Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
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School of Statistics and Computer Science

Flight Logs Visualisation

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A Report submitted in fulfilment
of the requirements for the degree of
B.A. (Mod) Integrated Computer Science

Declaration

We hereby declare that this Report is entirely our own work and that it has not been submitted as an exercise for a degree at this or any other university.

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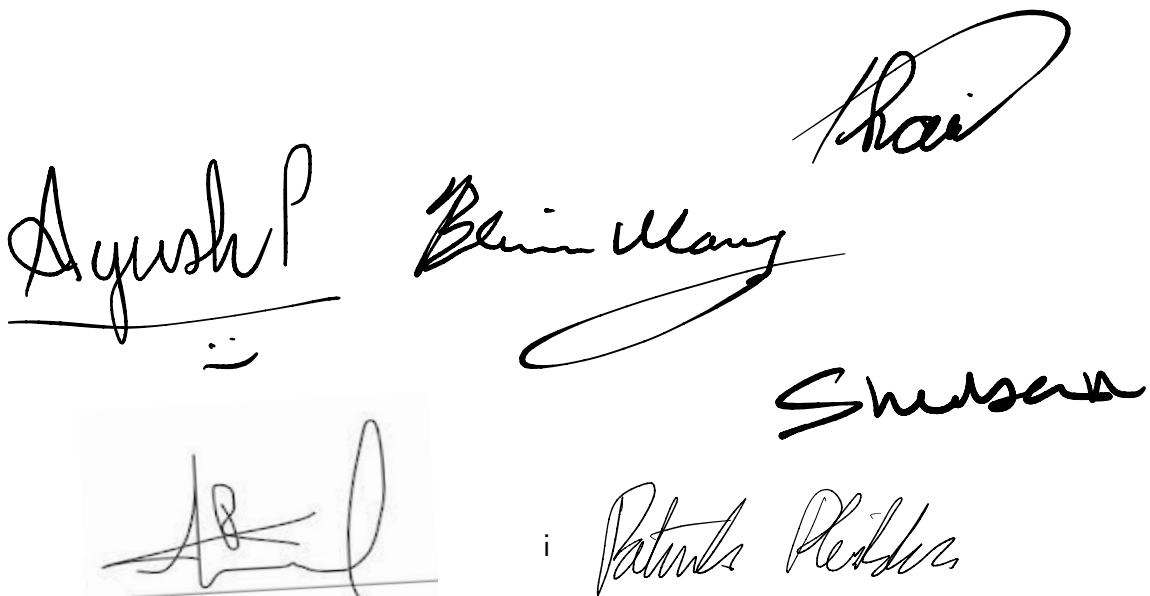

Abstract

The objective of this project was to develop an interactive application for analysing commercial flight data. Utilizing a dataset obtained from the US Bureau of Transportation Statistics, comprising one month of flight records, our application processes the data from the 'flights.csv' file and enables user exploration. Through visual data analysis techniques, we uncovered significant insights and relationships within the dataset, enhancing our understanding of the underlying information. Our approach includes 3D modeling, various graph formats, and efficient sorting algorithms with unique heuristics.

Acknowledgements

We would like to thank ourselves for our determination to make something we are proud of...

Contents

1 Introduction

Upon receipt of the project, we initiated a brainstorming session to devise approaches to tackle the problem. We formulated a comprehensive strategy encompassing a four-page system outlining the project. This system comprises the home screen, graphs screen, search menu, and an ambitious 3D modeling of Earth and flight paths, seamlessly integrated with 2D modeling of the United States map. All components are developed within the constraints of the Processing IDE.

1.1 Design Outline

Upon launching the project, users are welcomed by a dynamic 3D globe displaying our project name and logo. They are encouraged to navigate the program using tabs located at the top of the interface, which include options like Search, Maps, and Graphs.

The Search tab features a comprehensive search function, allowing users to filter data instantaneously based on criteria such as Origin Airport, Origin City, Destination Airport, Destination City, and Airline Carrier. Results can be sorted alphabetically or by distance, as preferred by the user.

In the Maps tab, users can explore flight paths through both 2D and 3D visualizations. By selecting an airport, users can view all direct flights from that airport on a 2D map of the USA or a 3D globe, highlighting the flight routes available in the dataset.

