

SWINBURNE UNIVERSITY OF TECHNOLOGY

COS30045

PROCESS BOOK

NAME & STUDENTID : Nguyen Gia Binh - 104219428
Nguyen Quang Dao - 104211864

CLASS : COS30045

LECTURER : HOANG XUAN TUNG
(txhoang@swin.edu.au)

TUTOR : HOANG XUAN TUNG
(txhoang@swin.edu.au)

MERCURY LINK : [Visualization Link](#)

Hanoi, April 1, 2024

TABLE OF CONTENTS

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION

1.1: Background and Motivation

1.2: Visualization purpose

1.3: Project Schedule

CHAPTER 2: DATA

2.1: Data source

2.2: Data processing

CHAPTER 3: REQUIREMENT

3.1: Must-have Features

3.2: Optional Features

CHAPTER 4: VISUALIZATION DESIGN

4.1: GEO MAP

4.2: LINE CHART

4.3: STACKED BAR CHART

CHAPTER 5: VALIDATION

CHAPTER 6: CONCLUSION

REFERENCE

CHAPTER 1: INTRODUCTION

1.1: Background and motivation

Migration is a natural and inevitable aspect of human history. In the current globalized world, international migration has become more common. In 2020 alone, there were an estimated 281 million international migrants worldwide, comprising 3.6 percent of the global population (UN DESA, 2020). There are both push factors like conflict, persecution and human rights violations that force people to flee, as well as pull factors like better economic opportunities and living conditions that attract migrants.

The situation of forced migration due to the Russian invasion of Ukraine has led to a significant humanitarian crisis, affecting millions of people. As of February 2024, nearly 3.7 million individuals within Ukraine have been displaced internally, highlighting the extensive disruption and displacement caused by ongoing military actions and violence. Additionally, the crisis has forced nearly 6.5 million people to seek refuge in other countries, with Poland hosting the largest number of Ukrainian refugees, approximately 60% of the total. The international community, through various organizations such as UNHCR and UNICEF, has been actively involved in providing humanitarian assistance, including legal aid, mental health support, and basic needs to those affected. More than 14 million people have been displaced since the onset of the conflict, with a substantial number finding refuge in neighboring countries. This displacement represents a significant portion of Ukraine's pre-war population, underscoring the profound impact of the conflict on the country's demographic landscape (UNHCR, 2024).

Understanding these complex forced migration dynamics is crucial for policies and international relations efforts to resolve the core Invasion and address the refugee crisis humanely based on international law (UNRWA, 2021).

1.2: Visualization purpose

In this assignment, several visualizations are made to explore and analyze geographic patterns and underlying events that contribute to complex issues. By synthesizing location-based data, the visualizations offer potential benefits. The topic we chose is the invasion of Russia in Ukraine. Using interactive map and other data visualizations allows viewers to delve into what's the number of refugees in a certain European country and the internal displacement Demographic of Ukraine. First, the line chart depicts the trend of migration coming from Ukraine each month since just before the war up to now to show

how devastating the situation is. Next, the map clearly shows exactly how many Ukrainian refugees a country in Europe has as of the current date. Finally, two stacked bar charts are deployed to give viewers a look into the Ukraine IDP demographic, comparing 2022 and 2024. By combining the geographic map with other visual elements like charts and graphs, you get a comprehensive, multi-faceted picture of the intricate migration and displacement flow before and after the invasion of Russia in Ukraine.

1.3: Project Schedule

Week	Tasks
6	<ol style="list-style-type: none">1. Choose the topic2. Find data about it
7	<ol style="list-style-type: none">1. Choose the topic2. Find data about it
8	<ol style="list-style-type: none">1. Finalize the topic2. Clean the data
9	<ol style="list-style-type: none">1. Start making the demo charts2. Start sketching the front-end to present the visaulization
10	<ol style="list-style-type: none">1. Choose what kind of visualization you want to use2. Visualize the EU map3. Code the charts out for Russia vs Ukraine4. Finalize on front-end design
11	<ol style="list-style-type: none">1. Sorting through the Demo code to finalize the design2. Bug fixing

12	<ol style="list-style-type: none"> 1. Bug fixing 2. Writing the report 3. Conclude the project
----	---

CHAPTER 2: DATA

2.1: Data source

This analysis on the invasion of Russia in Ukraine utilizes data from a variety of credible sources: IOM (International Organization for Migration), CEDOS (Center for Economic Development Studies), CEEOL (Central and Eastern European Online Library), Humanitarian Data Exchange(HDX) and EuroStat. We'll be meticulously combining and processing this information to create insightful visualizations. Each source brings unique strengths: IOM provides expertise in migration patterns, CEDOS offers insights into Eastern European development, CEEOL grants access to relevant academic research, HDX covers a wide range of categories relevant to humanitarian emergencies and crises, such as population statistics, administrative boundaries, displaced populations,..... and EuroStat supplies official statistics. This multi-faceted approach ensures we leverage the most comprehensive and up-to-date information to illuminate the topic at hand.

