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Senior Project Proposal
Compass: Guiding Teachers Towards their Student's North Star

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Project Summary

According to the National Center of Education Statistics (NCES), 15.4 million students were enrolled in an undergraduate, degree-earning program during the 2021 academic year (NCES, 2023). By comparison, there are an estimated 1.5 – 1.6 million teachers in post-secondary education (NCES, 2024). Across all types of degree offering institutions (such as private or public colleges), this results in a student-to-teacher ratio ranging from 10:1 and 24:1 (NCES, 2024). This ratio implies that one teacher who may teach at least three courses a semester is responsible for ensuring a quality education and academic success to anywhere between 30 - 72 students (Canyons, 2024). These are 30-to-72 names, final exams, and grades that a professor should ensure success toward. However, this high workload and large pool of people seldom allow teachers to keep up with all students. Compass addresses this problem by providing educators with a data-driven approach to help students achieve academic success.

Compass aims to give teachers specific insight into their student's performance – whether strong or weak – and advise the teacher on particular approaches the student can take to improve their performance. It uses data commonly available to teachers to achieve this goal, such as class size, student demographics, quiz/test scores, and letter grades. Its interactive interface and minimal design allow teachers to access academic data at different levels. These scopes include but are not limited to: overall student performance, student performance by class/subject, student performance by assignment type, and individual student performance. With Compass, there is less generalization in feedback and greater accuracy in outlining student success.

Significance

Back-end functionality will prioritize the privacy and security of Personal Identifiable Information (PII) – a crucial component of my data governance. Using principles from CSC 430A: Cybersecurity, such as safe network practices (not using public Wi-Fi) or requiring authentication for a user's log-in to the platform, will be crucial for this goal. Documentation will be made with an audience of teachers and developers in case Compass becomes apt enough to serve real-world environments beyond the Senior Seminar. Skills from CSC 240A: Writing Computer Science will be used to communicate directions for prospective collaborators and users of Compass in the README file or Website.

Compass will be built on principles of data governance (such as scraping, formatting, visualizing, and analyzing data) and human-computer interaction design principles. The manipulation and management of databases is taught in CSC 480A: Database & Filesystems, and data visualization and analysis using Python programming is addressed through CSC 370A: Data Mining. Personal experience from high school courses, hackathons, and internships has established an understanding of HTML, CSS, Java, and HCI principles (CSC 320A: Human-Computer Interaction) used to design a pleasing user experience. Knowledge from this HCI class will be employed early in my project as I design wireframes, entity relation diagrams, and prototypes. Additionally, tools such as Python, Microsoft Excel, Power BI, and PostgreSQL will create and manage the data and database used to make Compass a functional platform.

Required Tools & Availability

Compass will require access to Visual Studio Code (VS Code) version 1.93 (V.193) on any laptop, preferably running on an updated Windows system (Windows 11), and having the

Java, JavaScript, Python, HTML, and CSS languages running on the platform. The most updated version of each language will also be used as they are readily accessible through VS Code. While VS Code also offers generative AI assistive technology, such as GitHub Copilot (V.1.7) and ChatGPT (V.4o), minimal use will be preferred for this project in script writing (Stringer, 2024). Should there be any use, prompts will be sourced as mandated by the project specifications. PostgreSQL (V.16.4) and Microsoft Excel will be available at no cost, or through my DePauw student account (Group, 2024).

Additionally, Lucid Chart, Figma Design, and Power BI (V. 2.134.7227.0) are available for a free trial for designing ERDs and user interfaces (“Plans & Pricing”, 2024). Figma Design and Lucid Chart pose no issue with free trials, but Microsoft would prevent sharing a developed dashboard unless a 60-day free trial is requested (*Power BI, 2024*). For user-testing and submitting the project, this free trial will be requested during the latter half of Compass’ development.

A GitHub repository will be used to save code (“Git Guides - Git Commit”, 2024). VS Code has a plug-in which connects the IDE to a repository in GitHub: from here, all commits will be made to store project code in the cloud ("*How to Commit", 2024*). Simultaneously, files will also be stored locally by the *CTRL* command when edits are made in VS Code. Compass will be run and tested on a Dynabook laptop, which holds 16 GB of RAM and operates Windows 11 Pro. The website will also be maintained and shared through GitHub later in the user testing stage.

Demonstration Plans

On the demonstration day(s), Compass’s features will be presented in the Linux lab on my laptop and shared on my screen via Zoom. As a web-based application, I do not require any other tools

other than a mouse, mouse pad, and keyboard – all which function on my laptop. In the case where there is a hardware issue, such as poor Wi-Fi connectivity, I will have prepared a short recording the day prior which will be shared en lieu of the live demonstration. On the given check-point day, I will present the previously solidified features with the inclusion of bonus features if applicable. If a previous checkpoint was missed but later implemented, I can verbalize this feature's function but will not showcase it due to limited time.