The Graphs tab offers advanced data visualization tools. Through intuitive dropdown menus, users can generate custom visualizations of flight data, including cancelled, delayed, diverted, and all flights between airports. The inclusion of any airport and subsequent submission updates the displayed graphs (bar, scatter, line, and pie charts) instantly, ensuring accurate data representation.

1.2 Individual Contributions

Our team project benefited from a division of labor that aligned with individual interests and strengths, while also assigning tasks to merely meet weekly minimums, we established a project-long strategy, allowing several weeks for our efforts to integrate into a functional outcome. This approach enabled specialization without the need for constant updates or in-depth explanations of our code to others. To ensure coherence and address any assistance required, we held weekly meetings every Monday and Tuesday afternoon. For details on each member's specific contributions, please consult Table 2.1.

1.3 Enhanced Project Scope

From the inception of our collaboration, our team's synergy was palpable, driven by a collective ambition not just to achieve excellence academically but to exceed our peers through innovation and dedication. Our competitive spirit galvanized us to establish long-term objectives and actionable milestones, underpinned by rigorous weekly meetings every Monday and Tuesday to ensure relentless progress.

In addressing data handling, we eschewed conventional, tedious methods in favor of inventive solutions, notably employing CompletableFuture() for its proficiency in loading extensive datasets instantaneously. This approach not only enhances efficiency but also enriches the user experience by negating wait times.

Our user interface (UI) design is meticulously crafted, featuring intuitively placed tabs adorned with concise icons, and employs a harmonious color scheme that elevates the aesthetic appeal. The homepage stands out with its elegantly designed logo and a captivating 3D rotating globe, embodying our commitment to both functionality and visual excellence. (Figure for homepage 2.2)

Graphically, our project innovates with abstract classes, allowing for dynamic data manipulation—graphs update in real-time as data is added or removed. This fluidity is facilitated by the 'dataPoint' class, which pre-sorts data for instantaneous display. Our drop down menus enhance user interaction, intelligently categorizing data from most to least frequent routes, complemented by intuitive navigation across various graph types (line, scatter, pie, and bar). (Consult 2.3 for drop down and graphs collage.)

Our search functionality is meticulously optimized to provide immediate, sorted results—whether by alphabetical order or distance—displaying comprehensive details such as flight dates, times, cities, airports, distances, carriers, and delay statuses, all formatted for optimal readability. (Consult 2.4 for search bar functionality.)

The mapping feature is a technical marvel, accurately visualizing flight paths from our

dataset of approximately 500,000 entries. Whether through a 2D map of the USA or a 3D globe, users can explore every conceivable flight route, benefiting from seamless transitions between dimensions and detailed zoom capabilities for unparalleled visual clarity. (Consult 2.5 for data model collage).

Moreover, we have rigorously refined our codebase, ensuring the elimination of superfluous comments and unused code, which underscores our commitment to clarity, efficiency, and professional excellence in software development. We have written this report fully in LATEX to provide the most professional layout of our development.

GitHub: `https://github.com/ayushdad22/FlightLog`

2 Figures and Tables

2.1 Figures

Abdul	Played a pivotal role in the design and implementation of the program's graphical elements, including advanced widgets and the overall user interface. Additionally, Abdul contributed significantly to the aesthetic design and functionality of the graphs.
Ayush	Spearheaded the development of 3D globe visualizations within the Maps and Home tabs, making substantial contributions to both the visual appeal and the navigational framework of the UI. Ayush also played a crucial role in refining the color scheme, enhancing the 2D map's design, and addressing user inquiries.
Brian	Brian was instrumental in optimizing data sorting through enhancements to the 'dataPoint' class and implementing CompletableFuture() for instantaneous data processing. His dedication also extended to code refinement and significant input into the composition of the project report.
Patrick	Patrick's major contributions included the development of abstract classes for dynamic graph generation, seamlessly integrating data into the visualization tools, and enriching the UI with color-coordinated pie charts and intuitive dropdown menus.
Shuban	Shuban significantly enhanced team workflow and coding standards, contributing to the project's dynamic interface. His expertise was crucial in the search bar's efficient data sorting and search functions. Shuban also brought creative flair to the team with impactful logo designs. Contributing to the overall codebase to make readability a priority for all.
Thai	As the project's UI and user experience leader, Thai provided visionary direction in interface design and played a pivotal role in the strategic planning of the video report and scripting. Thai's efforts significantly shaped the tab layout and the program's overall visual narrative.

