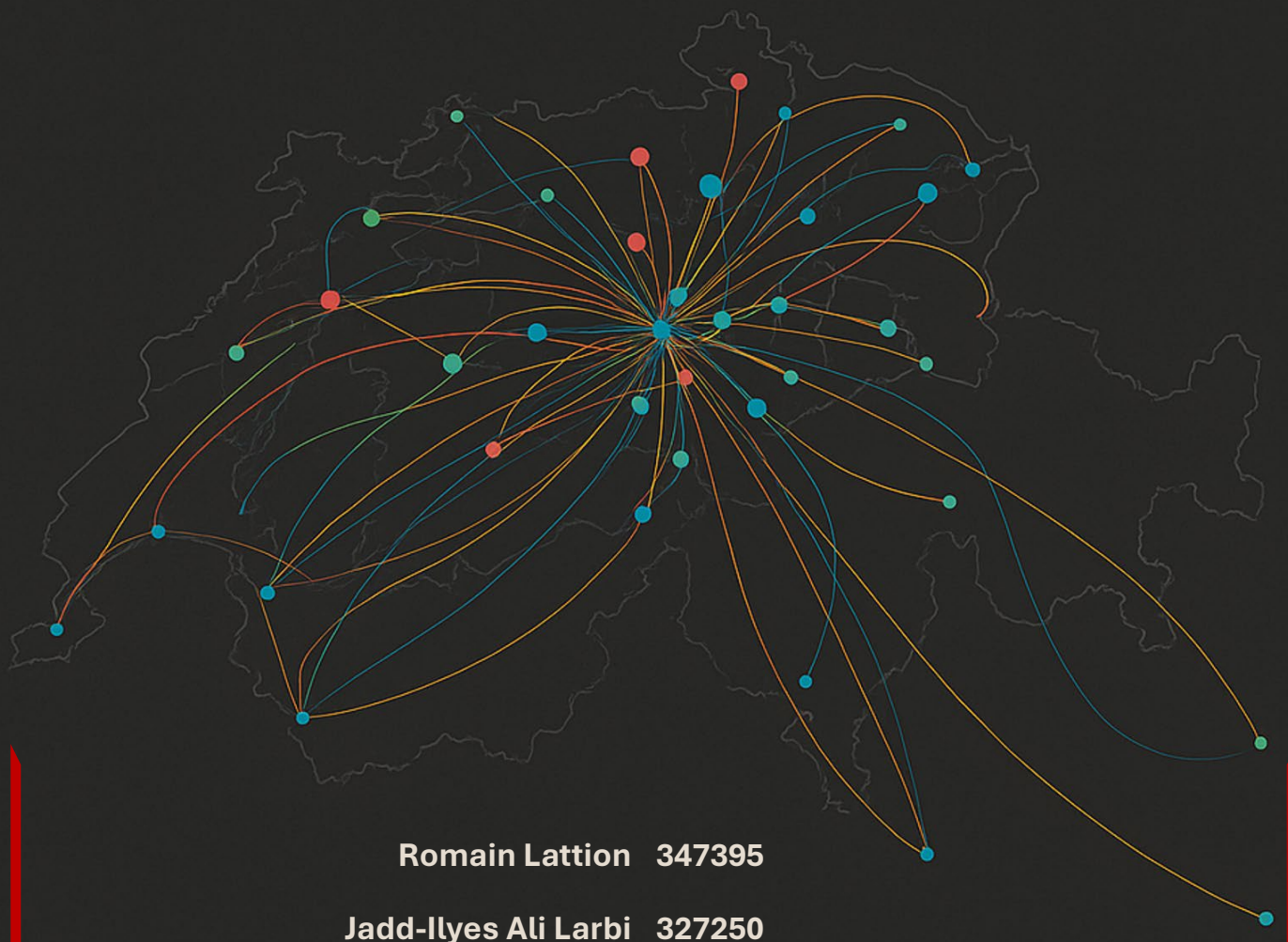
PROCESS BOOK SWISS PENDULUM

VISUALIZATION TOOL FOR SWISS COMMUTING ROUTES



Romain Lattion 347395

Jadd-Ilyes Ali Larbi 327250

Corentin Barut 329702

INTRODUCTION & MOTIVATION

Concept & Purpose
The *Swiss Pendulum* project was conceived as a visual exploration of commuter flows across Switzerland, based on official national statistics. Our aim was to go beyond traditional quantitative reports and deliver a compelling visual narrative of Swiss commuting patterns through an interactive, intuitive, and aesthetically engaging website. The platform allows users to explore spatial and temporal mobility dynamics, highlighting where people travel for work, how they commute, and how these behaviors have evolved from 2010 to 2023.

