DECLARATION: I understand that this is an **individual** assessment and that collaboration is not permitted. I have read and I understand the plagiarism provisions in the General Regulations of the University Calendar for the current year, found at http://www.tcd.ie/calendar. I understand that by returning this declaration with my work, I am agreeing with the above statement.

1 Part A: Graphics Fundamentals – Minard's Map of Napolean's Russia Campaign

This project implements a visual representation of the French Army's losses during Napoleon's Russian Campaign of 1812-1813. Inspired by Charles Minard's famous map, the project uses a custom dataset (minard-data.csv) and Processing to generate a visual that overlays troop movements on a geographic map of Russia, displaying both the attack and retreat routes of Napoleon's forces. Additionally, the project incorporates a temperature curve, reflecting the extreme weather conditions the army faced, with dates and temperature readings matched to the army's geographical positions.

Visualization Details:

1. Troop Movements: The orange paths represent the army's advance, while the black paths indicate their retreat. Each path's thickness corresponds to the size of the surviving troops at each stage of the journey, visually demonstrating the massive losses incurred.
2. Cities and Geographic Landmarks: Major cities and landmarks encountered by the army are marked with labeled circles, providing context to the army's route.
3. Temperature Graph: Below the map, a temperature curve is drawn to visualize the freezing temperatures the army faced during the retreat. Temperature readings are displayed in red at each significant point, with labels for the corresponding dates. The extreme cold is further highlighted by lines connecting the temperature data to the corresponding points on the army's path, showing the simultaneous decline in both temperature and troop numbers.

Code Implementation

1. The drawTroop() function handles the drawing of both the attacking and retreating army paths, with dynamically adjusted rectangle heights to represent troop numbers.
2. drawCity() marks the significant cities and places encountered by the army, based on their coordinates in the dataset
3. The tempCurve() function is responsible for drawing the temperature curve, with each temperature point connected to the army's path at corresponding longitudes.

The output is a detailed and visually informative map that combines the geographic journey of the army with a depiction of their dwindling numbers and the harsh conditions that contributed to their losses.

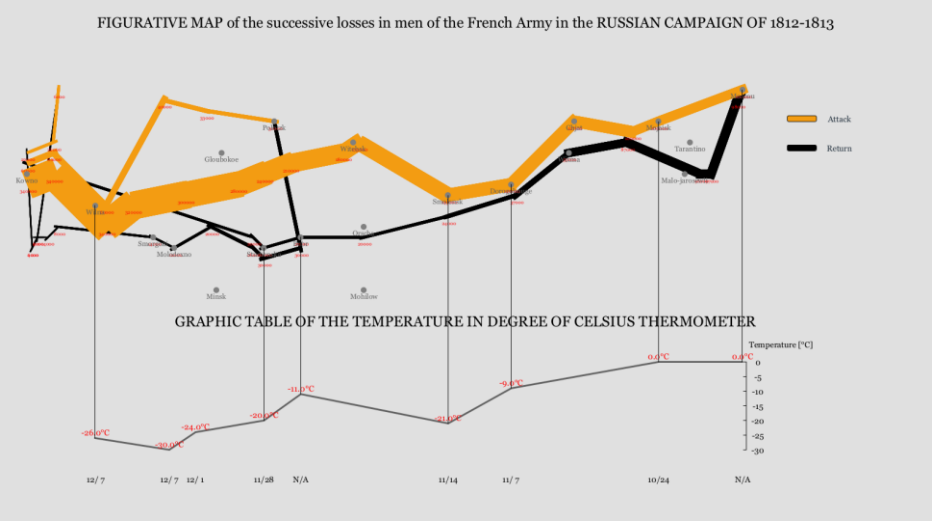


Figure 1: Visualization of Napoleon's Russia Campaign using Minard's Map

2 Part B: Visual Encoding Channels

Part A of this project first of all implements three distinct data visualizations that depict the correlation between GDP per capita (wealth) and life expectancy (health) for various countries in the year 2002.

The key challenge was to represent the quantitative attribute population through three different visual encoding channels while maintaining consistent representation for GDP and life expectancy across all charts.

