Swinburne University of Technology

Project and Group Reflection

COS30045

Data Visualisation

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Introduction

Migration is a complex phenomenon with profound social, economic, and cultural implications. As our world becomes increasingly interconnected, gaining insights into migration patterns is essential for policymakers, researchers, and individuals. This paper presents an individual's perspective on an interactive data visualization project focused on migration to and from Australia.

The objective of this project was to develop an interactive tool that enables users to explore and analyse migration data in a user-friendly and informative manner. By utilizing data visualization concepts and programming techniques, the aim was to create a visually engaging platform that effectively communicates the intricate nature of migration patterns.

Throughout this paper, I reflect on my personal learning process and contributions to the project, highlighting the achieved learning outcomes. I discuss my understanding of data visualization concepts and how I applied them to design and implement the interactive data visualization. Furthermore, I delve into the programming concepts I utilized, specifically emphasizing the use of D3.js to create visually captivating and interactive graphs.

Additionally, I discuss the teamwork and collaboration aspects, addressing my role within the project and how my dynamics evolved over the semester. I also describe the challenges or issues encountered and elaborate on the strategies employed to overcome them, ensuring a cohesive and successful outcome.

Learning Process

Concepts and techniques

During the course of this project, I acquired a deeper understanding of fundamental data visualization concepts. Two key attributes emerged as crucial factors when developing a visualization tool: scalability to handle large volumes of data and interactivity to provide users with multiple perspectives.

Scalability is essential to ensure that a visualization tool can effectively handle and present a significant amount of data. In our project, we focused on implementing techniques that enabled seamless scalability, even when dealing with extensive datasets. By optimizing data retrieval, processing, and rendering, we ensured a smooth and efficient user experience, regardless of the data size.

By applying these data visualization concepts, my objective was to create a tool that not only effectively conveyed information but also accommodated scalability and user interactivity. By considering these attributes during the design and implementation phases, I aimed to enhance the usability and usefulness of the visualization tool.

Tools that were used

During the project, I had the opportunity to apply various programming concepts, specifically utilizing D3.js, a powerful JavaScript library, to create interactive graphs for our data visualization. D3.js, also known as Data-Driven Documents, enabled us to manipulate data and dynamically generate visual elements based on that data.

With our project's focus on migration, particularly migration from and into Australia, we utilized D3.js to develop visually compelling and informative graphs. We employed programming concepts like data manipulation, data binding, and data-driven rendering to transform the raw migration data into meaningful visual representations.

Data manipulation played a crucial role in our programming approach. We processed and transformed the migration data to ensure its suitability for visualization, such as aggregating data by year, country of origin, and destination. This involved data cleaning, performing

calculations, and organizing the data in a format that could be easily interpreted and utilized by D3.js.

Period	New South Wales	Victoria	Queensland	South Australia	Western Australia	Tasmania	Northern Territory	Australian Capital Territory	Australia
OVERSEAS MIGRATION ARRIVALS									
2016-17	198,296	159,626	87,821	23,819	48,641	4,703	6,904	10,328	540,152
2017-18	191,451	161,166	85,440	24,104	44,193	5,107	5,024	10,973	527,524
2018-19	194,266	168,314	91,664	26,649	48,078	5,876	5,554	9,945	550,401
2019-20	172,446	150,633	85,581	27,741	50,404	6,507	4,122	9,378	506,859
2020-21	70,615	27,112	23,420	6,009	12,943	1,609	1,445	2,808	146,002
2021-22	149,099	123,769	61,586	21,687	32,242	5,084	4,950	8,721	407,223
2016	186,747	150,754	86,130	23,993	50,616	4,606	6,794	10,001	519,653
2017	194,414	159,713	86,413	23,700	45,733	4,906	5,884	10,559	531,372
2018	192,485	163,517	87,540	24,909	44,698	5,490	5,184	10,528	534,397
2019	208,820	185,728	102,075	30,817	56,850	7,230	5,595	10,700	607,872
2020	91,440	59,713	37,873	12,905	23,710	2,725	2,174	4,777	235,361
2021	88,089	58,033	31,784	9,128	16,127	3,161	2,932	4,733	214,024
2020									
September	10,630	2,471	2,718	815	2,074	157	273	469	19,627
December	21,723	6,006	5,324	1,396	3,058	445	384	787	39,127
2021									
March	18,433	8,848	6,819	1,685	3,600	615	426	894	41,329
June	19,829	9,787	8,559	2,113	4,211	392	362	658	45,919
September	12,541	9,327	6,731	1,477	3,699	537	1,070	728	36,113
December	37,286	30,071	9,675	3,853	4,617	1,617	1,074	2,453	90,663
2022									
March	55,111	49,453	23,567	9,726	10,860	1,646	1,565	3,530	155,490
June	44,161	34,918	21,613	6,631	13,066	1,284	1,241	2,010	124,957
September	58,951	47,240	26,718	8,784	17,434	1,261	1,614	3,708	165,740

Figure 1: Arrivals before cleaned.