Qualifications

Structured, presentable, and digestible data is key to emerging positive outcome(s). During my time as a DePauw Intramurals intern, our organization suffered from high levels of hours going into work with little to no outcomes; this cycle persisted for two years. However, one summer I worked as a Data Analyst intern garnered skills on the use of Power BI and Microsoft Excel to mine and visualize data. When I began intramurals in the fall, I compiled, formatted, and visualized the data for my supervisor and team members; this led us to make informed decisions on the event types which are likely to bring in more players. As a result, our spring semester saw a 450% increase in the number of participants in the intramurals program by the following spring. There were more players than all our previous years combined. Through this example, I understand the power of data-infused decision making.

This past summer, I further developed my skills in data governance using programming languages such as Python, Scala, and assistive AI technology to develop a dashboard that will help consultants better inform clients on metrics to track client performance. I became very familiar with the tedious, repetitive, and meticulous process of mining and formatting data to be scalable. I learned the importance of asking questions that will improve the value and

functionality of one's product. I wish to use this basis to develop a similar tool for educators to use in their classrooms and with their students.

Project Specifications

Functional Specifications

Compass will grant teachers with (1) a high-level overview of the class performance (2) student-specific performance and (3) recommendations for where students/individuals can sharpen their knowledge based on their test scores. These outcomes will be provided by filtration ability on the dashboard and interactive visuals that reflect fields selected by a teacher. These fields include but are not limited to: subject, assessment category, grade range, and academic quarter. Finally, teachers often are responsible for multiple classes, subjects, and students. One feature will provide teachers with probable reasoning as to why the student is performing well/poorly in class and give more specific guidance. This will be shown on the website/dashboard as a card that reflects trends in visualized data. This approach will help mitigate the generalization of feedback that may not always serve the student best.

User Interface Specification

Compass will be a website that is built of HTML, CSS, JavaScript, and Python. It will have authentication shown through a log-in screen followed by a display of a Power BI dashboard embedded into the website ("*Embedding Power BI", 2017*). Firstly, wireframes and prototypes will be built using Figma. Teachers will first be asked to authenticate themselves using a traditional username and password log-in. Subsequentially, teachers will be presented with a soft yet bold design for compass. The home page will have an interactive dashboard occupying 2/3rd of the interface, with a header and sidebar for select functionality such as signing

out, and about section, directions, and more occupying the remaining 1/3rd. The website will reference bootstrap to maintain a reactive view that will adapt to any changes to the browsing window. Most importantly, Compass will present an intuitive and amiable interface that will facilitate beneficial interaction between teachers and students.

Technical Details

Data and Databases are the foundation of Compass. Using Lucid Chart, a mind mapping platform, an entity relation diagrams (ERDs) with at least 5 tables will be created to connect between schools, teachers, students, classes, and grades. In each of these tables, will have a serial, primary key (PK) by the same table-name. For example, the *Teacher* table will have a PK named "TeacherID." Each instance of a primary key's presence in another table will be a foreign key (FK). For example, a "TeacherID" column in the *Student* table will be a FK. All instances of names or letters will be stored as text data-types (i.e., teacher's name, student's names, class's name). Conversely, all instances of numbers will be stored as numeric data types. For example, graduation year and grade point average (GPA) will be categorized as year and double, respectively. In the project's early stages, Python will be used to generate fake data through the Faker class ("*Welcome to Faker's",2024*). However, real data sources will be sought after from teachers, cleaned for the removal of imminently identifiable data PII such as names, emails, and phone numbers ("Protection of Personal", 2024). However, general, less identifiable information (race, gender, academic year, etc.) will be considered for visualization point in Compass.

PostgreSQL will serve as my primary database management platform. It will store queries and views used serve as a method of quality assurance visualized output versus tabular format. For example, if a visual showing the top performing students in a certain subject do not match the tabular format, this will be a sign of an error. Google Suite will be used to conduct

user interviews, with all information being stored and communicated through Google Docs or Google Meets. GitHub will maintain and be used to share the website.

Ultimately, these four platforms (VS Code, PostgreSQL, Power BI, and GitHub) will collaborate with each other to manage data governance and production of the web service that is Compass.