The three visualizations (charts) each explore different ways of expressing population size, creating opportunities for varying interpretations of the dataset. The chosen design choices and encoding channels were:

Chart 1: Population as Circle Size

In the first chart, the population is encoded through circle size. Larger populations are represented by bigger circles, while smaller populations are indicated by smaller circles. This makes it easy to identify which countries have large or small populations at a glance.

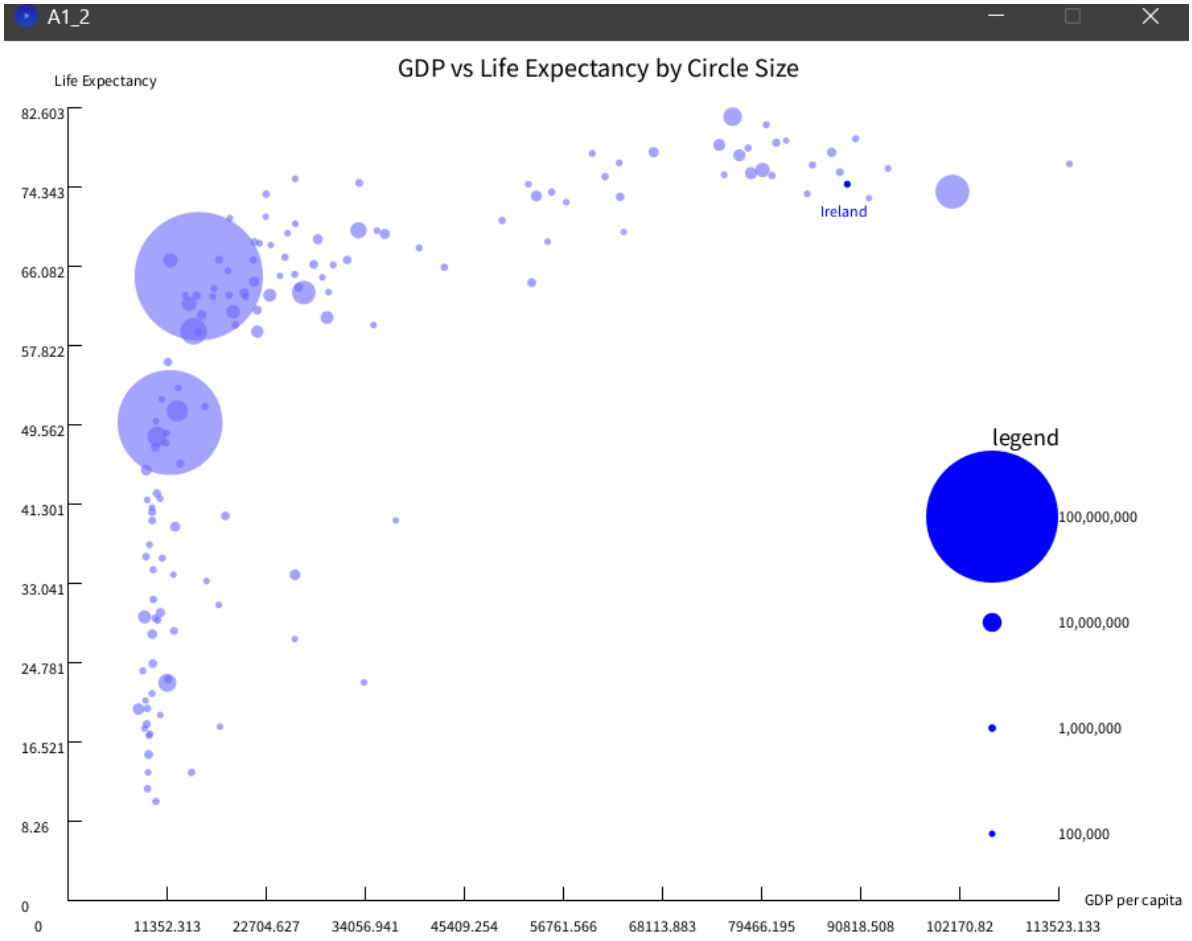


Chart 2: Population as Color Brightness

In the second chart, I encoded population size using color brightness, with darker shades representing larger populations and lighter shades for smaller populations. The key advantage of this approach is that it keeps all data points the same size, reducing any bias that may come from the varying visual importance of circle sizes.