Period	New South Wales	Victoria	Queensland	South Australia	Western Australia	Tasmania	Northern Territory	Australian Capital Territory
2016	186747	150754	86130	23993	50616	4606	6794	10001
2017	194414	159713	86413	23700	45733	4906	5884	10559
2018	192485	163517	87540	24909	44698	5490	5184	10528
2019	208820	185728	102075	30817	56850	7230	5595	10700
2020	91440	59713	37873	12905	23710	2725	2174	4777
2021	88089	58033	31784	9128	16127	3161	2932	4733
2022	158223	131611	71898	25141	41360	4191	4420	9248

Figure 2: Arrivals after cleaned.

Using D3.js, we employed data binding techniques to connect the migration data with visual elements like bars, lines, or dots. This binding established a relationship between the underlying data and the visual representation, enabling us to dynamically update the visualization as the data changed or in response to user interactions.

Additionally, we utilized data-driven rendering techniques to dynamically generate, and position visual elements based on the migration data. Through the use of scales, we mapped the data values to appropriate visual dimensions, allowing us to create accurate bar charts, line graphs, and geographic maps that effectively represented the migration patterns.

By applying these programming concepts, particularly leveraging D3.js, we successfully created interactive graphs that effectively communicated the migration trends to and from Australia. Our use of data manipulation, data binding, and data-driven rendering techniques transformed raw data into visually engaging and informative visualizations.

Contributions to the Project

During the project, I played a significant role in gathering and preparing the data for the visualization. My contributions involved sourcing and verifying information about migration patterns, ensuring the accuracy and reliability of the data used in our project. I collaborated with my team to cross-reference multiple sources and confirm the validity of the data.

We utilized two different sets of data to provide comprehensive insights into migration. The first set focused on the "Origins of migrants coming to Australia by each state," while the second set captured the "Amounts of migrations coming in and out of Australia divided by each state from 2016-2022." As part of my responsibilities, I cleaned and formatted the data to ensure its suitability for integration into the visualization. This involved refining and organizing the data, making it easier to implement and visualize effectively.

	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT
Country of birth	'000	'000	'000	'000	'000	'000	'000	'000
England	250.66	192.73	200.36	103.74	213.94	20.48	6.69	13.33
New Zealand	127.91	102.72	219.93	13.83	87.35	5.42	5.58	5.02
China(d)	256.05	176.64	51.64	26.77	29.96	3.27	1.42	11.93
India	153.80	182.84	53.10	29.01	53.37	2.13	4.24	10.92
Philippines	94.11	55.95	43.13	13.30	33.43	1.77	6.97	3.96
Vietnam	92.89	89.93	21.81	15.69	17.62	0.45	1.19	3.61
Italy	55.98	79.10	14.78	20.18	21.96	0.97	0.64	2.13
South Africa	47.74	30.32	44.74	7.15	45.55	1.72	1.08	2.15
Malaysia	34.93	55.34	16.44	8.44	32.25	1.56	0.84	2.62
Scotland	33.08	30.29	25.22	13.31	30.35	2.61	0.88	2.01
Sri Lanka	32.58	63.24	11.12	4.20	8.87	0.44	0.98	3.08
Germany	33.66	29.97	23.11	11.16	12.77	2.38	1.18	2.46
Greece	35.97	57.01	3.99	10.15	2.75	0.59	1.79	1.17
Korea, South	58.03	16.86	20.99	4.10	7.92	0.67	0.50	2.50
USA	36.93	24.26	20.92	5.23	11.45	2.00	1.66	3.30
Hong Kong	47.29	24.39	12.19	4.02	6.98	0.52	0.35	1.83
Lebanon	68.36	19.88	1.71	1.84	1.31	0.09	0.07	0.46

Figure 3: Origins before cleaned.

