

Swinburne University of Technology

Semester 1, 2023

COS30045- Data Visualization



Impact of COVID-19 on Migration in Australia

Process Book

Mercury link:

<https://mercury.swin.edu.au/cos30045/s103533868/FinalProject/index.html>

Tutorial session: Monday, 16:30-18:30

Authors: Group 8

Nghia Hieu Pham 103533868

Kim Duong Pham 103792850

Thanh Phat Vo 103792850

Word Count: 3748 words

Table of Contents

1. Introduction	3
1.1 Background and Motivation	3
1.2 Visualization Purpose	3
1.3 Project Schedule	3
2. Data	5
2.1 Data Source	5
Donut Chart:	5
Bar Chart (integrated with Donut Chart):	6
State Map:	6
Lollipop Chart (integrated with State Map)	7
2.2 Data Processing	7
Donut Chart:	7
Bar Chart (integrated with Donut Chart):	8
State Map:	9
3. Requirements	10
3.1 Must-Have Features	10
3.2 Optional Features	10
4. Visualization Design	11
4.1. First Visualization – Choropleth with Bar Chart	11
4.2. Second Visualization – Donut Chart with integrated Bar Chart	13
5. Validation	18
6. Conclusion	24
References	25
For scholarly ideas:	25
For our project:	25

1. Introduction

1.1 Background and Motivation

The COVID-19 pandemic had created a significant disruption globally in every aspect of lives. As a result, millions of people lost their jobs, schools are closed, and cities are locked down, altering the socioeconomic flow of the world, and world migration is no better. Between 10 March 2020 and 28 February 2022, 122,823 movement restrictions were implemented around the world. Assuming zero growth in the number of migrants between 1 March and 1 July 2020, it has been estimated that we have experienced a decrease of 2 million international migrants compared to the expected increase between mid-2019 and mid-2020 (Migration Data Portal 2022).

This visualization should be used by people interested in knowing how COVID-19 impacted Australia's migration trend, including both experts who wants to gain specific insights on both overall and state specific migration data, or normal users who wish to explore the impact of the pandemic on migration.

1.2 Visualization Purpose

Having experienced the pandemic ourselves, our team worked on this visualization project to further investigate the impact of this virus on migration trends, particularly in Australia, overall, and its regions separately, before, during, and after COVID-19 (2017-2022).

The users will be able to identify the overall migration trends by states and through time periods through the first visualization, which makes use of the net migration data in Australia, while the second visualization will help users to identify the specific migration trend that can be referred to socioeconomic conditions in Australia in different periods, with the use of the temporary visas data, therefore referring to existed policies and real-life events to explain the changes in visa categories.

1.3 Project Schedule

- Week 2: Initialization
 - Arrange weekly meeting schedule.
 - Create a GitHub repository.
 - Create communication channels (Discord, Facebook)
 - Create a Google Drive folder for sharing documentations.
- Week 3-4: Start working on the project.
 - Complete Section 1 of the Project Process Book
 - Discuss some approaches for visualization.
 - Discuss the progress with tutor in the Project Stand Up 1
- Week 5-6: Data research and analysis
 - Research from multiple sources

- Process data to be ready for use in the visualizations.
 - Complete Section 2 of the Project Process Book
- Week 7:
 - Draw design sketches for the visualizations.
- Week 8: Start of the implementation phase.
 - Start building the website.
 - Integrate the visualizations into the website.
 - Complete Section 3 of the Project Process Book
- Week 9-11: Improvements & Adjustments
 - Add CSS to style the website.
 - Discuss some improvements for the visualization design in Project Stand Up 2, 3.
 - Implement extra features in the visualization.
 - Complete Sections 4, 5, 6 of the Project Process Book
- Week 12: Project finalization
 - Final feedback from the tutor in Project Stand Up 4
 - Review the source codes to ensure it is well-formatted and commented.
 - Review the Project Process Book to ensure it is properly styled and has no typos or grammatical errors.

2. Data

2.1 Data Source

Donut Chart:

Arrivals and departures, by visa groupings, Australia, 2004-05 to 2021-22(a)(b)(c)						
Visa groupings(d)		2004-05	2005-06	2006-07	2007-08	2008-09
Permanent visas	Family	28,430	30,400	32,480	33,100	35,060
	Skilled (permanent)	35,540	42,750	47,540	51,600	48,360
	Special eligibility & humanitarian	13,580	12,320	12,400	9,470	11,630
	Other (permanent)	3,650	3,640	3,770	3,940	4,000
Total permanent visas		81,210	89,110	96,190	98,110	99,040
Temporary visas	Student - vocational education and training	7,990	10,500	19,970	31,420	53,570
	Student - higher education	32,750	42,040	57,940	73,150	72,080
	Student - other	25,440	20,550	25,810	29,160	27,110
	Skilled (temporary)	17,100	27,730	35,850	44,010	44,060
	Working holiday	12,930	17,080	21,630	29,120	34,300
	Visitors	35,770	36,100	37,590	49,990	42,340
	Other (temporary)	9,320	7,580	6,780	6,920	5,720

Figure 2.1.1: A section of the initial dataset of Pie Chart.

- **Source:** <https://www.abs.gov.au/statistics/people/population/overseas-migration/latest-release#data-downloads>
- **Method of data collection:** data is extracted from the Excel spreadsheet from the Australian Bureau of Statistics, containing overseas migrant arrivals and departures data by visa groupings by state or territory and financial year, during the period from 2004 to 2022.
- **Type of dataset:** table in Excel file (.xlsx format)
- **Attributes in the dataset:** categorical (visa types, period) and numerical (migrant arrivals and departures amount)
- **Data excluded:** For this chart, data is extracted from the "Table 2.1" sheet, which contains the data related to overseas migrant arrivals and departures by visa grouping throughout Australia. Also, Since the project only evaluates data from 2017 to 2022, any irrelevant period and data related will be excluded from the final dataset. In addition, the chart will visualize the temporary visa types of values, so values belonging to the permanent visa types will be excluded. Also, since the numerical data in the initial dataset represented the number of migrants by category, it needs to go through the transformation process to achieve the desired value (percentage of each category compared to the total amount) to be represented on the Donut Chart.

Bar Chart (integrated with Donut Chart):

Table 2.2 Overseas migrant arrivals and departures, by visa groupings, New South Wales, 2004-05 to 2021-22(a)(b)										
Direction	Visa groupings(c)		2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Overseas migrant arrivals(d)	Permanent visas	Family	12,370	13,250	13,530	13,810	14,230	13,950	13,090	13,120
		Skilled (permanent)	11,690	12,410	12,890	13,530	12,730	10,040	9,040	9,440
		Special eligibility & humanitarian	4,420	4,410	4,200	2,950	4,080	3,200	2,840	2,030
		Other (permanent)	1,350	1,360	1,370	1,470	1,460	1,470	1,550	1,600
	Total permanent visas		29,830	31,440	31,990	31,760	32,510	28,670	26,510	26,180
	Temporary visas	Student - vocational education and training	3,790	4,870	9,390	14,980	18,540	8,650	4,970	4,600
		Student - higher education	11,440	14,830	20,110	23,690	22,720	18,870	14,370	14,340
		Student - other	9,620	7,410	9,980	11,950	10,020	8,450	7,180	6,910
		Skilled (temporary)	6,330	7,820	9,590	11,790	10,410	7,500	10,990	12,860
		Working holiday	7,060	9,020	10,700	13,020	13,980	12,840	15,560	15,990
		Visitors	15,530	14,910	15,530	20,600	17,330	15,430	15,470	15,160
		Other (temporary)	3,070	2,540	2,390	2,550	1,720	1,780	1,950	2,030
		Total temporary visas	56,840	61,400	77,690	98,580	94,720	73,530	70,500	71,880
	New Zealand citizens (subclass 444)(g)		11,140	10,870	11,200	11,370	10,090	9,490	12,400	11,680
	Australian citizens (no visa)		23,860	25,190	26,070	26,170	27,840	28,130	28,420	27,090
	Total(h)		125,180	132,750	150,600	170,960	169,020	144,210	141,980	140,860
Overseas migrant departures(e)	Permanent visas	Family	1,800	1,900	1,940	2,020	2,000	2,210	2,290	2,220
		Skilled (permanent)	2,690	2,880	2,940	2,940	2,810	3,250	2,640	2,570

Figure 2.1.2: Initial version of Bar Chart Dataset in New South Wales

- **Source:** <https://www.abs.gov.au/statistics/people/population/overseas-migration/latest-release#data-downloads>
- **Method of data collection:** Like the Donut Chart, data is extracted from the same excel spreadsheet from the Australian Bureau of Statistics. The difference is that the donut chart uses data for the whole Australia country, and the bar chart uses data for each state in Australia.
- **Type of dataset:** Table in excel file (.xlsx format)
- **Values' datatypes:** categorical (visa types, period, state name) and numerical (migrant arrivals and departures amount)
- **Data excluded:** Like the Donut Chart, any data which was not from 2017 to 2022, or belonged to the permanent visa types were excluded.

