Snowfall in Copenhagen Visualized

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My background

I'm a second year (soon to be third) student studying Software Development, so I have a relatively comprehensive coding experience. I have also coded in High School, so I also have some basic experience from this.

I have not, before this course, had any real experience with data visualizations generally, and especially not creative ones.

I chose to do the project alone.

Topic choice

For multiple years, I remember that I as a child did not see as much snow in my birth town Copenhagen, as I have seen pictures of, and seen pictures of as a child. From this I wanted to see if this perhaps could have a correlation between temperatures, and generally if my impression that the amount of snow has declined in the last years, is correct.

Therefore, I chose Topic 2: the Forecast.

So, from this, I chose to research the topic:

"The decline in the amount of snow fall in Copenhagen"

I think the interesting thing to explore this topic is the years compared to each other and make the user able to draw their conclusions from this data.

I think that it would be interesting to both snow and lower temperatures to see its correlation to each other.

From my research I found that DMI has snow data for Denmark, from 2011 to the present day, and data from the lowest, highest, and middle temperatures for Denmark. Therefore, I chose to use this data for my visualization.

So, at last I came to the final conclusion the project should be summed up in one sentence:

"Within the topic of decline in snow fall, our project focuses on decline in snowfall in Copenhagen, and exploring if temperature has a correlation to this."

Audience, context and function

My goal for my audience's experience is for them to explore and learn, and make themselves explore and draw their conclusions from the data. This data being the amount of snow in the last years, and if this could have something to do with the rise of temperatures in the last years.

The target audience of my visualization would usually be residents in Copenhagen, who are curious about this decline in snow the last years, or other people in Denmark unaware of the decline. A secondary target could be people exploring the effects of temperature to the amount of snowfall in the whole world.

The audience would experience the data visualization in the context of exploring changing snowfall patterns over recent years, particularly in Copenhagen. It could be in the context in settings such as local community discussions, educational environments, or online platforms focused on climate and environmental changes.

Therefore due to the audience need to explore the data, the context/platform for this data I chose to be a website, that can be interacted with.

I wanted to make sure that this data would be exploratory for the users, like it is for me, so they can themselves can see the correlations between snowfall and temperature, in the different years, and if these patterns have changed.

So therefore this is primarily focused on the second function (from the design brief)

2. *Provide an interface to data in order to facilitate visual exploration*

Design principles and inspiration

The data that has been gathered is quantitative, due to it being numerical measurements of the amount of snow and the lowest temperatures over the years. If we then refer to the visualization from the lectures(put in appendix 1), we can see that the encoding forms that work best for these data are position/placement, text labels, length, size/area, angle and pattern density. These considerations I used to inspire me later in the sketching process, to make sure that the data would not be lost in the visualization.

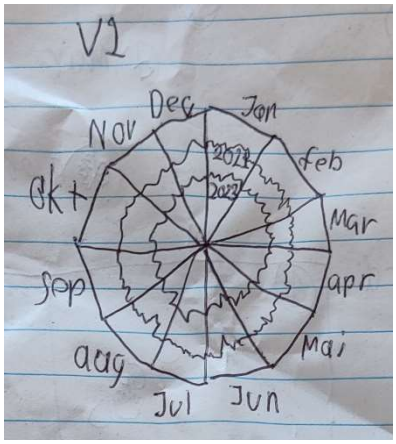
The amount of snow and lowest temperature are both continuous data types. It is continuous data because Continuous data can take any value within a range and is typically measured on a scale. (e.g., 0 to 100 cm of snow, or -10°C to 20°C).

If I wanted to integrate more data types in the visualization, I would probably have used something like "What did I think of the amount of snowfall, this year". This data would be Ordinal, due to it being a set of values that can be ordered but are not necessarily exact intervals between each other.

I have taken inspiration from the Weather Radials from http://weather-radials.com/ , because they also show a whole year, in one figure, and showing both the low temperature, high temperature, mean temperature, and even rainfall at once. This inspired me to research more into how the temperature data is communicated, here by positioning, and the color for the mean temperature.