Here are the URL to the dataset respective to our visualization:

Line chart:

- <https://data.humdata.org/dataset/ukraine-data-explorer-inputs?>
- <https://cedos.org.ua/en/researches/forced-migration-and-the-war-in-ukraine-february-24-march-24/>
- <https://stat.gov.ua/en/datasets/migration-movement-population>
- <https://cream-migration.org/ukraine-detail.htm?article=3573>

Geomap :

- The geomap itself :
<https://github.com/amcharts/amcharts4/blob/master/dist/geodata/es2015/json/region/world/europeUltra.json>

- [https://en.wikipedia.org/wiki/Ukrainian_refugee_crisis_\(2022%E2%80%93present\)#:~:text=An%20ongoing%20refugee%20cross%20began,country%20by%20late%20May%202022.](https://en.wikipedia.org/wiki/Ukrainian_refugee_crisis_(2022%E2%80%93present)#:~:text=An%20ongoing%20refugee%20cross%20began,country%20by%20late%20May%202022.)
- The data to incorporate with the map:
<https://data.unhcr.org/en/situations/ukraine>

Stacked bar chart:

- 2022: <https://dtm.iom.int/reports/ukraine-internal-displacement-report-general-population-survey-round-11-25-november-5>
- 2024:
<https://dtm.iom.int/reports/ukraine-area-baseline-assessment-raion-level-round-33-february-2024>

2.2: Data processing

The datasets obtained from the aforementioned organizations guarantee both high integrity and timeliness. However, it is essential to conduct data cleaning and restructuring on the original datasets to ensure they meet the necessary level of 'conformity' required for visualization in D3.

Line Chart

For the line chart, the datasets are a little problematic as no one site has the full dataset, each has just a part of it or some set of the dataset is missing so data imputation is a must in order to have the required data for the chart. The original dataset is comprised of daily, monthly figure of ukraine migration number and/or quarterly figure.

#	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	Year	Country o	Country o	Country o	Displaced	Displaced	Displaced	Asylum se	Asylum se	Number o	Number o	Host comi	Host comi	Internally	Internally	Other pec	Other pec	Others of	Others of	Refugees	Refugees	Stateless	Stateless	Persons	Outgoing				
2	#date+year	#country+country	#country+country	#country+country	#affected	#affected	#affected	#inneed	#inneed	#affected	#affected	#affected	#affected	#affected	#affected	#affected	#affected	#affected	#affected	#affected	#affected	#affected	#affected	#affected	#affected	#affected	#affected	#affected	#affected
3	2014	AFG	Afghanistan	UKR	Ukraine	3941	3941	3941	2397	2397	51	51	0	0	0	0	0	0	0	0	1544	1544	0	0					
4	2014	DZA	Algeria	UKR	Ukraine	12	12	12	12	12	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	2014	EGY	Egypt	UKR	Ukraine	20	20	20	15	15	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2014	ARM	Armenia	UKR	Ukraine	227	227	227	26	26	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	2014	AZE	Azerbaijan	UKR	Ukraine	222	222	222	46	46	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	2014	BGD	Bangladesh	UKR	Ukraine	126	126	126	120	120	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	2014	BLR	Belarus	UKR	Ukraine	47	47	47	26	26	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	2014	TCD	Chad	UKR	Ukraine	22	22	22	15	15	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	2014	CHN	China	UKR	Ukraine	10	10	10	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	2014	CMR	Cameroon	UKR	Ukraine	105	105	105	105	105	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	2014	COG	Congo	UKR	Ukraine	52	52	52	31	31	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	2014	COD	Democrat	UKR	Ukraine	216	216	216	150	150	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	2014	CUB	Cuba	UKR	Ukraine	12	12	12	12	12	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	2014	ERI	Eritrea	UKR	Ukraine	50	50	50	33	33	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	2014	ETH	Ethiopia	UKR	Ukraine	31	31	31	15	15	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	2014	GMB	Gambia	UKR	Ukraine	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	2014	PSR	State of P	UKR	Ukraine	188	188	188	150	150	12	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	2014	GEO	Georgia	UKR	Ukraine	176	176	176	114	114	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	2014	GIN	Guinea	UKR	Ukraine	140	140	140	135	135	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	2014	CIV	Côte d'Ivoire	UKR	Ukraine	41	41	41	36	36	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	2014	IRN	Iran (Iran)	UKR	Ukraine	128	128	128	71	71	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	2014	IRQ	Iraq	UKR	Ukraine	325	325	325	244	244	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	2014	JOR	Jordan	UKR	Ukraine	23	23	23	18	18	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	2014	KAZ	Kazakhstan	UKR	Ukraine	20	20	20	10	10	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	2014	KGS	Kyrgyzstan	UKR	Ukraine	162	162	162	155	155	19	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	2014	LBN	Lebanon	UKR	Ukraine	33	33	33	27	27	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	2014	LKA	Sri Lanka	UKR	Ukraine	74	74	74	64	64	12	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	2014	MU	Mali	UKR	Ukraine	11	11	11	11	11	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	2014	MAR	Morocco	UKR	Ukraine	5	5	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	2014	MMR	Myanmar	UKR	Ukraine	10	10	10	10	10	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	2014	NGA	Nigeria	UKR	Ukraine	84	84	84	79	79	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	2014	PAK	Pakistan	UKR	Ukraine	192	192	192	186	186	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	2014	RUS	Russian Fed	UKR	Ukraine	281	281	281	177	177	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	2014	SEN	Senegal	UKR	Ukraine	0	0	0	0	0	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	2014	SLE	Sierra Leo	UKR	Ukraine	19	19	19	14	14	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	2014	SOM	Somalia	UKR	Ukraine	423	423	423	305	305	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	2014	VNM	Viet Nam	UKR	Ukraine	25	25	25	20	20	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Our main focus is the A,D column as well as the U column (the V column is just a duplicate of the U column) as it tells us which year it is, what country this is from and what is the refugee number. The rest is pruned to simplify the data structure, improving readability, and also enhance the performance in data processing later on. This table has a significant flaw that is it doesn't have the month date respective to the input of the number. To account for the flaw i use another dataset from [HDX](#) namely the “Ukraine Data Explorer - refugees series” table which has precise date record date to it for cross checking