Country	New South Wales	Victoria	Queensland	South Australia	Western Australia	Tasmania	Northern Territory	Australian Capital Territory
United Kingdom	250700	192700	200400	103700	213900	20500	6700	13300
New Zealand	127900	102700	219900	13800	87400	5400	5600	5000
China	256100	176600	51600	26800	30000	3300	1400	11900
India	153800	182800	53100	29000	53400	2100	4200	10900
Philippines	94100	56000	43100	13300	33400	1800	7000	4000
Vietnam	92900	89900	21800	15700	17600	500	1200	3600
Italy	56000	79100	14800	20200	22000	1000	600	2100
South Africa	47700	30300	44700	7200	45600	1700	1100	2200
Malaysia	34900	55300	16400	8400	32300	1600	800	2600
Scotland	33100	30300	25200	13300	30400	2600	900	2000
Sri Lanka	32600	63200	11100	4200	8900	400	1000	3100
Germany	33700	30000	23100	11200	12800	2400	1200	2500
Greece	36000	57000	4000	10200	2800	600	1800	1200
South Korea	58000	16900	21000	4100	7900	700	500	2500

Figure 4: Origins after cleaned.

In addition to data preparation, I actively contributed to the design aspect of the project. Initially, we considered using only a choropleth map to represent the migration patterns. However, during the development process, we recognized the need for a more comprehensive and informative visualization. Drawing upon my creativity and design skills, I proposed the incorporation of two additional graph types: a line graph and a bar chart. These additions enriched the visualization by providing different perspectives and facilitating a more nuanced understanding of the migration trends.

Taking responsibility for the styling and aesthetics of the visualization, I ensured that all three graph types were visually appealing and easy to comprehend. I implemented smooth transitions between data points and employed suitable colour schemes to enhance the visual experience. Additionally, I provided clear and informative titles for each graph, enabling users to quickly grasp the context and purpose of the visualizations.

By contributing to the data gathering and preparation process, as well as the design and styling aspects, I played a key role in creating a visually appealing and informative data visualization. My efforts aimed to enhance the overall quality and user experience of the project.

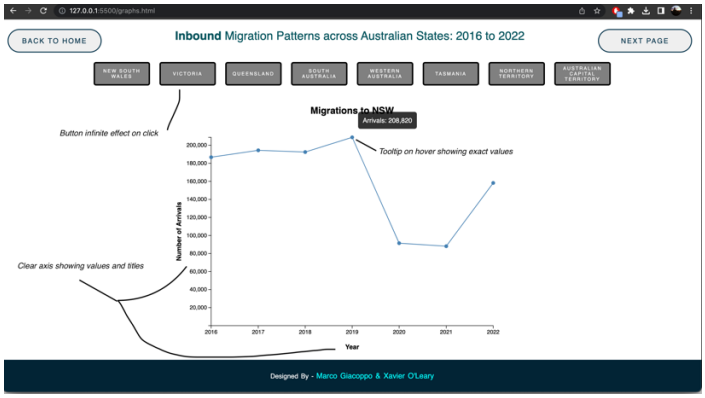

Figure 5: Line graph stylings

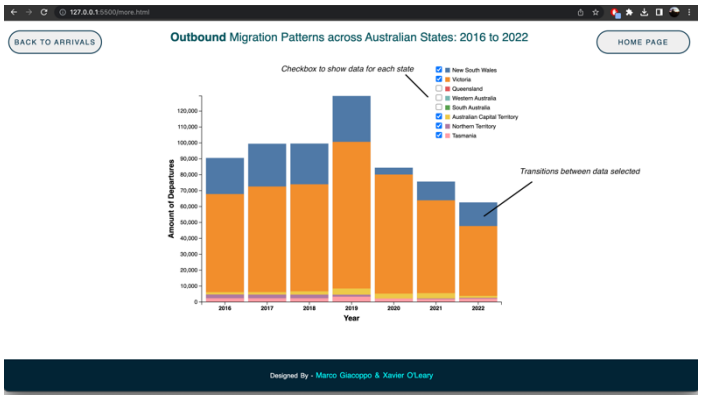

Figure 6: Bar chart stylings

Collaboration and Challenges

Throughout the semester, I collaborated with my teammate Xavier to work on the project. Our teamwork was primarily facilitated through communication on Discord, where we shared ideas, discussed project requirements, and coordinated our efforts.