Design process' sketches, research, reflection

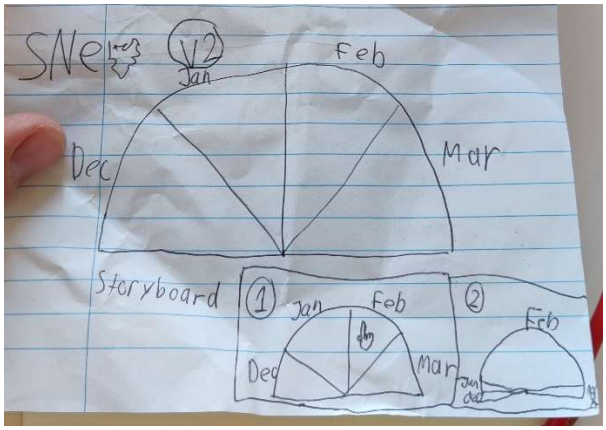
To reflect on how to pass on my message, I made some sketches with different designs to see which would be the best fitting:

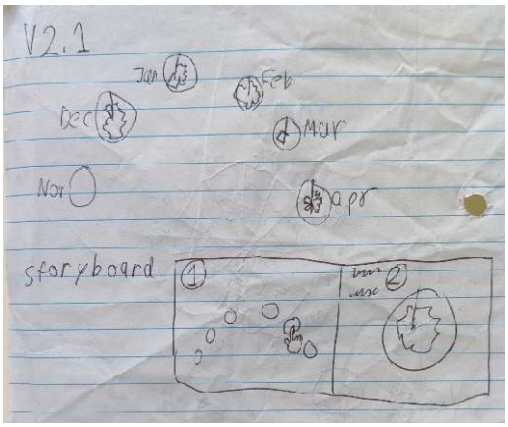


Version 1

Here in version 1, I wanted to show the amount of snow in a circle, where each line would be the different years.
However, this had many downsides, like the fact that temperature was not currently a part of the visualization.(Could have probably been implemented by color instead.) and another bad reason is that it does not snow the whole year in Denmark, so there would be no reason for plotting the summer months.

Version 2 and 2.1





Version 2, tried to tackle the problem in v1, where there were months that it didn't snow, that was still plotted. In the bottom of v2, a storyboard has been made to show the feature of clicking a month, that would then expand and show more details in that month.

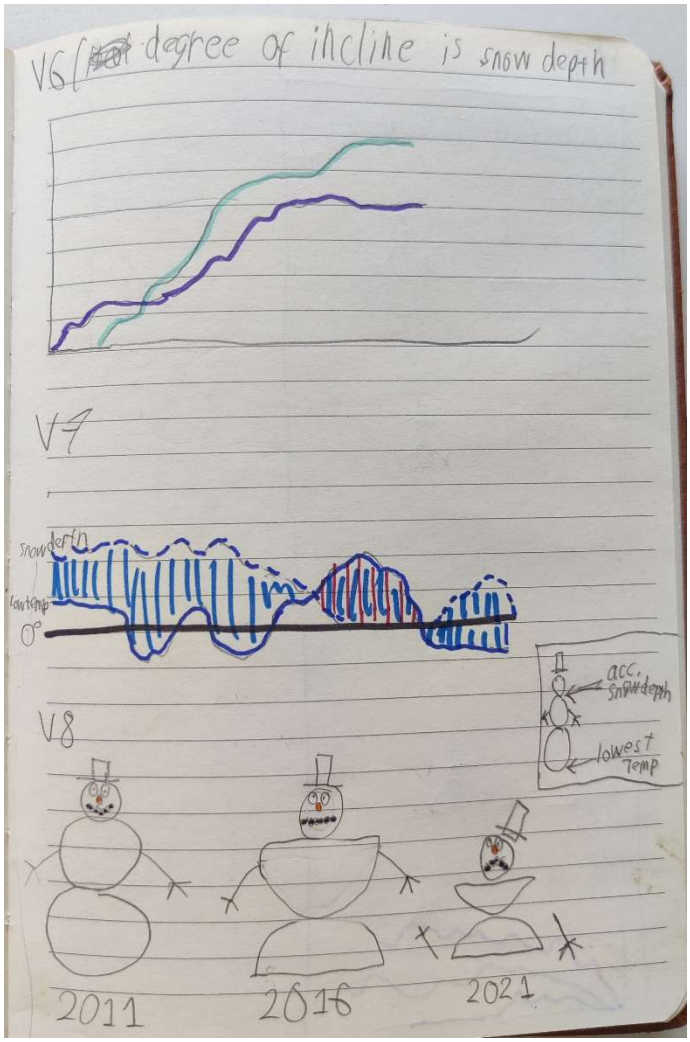
Version 2.1 was a new version of v2, where each circle would be a month , and again a month should be clickable to show more details. This visualization would be good to quickly get an overview of each month, with the amount of snowfall.