Example:

	A	B
1	RefugeesDate	NoRefugees
2	#affected+date+refu	#affected+refugees
3	25/4/2022	85000
4	27/4/2022	128300
5	3/5/2022	165700
6	9/5/2022	180700
7	18/5/2022	180894
8	19/5/2022	225894
9	21/5/2022	1005894
10	22/5/2022	1068175
11	23/5/2022	1143057
12	24/5/2022	1252598
13	25/5/2022	1509585
14	26/5/2022	1542006
15	29/5/2022	1565693

This table also has its own flaw, it does not have the data from January to April of 2022 so data imputation is required again to fill in. This time it is coming from the [Ukraine government](#)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
45980 Migration Ukraine	Total	Total	Total	Total	Not applicable	Not applicable	Not applicable	Not applicable	Annual	21261																		
45981 Migration Ukraine	Total	Total	Total	Total	Not applicable	Not applicable	Not applicable	Not applicable	Monthly		2272	4269	6142	7907	10223	11274	11655	12713	13954	15473	18875	21261	2282					
45982 Migration Ukraine	Total	Total	Total	Total	Not applicable	Not applicable	Not applicable	Not applicable	Annual	21261																		
45983 Migration Autonomous Rural	Total	Total	Total	Total	Not applicable	Not applicable	Not applicable	Not applicable	Annual																			
45984 Migration Autonomous Urban	Total	Total	Total	Total	Not applicable	Not applicable	Not applicable	Not applicable	Annual																			
45985 Migration Autonomous Total	Female	Female	Female	Female	From 0 to 4 years	Not applicable	Not applicable	Not applicable	Annual																			
45986 Migration Autonomous Total	Female	Female	Female	Female	From 5 to 9 years	Not applicable	Not applicable	Not applicable	Annual																			
45987 Migration Autonomous Total	Female	Female	Female	Female	From 10 to 14 years	Not applicable	Not applicable	Not applicable	Annual																			
45988 Migration Autonomous Total	Female	Female	Female	Female	From 15 to 19 years	Not applicable	Not applicable	Not applicable	Annual																			
45989 Migration Autonomous Total	Female	Female	Female	Female	From 20 to 24 years	Not applicable	Not applicable	Not applicable	Annual																			
45990 Migration Autonomous Total	Female	Female	Female	Female	25-29 years old	Not applicable	Not applicable	Not applicable	Annual																			
45991 Migration Autonomous Total	Female	Female	Female	Female	From 30 to 34 years	Not applicable	Not applicable	Not applicable	Annual																			

In this dataset, they have the migration number in monthly format and from Jan 2021 to Jan 2022. Since it is coming from the Ukraine government, there is no need for proof checking 2021 data and most importantly January of 2022. The only missing data points left is from 24 Feb 2022 (the day Russia start invading) - end of April 2022. According to [CEEOL](#) there are 6,210,526 people migrate from Ukraine in the first two month of the war with 3,626,546 people in the first few day which make March has the number of 2,583,980 and since UNHCR reported roughly 7.7 millions at the end of April, April now has the value of 1,489,474.

