were reminded that they must show up and be ready to learn on their own since sponsors typically don't know how to do the coding or they would just do it themselves.

4. Monitoring & Support

Learning new coding skills is routinely a trial-error process, and as such it can be important to give students (and their project sponsor) space to learn. Monitoring for most internships therefore requiring just a few checkpoints to ensure that students and sponsors are meeting the commitments. We used a short mid-internship survey (in Google Forms) to monitor the projects, and when appropriate we requested in-person/phone check-ins (such as, if the project was delayed and likely to take longer than the period of the internship). Internships were subsequently evaluated by the students and sponsors using a short post-internship survey (also in Google Forms).

When there were technical challenges encountered by the student interns, both the lead faculty and GW Coders community were helpful. In the GW Coders Slack app we include a "coding helpline" where students (interns or not) can post coding questions and receive help from the community. Students could, of course, always bring their coding challenges to a GW Coders meet-up session to discuss with those attending.

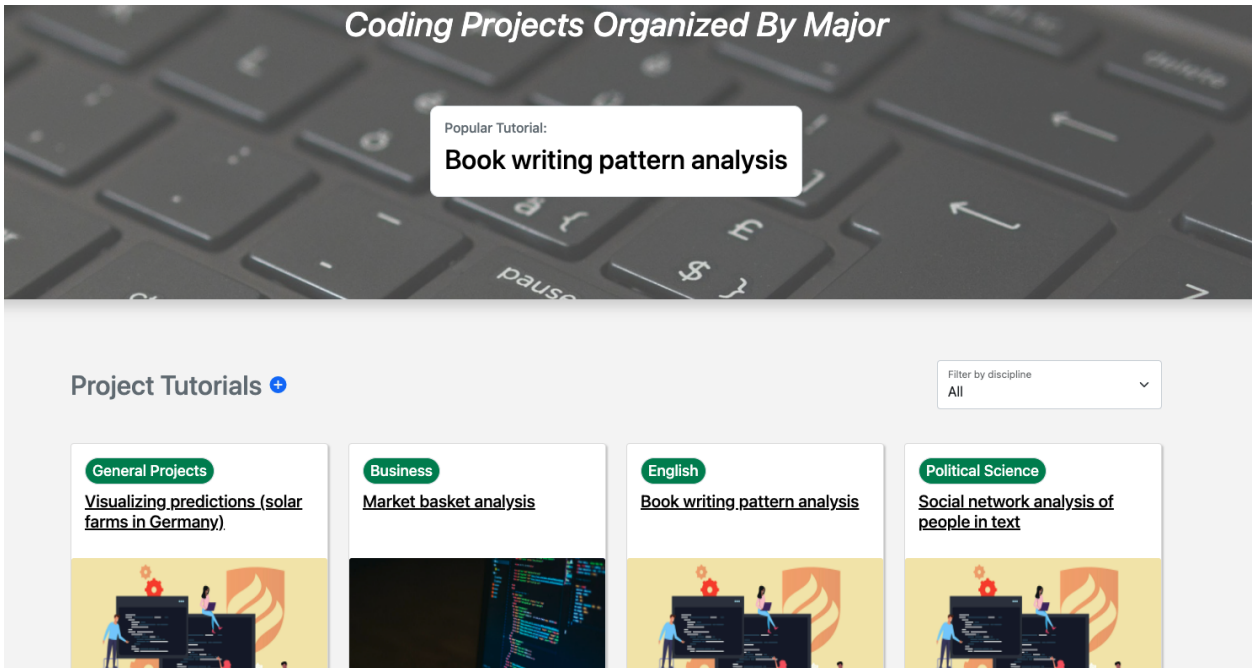
STEM and non-STEM

PIT capacity building and creating a coding culture can struggle with the perception that technology skills are primarily for STEM students. Despite this misguided perception, today computational tools are used in almost every discipline. While statistical analysis and data science applications of coding remain popular and useful, throughout the humanities and the social sciences students and faculty find applications for coding in their work as well.

1. Database of Coding Project Tutorials

Since non-STEM students and faculty who are new to computational tools routinely struggle to find applications in their disciplines, GW Coders decided that we would help find and organize "how to code" project tutorials for numerous non-STEM and STEM majors. The result is the initiative also led to opportunities for GW Coders students and faculty to grow their coding skills through the development of Python-based website:

https://go.gwu.edu/codingprojects



2. Peer-instructors

While formal courses and institutional workshops can offer students valuable opportunities to develop PIT-related skills, working with technologies (and especially learning to code) can benefit from peer-to-peer learning. With this in mind, we partnered with the GW Libraries and GW Data student organization to create a peer-instructors training program. The premise is to provide students who know how to code with (a) guidance on how to be an effective instructor and mentor to other students, and (b) curriculum resources that they can use to provide learning opportunities to their fellow students (for instance, in dorms or research labs).

Unfortunately we offered our first peer-instructor training programs in February 2020, and then during the COVID campus lockdown our students had few opportunities to apply what they learned. By maintaining our partnership, however, we do plan to re-establish the program as the campus reopens.

Other Tips for Success

Growing a community is rarely easy or fast. Patience and persistence are two critical skills for successful community organizers. Community building can be expedited by engaging with other partners or stakeholders who can encourage their members to join meet-ups or apply to scholarship or internship opportunities.

Acknowledgements

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Appendix A

Scholarship Recruitment Ad:

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GW Coders is excited to announce a scholarship opportunity for students from traditionally underrepresented groups in coding, who are also interested in public interest technology research and/or career paths.

Scholarships: Each scholarship will cover up to three (3) credit hours of tuition for a coding course offered at GW in Fall 2021. Courses can be in Python, R, Java, or another coding language.

Who is eligible: Current GW students…
(i) who have not taken prior coding courses,
(ii) who are passionate about public interest technology research and/or careers,
(iii) who are female, and/or LBGQT, and/or from a non-STEM major, and/or registered with GW Disability Support Services, and/or member of one or more marginalized racial and ethnic group (Black/African American, Hispanic/Latino/Latina/Latinx, Native American/Alaskan, and/or Native Hawaiian/Pacific Islanders). Priority will be given to applicants representing multiple groups that are traditionally underrepresented in coding classes, though everyone is encouraged to apply.

The scholarships are funded with support of a grant from the Public Interest Technology - University Network.

Students can apply for a scholarship at: [link to Google Form application]
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