State Map:

Total Australian-born	-18,680	-14,740	-12,790	-15,220	-2,280	-3,620	-8,130	-7,980	-9,840	-19,390	-23,000	-21,370	-15,870	-15,500	-12,360	18,060	7,470	-14,160
Total overseas-born	161,260	186,580	245,580	292,560	302,140	199,680	188,510	239,920	240,170	207,170	207,040	227,600	279,220	253,720	253,700	174,630	-92,410	185,080
Total	142,580	171,840	232,800	277,340	299,870	196,060	180,370	231,950	230,330	187,780	184,030	206,230	263,350	238,220	241,340	192,700	-84,940	170,920

Figure 2.1.3: A section of initial dataset for State Map

- **Source:** <https://www.abs.gov.au/statistics/people/population/overseas-migration/latest-release#data-downloads>
- **Method of data collection:** The data is extracted from the same excel spreadsheet from the Australian Bureau of Statistics. The state map chart using the total net migration of each year data for each state in each year in Australia.
- **Type of dataset:** Table in excel file (.xlsx format)
- **Values' datatypes:** categorical (countries) and numerical (net overseas migration)
- **Data excluded:** Like the all the other Chart, any data which was not from 2017 to 2022.

Lollipop Chart (integrated with State Map)

Table 1.1 Net overseas migration by country of birth, Australia, 2004-05 to 2021-22(a)(b)(c)

SACC code(d)	Country of birth(d)	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22(e)
7207	Tajikistan	0	10	0	10	10	10	10	10	0	10	0	10	10	10	10	10	10	10
7211	Uzbekistan	70	90	70	80	110	70	70	100	90	80	100	80	90	80	90	80	-60	40
8101	Bermuda	20	10	10	10	20	20	10	30	10	20	10	0	10	10	0	10	0	10
8102	Canada	1,650	1,800	1,790	2,130	1,560	1,530	1,890	2,240	1,550	1,160	1,190	1,110	1,040	800	980	860	-400	110
8103	St Pierre/Mique	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8104	USA	3,320	2,700	4,400	2,080	1,810	3,390	5,050	7,010	4,540	2,320	2,450	1,540	2,750	930	620	1,870	-10	-920
8201	Argentina	230	130	110	120	70	250	160	260	520	470	440	510	650	880	1,710	2,600	-390	290
8202	Bolivia	10	10	30	30	10	30	40	40	50	10	-10	10	30	30	50	50	-10	20
8203	Brazil	1,180	2,010	2,480	2,930	1,950	890	560	1,260	1,450	3,560	2,360	5,830	7,510	6,260	4,510	1,790	-1,750	2,000
8204	Chile	120	220	420	350	430	310	390	470	300	210	450	800	980	1,210	1,290	1,300	-400	600
8205	Colombia	280	700	1,400	1,830	1,990	1,250	680	1,330	1,570	1,270	1,610	2,610	3,690	3,650	4,950	4,650	-1,460	630
8206	Ecuador	40	40	30	50	50	70	70	80	170	370	80	-120	20	50	60	150	-40	40
8207	Falkland Is	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8208	French Guiana	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
8211	Guyana	0	20	10	10	10	0	20	20	0	10	0	10	-10	0	10	0	0	0
8212	Paraguay	10	20	0	0	10	20	10	10	20	0	0	10	60	10	10	20	-10	30
8213	Peru	230	470	640	810	700	440	250	280	320	190	170	180	270	440	410	560	-50	160

Figure 2.1.4: A section of the Bar Chart's initial dataset

- **Source:** <https://www.abs.gov.au/statistics/people/population/overseas-migration/latest-release#data-downloads>
- **Method of data collection:** The data is extracted from the same excel spreadsheet from the Australian Bureau of Statistics. Same as state map but instead look at the total net of each state in each year, we look at top 5 countries have the biggest positive values in each year for each state.
- **Type of dataset:** Table in excel file (.xlsx format)
- **Values' datatypes:** categorical (countries) and numerical (net overseas migration)
- **Data excluded:** Like the all the other Chart, any data which was not from 2017 to 2022, or not in Top 5

2.2 Data Processing

Initially, we did expect to deal with a considerable amount of data transformation work, since the dataset is not ready to be used by d3 and is filled with irrelevant text, sheets, and data to be processed as a visualization. From the original dataset, for every visualization we plan to extract the data (categories and values) that lies in the predefined period of before, during, and after COVID19 (2017-2022).

We processed the data by extracting them from the original file, organizing records and exporting those newly extracted data files to the suitable format to be processed. Details of the process will vary by different visualizations, which will be clarified in the upcoming section:

Donut Chart:

	A	B	C	D	E	F
1	types	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022
2	Student - vocational education and training	6	6.5	3.6	0.4	8.3
3	Student - higher education	32.5	31.7	24.2	2.5	40.4
4	Student - other	9.6	8.7	7.4	2.3	8.4
5	Skilled (temporary)	8.2	9.3	7.3	30.3	9.4
6	Working holiday	15.6	14	14	3.4	5.5
7	Visitors	24.3	26	37.5	26	16.3
8	Other (temporary)	3.8	3.8	6	35.1	11.7

Figure 2.2.1: Transformed dataset.

After extracting the desired values from the original dataset to a separate file, the data used for this chart was acquired by converting the number of temporary visas by type to the percentage of that compared to the total amount of temporary visas, using this formula:

$$\text{Percentage of temporary visa type} = \frac{\text{Number of temporary visa by type}}{\text{Total temporary visas granted}} \times 100\%$$

After implementing the formula, the result will then be rounded off to 1 decimal place. This process was implemented in Excel by using Excel functions ROUND, and SUM to calculate the percentages values from the original values, without having to calculate each value by ourselves. When all values are processed, the file will be saved in CSV format, and ready to be processed.

Bar Chart (integrated with Donut Chart):