That is not the end as we still need to calculate for the rest of the monthly number in “Ukraine Data Explorer - refugees series”. It is quite simple as i only have to take the (latest number of a month - the earliest number of a month) to get the final number of refugees. The final calculated value is then written into 2 separate csv files for more convenience during the line chart coding session which will be talked about more in chapter 4.

```

migration from ukraine 2021-2024.csv
1 month, 2021, 2022, 2023, 2024
2 1, 2272, 22820, 141132, 22400
3 2, 4269, 3626546, 58173, 26987
4 3, 6142, 2583980, 57799, 2737
5 4, 7907, 1589474, 42136,
6 5, 10223, 2866912, 31944,
7 6, 11274, 719742, 25546,
8 7, 11655, 746314, 20964,
9 8, 12713, 739498, 22056,
10 9, 13954, 529892, 18561,
11 10, 15473, 237056, 6402,
12 11, 18875, 116975, 63867,
13 12, 21261, 81661, 64381,

```

```

migration in a different format.csv
1 year, months, value
2 2021, 1, 2272
3 2021, 2, 4269
4 2021, 3, 6142
5 2021, 4, 7907
6 2021, 5, 10223
7 2021, 6, 11274
8 2021, 7, 11655
9 2021, 8, 12713
10 2021, 9, 13954
11 2021, 10, 15473
12 2021, 11, 18875
13 2021, 12, 21261
14 2022, 1, 22820
15 2022, 2, 3626546
16 2022, 3, 2583980
17 2022, 4, 1589474
18 2022, 5, 2866912
19 2022, 6, 719742
20 2022, 7, 746314
21 2022, 8, 739498
22 2022, 9, 529892
23 2022, 10, 237056
24 2022, 11, 116975
25 2022, 12, 81661
26 2023, 1, 141132
27 2023, 2, 58173
28 2023, 3, 57799
29 2023, 4, 42136
30 2023, 5, 31944
31 2023, 6, 25546
32 2023, 7, 20964
33 2023, 8, 22056
34 2023, 9, 18561
35 2023, 10, 6402
36 2023, 11, 63867
37 2023, 12, 64381
38 2024, 1, 22400
39 2024, 2, 26987
40 2024, 3, 2737

```


Geomap

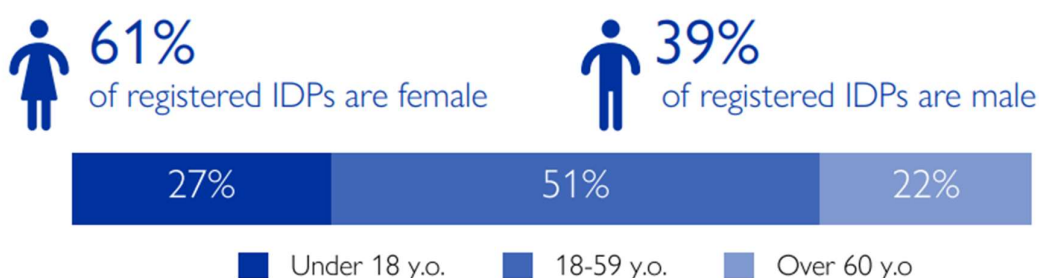
1	Name	Number	23	Italy	169165
2	Albania	7495	24	Kosovo	4245
3	Armenia	605	25	Latvia	47615
4	Austria	84135	26	Liechtenstein	590
5	Azerbaijan	4555	27	Lithuania	41490
6	Belarus	42785	28	Luxembourg	4260
7	Belgium	75030	29	Malta	2435
8	Bosnia and Herzegovina	225	30	Moldova	116855
9	Bulgaria	72775	31	Montenegro	85105
10	Croatia	24525	32	Netherlands	117950
11	Cyprus	17270	33	North Macedonia	18915
12	Czechia	381400	34	Norway	70085
13	Denmark	37530	35	Poland	956635
14	Estonia	38020	36	Portugal	59920
15	Finland	66195	37	Romania	77250
16	France	69465	38	Russia	1212585
17	Georgia	26660	39	Serbia	4245
18	Germany	1139690	40	Slovakia	117265
19	Greece	27365	41	Slovenia	11035
20	Hungary	34250	42	Spain	192390
21	Iceland	4010	43	Sweden	43710
22	Ireland	105210	44	Switzerland	65615
23	Italy	169165	45	Turkiye	41665
			46	United Kingdom	255060

In this geomap, our dataset is quite simple and not complicated for coders. Firstly, we found a lot of sources on google and all of those have a similar number so I decided to choose data from Wikipedia that I think is the most famous page to do research and have a newest update about my project(end of 2023). This table only has two columns that is Name and Number. Name is presented for the name of each country, while number is shown the number of Ukrainian refugees to the EU.

Stacked Bar Chart

This chart is about Ukraine internally displaced persons (IDP), and the most cite report we can find are “REGISTERED IDP AREA BASELINE ASSESSMENT” and “UKRAINE INTERNAL DISPLACEMENT REPORT GENERAL POPULATION”, both are from IOM and are done by round. For our purpose, we choose the use the round that is conduct at the end of 2022 and February 2024(latest). There are multiple section in the reports but what we need is in the Demographic section which is constant in both type of report.

REGISTERED IDP AREA BASELINE ASSESSMENT Round 33:



In the report, IOM recorded 3,413,472 IDP so that make the algorithm used to calculate the exact percentage is $(3,413,472 / 100) * \text{“target”}$.