Version 3, Version 4, Version 5

Version 3 was a map that was made to show the amount of snowfall(visualized by snowflakes) on a given day, and then there should be some kind of animation that goes between years and sees the difference.(This has been put in appendix 3)

Version 4 and Version 5 were some simple plots of data in a diagram. Version 4 was chosen to be with snowflakes as the measuring data points, where the size then would vary depending on the amount of snow for that day.(These have been put in appendix 3)

Personally, I found these visualizations to be a little too boring to continue with.



Version 6, Version 7

In version 6 and Version 7, I played around creating graphs to show the amount of snowfall.

In version 6, the degree of incline would be the snow depth on a specific day, so the x-axis would be time, and the different colors would be the different years.

Even though angle was one of the magnitude channels that are okay for showing data, and angle is also good for showing quantitative data (Appendix 1 and 2), I think that most of the data is lost/ hard to read in this visualization.

Version 7 was a version where I tried more to plot both temperature and snow at the same time (dotted line is amount of snow, and full line is temperature). The x-axis is time, and the area between the lines would be either colored blue, if there was more snowfall than the temperature in Celsius, or red, if the temperature was higher than the amount of snowfall.

Version 8

Version 8, was thinking of a more creative way to display this data, using snowmen, to stay in the theme of snowfall.

On the legend in the top right, you can see that the middle snowball shows the accumulated snowdepth of a year, and bottom snowball shows the lowest temperature reached. So the bigger the middle snowball is, the more snow has fallen that year, and vice versa.

I think this visualization would be great if my target audience was younger kids, to pass on this message graphically. Also note that the face is getting “sad” the smaller the snowballs are.

Two website ideas

Another idea that was explored was to make a website that would be scrolled through and tell a message from that. For this I made 2 sketches, that can be found in Appendix 5.

The first website used version 3 and version 2, to first show the decline in snowfall via version 3, and then the user would be able to explore into details via version 2.

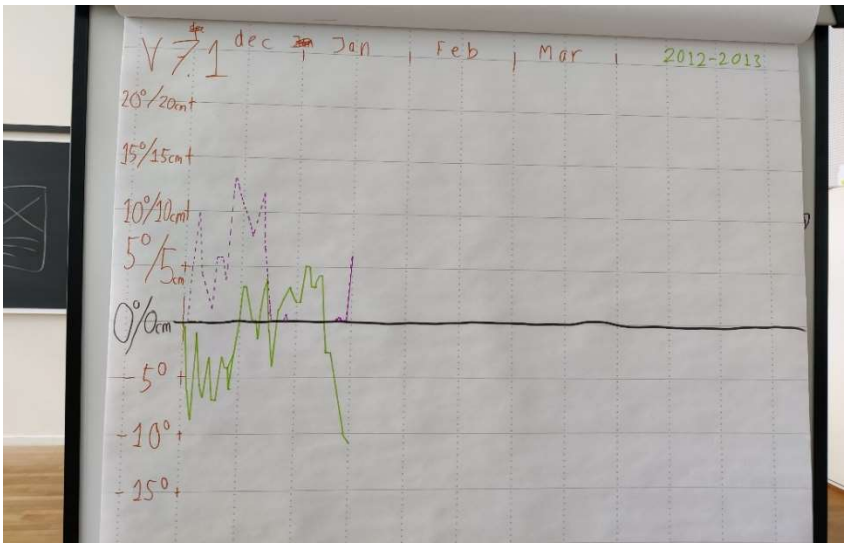
The second website used version 6 and version 8, where each year would be first explored with the graph from version 6, and the snowman from version 8, and at last all the graphs would be put together into one graph, to compare the years to each other.