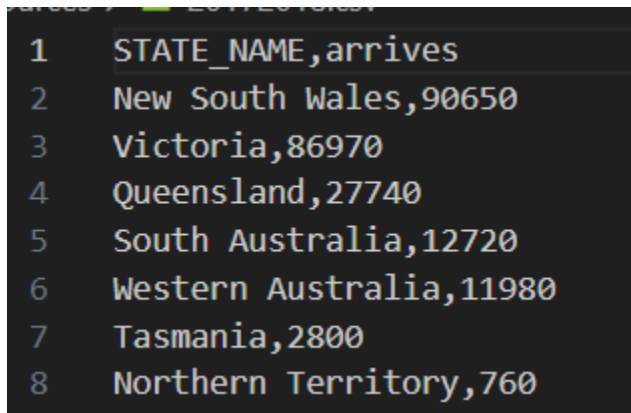
The original spreadsheet presents data for each state in a separate table, which is not suitable for the visualization. Specifically, the visualization requires the value of each temporary visa type for all Australia states in a specific year within 2017 to 2021. To achieve this, each table's data of temporary visa types was extracted and stored in a JSON file.

```
{
  "state_name": ["NSW", "VIC", "QLD", "SA", "WA", "TAS", "NT", "ACT"],
  "properties": [
    {
      "year": 2017,
      "data": [
        {
          "visa_type": "Student - vocational education and training",
          "value": [9180, 5580, 2580, 740, 1190, 90, 50, 230]
        },
        {
          "visa_type": "Student - higher education",
          "value": [38680, 38430, 13010, 5530, 6100, 1230, 330, 3230]
        },
        {
          "visa_type": "Student - other",
          "value": [11680, 9020, 6360, 1520, 1640, 280, 60, 900]
        },
        {
          "visa_type": "Skilled (temporary)",
          "value": [11380, 7620, 3330, 1010, 2650, 200, 370, 380]
        },
        {
          "visa_type": "Working holiday",
          "value": [19270, 13160, 10550, 1070, 5220, 470, 890, 350]
        },
        {
          "visa_type": "Visitors",
          "value": [30860, 25930, 10500, 2630, 7160, 590, 640, 1120]
        },
        {
          "visa_type": "Other (temporary)",
          "value": [4090, 4020, 1880, 560, 950, 150, 200, 470]
        }
      ]
    },
    {
      "year": 2018,
      "data": [
        {
          "visa_type": "Student - vocational education and training",
          "value": [10630, 5590, 3960, 820, 1170, 110, 160, 210]
        },
        {
          "visa_type": "Student - higher education",
          "value": [37440, 41990, 13760, 6330, 7710, 1360, 290, 2420]
        },
        {
          "visa_type": "Student - other",
          "value": [10600, 8950, 6460, 1520, 1820, 240, 100, 700]
        },
        {
          "visa_type": "Skilled (temporary)",
          "value": [13780, 9240, 4230, 1060, 3200, 320, 310, 480]
        },
        {
          "visa_type": "Working holiday",
          "value": [17700, 12870, 10210, 1120, 5560, 490, 880, 260]
        },
        {
          "visa_type": "Visitors",
          "value": [33820, 29110, 12840, 3910, 8530, 740, 930, 1350]
        },
        {
          "visa_type": "Other (temporary)",
          "value": [4420, 4440, 1870, 680, 1130, 220, 250, 410]
        }
      ]
    },
    {
      "year": 2019,
      "data": [
        {
          "visa_type": "Student - vocational education and training",
          "value": [10630, 5590, 3960, 820, 1170, 110, 160, 210]
        },
        {
          "visa_type": "Student - higher education",
          "value": [37440, 41990, 13760, 6330, 7710, 1360, 290, 2420]
        },
        {
          "visa_type": "Student - other",
          "value": [10600, 8950, 6460, 1520, 1820, 240, 100, 700]
        },
        {
          "visa_type": "Skilled (temporary)",
          "value": [13780, 9240, 4230, 1060, 3200, 320, 310, 480]
        },
        {
          "visa_type": "Working holiday",
          "value": [17700, 12870, 10210, 1120, 5560, 490, 880, 260]
        },
        {
          "visa_type": "Visitors",
          "value": [33820, 29110, 12840, 3910, 8530, 740, 930, 1350]
        },
        {
          "visa_type": "Other (temporary)",
          "value": [4420, 4440, 1870, 680, 1130, 220, 250, 410]
        }
      ]
    }
  ]
}
```

Figure 2.2.2: Bar Chart data after processing

This can also be achieved by creating 5 CSV files (each represent temporary visa data for a specific year within 2017-2021), but it is not as efficient as storing all of them in 1 JSON file.

State Map:



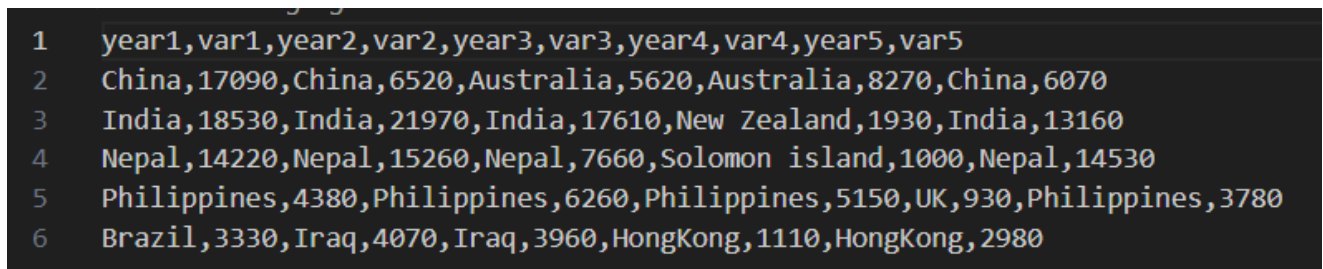
1	STATE_NAME,arrives
2	New South Wales,90650
3	Victoria,86970
4	Queensland,27740
5	South Australia,12720
6	Western Australia,11980
7	Tasmania,2800
8	Northern Territory,760

Figure 2.2.3: State Heat Map data after processing

After extracting the desired values from the original dataset to a separate file, the data used for this chart was acquired by taking the total net migration of each state from 2017-2022. All the data has been calculated in the dataset has been provided.

This can also be achieved by creating 7 CSV files as 7 states.

Bar Chart (integrated with State Map)



1	year1,var1,year2,var2,year3,var3,year4,var4,year5,var5
2	China,17090,China,6520,Australia,5620,Australia,8270,China,6070
3	India,18530,India,21970,India,17610,New Zealand,1930,India,13160
4	Nepal,14220,Nepal,15260,Nepal,7660,Solomon island,1000,Nepal,14530
5	Philippines,4380,Philippines,6260,Philippines,5150,UK,930,Philippines,3780
6	Brazil,3330,Iraq,4070,Iraq,3960,HongKong,1110,HongKong,2980

Figure 2.2.4: Bar Charts (State Heat Map) data after processing

Same with above but with this one, we need to select the top 5 countries that have the most net migration of each year, from 2017 to 2022.

This can also be achieved by creating 7 CSV files as 7 states.

3. Requirements

3.1 Must-Have Features

The visualizations in the project must include these features:

- **Title:** The name of the visualization (what it is, and what it is about)
- **Axes & Labels:** Help clarify data values used in the visualizations.
- **Legends:** List of labels to clarify each color used in the visualization
- **Color:** Simple, contrast color scheme to distinguish different data values
- **Interactivity:**
 - **Buttons:** Allow users to choose period of the data (within 2017 – 2021)
 - **Hovering effects:** When hovered, the element will be uniquely styled to distinguish with other elements.
 - **Tooltips:** Display the exact value of the hovered element
- **Transition:** Smoothly displays the changes happening to the visualization
- **Brief explanations:** The visualization may be complex for some people. Therefore, it is necessary to include a brief explanation about how to use and the context around the visualizations.
- **Charts:**
 - **Pie chart:** Able to display data in correct portions.
 - **Bar chart:** Able to update the data according to the selected visa type and periods.
 - **Heatmap:** Able to display data in the correct state position's
 - **Bar chart (Heat Map):** Able to update the data according to the selected state and year.

3.2 Optional Features

The following features are nice to have but not mandatory:

- **Feedback Form:** A form allowing users to submit their feedback on visualizations.
- **Zoom function:** A function allowing users to zoom in/out the visualization which will help the user to see sections clearer at will.
- **Animation:** Include animations to smoothen the data-changing process in the visualizations.

4. Visualization Design

4.1. First Visualization – Choropleth with Bar Chart

4.1.1. General ideas

By using Choropleth, we can show the total net overseas migration from 2017 - 2022 for each state, using a combination of buttons and mouse over, we can illustrate our data in each year and each state with just a single click and look at the color, for the specific data, they can just mouse hover the state to see it. Allow the user to interact more with the chart. If the user wants to know more about each state in that specific year, they can simply click on that state. It will show the top 5 countries that contribute most to the net migration of that state in that year as a bar chart.