UKRAINE INTERNAL DISPLACEMENT REPORT GENERAL POPULATION Round 11:

Percentage of Total IDPs	Total	Male	Female
Infants (U1)*	56,000	26,000	30,000
Children U5 (excl. U1)*	301,000	139,000	162,000
Children 5-17	1,149,000	532,000	617,000
Adults 18-59	3,194,000	1,333,000	1,861,000
Elderly (60+)	1,214,000	507,000	707,000
Total	5,914,000	2,537,000	3,377,000

Estimated group size	Total	Male	Female
Infants (U1)*	0.9%	0.4%	0.5%
Children U5 (excl. U1)*	5.1%	2.4%	2.7%
Children 5-17	19.4%	9.0%	10.4%
Adults 18-59	54.0%	22.5%	31.5%
Elderly (60+)	20.6%	8.6%	12.0%
Total	100%	43%	57%

In this report, the only number we have to calculate is the total percentage and recorded number of “Children” category as the report split it into 3 groups.

Finally, the number is put into 2 csv file with the same structure. The type like Child, Adult, Elder is map into 1,2,3 category as Javascript just seem to read it better than text format. The same goes for gender with Male and Female are map to 1 and 2.

age_group.csv:

```
1  year,1,2,3
2  2022,1205000,3194000,1214000
3  2024,921637,1740871,750964
```

gender.csv:

```
1  year,1,2
2  2022,2398000,3215000
3  2024,1331254,2082218
```

CHAPTER 3: REQUIREMENT

3.1 Must-Have Features

There are a few features that we consider to be very important to give the reader an easier time understanding of what the chart is for. These features include:

- Interactive visualization:
 - a) Hover effect: With hover effect, user can see the detail in which a point on the map or a section of a chart represent.
 - b) Zoom in: This effect allow the user to see the timeline closer especially in line chart or area chart
 - c) Clickable: Point on the map or sections of the chart may be clickable and would lead to a sub html page with smaller chart or found report representing that point or section
- Additional information:

- a) Label: This is a must be to help the reader quickly identify What the reader is seeing.
- Color: data can be categorize in dozens of type and column, the contrast between color can make some important element to shine through and get to the reader.

3.2 Optional Features

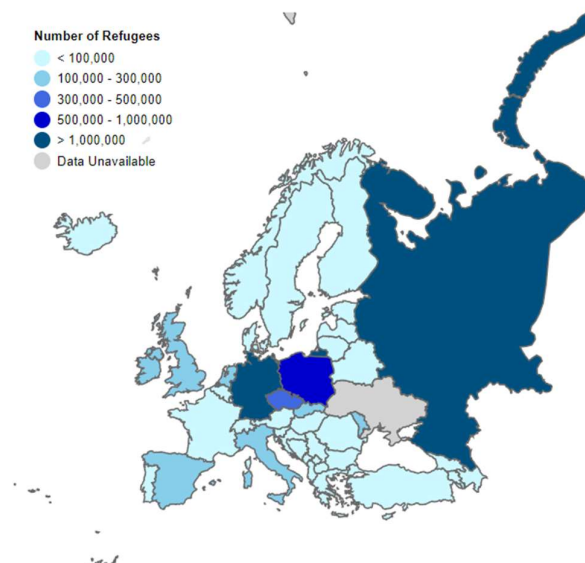
- d) Tooltip: in the first design, sub pages would be use to give a more detail view on the points or section of the data but if we use tool tip, there would need to be a sub page and therefore maintaining the page integrity would be easier but at the same time tooltip is relatively hard to implement effectively and easily in my experience.
- e) Guide: There should be a guide either by a button or render out next to the chart to give the reader an easier time indentify each section.

CHAPTER 4: VISUALIZATION DESIGN

The final version of our visualization can be access through Mercury : [Mercury](#) or through our Github repository: [GitHub](#)

Since the early stage of the visualisation design process, we aim to provide a simple, yet interactive and/or intuitive layout that would suit our targeted audiences which is the general public and not for experts.

4.1 Geomap



In this part, we decide to make a geomap that shows how many Ukrainian refugees are in the EU. For the concept, we try to make the EU map for the first look by using the europe.json file that we found on google. Secondly, we try to combine between the database and the colour of the map as a picture below. Finally, we add some functions to help viewers understand more about the geomap. For example, when viewers hover on each country, it will show the number of Ukrainian refugees to this country and it also changes the colour.

