

Work in Progress: Engaging First-year Computing Students with Extracurricular Service Learning

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Abstract

Service learning connects theories and concepts in the classroom with community service experiences and provides students with motivation and informative feedback. In recent years, the adoption of service learning in higher education institutions has emerged as a modern teaching and learning strategy.

However, it is challenging for first-year computing students to take advantage of service learning. Service-learning, traditionally part of a curriculum, is usually not offered at the first-year level. First-year students, as newcomers to computing communities, have fewer connections than established community members and thus have limited access to extracurricular service opportunities in computing. First-year commuter students, who live off campus, face additional challenges. They are more likely to be non-traditional-aged students or part-time students, with longer work hours, additional family obligations, and longer travel time to campus. To motivate and engage first-year commuter students through service learning, it is crucial to create service opportunities and roles that are flexible and appropriate for their technical knowledge and public speaking skills.

We propose an extracurricular service-learning approach grounded in the possible-self theory, levity, and psychological safety. Our approach offers easy entry and a minimal, flexible time commitment to motivate and engage first-year computing students on our urban commuter campus. We trained students in image classification using machine learning on an easy-to-learn online platform and provided opportunities to network with upper-class students at various stages of their careers and learn how their service-learning experiences helped them. We then enlisted first-year students to host a group of high school students on campus, where they assisted in introducing the “Teachable Machine” to these high schoolers.

We examined students’ experiences through a survey and a focus group interview. Our preliminary data indicate that the service-learning events increased students’ engagement and motivation to pursue their majors. Students reported that the activities were “engaging,” “fun,” “eye-opening,” “helpful,” and motivating. They appreciated the lectures and the opportunities to network and to serve high school students.

1. Background and Motivation

It is challenging to retain first-year computer science college students. In 2023, in the U.S., the second-fall retention rate for Computer and Information Sciences and Support Services was 70.4%. And the second-fall retention rates for part-time first-year Black and Latinx students at public 4-year institutions in 2023 were 39.3% and 50.8%, respectively [1]. According to the literature, engaging and strengthening first-year students’ science identity and sense of belonging is crucial to retention[2], [3].

Hatcher and Bringle [4] define service learning as a course-based, credit-bearing educational experience in which students participate in an organized service activity that meets identified community needs and reflect on the service activity to gain a deeper understanding of course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility [5]. It is a type of experiential education [4]. In recent years, the adoption of service learning in higher education institutions has emerged as a modern teaching and learning strategy. However, research is lacking on 1) the role of service learning in the higher education sector, and 2) the use of service learning and the issues in different academic disciplines [6].

Service learning's benefits include: 1) enabling students to comprehend theories and course concepts better by applying theoretical concepts in a real-world environment; 2) effectively capturing students' attention; and 3) enhancing the students' understanding of real-world problems [7], [8]. It also contributes to their overall personality development, character building, and growth [9].

Despite the benefits of service learning for motivation and engagement, first-year computing students face particular challenges in taking advantage of service learning:

- Technical knowledge/skills
- Communication skills (small group or public speaking)
- Confidence
- With fewer social connections than upperclassmen.
- Roles appropriate to the above to make the experience positive for them

Commuter students face unique challenges in service learning. A commuter student is a student who lives off campus [10]. They are more likely to be non-traditional-aged students (over age 25) or part-time students [11]. The commuter college student population has been growing rapidly in the U.S. [10], [12]. On the urban commuter campus where we conducted this study, part-time students comprised 54% of the Spring 2025 enrollment. Engaging commuter students in service learning requires creative strategies, as they face unique and complex challenges, including longer travel time to campus, longer work hours, and additional family obligations [10] [11].

In this study, we propose an extracurricular service-learning approach with a low, flexible time commitment and an easy entry point to motivate and engage first-year computing students at an urban commuter campus. We investigated the following research question: "Does this service-learning approach increase the motivation and engagement of commuter students to participate in computer science or a computer-related major?"

When implementing the approach, we selected technical skills that students could learn quickly, created roles with minimal skill requirements, used a peer-mentor approach, encouraged first-year students to take baby steps in public speaking, and had experienced outreach student leaders lead the sessions in which first-year students served as facilitators.

2. Theoretical Framework and Background Literature

In this section, we examine this approach's theoretical framework, which includes the following components: 1) service learning, 2) Possible Selves Theory, and 3) psychological safety and levity.