Produced visualization prototype(s)

I chose to take two versions of my sketches (version 2 and version 7), and try to plot some data on it, to make a visualization prototype, to look how data would form in it.

The reason that I chose these was both the artistic visualizations of these, and because it uses the magnitude channel that has the most effectiveness, that is “position on common scale”, and it uses the “color hue” to separate the years, which also is a very effective way of communicating data. (The channels can be found in appendix 2.)

Version 1.0

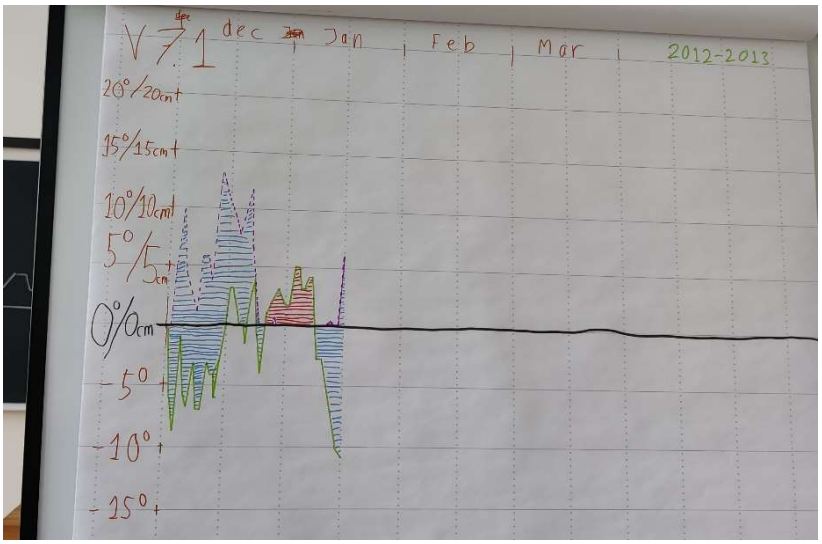


Here the snow and lower temperature is plotted from winter 2012-2013 from December to mid-January. From this data the dotted purple line is the amount of snow on the given day, and the green line is the lower temperature of the day.

The problem with this version and the next version is the black line going at 0, hides the purple line, when the snow is at 0 cm high.

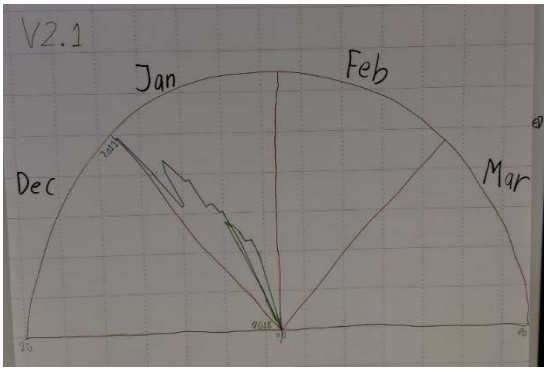
Already here we can see that in about end December(noted by the top axis) the temperature is over 0, and therefore also no amount of snowfall.