4.1.2. Design evolution

First, we produce a visualization that uses a Background map of states just to interact with then show the actual data in the line chart one the side. How Think about how much data we need to include I single chart, let the other do nothing, and make confusion. Instead, we produce an ideal that change the background map to choropleth map and make it show the total net migration and change the other line chart to the BarCharts and show the top 5 countries to support the heat map, make both charts meaningful. Plus, we, add button change the choropleth map, so we

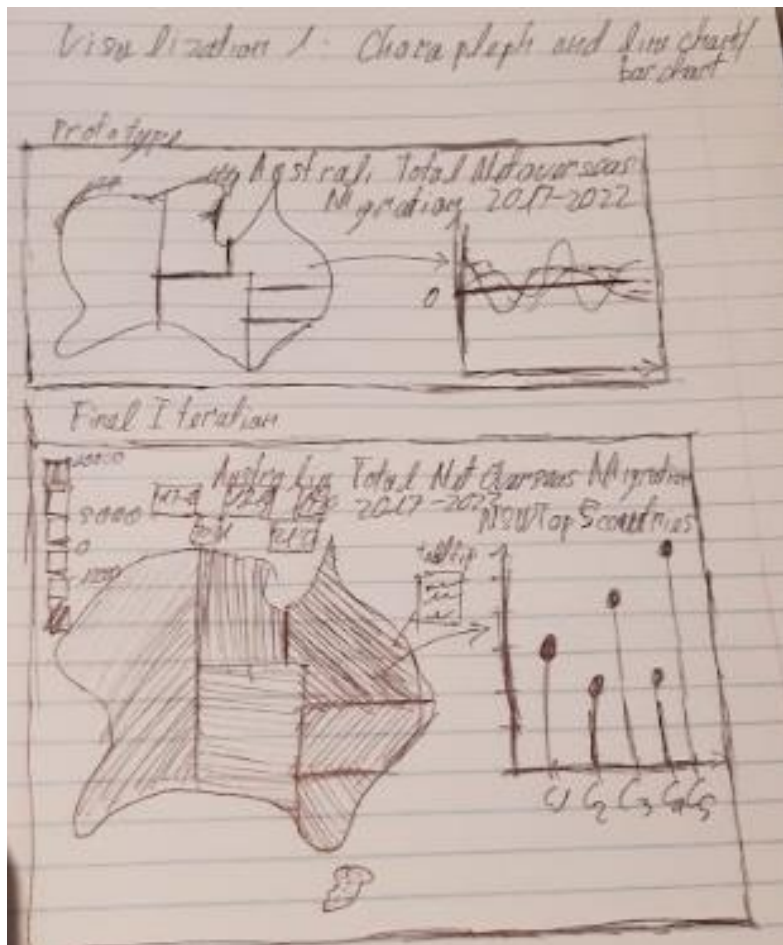


Figure 4.1.2.1: Final Iteration of Choropleth map and bar chart

4.1.3. Alternative ideas

- Before producing the final iteration, we thought about using 2 different charts to provide information and interaction by using a button and a mouse. Still, then we consider how to make the visualization provide meaningful data for the user in the easy was too much and take more time to understand the visualization. So, a better way is using one to interact with the other is a better.

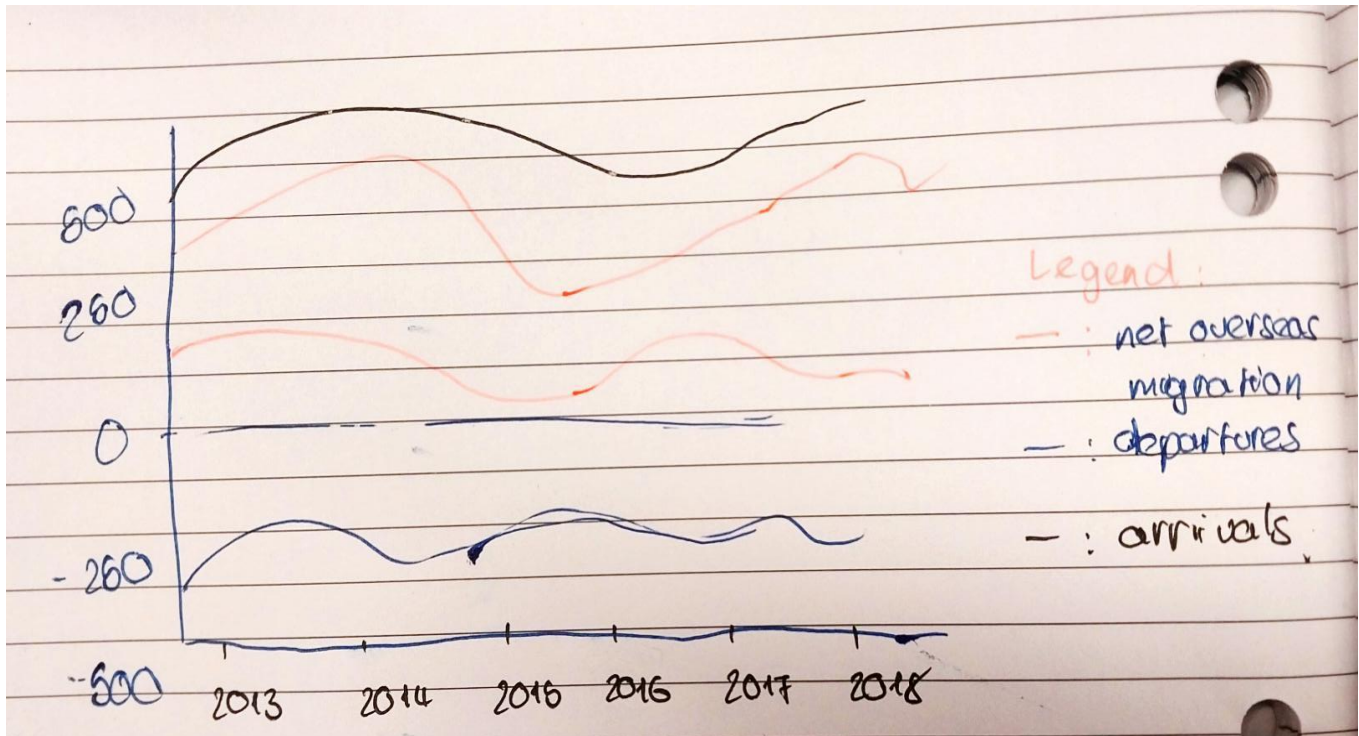


Figure 4.1.2.2: Another ideal of Choropleth map and bar chart

4.1.4. Visual encoding and idioms

- The Idiom of this visualization was combining combination of a choropleth and bar chart. In these ways, a lot of information can be provided to the reader without reading, they can simply understand the visualization just by looking at it. By using choropleth and button, we can show data of each state at each year and using the bar chart to show the top 5 countries that contribute to the net. Both charts support each other to provide the full meaning of the visualization. And the difference between year support by button, it shows the impact of the covid-19 to the net of migration to Australia.
- In addition, in this visualization, color hues and saturations on each state to clarify the difference between total net overseas migration, while improving the overall aesthetic, visibility on the website (as it does not conflict with the website colors).
- We also provide a highlight went hover the state by using the thickness of lines with colors saturation around the state border and blur other state by decreasing the capacity.

4.2. Second Visualization – Donut Chart with integrated Bar Chart

4.2.1. General ideas

The pie chart will show the proportions of temporary visa types in Australia in different periods, which will allow the user to analyze the change of values by time, during the period of 2017-2022. The specific percentage values will be shown to the users by hovering through the desired slices. Moreover, the user can zoom in the pie chart and drag at will to see the difference between pie slices or indicate a minor section in the bar chart.

To further analyze the data trend by states, a bar chart is also integrated, which show the specific number of temporary visas granted for specific states in Australia. This chart will change according to the user's hover action, so that when the user hovers the mouse over a specific visa type in a period, the bar chart will display the number of visas granted that belongs to that type in every state, and in the same period as the pie chart.

While the pie chart was implemented with a color scheme with different hues and saturation to clarify the different visa types, the bar chart uses assorted color saturations to clarify the difference in quantities.

