Title: MM802 - Visualization Mini-project	
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Project Title: Canadian Post Secondary Institution Data Visualization	

1 Abstract

This report underscores the critical significance of the "Canadian Post Secondary Institution Data Visualization" project, addressing a notable gap in comprehensive data visualization within the Canadian post-secondary education sector. With international students in Canada contributed an estimated 21.6 billion Canadian Dollar to Canada's GDP in 2018 [1], the urgency to provide accessible and informative platforms for decision-making is paramount. Leveraging data sourced from the Canadian government's official website, the project aims to create an interactive visualization platform using modern web technologies like HTML, CSS, JavaScript, Plotly.js and D3.js promising a user-friendly experience.

Beyond data visualization, the project holds the potential to benefit various stakeholders, including prospective international students seeking suitable universities, education agencies facilitating student placements, and the Canadian government aiming to bolster the competitiveness of its education sector. By facilitating informed decision-making and fostering transparency, this initiative has the capacity to contribute significantly to the growth and sustainability of the Canadian economy. In conclusion, this project represents a pivotal advancement towards enhancing accessibility and transparency in the Canadian education landscape.

2 Introduction

Education services have a major impact on the Canadian economy, In 2018, international students in Canada contributed an estimated 21.6 billion Canadian Dollar to Canada's GDP and supported almost 170,000 jobs for Canada's middle class [1]. However, despite its tremendous impact, the data visualization of this sector is often neglected. With numerous post-secondary institutions across Canada, it is challenging for international students to choose the most suitable university and program that aligns with their needs. By visualizing post-secondary institution information across Canada and providing detailed information and interactive displays, it can be highly beneficial for multiple parties, including prospective international students, education agencies, and the Canadian government.

In this project, we are visualizing a dataset from the Canadian government's official website for the list of post-secondary academic institutions and programs validated by the Public Service Commission [2]. This dataset includes the list of all post-secondary institutions in Canada as per 2024, along with detailed information such as institution name, academic level, area of study, program of study, program length, duration of term, as well as the institution's contact person and their email address.

We're using HTML, CSS, and JavaScript for the website, with PHP for server-side connections. We're enhancing the user experience with jQuery animations and Lottiefiles. For data visualization, we're using Plotly.js and D3.js for their versatility and popularity.

3   Project Status

As of the present moment, our project has successfully acquired the requisite dataset from the official Canadian government website [2]. This dataset contains comprehensive information regarding post-secondary institutions across Canada, encompassing crucial details such as institution names, academic levels, areas of study, program specifics, and contact information. We are currently in the process of integrating this dataset into our platform to facilitate client-side data visualization.

Given the constraints imposed by time considerations, our immediate focus is on implementing interactive client-side data visualization features. This approach enables users to engage dynamically with the data, fostering a more immersive and informative experience. However, it is important to note that our ambitions extend beyond the current scope. We aspire to develop a server-side portal that empowers each post-secondary institution in Canada to directly input and manage their institutional data. This future enhancement will not only streamline the data management process but also ensure the most up-to-date information is available for visualization.

Furthermore, it is worth highlighting that rigorous testing has been conducted on the project's code to ensure robust functionality and performance. Testing has been carried out across both local and live server environments, validating the integrity and reliability of our solution. This project can be accessed online through this link: https://fransiscustobias.com/mm802/. This demonstration serves as a testament to our commitment to transparency and accountability in delivering a high-quality data visualization solution.

4   Project Status

Contribution of Tobias Tobias

- **JavaScript Logic:** Implemented JavaScript code to handle the functionality of the web pages. This includes retrieving query parameters from the URL, fetching data from the institution.csv file, filtering data based on user-selected parameters and handling user interactions such as dropdown selection and button click events.

- **CSS Styling:** Created a CSS file (style.css) to apply styles to the HTML elements and improve the visual presentation of the web pages. This includes styling the header, container, filter section and visualization result to enhance the overall appearance and user experience.

- **jQuery Animation Library Lottiefiles Integration:** Integrated the jQuery animation library Lottiefiles animations into the project to enhance the user interface with interactive animations and create a more immersive user experience.