Service Learning

Service learning differs from volunteerism and internships by focusing on enhancing students' understanding of their theoretical knowledge through service experiences in the community and reflection on those experiences, whereas internships mainly emphasize the acquisition of specific career-oriented skills, and volunteerism focuses on benefiting the recipients of the service.

Service learning literature is categorized into the following areas: (1) studies of service learning implementation within a specific discipline, (2) conceptual and theoretical studies, and (3) studies that explore and validate the significance and positive outcomes of this pedagogy [6].

Significant issues in implementing service learning include time management, limited financial resources, facilitating effective interaction among participants, assessing service learning, and aligning course learning objectives with community service [6].

Possible Selves Theory

Markus and Nurius introduce the concept of an individual's repertoire of possible selves as the cognitive manifestation of enduring goals, aspirations, motives, fears, and threats [15]. Possible selves derive from representations of the self in the past and include future self-representations, providing the essential link between the self-concept and motivation [15]. They are individualized yet distinctly social, many of which are the direct result of previous social comparisons in which the individual's own thoughts, feelings, characteristics, and behaviors have been contrasted with those of salient others within the individual's sociocultural and historical context and immediate social experiences, including the models, images, and symbols provided by the media. While possible selves reflect the extent to which the self is socially determined and constrained, they also have the potential to reveal the inventive and constructive nature of the self [16].

Psychological Safety and Levity

Psychological safety and trust in groups are positive feelings tied to the belief that it's okay to speak or act, even if doing so could make one vulnerable to negative judgment or exploitation by others. The literature shows that psychological safety enhances team creativity and innovation by creating an environment where individuals feel psychologically safe [17][18] and increases team and individual learning [19][20][21].

Levity increases authentic feelings of psychological safety, the belief that you won't be punished or humiliated for speaking up with ideas, questions, concerns, or mistakes in a group. People feel safe when they, and everyone around them, bring a spirit of play [22]. Levity and playfulness

make us feel confident that it's safe to play, and that sense of safety helps us pursue our goals [22].

An opportunity mindset, which sees challenges as chances rather than threats, mediates the performance boost [23]. "When we're happy and engaged, our mindset changes. We widen the scope of our attention. We consider more things we could do, which improves our creativity and the decisions we actually make [22]." Levity also brings people closer and triggers mutual disclosure [22].

In our extracurricular service-learning approach, we use levity to increase first-year students' psychological safety, thereby strengthening their sense of belonging and motivation to learn.

3. Approach

We propose an extracurricular service-learning approach with easy entry and a minimal, flexible time commitment to engage and motivate first-year computing students on our urban commuter campus. We conducted a mixed-methods study to assess the approach's effectiveness. Compared with traditional course-based service learning, our approach aims to increase students' engagement with the computing discipline and motivation to pursue their majors, rather than immediate academic outcomes, such as course objectives.

Our unique approach includes the following.

- Service learning that engages first-year students in the computing community and practices, aiming to increase their disciplinary motivation and engagement.
- Social experience in which students observe others and reflect on their own behaviors to create possible selves with identities in computing, providing them with social processes and shared experiences that help develop their computing identities.
- Levity to increase first-year students' psychological safety and bring them closer to each other and to other members of our department community.

In Spring 2025, we implemented our approach as part of a National Science Foundation-funded project: HBCU Learning Community-based Intervention in Computing, in which incoming first-year students were recruited to participate in a program that includes a summer bridge session, service-learning activities during the fall and spring semesters, and a yearlong seminar series. We hosted two service-learning events: 1) an AI workshop and party as the training event; 2) Senior Presentation Day Outreach as the service event.

In the workshop, we trained first-year students on "Teachable Machine," an online platform that lets users quickly program a machine learning model and experiment with images for classification. We included a networking component so service-learning students could meet upper-class students at various stages of their careers and learn how their service-learning experiences helped them. We then enlisted the first-year students to host a group of high school

students on campus during the outreach event, where they helped introduce “Teachable Machine” to the high schoolers and then jointly visited our department’s senior presentations.

We used the following strategies to implement the approach in Spring 2025: 1) Creating easy-entry roles and 2) Creating valuable, fun, and convenient training and service events. We explained them in detail below.

Creating low-entry roles

We created low-entry roles in service-learning events through selecting appropriate technical content and assigning appropriate responsibilities.