4.2.2. Design evolution

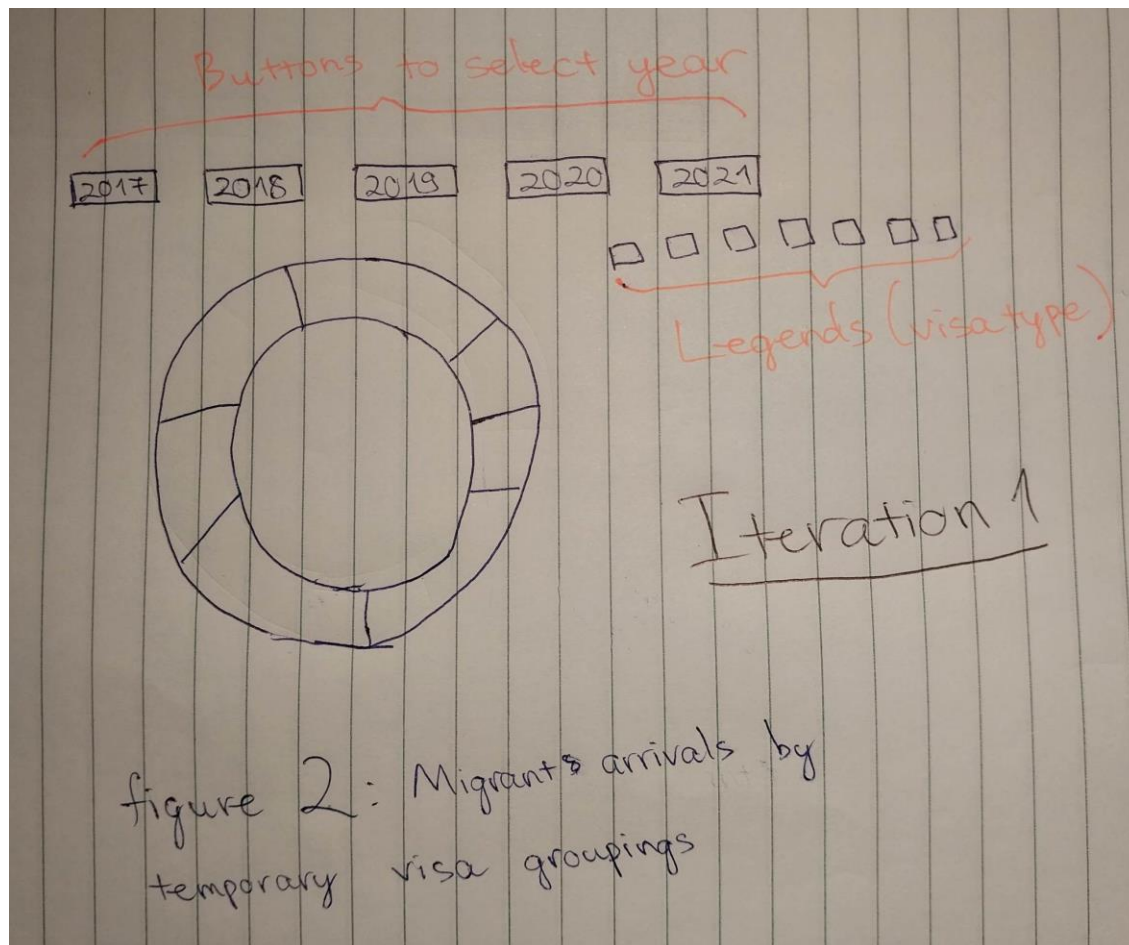


Figure 4.2.2.1: Second Visualization's Iteration 1

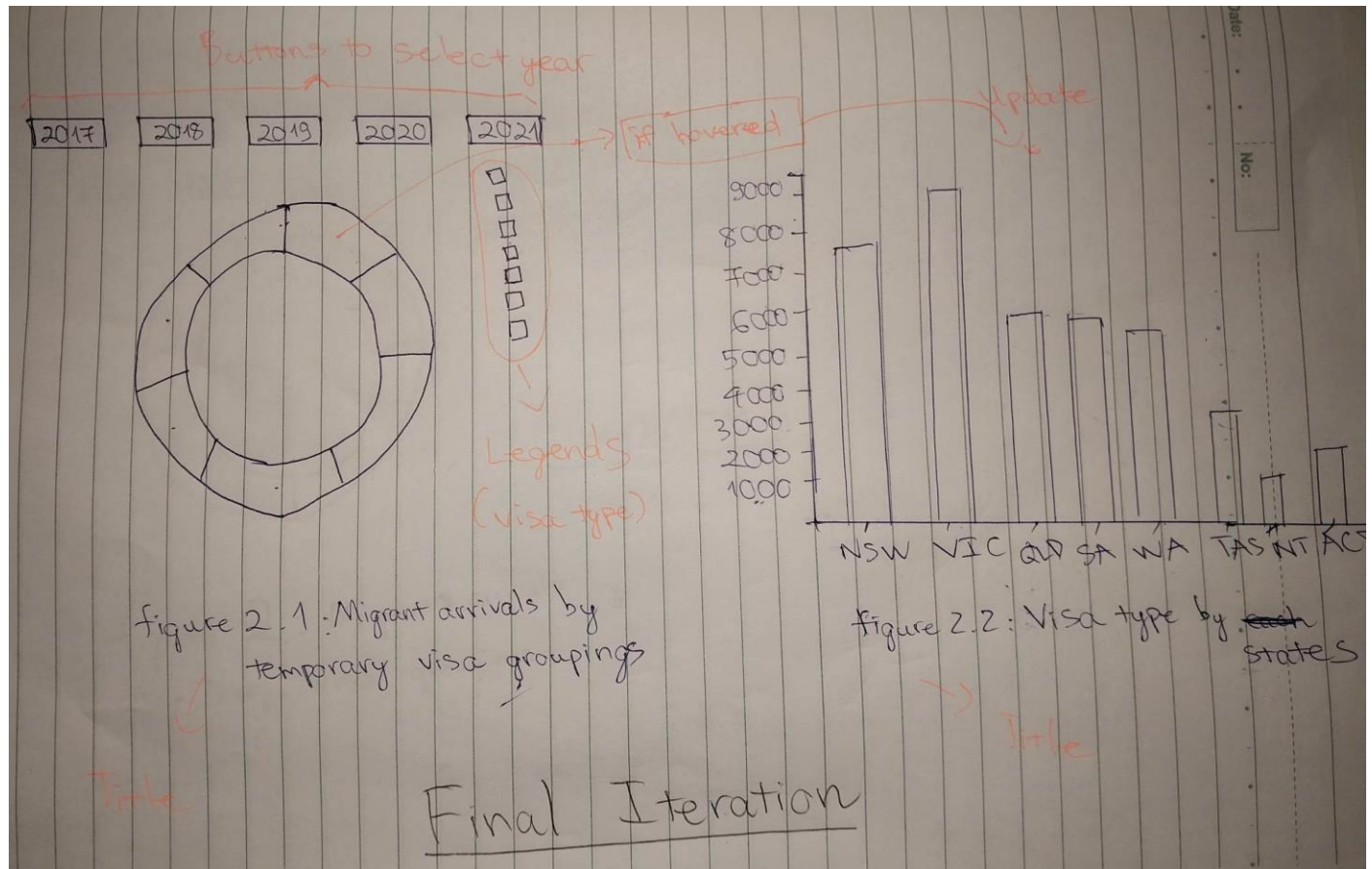


Figure 4.2.2.2: Second Visualization's Final Iteration

- The first design simply includes a donut chart with legends to help identify the color of each visa type in the donut. There are also buttons that allow users to select year, and the donut is updated when a button is clicked. It is nice but quite simple.
- The final design includes a side bar graph which interacts with the pie chart. Specifically, whenever users hover over a slice of the donut chart (bound to a visa type) to, the bar graph will update its data to show the number of that visa type grouped by Australia states. In addition, the titles of both graphs are updated if users select different data.

4.2.3. Alternative ideas

While producing the final design, we have also considered alternatives to visualize our data, such as a stacked bar chart, side bar chart, and the pie charts, integrated with parallel chart.