- **Testing and Debugging:** Tested the functionality of the web pages to ensure that filters and visualization work as expected. Debugged any issues encountered during testing to ensure

smooth operation.

- **README File:** Created a README.md file to provide documentation and instructions for using the web application. The README includes an overview of the project, installation instructions, usage guidelines, and any additional information necessary for users.

Contribution of Soumya Kulal

- **Data Preprocessing:** Preprocessed the institution data in the institution.csv file to ensure its compatibility with the web application. This may include cleaning the data, handling missing values, and formatting the data appropriately for visualization and analysis.

- **Data Processing:** Utilized D3.js for data processing, including loading data from the institution.csv file and filtering it based on user-selected parameters. This involved parsing CSV data, filtering records, and preparing data for visualization.

- **HTML Structure:** Created the HTML structure for both the first page (index.html) and the second page (secondpage.html). This includes setting up the header, container, filter section and visualization result.

- **Navigation:** Implemented navigation functionality to allow users to navigate between the first page and the second page using buttons and links. This includes passing query parameters in the URL to maintain state across pages.

- **Project Report:** Making of the report for project to detail all aspects.

5 Development Environment

Network Configuration

- **Server:** XAMPP provides a local Apache server for hosting web applications. This server is accessed via localhost or 127.0.0.1 on the development machine.

- **Clients:** The development machine acts as the client, accessing the web applications hosted on the local Apache server.

- **Mobile Devices:** Mobile devices can also access the locally hosted web applications for testing purposes. Developers can use features like port forwarding to access the local server from mobile devices connected to the same network.

Software Used

- **XAMPP**: XAMPP is the primary software tool used for creating a local web server environment. It includes Apache as the web server, MySQL/MariaDB as the database server, PHP, and Perl.

- **Text Editor/IDE**: Developers typically use text editors or IDEs like Visual Studio Code, Sublime Text, or PhpStorm for writing code and we used the Notepad as our text editor.

- **Web Browsers**: Standard web browsers such as Google Chrome, Mozilla Firefox, or Microsoft Edge are used for testing and debugging web applications hosted on the local server and we used Google Chrome as our browser.

- **Database Management Tools**: Tools like phpMyAdmin, included in XAMPP, are used for managing MySQL/MariaDB databases so we used the same.

- **Command Line Interface (CLI)**: Developers use the command line interface for tasks like starting/stopping the Apache server, managing databases, and running scripts.

6 Development Work

Software Libraries and Tools Used:

- **D3.js:** Used for data manipulation and DOM manipulation in JavaScript. It's primarily utilized for reading data from CSV files (institution.csv) and populating dropdown menus dynamically based on the data.

- **Plotly.js:** Utilized for creating interactive data visualizations such as pie charts, bar charts and table. It's used in the `secondpage.html` to generate the program type pie chart, the duration of term bar chart, and contact list table.

- **XAMPP:** The development environment includes XAMPP for setting up a local Apache server environment. XAMPP provides Apache as the web server for hosting web applications.

How to Use the Project:

- **First Page (`index.html`):** Users can select an institution, academic level, and program length from the dropdown menus. Upon making a selection, they can click the "Go to Second Page" button to navigate to the second page (`secondpage.html`).

- **Second Page (`secondpage.html`):** This page displays visualizations based on the selections made on the first page. Users can view the program type pie chart, the duration of term bar chart, and contact list table corresponding to their selections.

Sample Output Figures:

- The sample output figures would include screenshots or visual representations of the dropdown menus populated with options based on the data from `institution.csv`.

Figure 1: Institution list CSV dataset

- Additionally, sample output figures would include screenshots of the visualizations generated on the second page, such as the program type pie chart and the duration of term bar chart and contact in the table format.

Limitations:

- **Local Environment Dependency:** The project relies on a local server environment provided by XAMPP. Therefore, it may not be suitable for deployment in a production environment without appropriate adjustments.

- **Limited Data Interaction:** While the project provides dynamic dropdown menus based on the data from `institution.csv`, it may not handle large datasets efficiently, leading to potential performance issues.

- **Solely Frontend Implementation:** The project appears to be primarily a frontend implementation with no backend functionality. As a result, it may not support dynamic data fetching or real-time updates without additional backend integration.