Figure 2.1: Overview of general features each member worked on.

Figure 2.2: Overview of home page, the actual globe rotates.

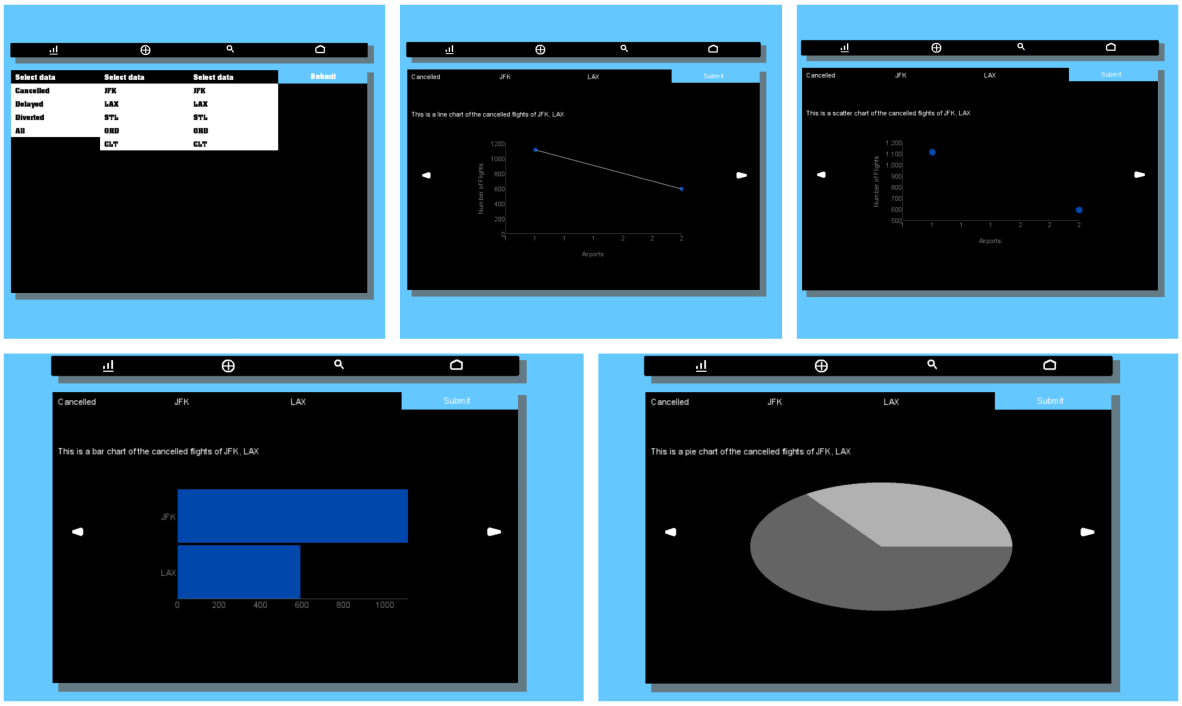

Figure 2.3: Overview of drop down menus and graphs.

Figure 2.4: Overview search bar and associated drop down menus.