- **Selecting appropriate technical content:**

Through trial and error, we developed the following selection criteria for service-learning technical content:

- Manageable for the first-year students to quickly learn and become confident to show others
- Hardware-independent, so that they can practice at home
- Hands-on for better engagement

We decided to leverage our expertise in computer vision and machine learning. These topics are cutting-edge research and more likely to inspire and motivate students to pursue computing. We chose to use one of the Major League Hacking video series for training to avoid recording sessions and dealing with participant absences. It could also be replayed by students to learn at their own pace. We selected the following video for our students to learn quickly and be confident in assisting high school students with hands-on work: Create Your First Image Classifier Using “Teachable Machine.”

- **Assigning appropriate responsibilities:**

We asked first-year students to serve as assistants to small groups of three to five high school students, while the faculty and graduate teaching assistant led the hands-on activities.

Creating valuable, fun, and convenient training and service events

Valuable.

- During the training event, we invited students at various stages of their matriculation (sophomores, seniors, MS, and Ph.D.) to share their learning and development experiences and to serve as mentors and role models for first-year students. The graduate students are actively engaged in research in computer vision and machine learning. The teaching assistant, the undergraduate sophomore, and the seniors all volunteered in previous outreach activities and shared how those experiences benefited them. We used

existing office hours and grants to cover the student assistants' efforts, and we expressed appreciation to those who volunteered.

- We arranged the service event on our department's senior capstone presentation day, so first-year students could visit the presentations after their service.

Fun. To create a fun experience, for our service-learning events, we

- provided refreshments, used party decorations, and swags.
- Added social networking time to both events
- Used the language to foster playfulness

Convenient. When selecting the dates, times, and locations for our events, we aim to maximize convenience for our first-year students. A convenient time, such as immediately before or after a class, significantly reduces the time and effort required for a commuter student to attend the events. We also chose locations our participants had been to before, since first-year students are not yet familiar with the campus.

Finding a common, available, and convenient time slot for all participating commuter students is challenging. They not only have different class schedules but also commute to class. It helped that the University began, in Spring 2025, reserving two time slots per week for meetings. We examined each student's class schedule, identified their common availability, and sent an announcement one month before the training event and two months before the service event to confirm their availability.

When coordinating our high school partner's visit to our campus, we encountered a challenge: the date that worked for our student fell during our partner's exam week. However, because we planned early, our partner was able to work with their administration to obtain an exemption allowing the students to visit that week. Our experience highlights the challenges of implementing service learning in an urban commuter environment and the importance of early planning to secure activity dates.

Below are brief descriptions of the two service-learning events.

- **Training event: AI Workshop and Party**

It was a 2-hour event with an additional 30 minutes for setup. The first 30 minutes were for food, self-introductions, and sharing experiences. The workshop lasted about 50 minutes. The first author and a graduate teaching assistant led the session. The tutorial, instructions, and lesson plan were provided to the TA before the event, and the TA checked the lab equipment for the hands-on portion. Two CUE students and three other first-year computing students participated in the event. Guest speakers included a senior cybersecurity student, a Ph.D. student, a master's student in computer science who also served as the teaching assistant, and a sophomore. Guest speakers introduced themselves, shared their experiences at the University, and discussed their recent internships and research. One faculty member presented his most recent research at the event. We ended with picture-taking and quick student feedback.

- **Service Event: Outreach service on Senior Presentation Day**

We enlisted trained first-year students to host a workshop on the same technical content for a group of students from a local partnering high school. The first-year students served as helpers to faculty members, a graduate teaching assistant, and a senior. They prepared the room, set up equipment, and introduced themselves and their experience at the University when the visitors arrived. After the workshop, they accompanied the visitors to senior presentations. Afterward, they participated in a group interview during lunchtime. Fifteen high school students participated in the event. Under the leadership of four faculty members, five first-year students participated in the service-learning event as helpers. More details of the training plan and the service event are in the Appendices.

4. Evaluation Methods

For this mixed-methods implementation and outcomes study, we developed the Service-learning Motivation and Engagement Scale (SL-MES) to measure students' motivation and engagement in computing following service-learning activities, both quantitatively and qualitatively. The questions in the instrument are listed in **Appendix C**.

