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Introduction

We have created a program to process all the information about flights in the USA in a given month, and display it in a concise, productive manner. Our work stands out for its speed and efficiency in organising the data - from pressing the 'Start' button, it takes <2 seconds to fully load all 537,000 flights. We present a pleasing user interface, which includes several accommodations designed to improve the experiences of people with conditions such as dyslexia colour-blindness.
Our goal was to efficiently process the given data and communicate it to the user in a proficient manner to give them the best experience possible. This document will guide you through our many features.

1. Accessibility Features

The key to a great interface is how accessible and usable it is to as many different people no matter their conditions. We wanted to make sure that where we could, we would make our interface as friendly for certain types of common disabilities as possible. We went about this in the following ways:

Background & Text

Studies have shown that people with dyslexia prefer and find it significantly easier to read text that is black on a yellow background (BDA, "Creating A Dyslexia Friendly Workspace, 2019). We used this information and chose a pastel yellow background on every screen.
Sans serif fonts such as Arial also appear less crowded to people with dyslexia, so we implemented this font system-wide. Underlining and using italics can also cause difficulty, so we did not use any here. (Web Accessibility Initiative, "Optimal Colours to Improve Readability for People with Dyslexia," 2012).

Alignment

Left aligning text makes it easier to find the start and finish of each line, so all our text is aligned this way. This can be seen in the key for the heatmap, flight info screen, and the text output on the Airport issues screen (British Dyslexia Association, "Creating A Dyslexia Friendly Workspace, 2019).

High-Contrast Colours

For people who suffer with colour-blindness, it is important to use contrasting colours that can be distinguished despite their condition (7: Eric Mkhitaryan). We used an accessible colour palette generator (Venngage Inc., "Accessible Colour Palette Generator, 2023) to help us choose colour-blind friendly colours, which we implemented in our pie charts and bar charts (Cravit, R. "How To Use Colour-Blind Friendly Palettes To Make Your Charts Accessible," 2022). Our heatmap uses red and yellow as its main colours, which are easier for most colourblind people to see.

2. Screen Layout

On the left side of the screen, there is an interactive map of the USA. The right side of the screen displays user controls at the top. One of the user controls is the drop-down menu, which is used to switch between the tabs in the bottom part of the right side. The tabs present the data in various forms such as information about specific flights or summary statistics.

3. Filtering

A user can filter the flights by various parameters. There is a date picker to select the date range and a text input box, which can be used to filter the flights by city or by carrier. The user can also select a departure airport and an arrival airport on the map to filter by them. All displayed information about flights uses only the subset of flights which satisfies all filtering criteria. Heatmap is not filtered because modifying the properties of the SVG file is too slow to be done each time filtering criteria are changed.

4. Airport Issues Screen

The airport issues screen can be displayed by clicking it from the dropdown menu at the top of the screen. It displays city specific information in text and graphical forms. Firstly, the user can choose to use the text box in the top right corner of the screen to filter the information by city (typing "New York" will display the information on the airports in New York). If the user types nothing, then the information displayed represents the entire database of flights."

The user can also filter the data by a range of dates using the blue bar at the top of the screen (e.g. 22/01/06-22/01/23).

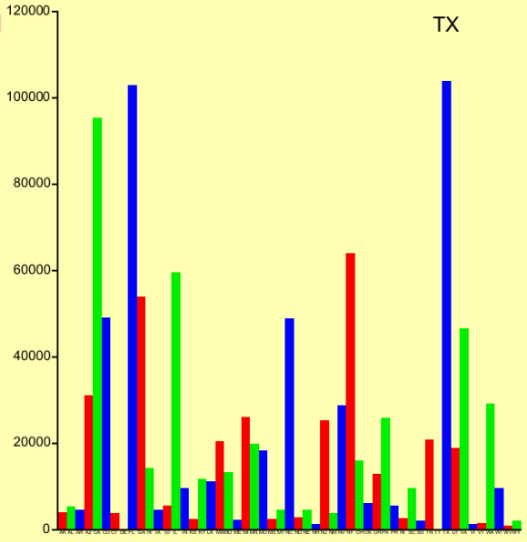
The screen uses text to display 3 pieces of information; The average flight delay, average flight distance (in miles), and the total flights.