Conclusion:

Step 1: create a EU map

Step 2: link dataset with the map

Step 4: link color value to number of refugee in the dataset

Step 5: link them both to the map

Step 6: check and debug the final result

4.2 Line Chart

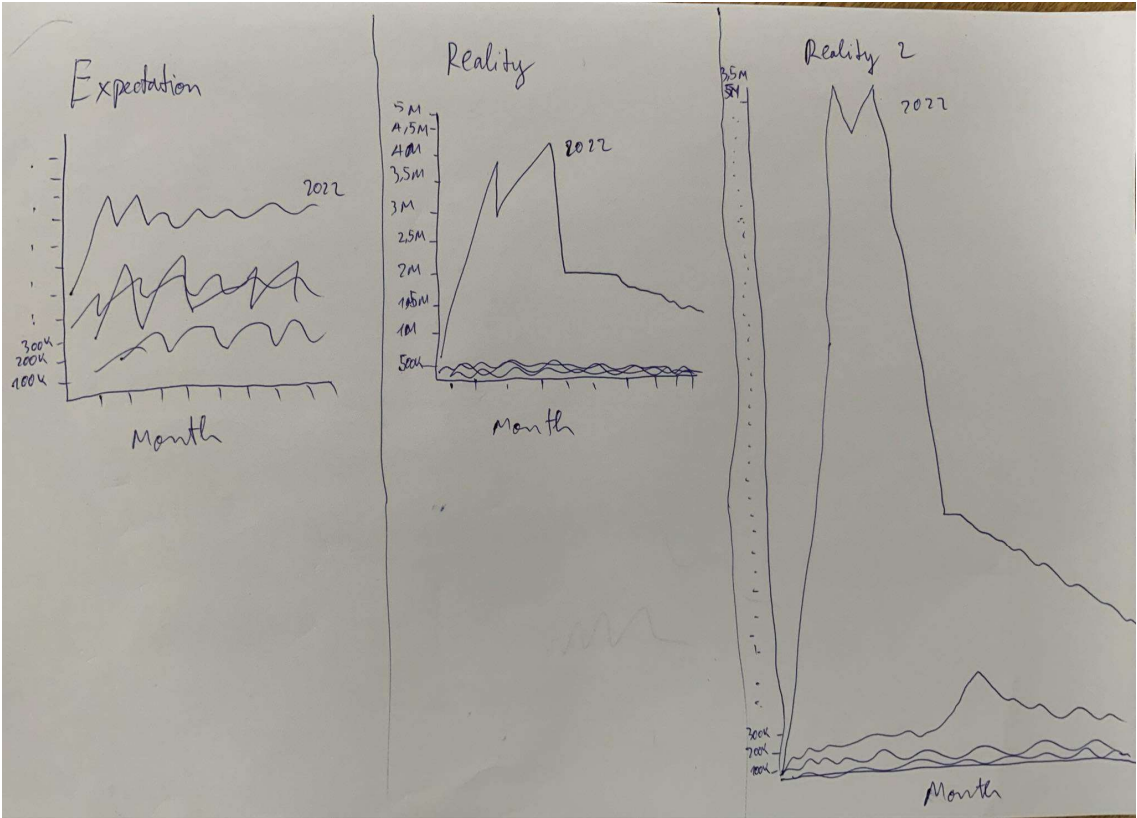
The general idea of this line chart visualization is to reveal the trend of migration from Ukraine to countries in Europe territory, viewer should be able to view different line representing different year, particularly 2021,2022,2023 and 2024. The general design is consist of:

- X-axis for month or year
- Y-axis for the value of each datapoint that mek up the line
- Line: Same color when group in one chart and the line of 2022 is a different color since that is the year Russia start the invasion
- Tooltip: the tooltip will follow viewer cursor and display the information of the closest datapoint. What display is consist of what time of the year it is or what month this is as well as the data value correspond with that datapoint

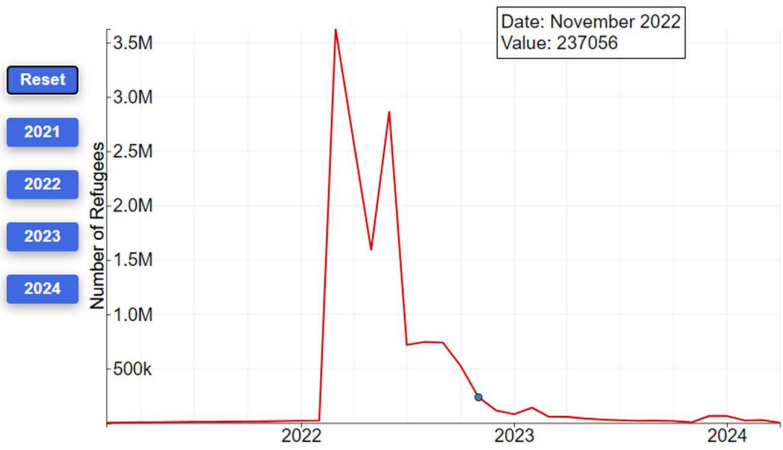
In the early stage of designing the line chart, i expected the line to be beautifully intertwined with each other, different color for different year and hover effect which will fade out everything else except for the line in which the viewer are hovering over. The idea was there but the expectation was too high as in reality, the data for 2022 has massive number that straight up put the datapoint of other years clustering together at the bottom of the chart. Another variation was tried that would stretch the y axis out to accommodate the massive size of 2022 value but it end up longer than the screen size or if we scale it down, it would be too