At the beginning of the project, we both took an active role in brainstorming and conceptualizing the design and functionalities of the interactive data visualization. We drew sketches and visual representations of how we wanted the final result to look, ensuring that we had a shared vision and understanding of the project's direction.

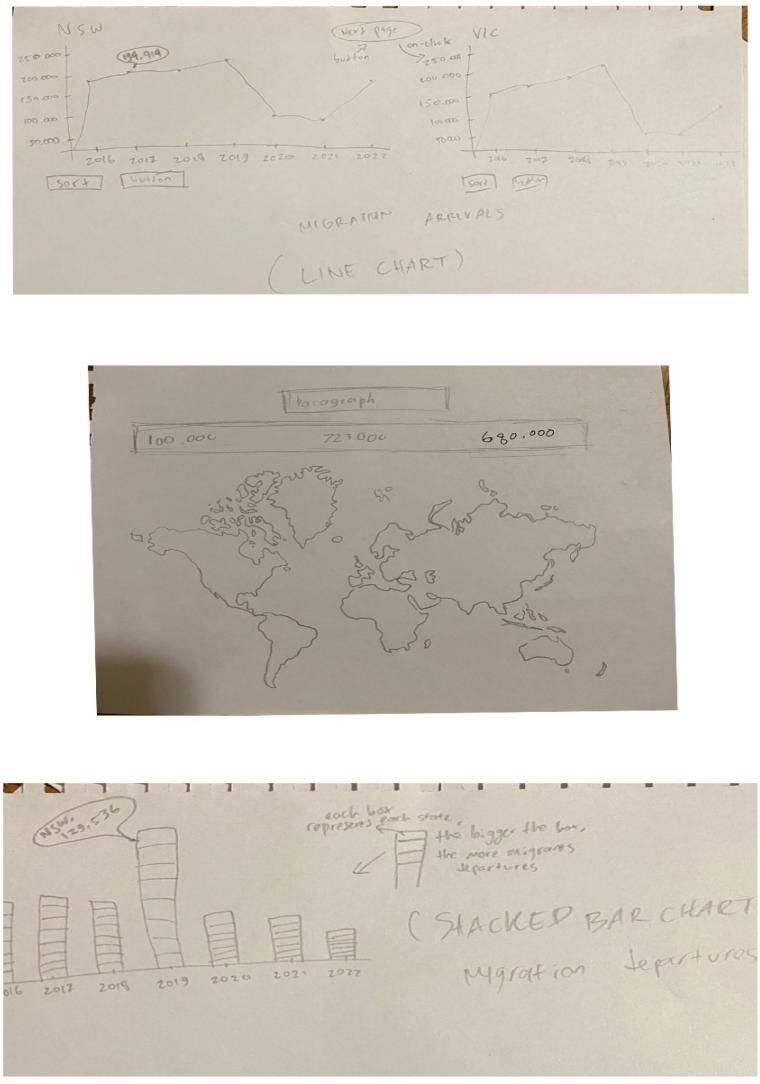

Figure 7: Initial Sketches.

To ensure a fair distribution of work, I adopted a collaborative approach, dividing tasks appropriately and leveraging our skills and strengths. Regular communication and progress updates helped us stay informed and aligned throughout the development process.

One of the challenges I faced was gathering accurate and reliable data for the graph. To overcome this, I conducted thorough research on credible and up-to-date data sources. I cross-referenced multiple reputable sources to obtain comprehensive and accurate migration statistics specific to Australia. Additionally, I encountered challenges during the design phase of the visualization. I needed to experiment and modify the code to ensure that I was satisfied with the final result. One specific challenge I faced was with the tooltip functionality, and I employed various techniques and resources to resolve the issue.

In dealing with challenges or disagreements, I maintained open and constructive communication. I actively listened to different perspectives and sought common ground to resolve any issues that arose. This approach fostered a positive and collaborative working environment, enabling me to navigate challenges effectively and maintain a cohesive workflow.

Enhancing Data Visualisation

In our project, we placed a strong emphasis on visual communication to ensure that our data visualization was not only visually appealing but also effectively conveyed the migration patterns. We employed various visual design principles and techniques to create clear, readable, and professional graphs.
To represent the migration data, we utilized three different types of graphs: a choropleth map, a line graph, and a bar chart. Each graph served a specific purpose in visualizing different aspects of the migration patterns. By incorporating multiple graph types, we aimed to provide a comprehensive and multi-dimensional view of the data.