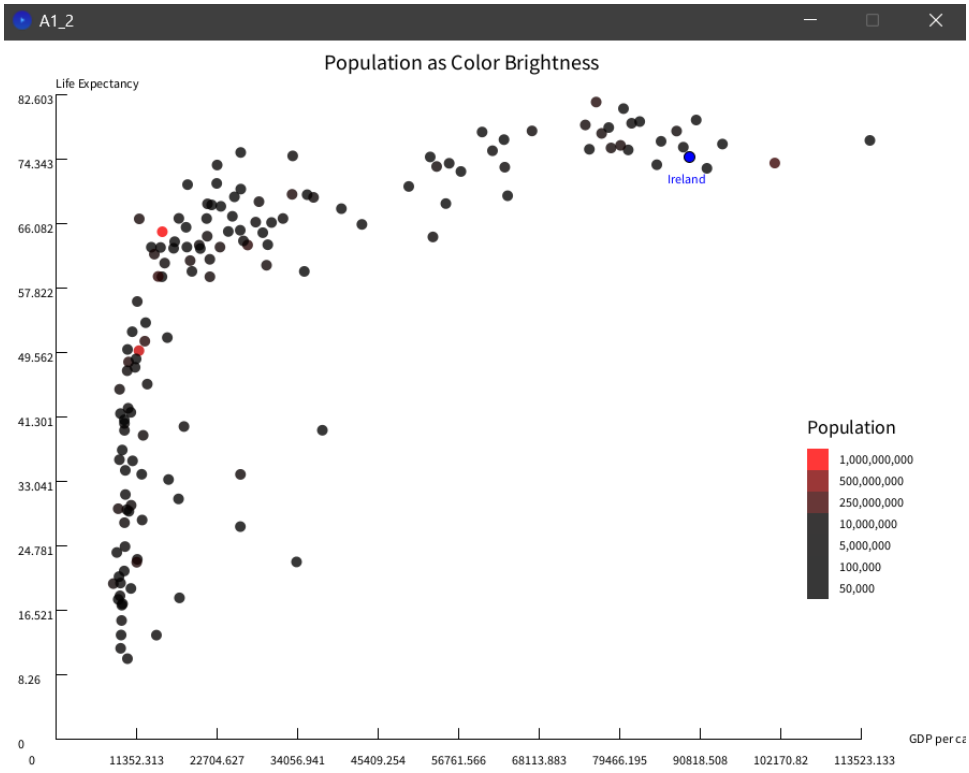
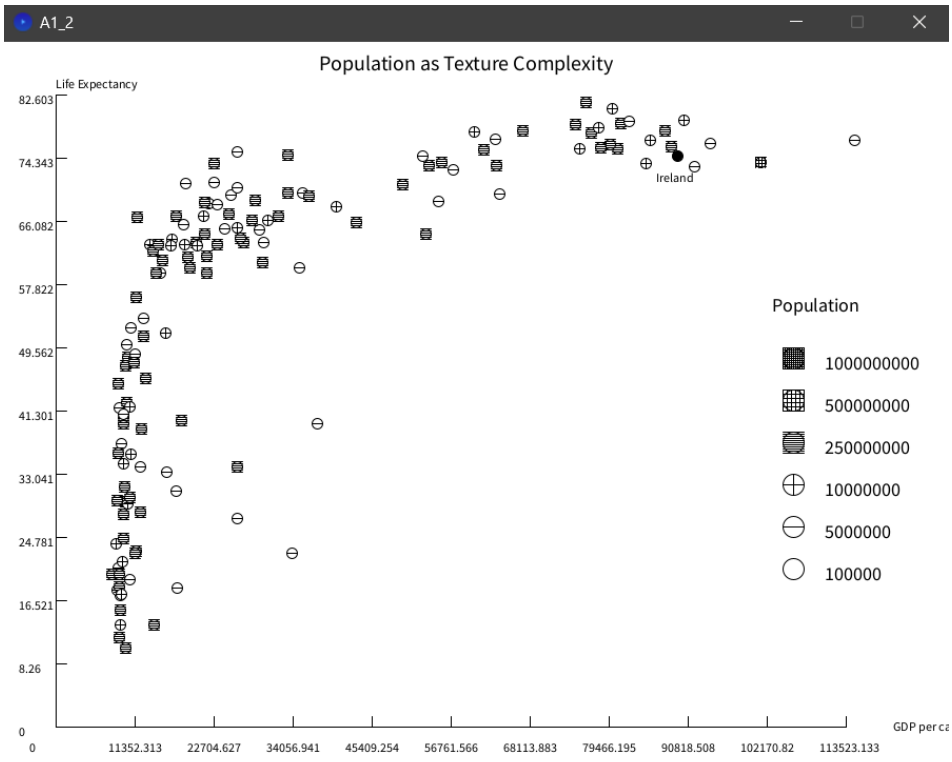