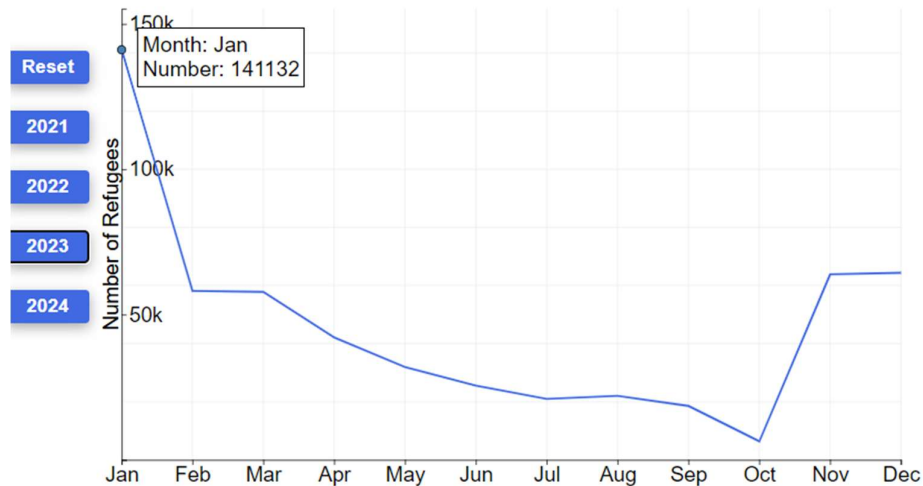
small to see the details as well as having little to show for nearly 90% of the chart .

This is what it would look like if the line chart was to visualized with separate line for separate years on the same canvas:



In the end, i decide to split the chart into 5 different line chart that would be view through pressing buttons , the button will delete everything of the previous chat except for the container drawn since it is constant and then draw the new chart in it. We still have one chart to show the whole period since 2021 but this time it is drawn on one chart and the axis is scale down tremendously. Here are some examples:

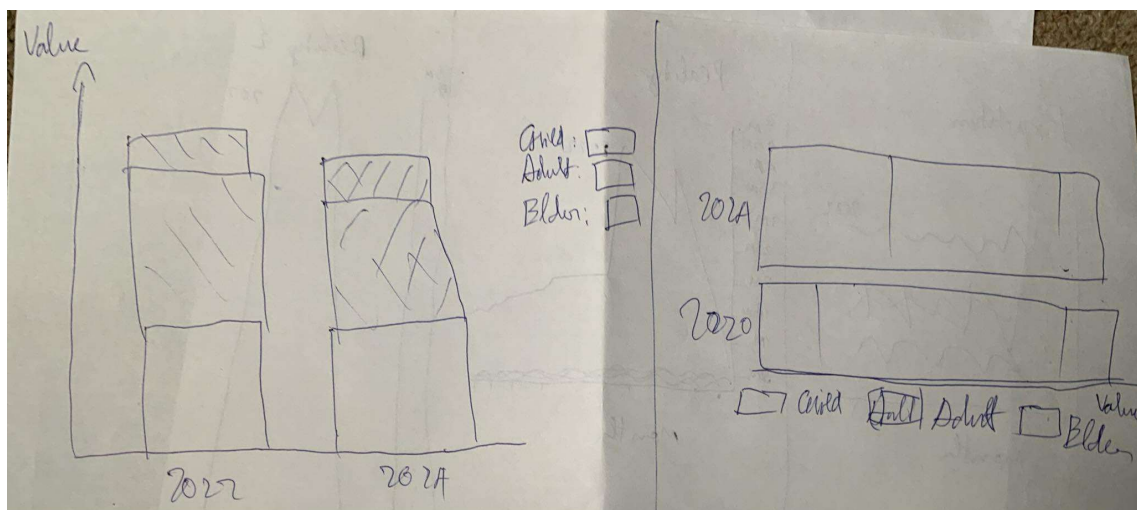




4.3 Stacked Bar Chart

The idea for this chart is very straightforward, we want to compare the IDP Demographic in 2022 with 2024 to see if it has decreased and what is the ratio between age group and gender. We have 2 variations to consider, one being vertical bar and the other horizontal. The vertical was ok to be honest but it has a lot of space that needs to be improved. One of which is that there are only 2 bars total so making them stand vertical would risk having too much space wasted and if we make them get closer together then it would just look very cramped and unpleasant. The solution to most of the problem is making a horizontal bar chart instead, this way less space would be wasted since they got close together vertically but horizontally they still take a lot of space. Furthermore, the y-axis is virtually invisible yet viewers can tell which bar is 2022 and 2024.

Here is the sketch:



For the official design, I chose a color scheme that is bright and distinguishable, blue and green have a vulnerability for potential colorblind people so I chose a lighter shade of green

and since there are 3 categories i can put orange in between blue and green to further drive the contrast up as well as the chart distinctability. The other stacked bar chart is vastly different as it is depicting Male and Female. Luckily, i dont have to think too much about the color scheme since the color blue for male and light pink for female have already been recognize to be the official colors for the two gender.