Audience & Scope
Our approach was guided by a balance between statistical rigor and visual accessibility—making the data approachable without oversimplifying its richness. From the outset, we wanted the site to speak to both specialists (researchers, urban planners, policy-makers) and the general public. To do so, we structured our work around three core dimensions: geography, time, and behavior.

Inspirations & References
Several references and inspirations shaped our vision. While the Swiss Federal Statistical Office (OFS) provides rich data and visualizations, their presentation tends to be static. We looked instead toward more dynamic projects, such as *Flowmap.blue*, animated ranking charts widely shared on social media, and interactive transport dashboards. These inspired us to rethink how to present spatial and temporal data in a way that is engaging, clear, and informative.

Visualization Overview
The website is built around five core visualizations, each offering a unique perspective on the data. The first is a commuter flow map, where users can select a departure region and see directional, weighted arrows that represent inter-cantonal movements. The map includes filters by year and type of flow (departures, arrivals, round-trips). The second visualization is a bar chart race, illustrating the changing rank of cantons in terms of commuting volume over time. Third, we created a comparative view of transport modes, displaying modal shares (car, train, bike, etc.) and allowing zoomed-in views to trace trends for a specific mode. The fourth component is a distance plot showing the distribution of commute distances across years. Lastly, a radial "time clock" visualizes commute time peaks throughout the day.

Design & Visual Identity
In terms of design, we chose a minimalistic and elegant graphic identity. The base interface is dark-themed, using shades of grey and black to make the data pop through color accents (blue, red, orange, depending on context). This aesthetic was inspired by Swiss train station displays—functional, legible, and hierarchical. Typography was selected for modernity and readability, reinforcing a professional and sleek appearance.

Technical Implementation
Technically, we relied on D3.js for most visualizations due to its versatility and fine control over SVG elements and animations. The radial clock was developed using p5.js, and Chart.js was used for static comparisons. The entire website is built using HTML, CSS, and vanilla JavaScript, without a backend, enabling lightweight deployment via GitHub Pages. This choice reflects our commitment to making the tool accessible, sustainable, and easy to maintain.

DATA & PREPARATION

Data Sources and Structure

Our project uses commuting data from the Swiss Federal Statistical Office (OFS), structured into four Excel files—each focusing on a different mobility aspect: commuter flows, transport modes, travel distances, and durations. These served as the base for all visualizations.

We used Python scripts to clean, format, and convert the Excel files into JSON—more suitable for JavaScript-based visualizations. To improve performance during development, we created a reduced version (~2,500 rows) of the largest dataset (initially over 95,000 rows).

Each file remained separate—no merging or cross-referencing—since each dataset supported a distinct visualization (e.g., transport type, duration), allowing for modularity and clarity.

Data Cleaning and Formatting

The data preprocessing was done using Python and the pandas library, mainly through Jupyter notebooks. Each Excel file required targeted cleaning operations, such as:

- Removing unnecessary metadata rows,
- Standardizing canton and city names,
- Formatting columns consistently,
- Dropping missing or unusable values.

Once cleaned, the data was transformed into structured JSON files tailored for each visualization. These files were stored in the project's /datasets directory and loaded dynamically on the client side using JavaScript.

Geographic Coordinates and Maps

Assigning precise coordinates to cities was a major challenge. While canton borders used GeoJSON, many city coordinates were missing. We resolved this by scraping latitude and longitude from *latlong.net* using Puppeteer.
These coordinates enabled accurate map positioning and directional flow computation. The map combines them with commuter volumes to show top routes (departures, arrivals, round-trips) and supports time-series pop-ups.

Data Integration Strategy

Instead of one unified dataset, each visualization relies on a specific JSON structure:

- **Map**: city-to-city flows by year
- **Bar chart**: canton totals by year
- **Transport modes**: modal share per year
- **Clock**: duration segments
- **Distance**: ranges by year

This modular setup keeps the frontend efficient and ensures data-visual consistency.