Finally, we also have 2 pie charts, each displaying different information. The leftmost pie chart shows the delayed vs timely flights. The Delayed flights is displayed in red, and the on-tine flights are shown in green. Below the chart the information is also displayed in text for clarification.

The second pie-chart shows the ratio of Diverted, Cancelled, and Regular flights. Diverted is shown in red, cancelled is shown in blue, and regular flights are shown in green. Similarly to the first pie-chart, the information is also displayed in text form underneath the graph.

5. Flights by State Screen

The 'Flights By State' feature displays a bar-chart of the most frequented states in the USA. When the user hovers their mouse over a bar, the state that the bar represents is printed in large, bold, black letters directly above the bar. We chose a colour palette of red, blue and green to distinguish the bars from one another, as they are statistically the three most popular colours globally (Grad, "The Most Popular Colour in the World,"

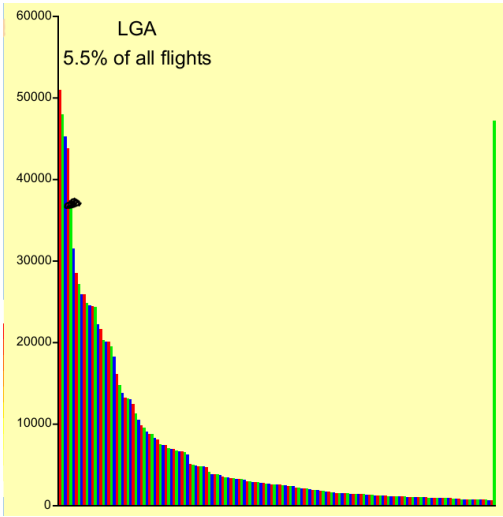


2011), as well as being distinguishable for many different types of colour-blindness (as discussed in the accessibility section). The width of each bar is calculated with the resolution of the user's PC.

To process the data, we searched through every individual flight and found the origin and destination states of the flight. Then, we looped through an ArrayList of states to find both states and incremented their individual instance variables ('totalNumberOfFlights'), which represent the total number of flights in the state.

This bar-chart is simple, but proficient in conveying the number of flights each state has, and how the volume of air traffic compares across all the states.

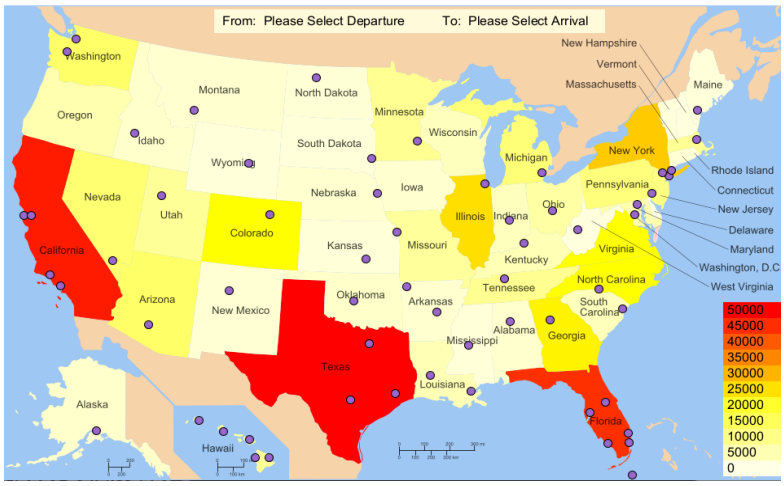
6. Flights By Airport Screen



'Flights By Airport' extends the functionality of the 'Flights By State' feature to airports. However, it has two significant differences: the number of airports shown, and their ordering. Firstly, since there are 738 airports to filter data from, we decided to display at most 161 top airports, as displaying more made the columns too narrow. They are ordered from highest number of flights first, to lowest number of flights last.

Secondly, when you hover over a bar, the program displays the airport code, and its share of the total US air traffic. This demonstrates, both very quickly and effectively, the disproportionate number of flights that just a few airports accommodate. We collected this data in a similar fashion to the 'Flights by States' bar-chart.

Thus, our airport chart clearly communicates the most important airports quickly, efficiently, and effectively to the user.



7. Heat-Map

The heatmap is a constant feature integrated into the main map on the left side of the window. It works by calculating the maximum number of flights for a single state, then running through all the states and calculating what percentage of the maximum that each state it. RGB values are assigned to each state using the setFill() function based on what percentage of the maximum they meet, e.g., Texas has the most

flights, so its RGB values are (255,0,0).