Overcoming Limitations:

- **Local Environment Dependency:** Deploy to a cloud-based server or use Docker for containerization.

- **Limited Data Interaction:** Implement server-side scripts or APIs, and utilize database systems for data management.

- **Solely Frontend Implementation:** Integrate a backend framework, implement RESTful APIs or GraphQL, and utilize modern frontend frameworks.

7 Concluding Remarks

Accomplishments:

- Developed a web application with dynamic dropdown menus and interactive data visualizations using D3.js and Plotly.js.

- Established a local server environment using XAMPP, enabling data manipulation and visualization on the client-side.
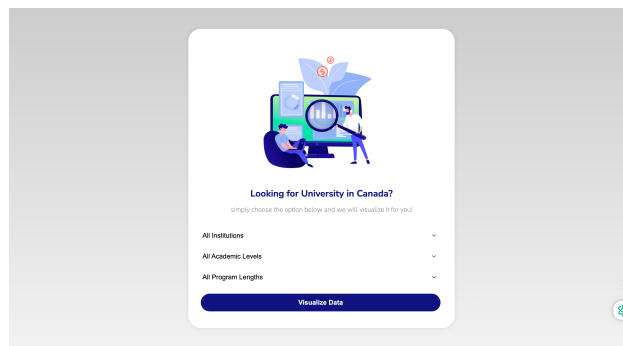

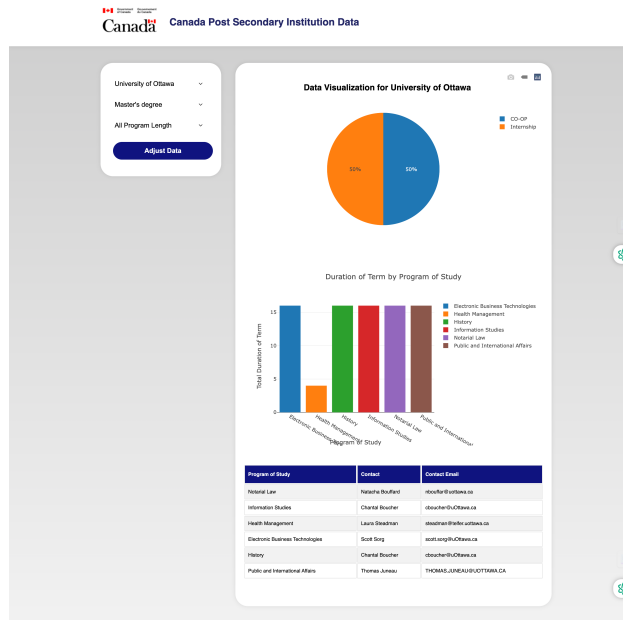Figure 2: Institution search homepage

Figure 3: Institution data visualization

Lessons Learned:

- Understanding the importance of frontend-backend integration for dynamic data handling and real-time updates.

- Gained proficiency in utilizing JavaScript libraries like D3.js and Plotly.js for data visualization tasks.

- Learned techniques for populating dropdown menus dynamically based on external data sources.

Possible Future Extensions:

- Implementing a backend server using frameworks like Node.js or Flask to enhance data interaction capabilities.

- Integrating a database system for persistent data storage and retrieval, enabling scalability for larger datasets.

- Enhancing user interactivity with features like filtering, sorting, and searching within the visualizations.

- Adding authentication and user management functionalities to secure the application and personalize user experiences.

Notes

The project utilizes various tools and libraries such as D3.js, Plotly.js, lottiefiles and XAMPP.

References

[1] G.A. Canada. Canada's International Education Strategy (2019-2024). https://www.international.gc.ca/education/strategy-2019-2024-strategie.aspx?lang=eng, 2024.

[2] Government of Canada. List of post-secondary academic institutions and programs validated by the Public Service Commission. https://open.canada.ca/data/dataset/ab36a4ab-9b69-49b1-8be6-6faa3f0d0c67/resource/5d42f06e-2484-42e0-8681-4a360198202c/download/cfppsc$_c$oop$02 - bom - 2024_03_01.csv$, 2024.