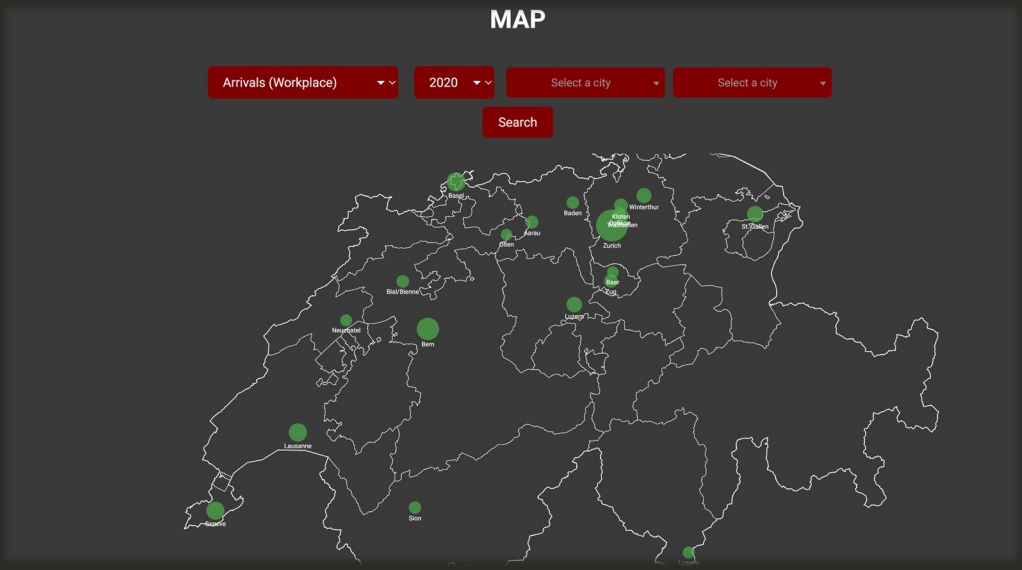
INTERACTIVE COMMUTING MAP

Initial Idea & Objective
We envisioned an interactive map to let users explore commuter flows between cities. The goal was to visualize arrivals, departures, and the most frequented routes across Switzerland over time, with interactive filters.

Early Sketches
We planned to draw arcs between cities, with each city accurately geolocated and represented by a dot scaled by commuter volume. Our early mock-ups included dynamic transitions, city selectors, and hover-based tooltips.

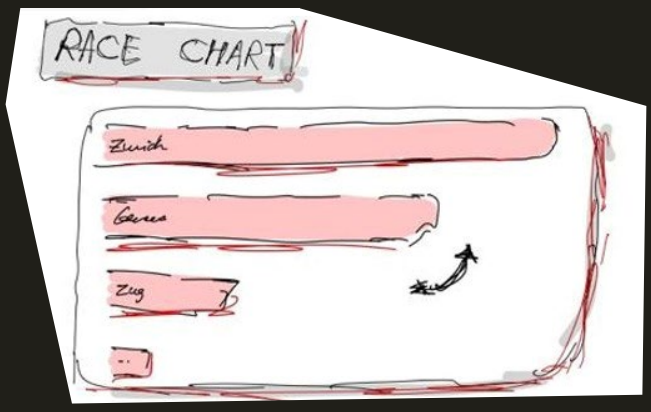
Challenges Encountered
A major difficulty was obtaining accurate latitude and longitude values for all cities. Despite attempting to scrape coordinates, inconsistencies in naming and formatting made it difficult to match data cleanly. In the end, we chose a **simplified approach**: rendering the country's contours over a dark background, and placing city nodes manually based on approximated centroids.

Final Result
The final version features a clean map with visual filters for year, flow type, and city. Clicking on a city or route reveals historical trends. The map's clarity and responsiveness were key priorities, and the compromise on geographic precision helped improve performance and maintainability.