Chart 3: Population as Texture Complexity

In the final chart, texture complexity was used to represent population, with increasingly intricate textures as population size increases. Simpler shapes (a plain circle) represent small populations, while more complex textures (such as intersecting lines) indicate larger populations. This technique introduces an additional layer of visual encoding that can convey information without altering color or size.



Part B of this project secondly implements visualization for the evolution of life expectancy over the years from 1957 to 2007. The goal was to explore various visual encoding channels to express different aspects of the data, with a focus on showing the life expectancy trends across continents while ensuring that Ireland was distinguishable from other countries.

The three visualizations (charts) each explore different ways of expressing evolution of life expectancy over the years, creating opportunities for varying interpretations of the dataset. The chosen design choices and encoding channels were:

Chart 4: Color Encoding

The first variant employed color as the encoding channel to distinguish between continents. I assigned specific colors to each continent:

Europe: Red, Asia: Green, Africa: Blue, Americas: Orange, Oceania: Purple

I also ensured that Ireland was visually highlighted using a distinct black color.

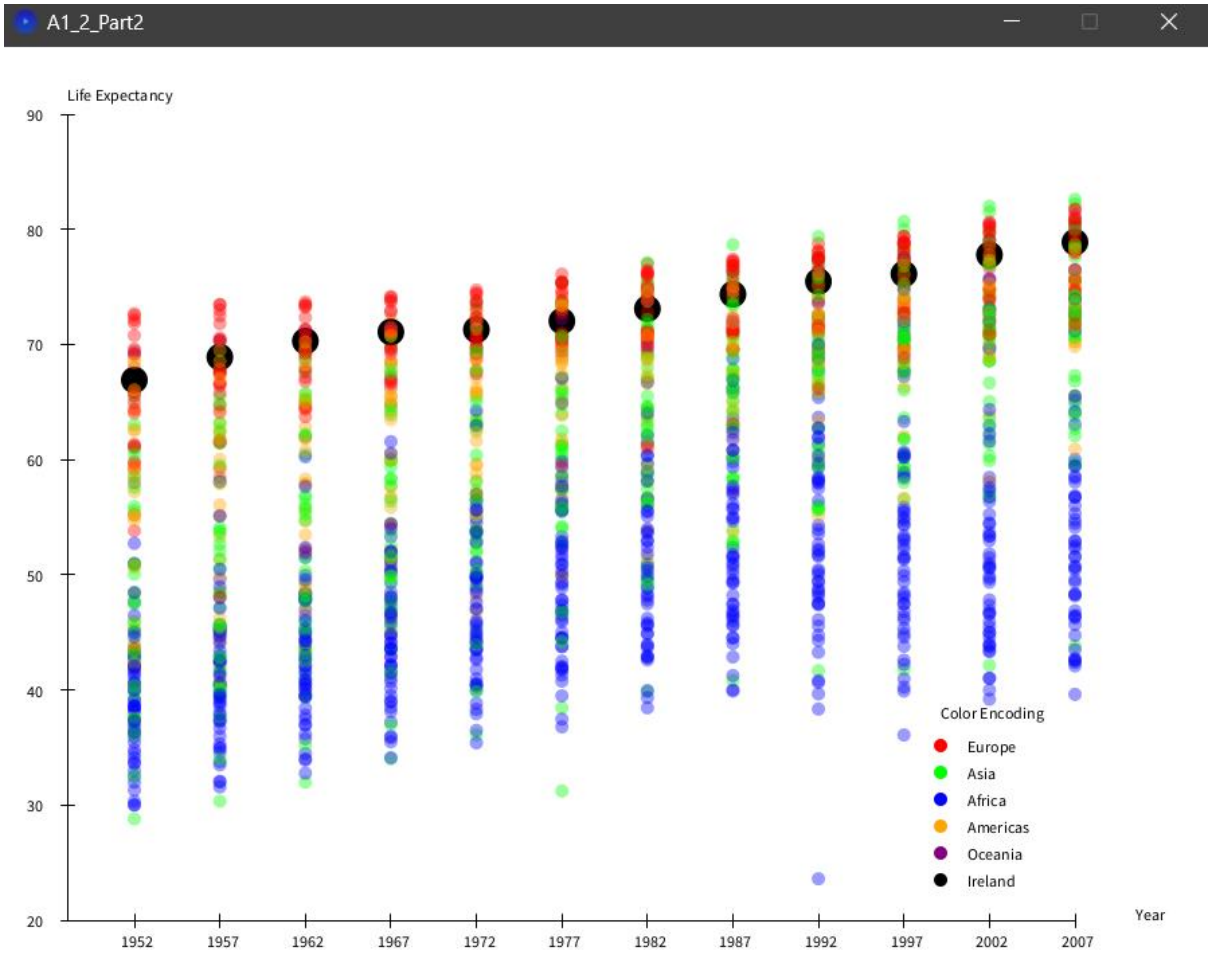


Chart 5: Shape Encoding

The second chart used shape to represent the different continents. Each continent was assigned a distinct geometric shape:

Europe: Triangle, Asia: Square, Africa: Pentagon, Americas: Star, Oceania: Semi-circle

Incorporated transparency into the shapes, which ensured that data points did not completely obscure one another when overlapping. Ireland was again distinguished from other countries by using a solid black circle.