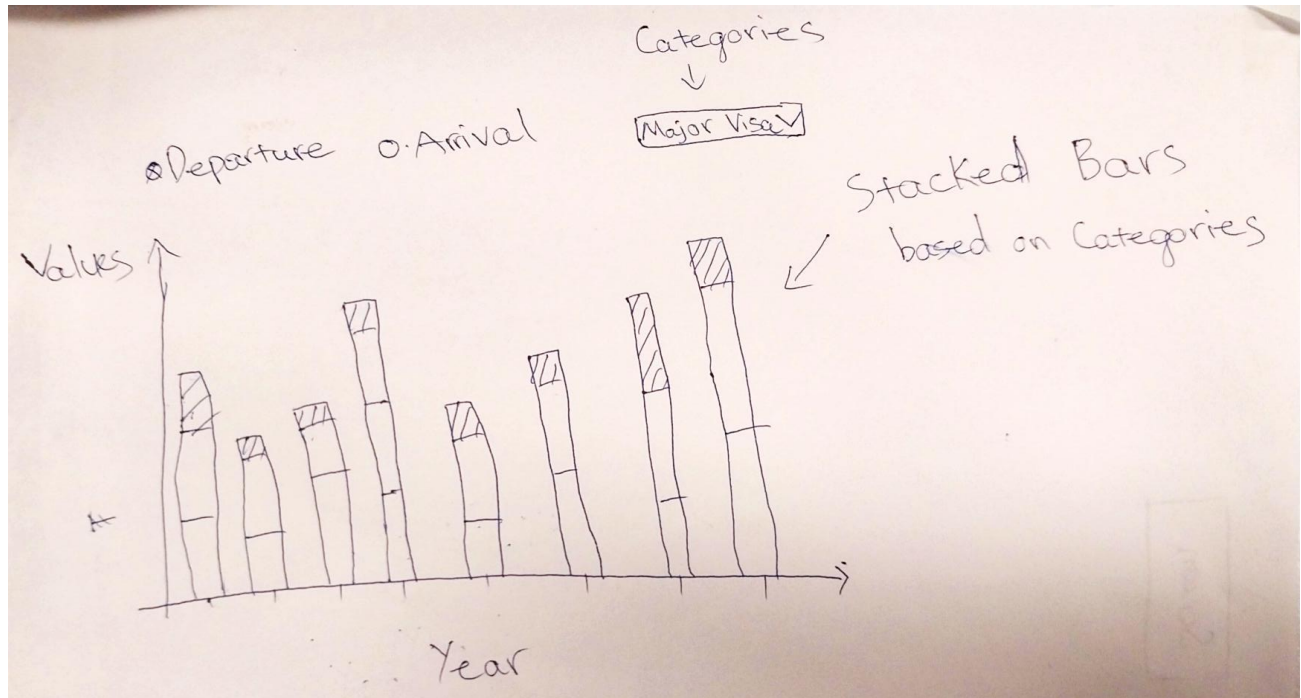


Figure 4.2.3.1: Stacked bar chart design

The stacked bar chart will allow us to show the weight of various categories, in comparison to the overall value, by multiple categories. However, as we wanted more complexity and effectiveness for the visualization, this option was not chosen since it is simple and did not have the ability to extend the data range further, such as specific States's number of immigrants by visa types.

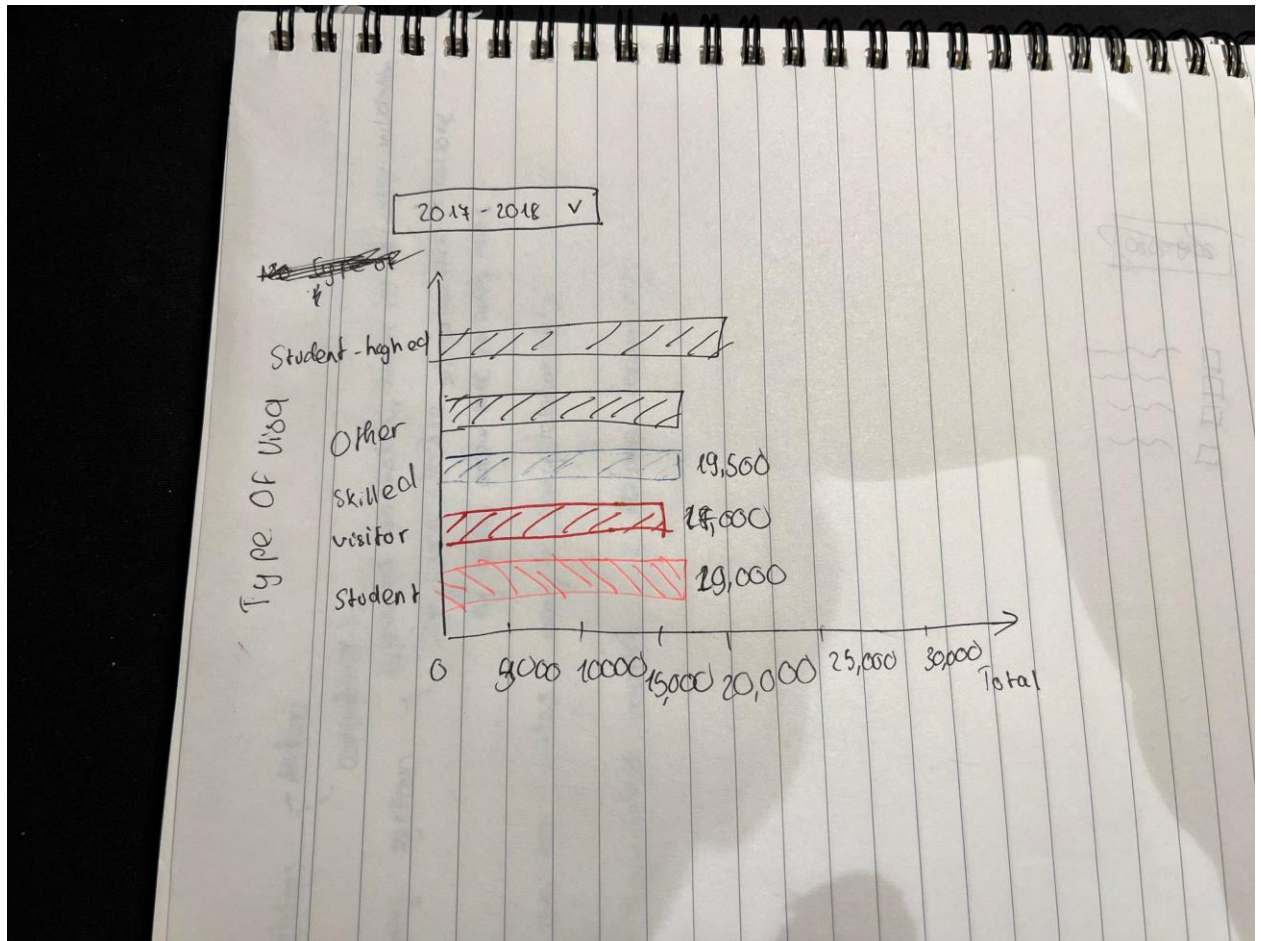


Figure 4.1.3.2: Side bar chart design

The number of migrants for different granted temporary visa types can also be represented with a side bar chart, however, it did not offer the capability to represent more context and depth of data, same as the previous option. As a result, we also did not choose this to be our final implementation and move on with another attempt to find the suitable visualization for our needs.