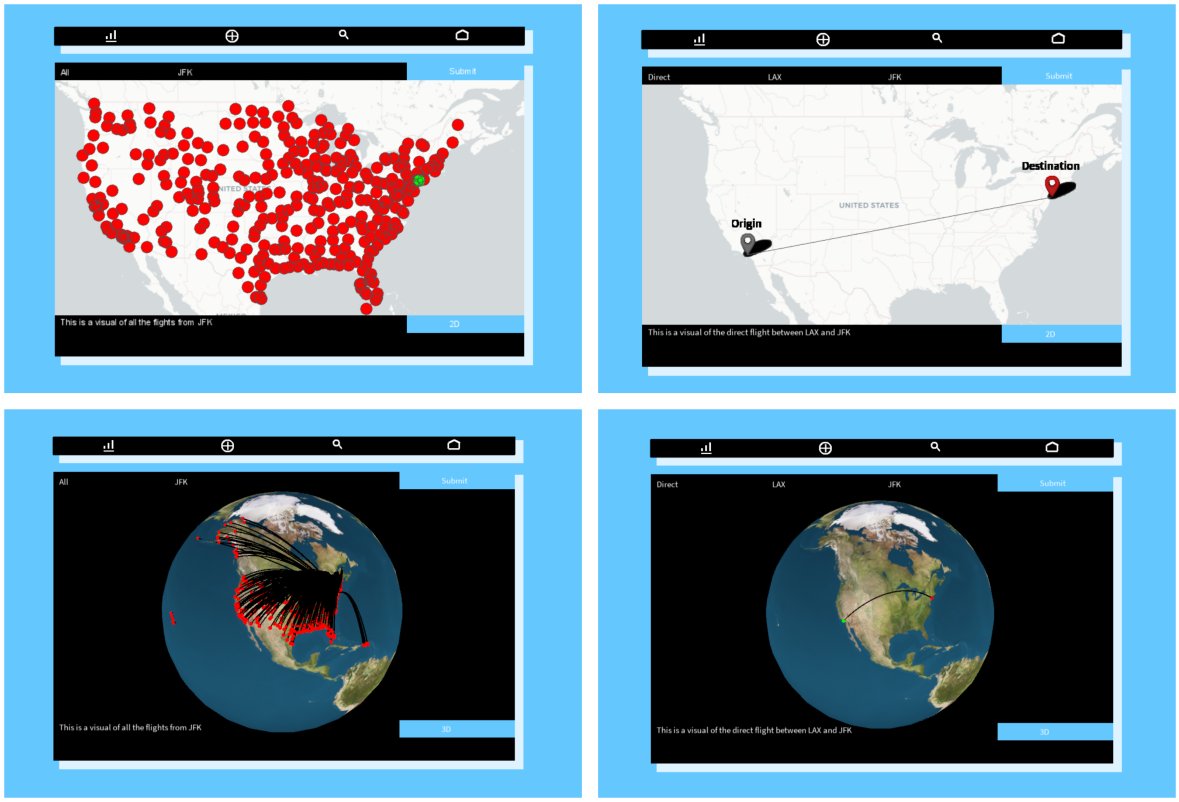

Figure 2.5: Overview of 2D and 3D map flight path visualisation.

3 LaTeX

LaTeX, or more properly "LaTeX 2_ε", is a very useful document processing program. It is very widely used, widely available, stable and free. Famously, TeX, upon which LaTeX is built, was originally developed by the eminent American mathematician Donald Knuth because he was tired of ugly mathematics books [**?**]. Although it has a learning curve (made much less forbidding by online tools and resources – see below), it allows the writer to concentrate more fully on the content, and takes care of most everything else.

While it can be used as a word processor, it is a *typesetting* system, and Knuth's idea was that it could be used to produce beautiful looking books:

> *LaTeX is a macro package which enables authors to typeset and print their work at the highest typographical quality, using a predefined, professional layout.*[1]

LaTeX has great facilities for setting out equations and a powerful and very widely supported bibliographic system called BibTeX, which takes the pain out of referencing.

Three useful online resources make LaTeX much better:

(1) An excellent online LaTeX environment called "Overleaf" is available at `http://www.overleaf.com` and runs in a modern web browser. It's got this template available – search for a TCD template. Overleaf can work in conjunction with Dropbox, Google Drive and, in beta, GitHub.

(2) Google Scholar, at `http://scholar.google.com`, provides BibTeX entries for most of the academic references it finds.

(3) An indispensable and very fine introduction to using LaTeX called *"The not so short introduction to LaTeX 2_ε"* by [**?**] is online at `https://doi.org/10.3929/ethz-a-004398225`. Browse it before you use LaTeX for the first time and read it carefully when you get down to business.

Other tools worth mentioning include:

[1] This is from [**?**]. Did we mention that you should minimise your use of footnotes?

- `Draw.io` – an online drawing package that can output PDFs to Google Drive – see `https://www.draw.io`.