Version 1.1



To make sure the point mentioned above about it being hard (nearly impossible) for snow to fall when the temperature is above 0, I wanted to see if I could add colors to get this point across. The colors chosen were blue and red, with the point being blue is where the amount of snow is higher than the number of degrees, and red is where the lower temperature is higher than the amount of cm’s of snow. This should get the point across that Blue is good, and red is bad, regarding the amount of snow. This did however make the data harder to read, because it is harder to differentiate the snow dotted line, and the solid temperature line. It was, however, more artistic, and got another point across.

Version 2.0



To test out if the version 2 sketch would work, I tried to plot the amount of snowfall of January of the years 2011 and 2016.

When looking at the graph, I thought that there was a lot of data lost when getting closer to the middle, because of how little of an angle each day should move. If it should be made again, I would have probably made the middle part not used, and but the outer part still 20, so zero would instead be at a circle that is half the diameter of the circle.

Another reflection I later made was that there could have been a merger of this version and Version 1.1(just above), where each year got its own slice of the half-circle. So, the outer circle graph would be 2011- and the inner circle graph would be 2022.

Version 1.0.0

When programming version 1, I quickly discovered that there was way too many lines too navigate in it, and see specific years, therefore I Chose to implement a .hover feature where if you hover over a graph, it fades out the other graphs, and also made buttons on top with each year, where the user then can compare x amount of specific years with each other, and hiding other years. Before implementing this feature, I sketched out how this would work, which can be found in appendix 6.

From this it was also implemented that if no years are marked, then all years are shown. Another feature added in this version was that there in the bottom right are examples of data, that can be shown when clicked, like: “Lowest temperature measured on a day” or “Years with most and least amount of snow”.

A last feature also added, was an invisible line behind all lines, to make hovering easier. Also the snow lines colors, and the temperature lines were made the same color, to adhere to the gestalt principles about Similarity of color. This was also important now that the lines don’t necessarily adhere to the principle about proximity.

Final reflections and future expansions

I chose to plot the winters from 2011-2012, to winter 2022-2023. These were chosen trying to limit the amount of data, so it would not be too much data. If I wanted to use the red and blue area, from prototype version 1.0, I would have probably tried to make them appear on hover, however this would hide the other data, if you were trying to compare two years.

As some final reflections, I would say that this project helped me understand more about making data for a specific user, and how to make this huge amount of data readable, but not unmanageable. I also very much enjoyed making the visualization as exploratory as possible, to make sure the end user could navigate the project and data.

As some future expansions I would like to add more smooth lines, so the visuals would look more visually pleasing. This would probably also better the Run time of the program A lot, because it then would be one solid line that is shown on hover, and not multiple small lines.(Currently about 420 small lines are shown for each year). Other than that, the lines could have been smoothened out more, I am satisfied with the visuals

of my program, and think that this project can help people explore the topic of decline in snow fall in Copenhagen.

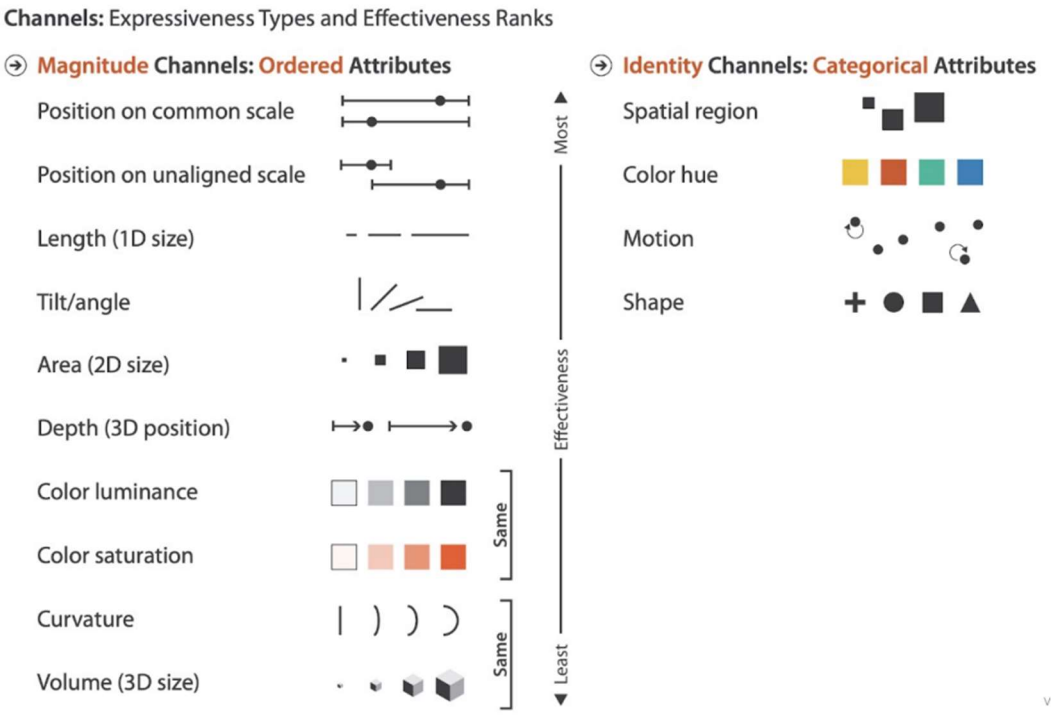
My visualization has also been uploaded to a website, so it can be found online. The website is https://casper2411.github.io/