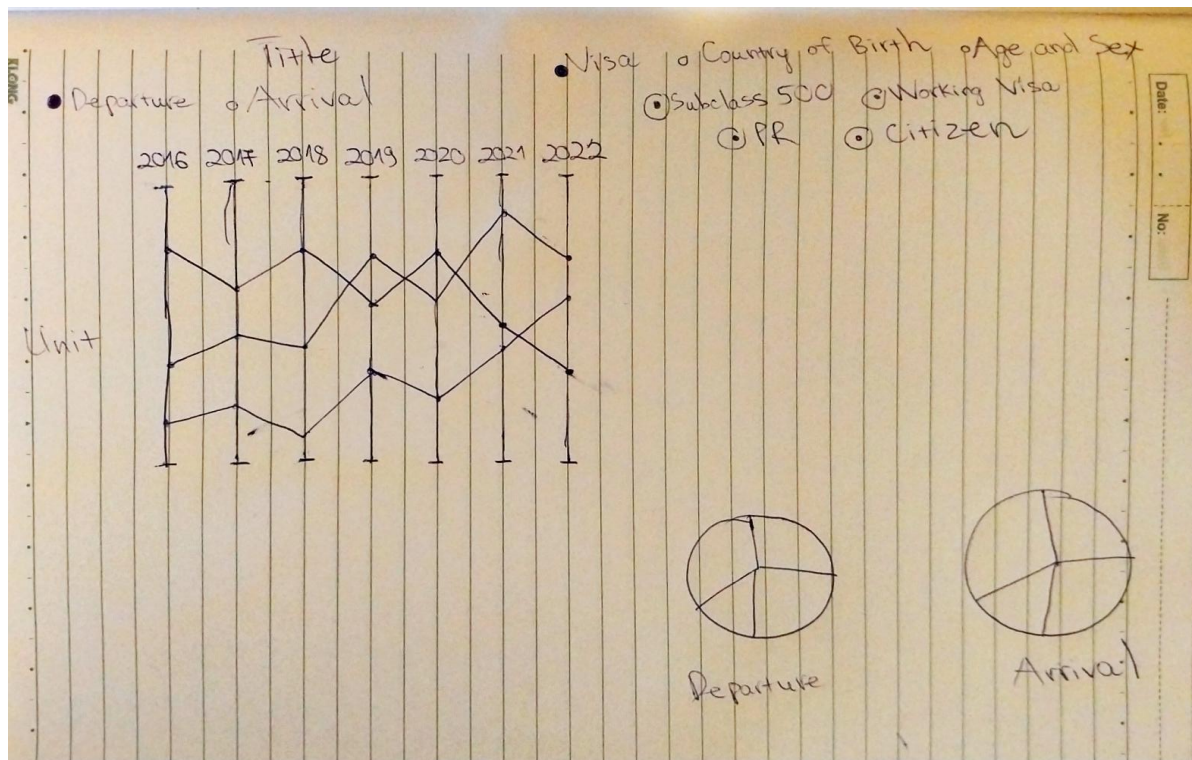


Figure 4.1.3.3: Pie chart with integrated parallel chart design

This alternative offers the integrated chart type that we aim for, with multiple potential interactivity and data representation, however, we thought that the parallel chart might not be a suitable representation for our selected data, as it may provide unneeded complexity for the users to understand and extract information from the visualization. In addition, we thought that compared to the simple bar chart representation, this chart is not as effective and “information-dense” as its peer.

4.1.4. Visual encoding and idioms

The idioms used in this visualization are donut (pie) charts and bar charts. These two idioms are integrated with each other to fully maximize the properties of each type. The goal for this visualization is to not only displays the temporary visas data in Australia, but also to visualize the data of that visa type in different states of Australia, allowing the user to have an overall view of the problem domain, as well as assessing and evaluating the data in a wider picture.

In addition, in this visualization, color hues and saturations for different visa types were used on the donut chart to clarify the difference between categories, while improving the overall aesthetic, visibility on the website (as it does not conflict with the website colors).

For the bar chart, color saturations were used to display the numerical data, which helps the user to identify the difference of the number of visas between states more clearly and effectively.

Also, we have grouped the change of pie slices with the bar chart, so that whenever the user hovers through a pie slice of a particular time period, the bar chart (along with its axes) will change accordingly to match the period and the temporary visa category in a short amount of time, creating a smooth data transition for the user to interact and explore with the visualization while improving the user’s visual experience and satisfaction.

5. Validation

To gain more insights into the visualizations we created, we have included a survey for users to test the website's usability and the user's experience. The survey included several questions related to the information that can be extracted from the website, as well as the evaluation of the users' experience with the website and their recommendations to improve the website further in the future.

We have conducted the survey and collected 8 responses:

1. Which type of visa had the highest percentage of migrant arrivals during (2018-2019) period?

[More Details](#)

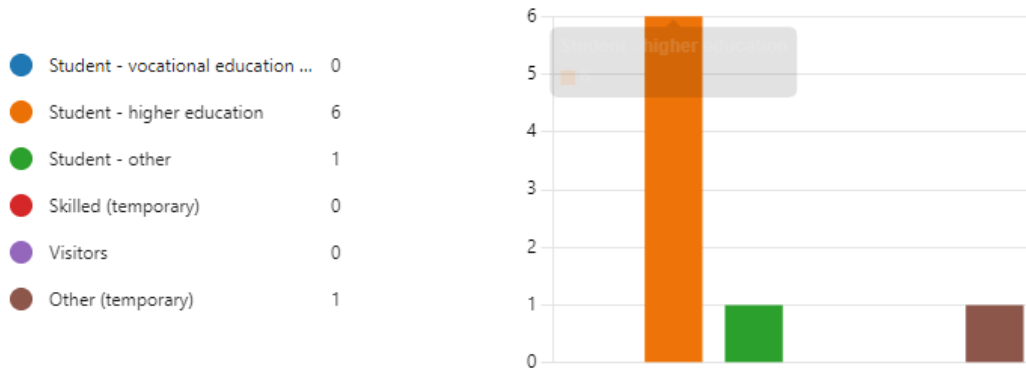


Figure 5.1: First question of the survey

2. During the period of "2017-2018", which state have the highest number of "Student - vocational education and training" visa migrant?

[More Details](#)

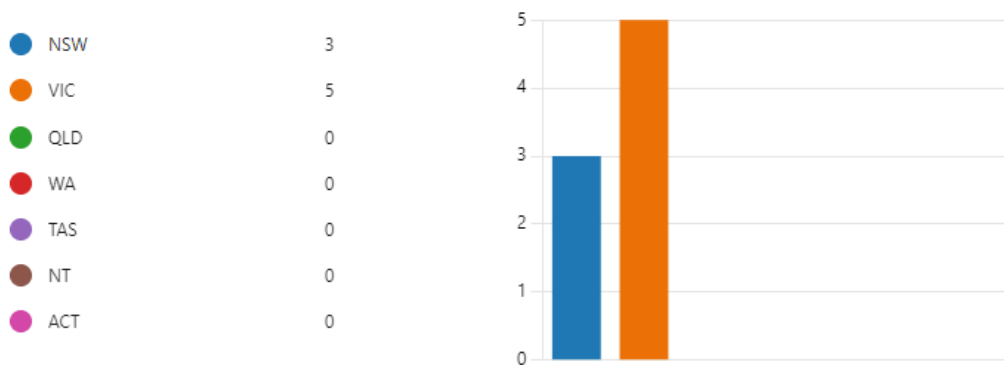


Figure 5.2: Second question of the survey

3. In 2019, what type of visa accounted for the largest proportion?

[More Details](#)

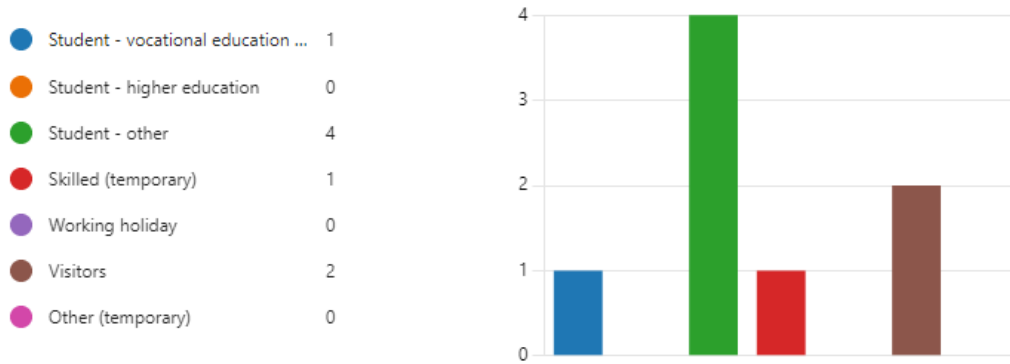


Figure 5.3: Third question of the survey

4. During the "2019-2020" period, which state have the highest net overseas migration value?

[More Details](#)