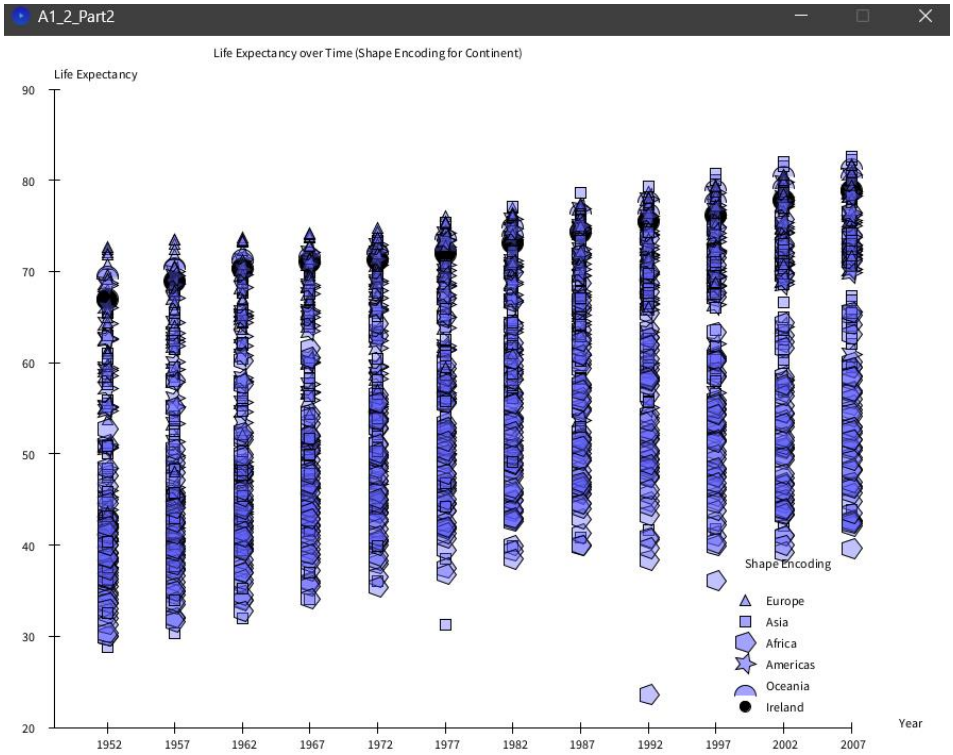
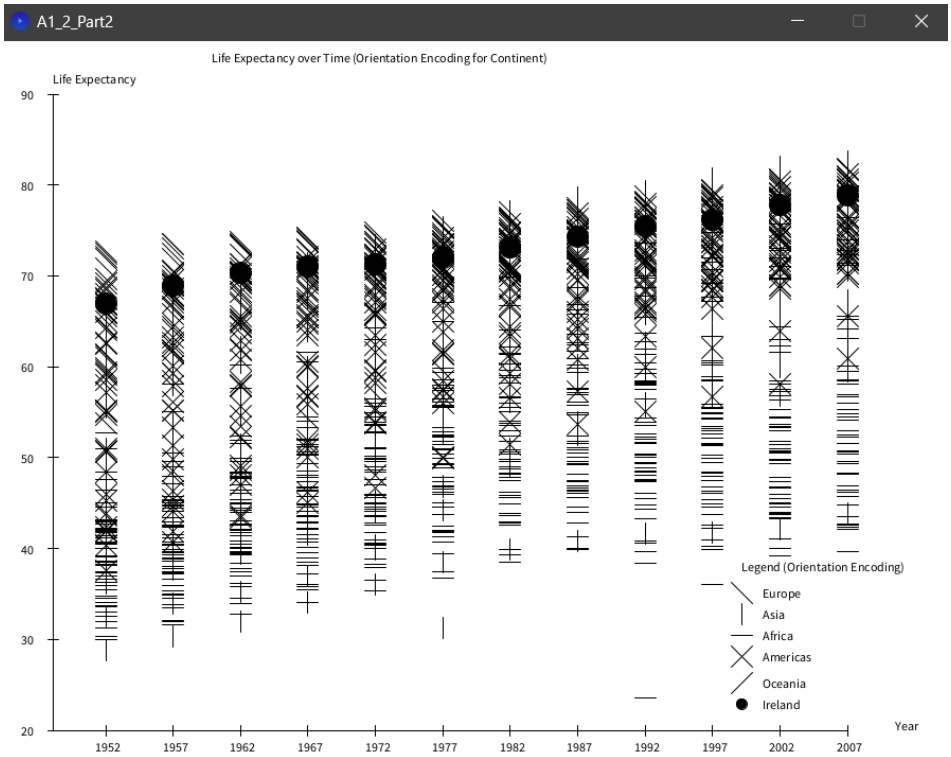


Chart 6: Orientation Encoding

For the third chart, I chose orientation as the encoding channel:

Europe: Diagonal line, Asia: Vertical line, Africa: Horizontal line, Americas: Cross, Oceania: Diagonal line in the opposite direction