Our SL-MES is based on the Situation Motivation Scale (SIMS) [25], a well-validated 16-question survey that quantitatively measures students' situational motivation in an activity. Our service-learning committee, composed of computer science faculty from the participating institutions, reviewed the instrument and removed some redundant items to simplify SIMS.

Survey participants were asked to rate different reasons for service learning on a Likert scale ranging from disagree strongly (1) to agree strongly (5). Following SIMS, SL-MES includes two items for intrinsic motivation (Because I think the activity is interesting; Because I feel good when I do the activity); one item for identified regulation (Because I believe that it is important for me); two items for external regulation (Because I am supposed to do it; Because I feel that I have to do it); and two items for amotivation (There may be good reasons to do it, but personally, I don't see any; I did it, but I am not sure it is a good thing to pursue it). We also added the following survey questions to collect qualitative results:

In addition to the survey, four students participated in an in-person, 30-minute focus group with the program's external evaluator immediately after the second service-learning event. The focus group was guided by an evaluator-developed semi-structured interview protocol based on the grant's research questions and included questions on service learning as well as other aspects of the entire program, including the summer bridge and the lecture series. The service-learning questions are in **Appendix D**.

5. Data Collection and Analysis

The first cohort included six first-year students, as classified in the University's enrollment system based on their admission applications. One student had college credits from another

university in a different major but was classified as a first-year student in the cybersecurity major at our university. They were recruited for the summer bridge session, the first part of the larger program that includes service learning.

We administered the SL-MES to these participants at the end of the semester, after the service-learning events, as part of a larger program survey. Five of the six participants responded to the survey (an 83% response rate). Only three of the five respondents completed the service-learning questions. The other two could not recall whether they had participated in the service-learning activities, even though they had. The following results are based on students' responses to the survey (N=3) and the focus group (N=4).

Overall, students said the service-learning activities they participated in were interesting and valuable. All survey respondents said the activity was good for them. Two of the three respondents agreed or strongly agreed that they felt good when doing the service-learning activity. (see Figure 1). One student said, "It [makes me want] do research outside of my major, to increase my knowledge of new technology outside of my major." Another spoke to why the service learning was good to do, noting, "Being able to engage with and help out with the high schoolers [was the best thing about the service learning], because I remember when I was in their position, and now the roles are reversed."

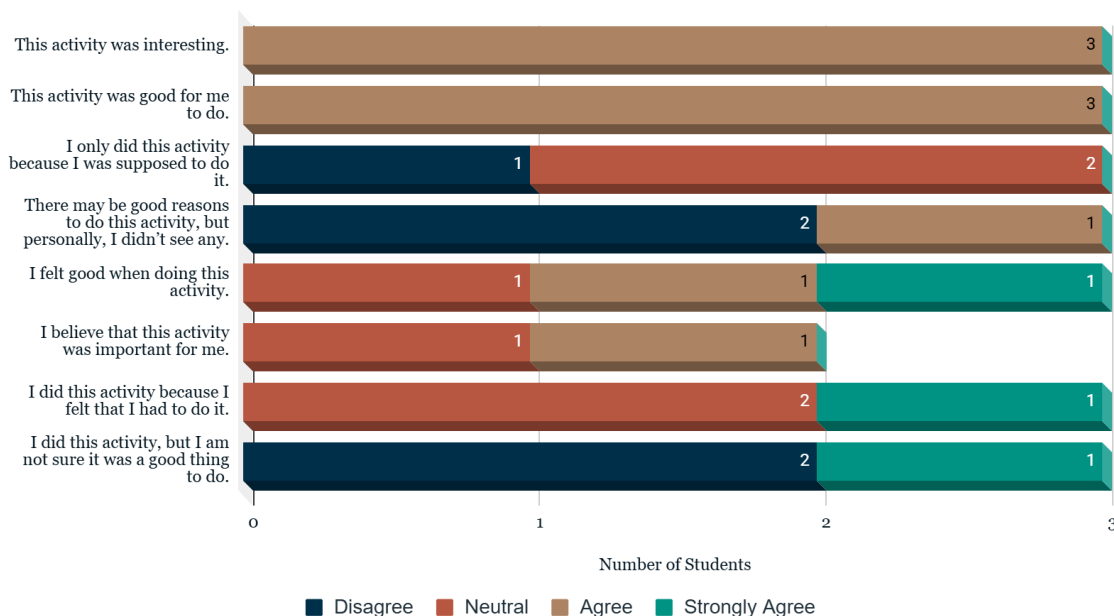


Figure 1. SL-MES Item Results (N=3)

Students also found the service-learning helpful in developing important academic and career skills. All (N=3) said that the service-learning experience helped them very much in acquiring job- or career-related knowledge and skills. In addition, all said that participating helped them work effectively with others (see Figure 2). One student said, "I would say the best was learning

more about the advancing and upcoming technology and being able to network with new people.”