A theoretical state with 0% of the number of flights that Texas has would then be given the RGB values (255,255,230), which is the closest to white a colour can be in this heatmap.
There is also a legend in the bottom right corner of the screen, detailing 11 increments of colours that are used, and labelling them with the number of flights a state must have in the user selected window to be able to reach this colour.

8. How Position & Sizes of Airports Are Plotted onto the Map

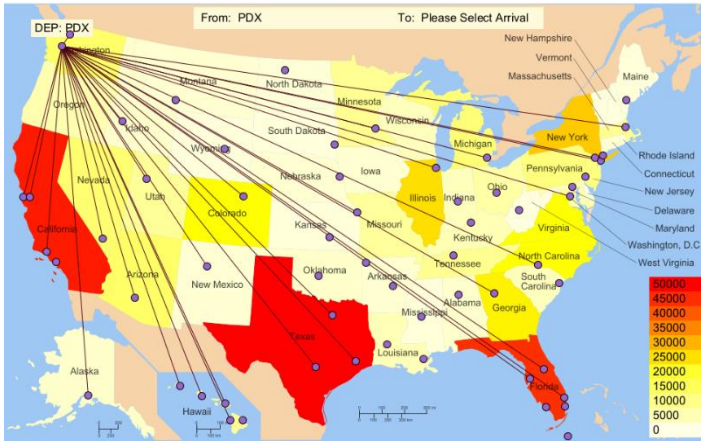
To plot the airports on the map, we at first wanted to use a csv file with latitude and longitude data for each airport and transform this data so that it would be with the x and y axis of our map. However, due to our map being slightly curved, we could not proceed that way as the airports were too far from the position they should be at. We then decided to plot each of them manually.

To do so, we would display the x and y coordinates using "mouseX" and "mouseY," we found the position of the airport on Google Maps and put our cursor on the exact same position on our map. Then, we read the x and y, and divided them by the map width and height to get the positions as ratios of the map size. These ratio values were crucial because if we decided to change the map size, and the coordinates were not set as a ratio but just as hardcoded values, the airport would be displayed at the wrong position.

9. Drawing Inter-Connecting Routes Between Airports

Using the array of airports positions created in the previous step, we then proceeded to draw lines to show existing connections between airports. The first part for this was making the user able to choose his departure and arrival. When the user hovers over an airport, this one will be highlighted; if he decides to choose this airport, all the user needs to do is click on it. The first airport clicked is the departure, the second is the arrival and to unselect them, he can just click on any airport on the map to unselect both.

After selecting a departure, lines towards airports with existing connections are drawn. This was possible using the filtering feature explained in the second step. When a departure is selected, the filtering checks whether an existing flight exist between the airport chosen and any airport on the map; if there is one, a line is drawn. Once the departure and arrival are chosen, on the flight info tab will be displayed all existing flight matching his criteria. At the same time, on the map,



there is a small circle that travels from the departure to the arrival to remind the user the direction the flight is going in case the user mixed up the departure and arrival. Lastly, if the user selects Lastly, if the user selects a departure, he can also browse for arrivals using the city search bar in the top-right corner - this enables him to search for airports within the city he searched for. For example, if the user chooses Los Angeles as a departure and wants to find all flight to New York, it will show him flights to JFK or LGA.

Conclusion

Our program provides a simple, yet thorough and educational experience. The buttons are easy to use and help create a satisfying user interface, while many aspects, such as the heat-map and date-filter option, are intuitive even to non-English speakers. The many different charts, (such as the 'Flights Delayed' pie-chart and 'Flights By State' bar-chart) are easily comprehensible for the users.

Finally, we made sure to accommodate the difficulties experienced by those with conditions such as dyslexia and colour-blindness, by considering their needs when choosing the background, text, and graph colours, as well as the text alignment and font itself.
Thus, we have efficiently processed the given data and communicated it to the user in a proficient manner to give them the best experience possible.

Journal Articles:

Apartment Therapy, (2011). "The Most Popular Colour in the World." Available at: https://www.apartmenttherapy.com/the-most-popular-color-in-the-157991 (Accessed on: 20/3/2023)

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Others:

7: Eric Mkhitaryan; a friend who was contacted to help inform us in making sure our program was colourblind friendly