Developer Work Plan

For this section, my timeline will be presented in terms of preparation for my checkpoints. Each quarter will detail the activities I will complete leading to the presentation of my checkpoint. To maintain accountability and coherent communication, I will provide Professor Webb with a set of advances and challenges in bi-weekly manner. This will also develop a proper cadence to my workflow and accountability for myself and my work. Prior to every check-in, an appointment will also be made at the TLC's S-center to practice my presentation and ensure all checkpoint features are represented within the 5-minute time limit. The W-Center will also be utilized as a form of quality assurance for all written work produced in this course.

In preparation for Checkpoint 1:

I will dedicate 10 hours/week to ensuring my final proposal reaches approval and developing my data architecture and ERD diagrams. This includes a visual that explains the workflow of my data from collection, storage, transformation, and visualization across all software except the laptop's operating system. Additionally, at least 5 bodies will be created, detailed, and connected for the ERD. I will use at least 5 different data types to describe an object's attribute ("*SQL Data Types", 2024*). I will then proceed to develop a Python script that produces fake or "dummy" data. This data will be used to fill tables on PostgreSQL based on the

diagram. During this time, I will also reach out to a network of teachers in Greencastle to discuss if they would be willing to help me develop Compass by providing user feedback, user testing, and if possible, real student records. Deliverables from these efforts should be two Lucid Chart designs, one Python script, and one set of .csv files with "dummy" data.

In preparation for Checkpoint 2:

I will dedicate 10 hours/week to developing a high-fidelity prototype of the Compass website on Figma. This step involves producing wireframes and developing the brand-identity of Compass such as the colors, font, tone, and feel. Exploring websites marketed towards teachers or the use of templates for inspiration will likely take place in this process as well. If a teacher to collaborate with has been found by this timeframe, I will work closely with them to conduct user testing and receive user feedback by in-person or virtual means. As a back-up, I will search my network for peers who are majoring in education studies and have backgrounds in tutoring or teacher apprenticeship. I will plan to either finish the majority of my work prior to fall-break *or* complete the bulk of prototype finalization and user testing during fall-break. Outcomes from this stage should be one high-fidelity, interactive, and dynamic prototype catered towards teachers and at least 5 points of feedback provided by the user. An additional step will be taken to reflect at least 50% of the feedback provided from user testing.

In preparation for Checkpoint 3:

I will dedicate at least 10 hours/week to refining my ERD, programming a draft of the Compass website, an ensuring the back-end functionality runs appropriately. Based on my user-feedback, I will update all previously recommended suggestions included but not limited to my wireframe and data being tracked/managed. Additionally, I will factor potential features requested by the user if it is (1) minor (2) feasible, and (3) will directly improve user experience.

For example, a hover feature which explains the function of a certain button would meet the criteria of a minor, feasible update that clarifies functionally. A button that opens a new webpage add more students is feasible and improve usability. However, this ask is not minor and would therefore not be refined into the current project.

The bulk of this phase will be spent on developing an accessible version of the website on my local search Engine, Microsoft Edge. This will be as direct of an implementation of the Figma prototype as possible; Visual detail and functionality should be closely reflected on the local webpage. By this time, I will check-in again with my collaborator for any possibility of using real-world student data to elevate the potential feasibility of Compass being active in classrooms. The result of this stage should be one functional webpage prototype that offers user authentication through a log-in.

In preparation for Checkpoint 4:

I will dedicate at least 10 hours/week to finalizing the functionality, usability, and experience of classroom for teachers. To achieve this, I will conduct at least one more round of user testing with the educator or peer which I collaborate with. As feedback is given, I will assess the feasibility and refine it into the Compass website. This stage of development will also see debugging and quality assurance in my code, website, and documentation. This may look like comments in my IDE, a detailed README file and all content uploaded to GitHub, and an efficient and functioning website. Last but not least, I will record a video of a successful use case to be shared as part of the final presentation. Deliverables for this stage include a recorded video, check-point 4 slides, and all items uploaded to GitHub, and a draft of a LinkedIn post to showcase my senior project.

Timeline

Checkpoint 1 (Oct 1):

- **Data architecture diagram modeling the life cycle of data from collection to visualization** (I will show this by demonstrating a Lucid Chart diagram and explaining the different stages of my process.)
- **ER Diagrams** (I will demonstrate the relationships of my data types – including but not limited to – school, teacher, and student entities)
- **Creation of "Dummy Data"** (I will successfully explain and demonstrate the script which produces dummy data)

Checkpoint 2 (Oct 22):

- **High-Fidelity Website and Compass Wireframe** (I will show this through designs on Figma, demonstrating the log-in process and functional concepts of the dashboard)
- **User feedback from an educator** (I will show visual accents on the prototypes, such as a circle or before/after, with notes from educator(s) where changes were recommended and/or made)

Checkpoint 3 (Nov 12):

- **Data Export/Storage** (this may look like me saving the outcome of my script, uploading it to my database platform, and showing what it looks like inside of my database)
- **Demonstration of Compass Website** (I will authenticate and log myself in as a teacher using Compass through the website.)