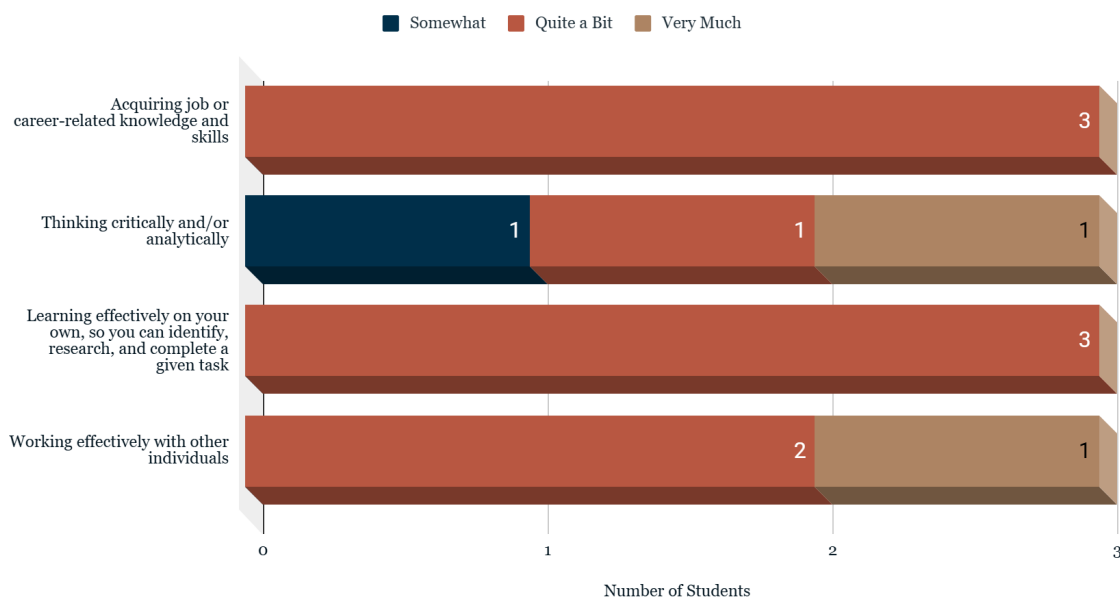


Figure 2: Helpfulness with Key Skills: To what extent did the program’s service-learning experience help you in the areas of: (N=3)

Students also found the service learning to be engaging, with two rating it “quite a bit,” and one saying it was “very much” engaging (see Figure 3).

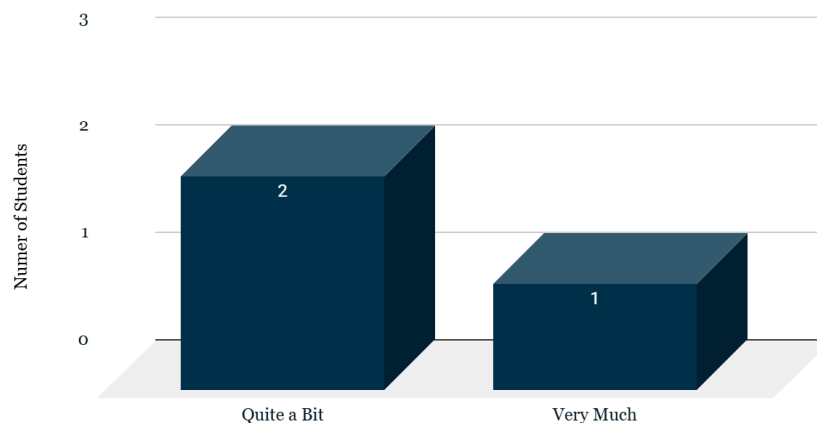


Figure 3. To what extent was the program’s service-learning experience engaging? (N=3)

Students also reported that the program’s service learning motivated them to pursue their majors, with two students saying it motivated them “quite a bit” and one saying it motivated them “very much” (see Figure 4).