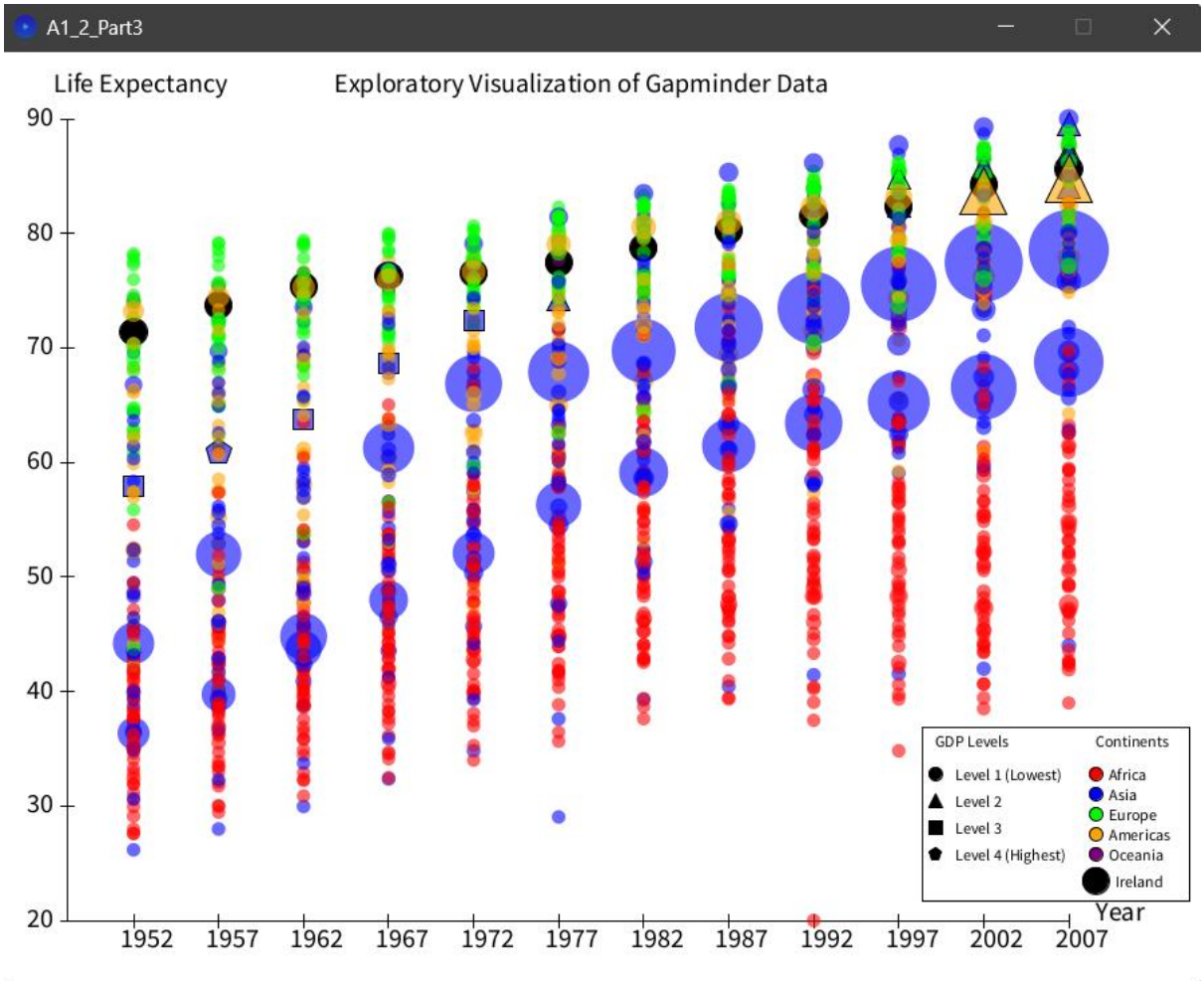
The use of line orientation allowed for a minimalist design, while still effectively communicating the categorical information. Ireland was again highlighted with a black circle for consistency and distinctiveness.



Part C of this project lastly implements an exploratory visualization that encodes the five attributes from the Gapminder dataset: continent, year, life expectancy, population, and GDP per capita.

To represent these variables, I adopted different visual encoding channels: position, color, shape, and size.

1. Year and Life Expectancy: Position
   The X-axis represents the year from 1952 to 2007, and the Y-axis encodes life expectancy, with values ranging from 20 to 90.
2. Population: Size of Shapes
   Population is encoded through the size of the visual elements. Larger populations are represented by larger shapes, scaling proportionally between a minimum size of 10 pixels and a maximum of 60 pixels.
3. GDP per Capita: Shape of Elements
   The GDP per capita is discretized into four levels, each represented by a different shape:
   Level 1 (lowest GDP) is represented by a circle.
   Level 2 uses a triangle.
   Level 3 is depicted as a rectangle.
   Level 4 (highest GDP) is a star.
4. Continent: Color Coding
   Each continent is assigned a distinct color. The color scheme helps to distinguish between regions and observe continent-specific trends.:
   Africa: Red
   Asia: Blue
   Europe: Green
   Americas: Orange
   Oceania: Purple



References

[1] T. Munzner, Visualization Analysis and Design, AK Peters / CRC Press, 2014.

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[3] Knuth, “Computers and Typefaces,” [Online]. Available: http://www-cs-faculty.stanford.edu/~uno/abcde.html.