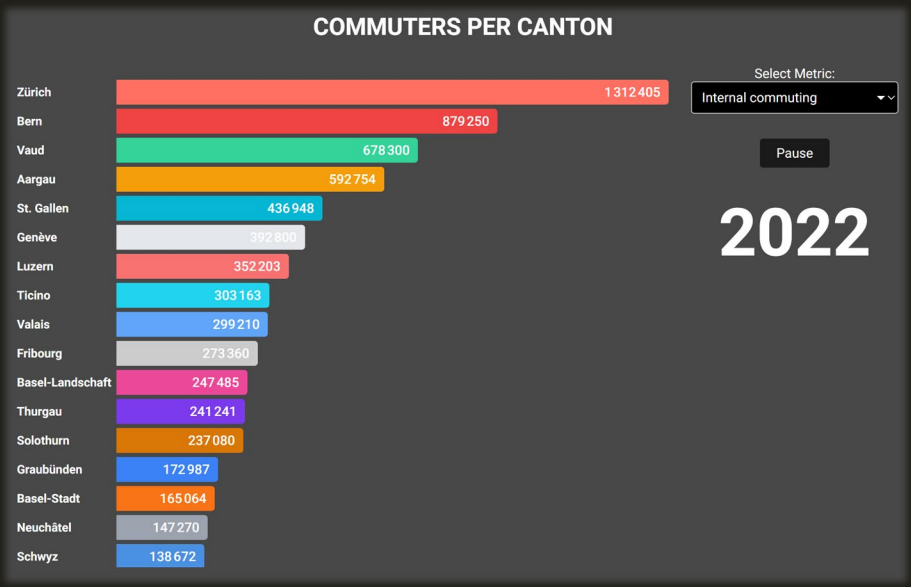
RACE CHART

Initial Idea & Objective
We aimed to illustrate the evolution of commuter volumes per canton through time, using a dynamic bar chart race to highlight trends and relative ranking changes year by year.



Early Sketches
Our sketches displayed animated horizontal bars sliding in and out as values changed. Each bar was color-coded, and the current year displayed prominently.

Challenges Encountered
We faced issues with the **bar swap transitions**: when one canton overtook another, the animation sometimes became visually confusing or jittery. Timing overlaps and value updates needed careful synchronization.



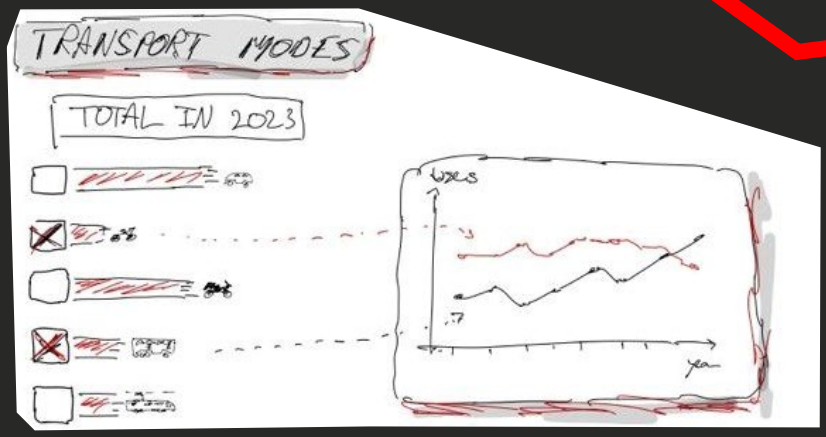
Final Result

After refining the transitions and introducing smoother delays, we achieved a clean and informative animation. The final chart clearly shows dominant cantons like Zürich and Bern rising over time, while also offering play/pause controls for user engagement.

TRANSPORT MODES

Initial Idea & Objective

This component was meant to show the share of different transport modes (car, train, bike, etc.) in a visually friendly and comparable way. The main view presents data for a single year, and clicking a mode reveals its evolution over time.



Early Sketches

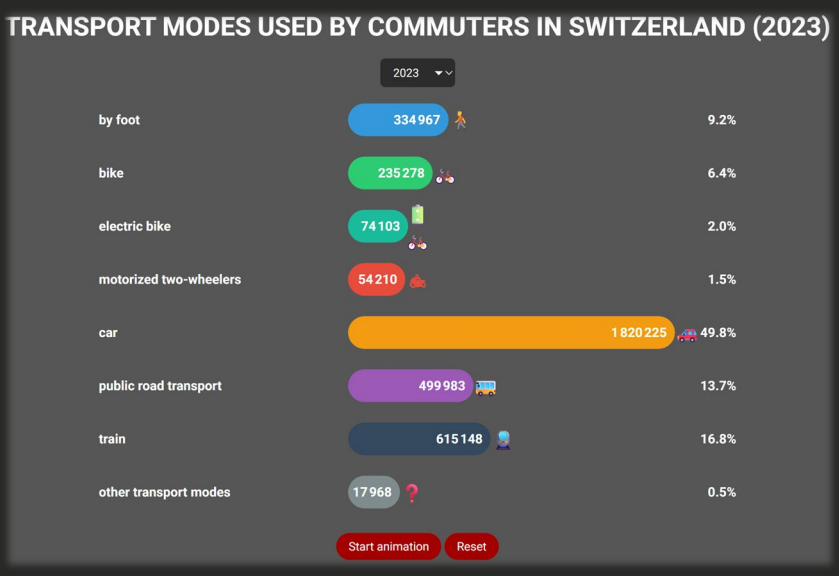
We used bold colors, emoji icons, and horizontal bars to make the chart intuitive. The historical evolution chart used lines for multiple modes.