CHAPTER 5: VALIDATION

1. How easy was it to understand the information presented in the line chart

Name	1	2	3	4	5
Huy					x
Tuấn Đức					x
Mai Hạnh					x
Khôi					x
Sơn					x

2. How would you rate the visual design of the map in terms of its color choices and layout?

Name	1	2	3	4	5
Huy					x
Tuấn Đức					x
Mai Hạnh				x	
Khôi					x
Sơn				x	

3. How would you rate the interactivity level overall

Name	1	2	3	4	5
Huy				x	
Tuấn Đức					x
Mai Hạnh				x	
Khôi					x
Sơn					x

4. How did the color choices across the charts affect your ability to interpret the data quickly?

Name	Answer
Huy	Easily distinguishable
Tuấn Đức	good
Mai Hạnh	Pretty good
Khôi	Easy enough
Sơn	ok

5. Were there any elements in the charts that you found distracting or unnecessary?

Name	Answer
Huy	X-axis value of stacked bar chart look unintuitive
Tuấn Đức	The year in paragraph need to be more clear (bold font)
Mai Hạnh	Preferably something less bright for map hovering effect
Khôi	Spacing issue in button and y axis of line chart
Sơn	Spacing issue in button and y axis of line chart

CHAPTER 6: CONCLUSION

Since the invasion of Russia in Ukraine on the 24 of February 2022, migration from Ukraine to European countries and Ukraine internal displacement numbers have been higher than ever, especially in the first two months of the invasion. The migrant number experienced a downward trend after about a few after the invasion started

To present the phenomena above, we collected, extracted and analyzed corresponding datasets and visualized them into 3 distinct kinds of chart. We use line chart to illustrate the trend of migration from Ukraine to European countries in 5 different time periods which are 2021-2024 and each year of that period separately. Geomap is deployed to give viewer a better insight on how many refugee there are in each European countries. Additionally, we made a horizontal stacked bar chart to showcase the percentage of Ukraine IDP Demographic, particularly age group and gender. Finally, a good visualization rarely stand apart and for that we also include text explanation with story telling sprinkled on top of it right beside each chart, map for better understanding of what we are trying to present.

We also make a basic survey to find out how the general public view of our visualization. Some of the people that took the survey are business analysis students and some are IT students. Results were pretty good but clearly there are space to improve though they specified this is more of just their preference.

Overall, we have gain valuable experience in designing and doing a visualization project. It has enhanced our analytical and technical skills, teaching us the importance of transforming data into compelling visuals.

REFERENCE

- Europe - mixed migration flows to Europe, yearly overview (2023)*. Europe - Mixed Migration Flows to Europe, Yearly Overview (2023) | Displacement Tracking Matrix. (n.d.). <https://dtm.iom.int/datasets/europe-mixed-migration-flows-europe-yearly-overview-2023>
- Filipchuk, L., Lomonosova, N., Syrbu, O., & Kabanets, Y. (2022, May 4). *Forced migration and the war in Ukraine (February 24 - March 24, 2022)*. Cedos. <https://cedos.org.ua/en/researches/forced-migration-and-the-war-in-ukraine-february-24-march-24/>
- Koroutchev, R. (n.d.). *UKRAINIAN MIGRATION DURING THE FIRST YEAR AFTER THE BEGINNING OF THE RUSSIAN ARMED CONFLICT IN 2022*UKRAINIAN MIGRATION DURING THE FIRST YEAR AFTER THE BEGINNING OF THE RUSSIAN ARMED CONFLICT IN 2022. PDF Viewer. <https://www.cceol.com/search/viewpdf?id=1207439>
- Statistics explained*. Statistics Explained. (n.d.). https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Temporary_protection_for_persons_fleeing_Ukraine_-_monthly_statistics
- Ukraine - internal displacement report - General Population Survey Round 11 (25 November - 5 December 2022)*. Ukraine - Internal Displacement Report - General Population Survey Round 11 (25 November - 5 December 2022) | Displacement Tracking Matrix. (n.d.). <https://dtm.iom.int/reports/ukraine-internal-displacement-report-general-population-survey-round-11-25-november-5>
- Ukraine - area baseline assessment (raion level) - round 33 (February 2024)*. Ukraine - Area Baseline Assessment (Raion Level) - Round 33 (February 2024) | Displacement Tracking Matrix. (n.d.). <https://dtm.iom.int/reports/ukraine-area-baseline-assessment-raion-level-round-33-february-2024>
- Situation Ukraine refugee situation*. UNHCR Data Portal. (n.d.). <https://data.unhcr.org/en/situations/ukraine>
- Home*. Humanitarian Data Exchange. (n.d.). <https://data.humdata.org/dataset/ukraine-data-explorer-inputs>
- International Migrant Stock 2020. (n.d.). https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/files/documents/2021/Jan/undesapd_2020_international_migrant_stock_documentation.pdf
- Canton, H. (2021). United Nations Relief and Works Agency for Palestine Refugees in the Near East—UNRWA. In *The Europa Directory of International Organizations 2021* (pp. 286-289). Routledge.