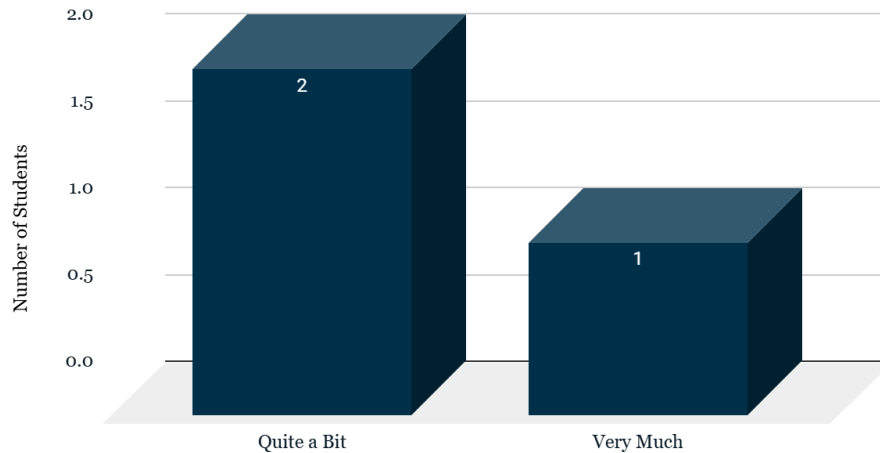


Figure 4. To what extent did the program’s service-learning motivate you to pursue your major? (N=3)

Program participants enjoyed working with high school students, learning about AI, and coding, and said:

- “It became very engaging when the students in the program had to help and guide the high school students through the demonstration.”
- “I think the program was very fun, and we learned a lot about AI, and we learned that it was good to learn about coding.”
- “I feel like the content that was presented in the program service-learning was very eye-opening, and that made me engaged.”
- “The lectures [by professionals in the field and academia] were good and they were very good because they were detailed.”

Several participants reported not remembering participating in service-learning activities, which revealed an issue with our communication. We believe this was because the students were unfamiliar with the term and concept of “service learning,” and we need to introduce or explain the term to them. Such communication is especially important when service learning is embedded in a program with other activities. In the future, we will emphasize communicating the concept of “service learning” throughout the program.

6. Conclusions and Future Work

We propose a first-year college student service-learning approach that offers 1) low-barrier entry roles and technical content that are easy to learn, hardware-independent, and hands-on; 2) valuable, fun, and convenient training and service events. Our preliminary data indicate that our approach increased participants’ engagement and motivation to pursue their majors. They appreciated the lectures and the opportunities to network and serve high school students. These

findings suggest that this approach can engage and motivate first-year students through service learning.

The small cohort of first-year students in the program limits our current results. In the future, we will continue to collect data from our second and third cohorts. We are also opening the service-learning activities to first-year students who did not participate in the summer bridge session. The accumulation of data and the expansion of the program will give us significantly more data to analyze. In addition, we plan to conduct thorough qualitative data collection and analysis. We plan to design and conduct an interview focused on service learning to examine students' experiences. The combination of increased qualitative and quantitative data will help us to evaluate our approach thoroughly.

We also plan to engage participants beyond their first year by inviting them to serve and conduct service learning with later cohorts. This will give participants additional opportunities to further develop the skills learned through service learning and to continue serving, engaging, and staying motivated throughout matriculation.

We will also refine our approach by selecting various topics and creating more entry-point roles in service learning, along with a flexible mechanism for students to participate, such as multiple opportunities per semester on different days of the week that fit their schedules.

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Appendix A. Midterm Celebration & AI workshop

Roles

- Lead:
- Flyer Designer:
- Promotion
- Photographer:

Date/Time

Total 2 hours, first 30 minutes for food, a game and catching up.

Topic: Create your first image classifier (does not need coding)

Preparation:

1. **TA watch the following videos**
 - 1) https://www.youtube.com/live/xpOsUD-mpeA?si=VwM0_3MbGmtfMo8M
 - 2) The teachable machine training video (2') <https://youtu.be/DFBbSTvtpy4>
2. **TA test the equipment in the lab**
 - Enough number of working computers for participants?
 - Are the websites working on these computers and the instructor machine?
 - Are the projection and audio working?