- **Compass working prototype** (I will show the working prototype of my Power BI dashboard with visualizations of the dummy data)

Checkpoint 4 (Dec 3):

- **Full Demonstration and Functionality** (I will give a live demonstration of a plus scenario where a teacher and student interact and the student leaves with a solid understanding of why their class performance is poor and what they can do to improve it.)

Future Enhancements

- **Institution View**; Compass is currently designed for single-teacher use. In the future, it may develop a "school-wide" account for schools to monitor school-wide student performance.
- **Student view**; Compass is currently designed for single-teacher use. In the future, it may develop a "student" account for individual students to monitor personal academic performance.
- **Chatbot;** While it is expected that there will be a card that can provide insight into general trends on student performance, a potential, future feature would be a chatbot that can consult with the teacher on potential approaches towards improving student performance
- **School Theme Matching**; To provide a more user-centered user experience, a plausible feature would be having the dashboard adapt to the school's branding. Though would include but not be limited to: school color, school logo, and an a chatbot that resembles the school's mascot.

- **Future Grade Analysis**; this would be a feature that uses a method of analysis to predict the semester grade of a student based on factors such as grades, attendance, and demographic. There is complexity behind including demographic, but demographic plays a role in student experience which can impact final grades.

Ethical Considerations

Findings show that the demographic of students in higher-education is disproportionally White. In fact, White students represented 50% of the student body in 2021 (NCES, 2024). Demographic experience in higher-education plays a focal role in student experience, and consequentially, student performance. Compass will primarily operate off statistical data and is currently not envisioned to factor in the lived experience of certain demographic of the student population. This creates a false narrative that all student experience is equal regardless of race, gender, mental ability, etc., and implies that this tool will work best for all students when it only addresses classroom performance. With time, Compass has the potential to factor in these aspects of student life through surveys and sentiment analysis. This is why it will be extremely important for educators to simply use it like a guiding tool and provide their humanity in the process as well.

Transparency and Accountability: Compass will maintain transparency and accountability through its robust documentation. As a tool that is intended to help educators improve student performance, it is crucial that Compass communicates the type of information necessary to achieve this goal and directions on how to do so. As a senior project, I will also specify that it is not intended or ready for commercial use due to lacking the security mechanism to protect storage of personal information.

Risk Disclosure: A full-fledged version of Compass would manage PII of students and teachers, such as their name, email, and locale. For the development process, fake user data will be generated and used instead of real-world information. However, in the later state and if possible, it will be necessary to communicate with collaborators who provide real PII that it will be transformed using methods of generalization to prevent the security risk of leaks identifying real people.

Bibliography

Embedding Power BI Reports in Web Pages. Directed by Learning Tree International, 2017. *YouTube*, https://www.youtube.com/watch?v=V9Xp0X7hLBk.

"Git Guides - Git Commit." *GitHub*, 2024, https://github.com/git-guides/git-commit.

Group, PostgreSQL Global Development. "PostgreSQL." *PostgreSQL*, 20 Sept. 2024, https://www.postgresql.org/.

"Guidance on the Protection of Personal Identifiable Information." *DOL*, https://www.dol.gov/general/ppii. Accessed 18 Sept. 2024.

How to Commit and Push in Git Using Visual Studio Code. Directed by Rabi Gurung, 2023. *YouTube*, https://www.youtube.com/watch?v=uuNbZ79SkEo.

My Grammarly - Grammarly. https://app.grammarly.com/. Accessed 18 Sept. 2024.

National Center for Education Statistics. "Postsecondary Education." *Undergraduate Enrollment*, May 2023, https://nces.ed.gov/programs/coe/indicator/cha.

"Plans & Pricing." *Figma*, https://www.figma.com/pricing/. Accessed 18 Sept. 2024.

Power BI. https://app.powerbi.com/home?culture=en-us&country=us&experience=power-bi. Accessed 18 Sept. 2024.

SQL Data Types for MySQL, SQL Server, and MS Access. https://www.w3schools.com/sql/sql_datatypes.asp. Accessed 18 Sept. 2024.

Stringer, Kyle Wiggers, Cody Corrall, Alyssa. "ChatGPT: Everything You Need to Know about the AI Chatbot." *TechCrunch*, 12 Sept. 2024, https://techcrunch.com/2024/09/12/chatgpt-everything-to-know-about-the-ai-chatbot/.

Welcome to Faker's Documentation! — Faker 28.4.1 Documentation. https://faker.readthedocs.io/en/master/. Accessed 18 Sept. 2024.