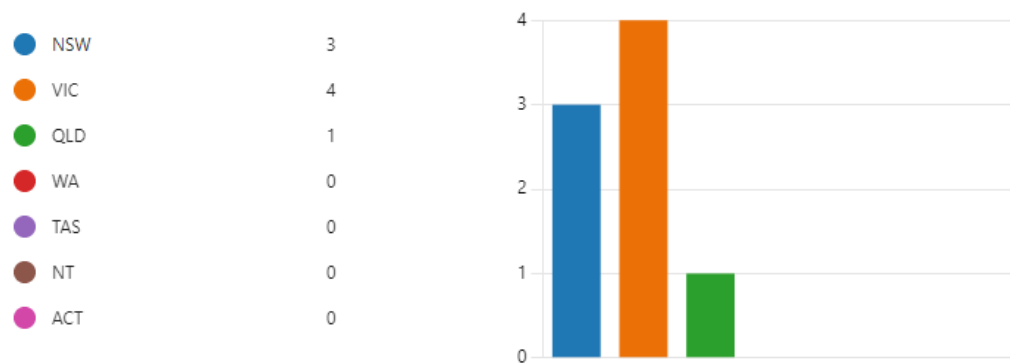


Figure 5.4: Fourth question of the survey

5. From 1-10, how easy it was to answer the questions from the information gained by using the website?

[More Details](#)

8.75
Average Rating

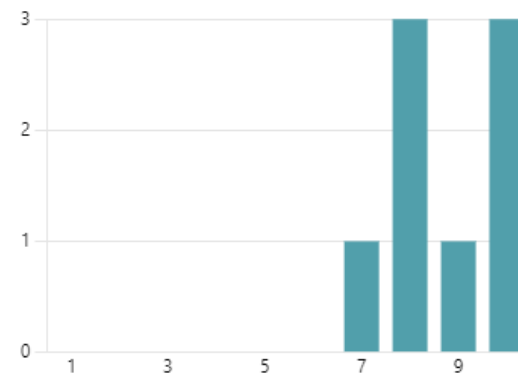


Figure 5.5: Fifth question of the survey

6. From 1-10, how will you rate the website's interactivity?

[More Details](#)

9.13
Average Rating

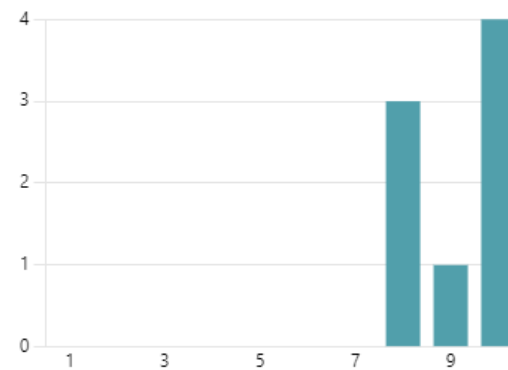


Figure 5.6: Sixth question of the survey

7. From 1-10, rate your satisfactory level based on the website's aesthetics (color scheme, layout)?

[More Details](#)

8.88
Average Rating

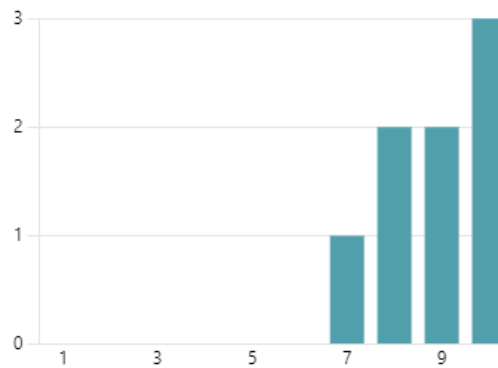


Figure 5.7: Seventh question of the survey

8. From 1-10, rate your level of satisfaction based on information gained from our website.

[More Details](#)

8.43
Average Rating

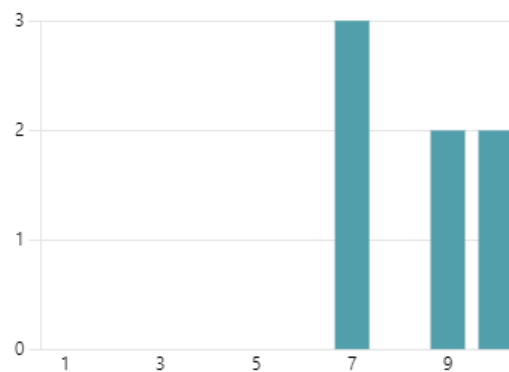


Figure 5.8: Eighth question of the survey



9. Is there any particular points that you find interesting in our visualisations? If yes, can you explain your answer?

8 Responses

ID ↑	Name	Responses
1	anonymous	no
2	anonymous	I find the ability to link two different charts interesting, as it clarifies the information in the first chart on the left hand side, while having smooth transitions of data.
3	anonymous	The hover ability of the charts, as it is pleasing aesthetically, as well as the integration with the other charts with smooth transitions while gaining more specific data.
4	anonymous	The visualizations are well-designed, and easy to use
5	anonymous	The way charts interacts with each other, as it help the user to gain more information while being neat and clean on the website. which does not have too many charts in order to depicts the information needed.
6	anonymous	The overall theme of the website is catchy with good choice of color scheme.
7	anonymous	no
8	anonymous	no

Figure 5.9: Ninth question of the survey

10. In your opinion, are there any features that we can improve with this website? If yes, what can be improved on this website to make your experience better?

8 Responses

ID ↑	Name	Responses
1	anonymous	no
2	anonymous	I think the website aesthetic can be improved, with more pictures for example to make it less plain.
3	anonymous	The website layout can be more organized.
4	anonymous	No
5	anonymous	no
6	anonymous	I think no
7	anonymous	no
8	anonymous	no

Figure 5.10: Tenth question of the survey

From the collected data, our website has received positive responses from users about their experience. Most users managed to get the correct answer for the data-related questions. In addition, the results suggest that the website is user friendly to most users, and the visualizations interactivity, as well as the website's aesthetics are appealing and improved the users' experience.

The text feedback suggests that the chart with integration of another chart is appealing to users, as well as the color scheme selected and the hover interaction. However, some suggest that the website's overall aesthetic and layout can be improved with more pictures or organization of contents.

6. Conclusion

In conclusion, through the implementation of the website using D3.js library, and the development of the visualization project about Migration to Australia, with respect to the recent COVID-19 pandemic, our group has gained critical knowledge on utilizing the D3.js library, and on understanding and applying visualization concepts to build graphs using real data. Moreover, as the project was designed to be like a significant business project, we have gained invaluable experience on working as a team collaborating on GitHub, documenting progress, and reporting it every project stand up, and testing, debugging the final product. We believe those experiences are beneficial to our career path.

References

For scholarly ideas:

Australian Bureau of Statistics, Overseas Migration, Australian Bureau of Statistics, viewed 3 June 2023, <https://www.abs.gov.au/statistics/people/population/overseas-migration/latest-release?fbclid=IwAR2OYGNIUeyPvTDCCul5qXju-TH2_9ywwTkwqSvXiETLkYtm_4A9hsS48rg#data-downloads>.

Migration Data Portal 2022, Migration data relevant for the COVID-19 pandemic, Migration Data Portal, viewed 1 June 2023, < <https://www.migrationdataportal.org/themes/migration-data-relevant-covid-19-pandemic>>.

For our project:

<https://gist.github.com/dbuezas/9306799>: used to learn how to build the donut chart with a data transition animation.

<https://www.youtube.com/watch?v=6HFpw5fcaD8>: used to learn how to build the navigation bar on the webpage.

<https://youtu.be/oYRda7UtuhA>: used to learn how to build the website with proper first page and sections.

https://medium.com/@kj_schmidt/making-an-animated-donut-chart-with-d3-js-17751fde4679: used to learn how to build the donut chart and tooltips.

<https://stackoverflow.com/questions/38971140/how-to-use-zooming-with-pie-in-d3-charts>: used to learn how to implement the zooming function.

https://d3-graph-gallery.com/graph/line_change_data.html: used to learn how to change data in graphs.

<https://raw.githubusercontent.com/tonyw71/GeoJson-Data/master/australian-states.json>: for Australia GeoMap