Lesson Plan:

1. **The teachable machine demo and hands-on (20-25 minutes):**
 - **Faculty or TA demo My image Model (glasses no glasses) or** <https://teachablemachine.withgoogle.com/models/CIgv5M1cm/>
 - TA play above video 24'-41', 17 minutes long
2. **Theory of machine learning:** TA play video starting at 4'57" (20 minutes)
3. **Sharing:** Students walk around try each other's classifier (15 minutes, TA assist). Or split into two groups, take turns to present to the other half (this is rehearsal and public speaking)
4. Introduction to service learning (**faculty and student assistants, 15 minutes**)
5. Upper class students present their related projects (15 minutes)
6. Group picture (5 minutes)

Appendix B. Senior Presentation Day Outreach and Service Learning

Roles

- Lead:
- Promotion:
- Photographer:

Date /Time

School Senior Presentation Day

Within the range of departmental presentation time

Location

- Departmental presentation location, a lab and a meeting space

Schedule:

- 10:30 am - 11:30 pm service-learning students offer workshop and hands-on in the lab
- 11:30 pm - 12:15 service-learning students join the high school students in listening to two senior presentations (15 minutes each)
- 12:15-1pm Pizza lunch in the lab and service student focus group in the meeting space
- 1-2pm visit the poster session (optional)
- In case that the high school bus is late, the backup plan is to do the service learning component during lunch time

Appendix C. Service-learning Motivation and Engagement Scale (SL-MES) Survey Instrument

Q1 - Directions: Read each item carefully and choose the rating on the scale that best fits you when you think about your recent computer-related service learning: 1: strongly disagree; 2: disagree; 3: neutral; 4: agree; 5: strongly agree.

- This activity was interesting/pleasant/fun.
- This activity was good for me to do.
- I only did this activity because I was supposed to do it.
- There may be good reasons to do this activity, but personally, I didn't see any.
- I felt good when doing this activity.
- I believe that this activity was important for me.
- I did this activity because I felt that I had to do it.
- I did this activity, but I am not sure it was a good thing to do.

Q2. To what extent did the recent service learning training and activities help you in the areas of? Scale: 4: very much; 3: quite a bit; 2: some; 1: very little

- Acquiring job or career-related knowledge and skills, e.g., public speaking
- Thinking critically and/or analytically
- Learning effectively on your own, so you can identify, research, and complete a given task
- Working effectively with other individuals

Q3. To what extent were the service-learning training and activity engaging? Scale: 5: 5 very much; 4: quite a bit; 3: somewhat; 2: very little, 1: not at all

Q3.5 Please explain your response to Q3

Q4. To what extent did the service-learning training and activity motivate you to pursue your major? Scale: 5: 5 very much; 4: quite a bit; 3: somewhat; 2: very little, 1: not at all

Q4.5 Please explain your response to Q4

Q5. To what extent did the service-learning make you feel like you were part of the HBCU community?

Q5.5 Please explain your response to Q5

Q6. Overall, what was the best part for you about doing the service learning activity? Why?

Q7. Overall, what was the least useful part for you about doing the program's service learning activity, if anything? Why?

Q8. Please share your recommendations for making this service learning activity better in the future.

Adapted from F. Guay, R. J. Vallerand, and C. Blanchard, "On the assessment of situational intrinsic and extrinsic motivation: The Situational Motivation Scale (SIMS)," and S. Ahlfeldt, S. Mehta, and T. Sellnow, "Measurement and analysis of student engagement in university classes where varying levels of PBL methods of instruction are in use," *High. Educ. Res. Dev.*

Appendix D. Interview Protocol Questions

Protocol questions specifically about service learning included:

- a. Did you participate in the service-learning activities on (dates)?
- b. By activity, was the activity engaging? Why or why not?
 - i. If it was engaging, what made it engaging?
 - ii. What effect, if any, did that engagement have on you during the event? After?
- c. Did the service-learning activity make you feel like part of your program community?
 - i. If yes, HOW did it make you feel like part of your program community? Did that feeling persist after the event?
 - ii. If no, why not? What would have helped?
- d. Did the service-learning activity have any effect on your motivation to stay in your major?
 - i. If yes, what effect? Please describe in detail
 - ii. If no, why not? What would have helped?
- e. Did the service-learning activity help you build confidence in any way?
 - i. If yes, how?
 - ii. If no, why not? What would have helped?