In order to enhance readability and clarity, we implemented several design elements. Each graph had clear axes with appropriate labels, ensuring that users could easily interpret and understand the data being presented. We also included informative titles for each graph, providing context and guiding users in their interpretation.

To aid users in obtaining precise information from the graphs, we incorporated tooltips. These tooltips displayed the exact values of data points when users interacted with them, allowing

for a more detailed examination of the migration statistics. This feature enabled users to access specific information about the number of migrants in certain years, facilitating a deeper understanding of the data.

Additionally, we gave careful consideration to the colour scheme of our graphs. By using a pleasing and effective colour combination, we ensured that users could clearly distinguish between different data categories or elements within the visualization. This colour differentiation enhanced the legibility and accessibility of the graphs, allowing users to easily extract information and insights from them.

Through the implementation of these visual design principles and techniques, our graphs achieved a balance between aesthetics and functionality. The clear axes, informative titles, interactive tooltips, and thoughtful colour choices contributed to a visually engaging and informative data visualization.

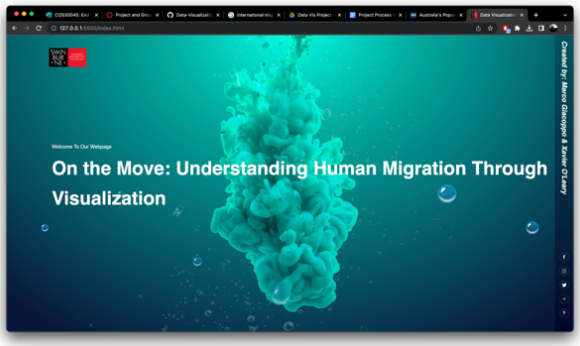

Figure 8: End-result home page

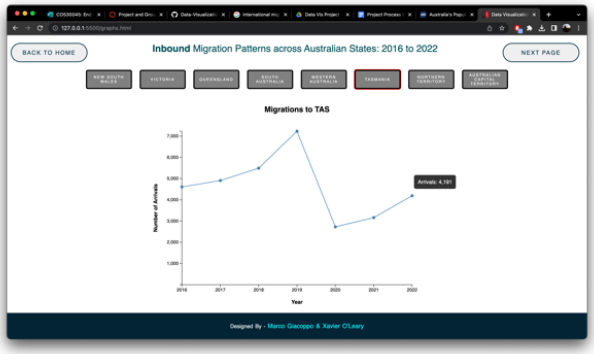

Figure 10: End-result Line Graph

Figure 9: End-result Choropleth map

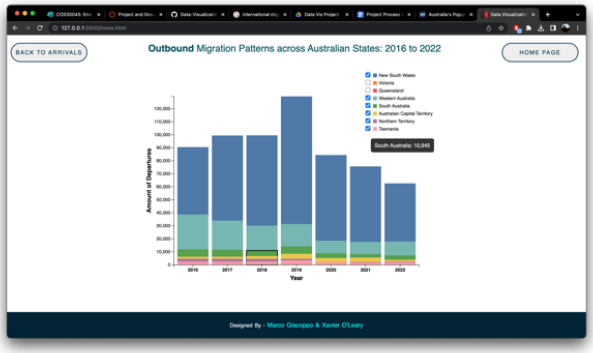

Figure 11: End-result Bar Chart

Conclusion

In conclusion, this project on migration data visualization has been a transformative learning experience, providing valuable insights into data visualization, programming, and collaboration. I have gained a deep understanding of scalability and interactivity principles, effectively handling large datasets and offering users an intuitive exploration experience.

By leveraging D3.js, we have developed proficiency in data manipulation, binding, and dynamic rendering, transforming raw data into compelling visual representations. Collaborating closely with my teammate, Xavier, we have honed our teamwork and communication skills, resolving challenges and fostering a positive working environment.

Our focus on visual communication has resulted in visually engaging and informative graphs, incorporating design elements such as clear axes, informative titles, interactive tooltips, and thoughtful colour choices. These elements enhance data comprehension and user experience.

As I conclude this paper, we celebrate our growth and achievements throughout the semester. We have successfully created an interactive and informative data visualization tool that effectively communicates migration patterns. Our journey in this project has deepened my understanding of data visualization, expanded my programming skills, and highlighted the significance of collaboration in achieving meaningful outcomes. I am excited to apply these learnings to future projects and contribute to the ever-evolving field of data visualization.

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