Challenges Encountered

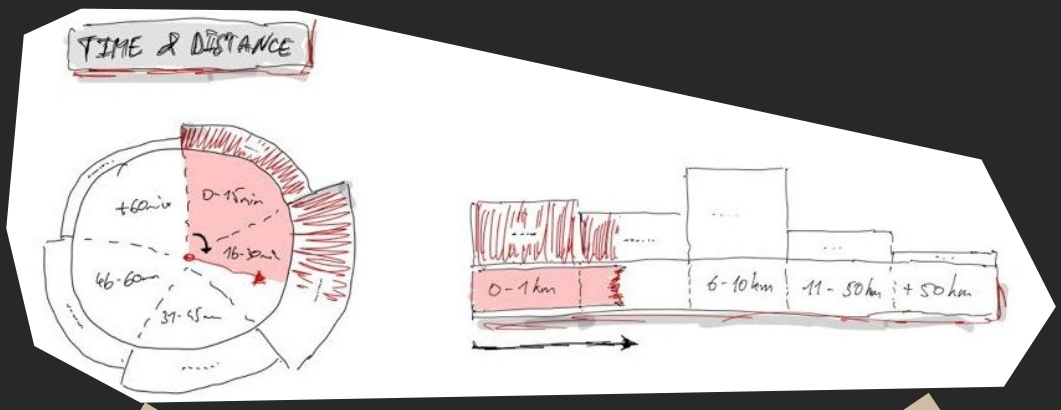
We had several issues aligning **emoji placement and value labels** across browsers and screen sizes. Emojis would sometimes overlap or misalign with the bars, making them hard to read. We also had to adjust spacing between bars for better clarity.

Final Result

The current chart is clean and expressive. Clicking a mode opens a modal with a multi-line chart for historical trends. The emojis add personality and help quickly identify each mode, while the layout ensures readability across devices.



COMMUTING TIME CLOCK & DISTANCE COMPARISON CHART



Initial Idea & Objective

We wanted to represent how commuting times were distributed — short, medium, or long trips — in a format that reflects the rhythm of a day. A radial clock was chosen for its metaphorical power.

We wanted to allow users to compare commuting distances between two different years, and detect how short or long-range commuting evolved over time.

Early Sketches

We planned for circular segments corresponding to time intervals (0–15 min, 16–30 min, etc.), with proportions reflecting the number of commuters. A central "clock hand" indicated peak intervals.

Our early concepts included dual-color bar charts with a year selector and animated transitions. We added a car icon to create an intuitive metaphor for the journey.

Challenges Encountered

One of the trickiest parts was displaying **exact values legibly** within curved segments. Another issue was **positioning the central needle** in a way that was both aesthetic and informative. Fine-tuning the geometry took multiple iterations.

Synchronizing **bar updates with the animated car** was challenging: we had to coordinate data refreshes, animation triggers, and visual transitions to feel seamless. Matching both bars and motion in real-time required precise timing control.

Final Result

The final version shows a clean radial chart with time intervals clearly labeled and proportional arcs. The needle provides a quick visual sense of peak times, and year transitions are smooth.

The final distance chart offers smooth year-to-year comparison with clear distinctions between distance ranges. The animated car adds a playful and intuitive dimension to the interface, reinforcing the theme of mobility.

CONCLUSION

Swiss Pendulum began as a simple idea: making Swiss commuting data more visible, interactive, and accessible. Through a process that combined creativity, technical trial-and-error, and careful data preparation, we developed a complete web platform with five interactive visualizations, each providing a different lens on mobility across Switzerland.

The project taught us how to balance visual clarity with data complexity, how to solve real-world integration problems, and how to iterate as a team on both code and design. While there were compromises along the way—especially around data granularity and interactivity—we believe the result successfully bridges storytelling and statistical accuracy.

By focusing on modular, reusable components and maintaining a cohesive visual identity, we created a tool that invites users to explore and reflect on how people move across space and time. The experience has been both technically enriching and creatively rewarding, and we are proud of what we have built.

Team Contribution Breakdown

•**Website Development:** all members contributed to the site.

- **Corentin** handled several animations and led the final site assembly.
- **Romain** contributed to various animations.
- **Jadd-Ilyes** assisted with debugging animations and was responsible for retrieving geographic coordinates of cities.

•**Presentation Video:** produced and edited by **Corentin**.

•**README Documentation:** written and structured by **Romain**.

•**Process Book:** designed and authored by **Jadd-Ilyes**.