Appendix

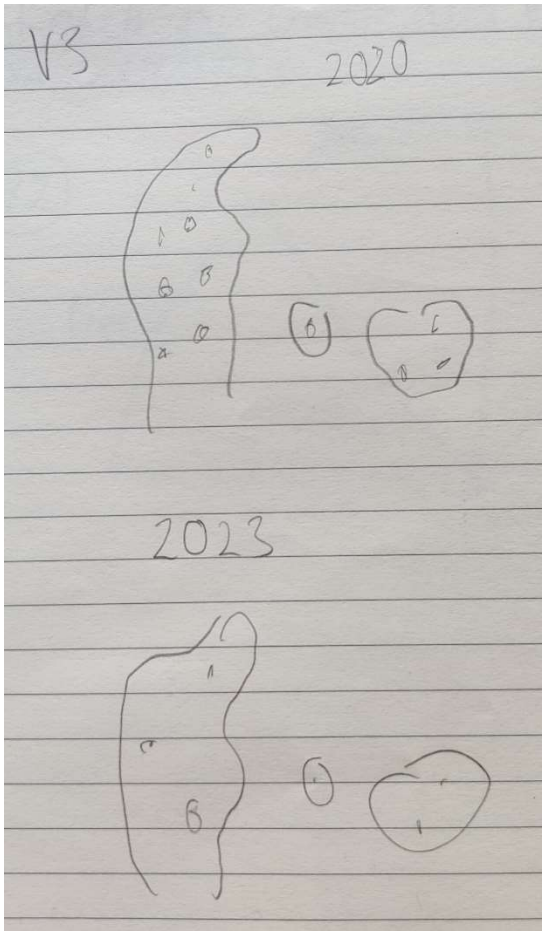
Appendix 1

Example	Encoding	Ordered	Useful values	Quantitative	Ordinal	Categorical	Relational
	position, placement	yes	infinite	Good	Good	Good	Good
1, 2, 3; A, B, C	text labels	optional alpha or num	infinite	Good	Good	Good	Good
	length	yes	many	Good	Good		
	size, area	yes	many	Good	Good		
	angle	yes	medium	Good	Good		
	pattern density	yes	few	Good	Good		
	weight, boldness	yes	few		Good		
	saturation, brightness	yes	few		Good		
	color	no	few (<20)			Good	
	shape, icon	no	medium			Good	
	pattern texture	no	medium			Good	
	enclosure, connection	no	infinite			Good	Good
	line pattern	no	few				Good
	line endings	no	few				Good
	line weight	yes	few		Good		

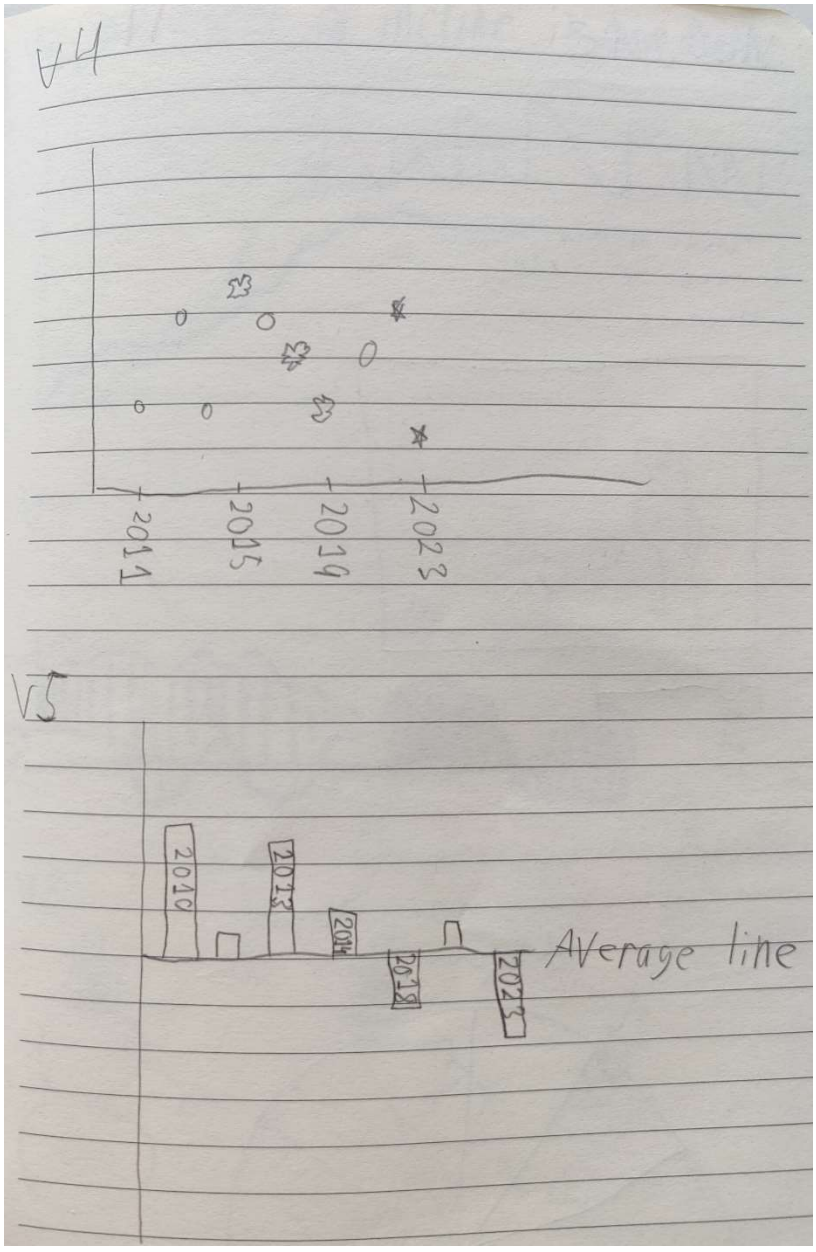
Appendix 2



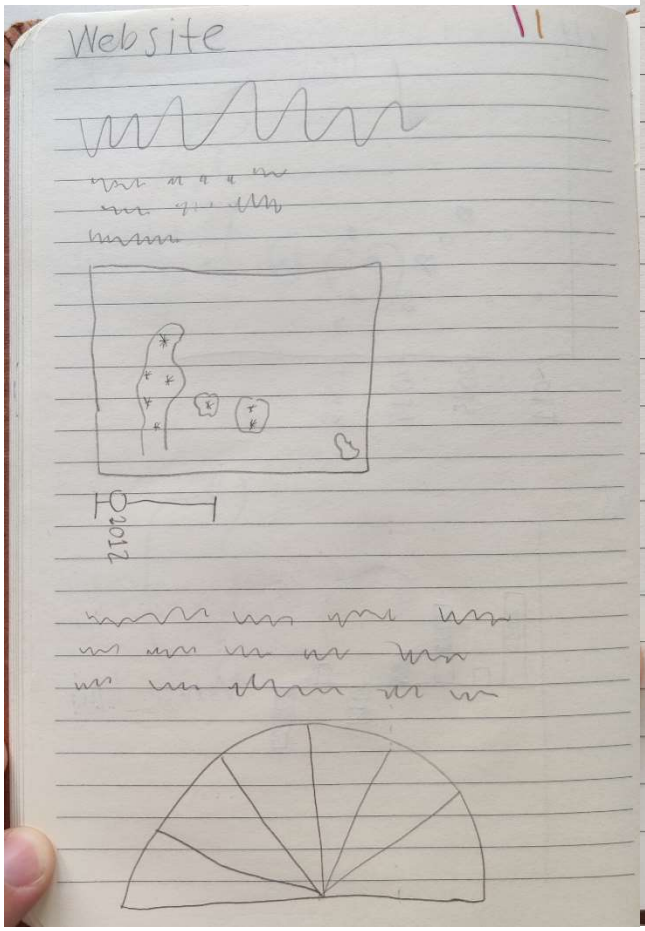
Appendix 3

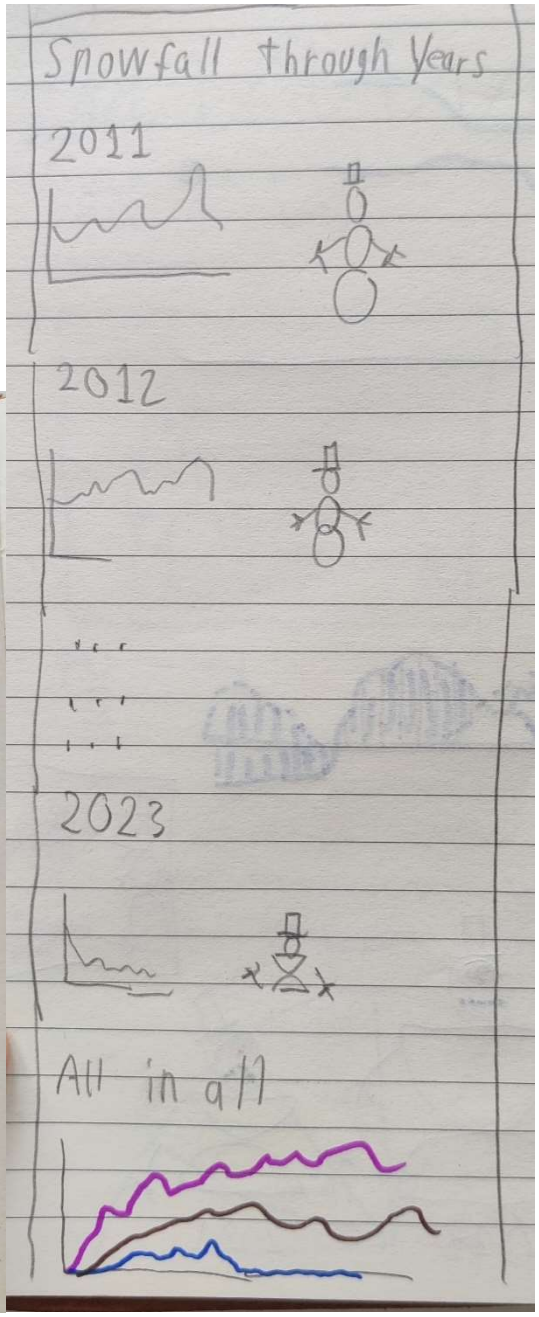


Appendix 4



Appendix 5


Website
2012


Snowfall through Years
2011
2012
2023
All in all

Appendix 6

Storyboard: