Process Book - An Analysis of the Olympic 1500m

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1 Introduction

In this project, we analyzed and visualized athletic performance for the Olympic 1500m athletic event. We focus on country performance trends, medal distribution and race strategies. Drawing inspiration from successful visualization projects, we integrated interactive elements for an engaging user experience. Our journey involved conceptualizing ideas, exploring various presentation tools, and refining visualizations based on feedback and new insights.

2 Visualisations

2.1 Country Times

The first visualization idea was to show performance trends of top-14 countries in sports events using a time-series bar chart. The aim was to provide a chronological view to help users identify patterns in athletic performance over time.

Our focus was on creating a clear and user-friendly design with interactive features like tooltips, and sliders for a better user experience. This visualization needed careful data preprocessing and design to communicate trends and insights effectively.

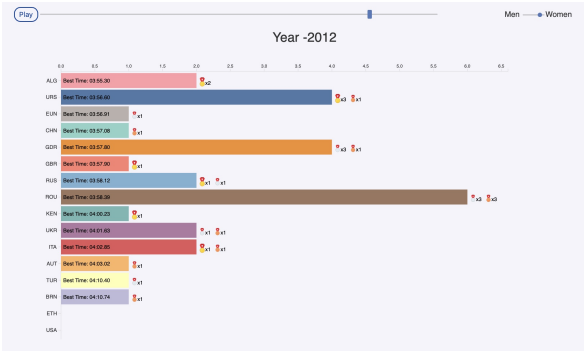

Figure 1: Race Chart - Women's Event Evolution 2012

In particular, the animated race bar chart truly depicts the advancement and continuous time improvement made by the athletes over the year. In the beginning, we mostly saw the United States, Australia, and Great Britain, countries that have historically dominated middle-distance running. The USA leads in participation and success. In the 21st century, emerging nations like Kenya started achieving top results.

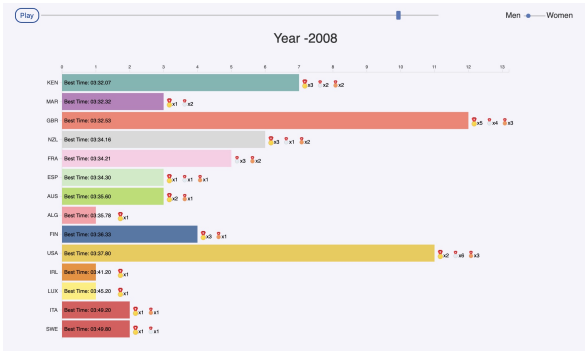

Figure 2: Race Chart - Men's Event Evolution 2008

Due to some lack of data, the other graph envisioned during milestone two, which was a country-specific graph displaying the time evolution could not be created. Instead, given the first graph, we felt it would be better to provide another visualisation relating to the historical evolution of the performances. To achieve this, some of the gold medal times in the 1500m event over the past 120 years were taken, and put in perspective with one another.

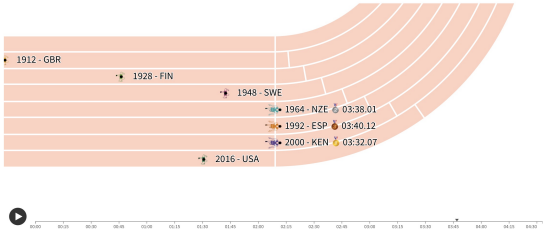

Figure 3: Race Chart - Comparing Times Across Time

The chosen 8 key moments truly highlight the

progression of top athletes and how they have surpassed previous records.

It is particularly interesting to see that some athletes that win first place achieve times comparable to those 40 years prior. It can only make us wonder if the improvement of race times is truly expected to continue, perpetually pushing the limits of what the human body can achieve, or weather we are getting to the plateau of record-breaking performances.

2.2 World Medals & Introduction

Colors

The colors were chosen according to different criteria. We wanted to create a positive atmosphere on our site, so we chose bright colors. We also looked at the Olympic visual identity, to match their energy. With the help of color generation tools, we created our color palette palette. To help people know where they are, the header color changes when changing pages.

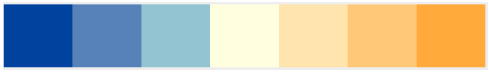

Figure 4: Partial color gradient

As the main goal was to make a visually attractive website, it took some time to have every item perfectly aligned with another and to find the correct color gradient for the map, making sure it transmitted the right message. The color shades on the introduction page reflect each athlete's ultimate goal - to win gold. This is how we enter the site, by clicking on a golden button, that moves around to invite the viewer to click on it. To have the feeling of continuity between the pages, we added a smooth transition between them. Choosing the right image for the first page was also important and a matter of color. Many online images don't have enough quality to be displayed in full screen, further, we wanted an image that stays in the shades of the rest of the website. The first impression is the most important, so this page needed to be visually satisfying.

Introduction

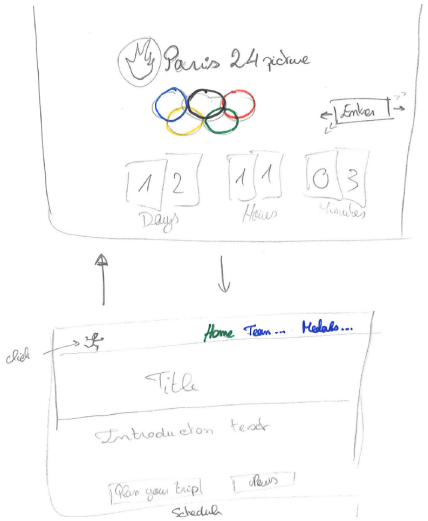

Figure 5: Final sketch - Interaction between pages

The countdown was made for the same purpose as the news: to get us into the mood of the Olympic games. If someone visits a website about the 1500m discipline, they probably want to know about the next Games. That's why we added the current rankings, the race's schedule, and a link to other disciplines. Sadly, we didn't find any crispy information, so we limited the news section to the schedule and ranking.
After realizing both tables, it felt something to motivate the viewer to follow the next games. Therefore we thought about video with engaging music to make them feel part of the event before it starts.

To facilitate the navigation between the different parts of the website, we added buttons and clickable words as shortcuts to go directly to the visitor center of interest.

World Map

Figure 6: Final Sketch - World Map with details

At first, we wanted to create a map showing countries that won 1500m competitions, and when a country is clicked on, the evolution of the number

of medals won by this country over the years would be displayed.

As previously mentioned, the main issue was the number of data available. If we only took the 1500m data, not many countries would have been displayed on the map. To keep the idea of the geographical medals distribution, we started to look at other running disciplines. This gave us more data and included more countries. Because we had several disciplines involved, we added the click-on histogram, which shows the country's medals by discipline and type (gold, silver, bronze). It enables us to get comparative information about the performances of each country depending on the different disciplines. The histogram uses the same colors as the medals. When clicked on, the country changes color, which helps to keep track of what we are looking at.

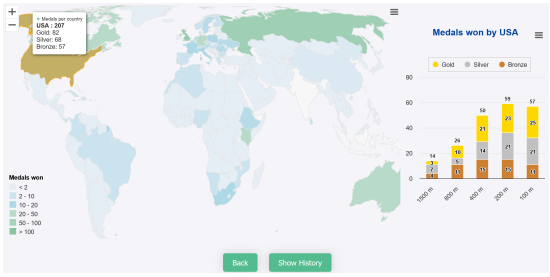

Figure 7: Medals - World Map with details

We tried adding the number of times each country took part in the olympic games, but it made the chart too crowded and confusing. So, we only kept the total medal counts.

To design the interactive map, we first look at all possible libraries available on the internet. It came out that Highcharts library was very complete and adapted to get the best visual outputs.

We started to the history chart it with DS3, but to keep the visual style consistent, we finally transformed everything using Highcharts. The data was pre-processed to compute the total number of medals per country, to get the distribution between the disciplines and medal type. We then used the obtained JSON file to create the interactive map. We chose to create JSON files, because those files are easier to work with and we already processed the data in a jupyter notebook, we just needed to convert the dataframe into JSON type.

1500m Medals History

As the first idea was to show the evolution of medals won in the 1500m discipline over the years through a linear chart when the countries were selected, we chose to adapt it to a bar chart to fit our data. The user can now select a country from a list, and it will only display the years where it won some medals. Only countries that ever won a medal are proposed to click on. It avoids having too much empty data. This chart also shows the names of the medal winners. We didn't separate the gender anymore, again to have more data at once on the screen.

It was interesting to see that many countries won only once, while countries like the USA won many times. The concept of a dominant nation is also confirmed in the map, where we see that again the country that won the most medals is the USA.

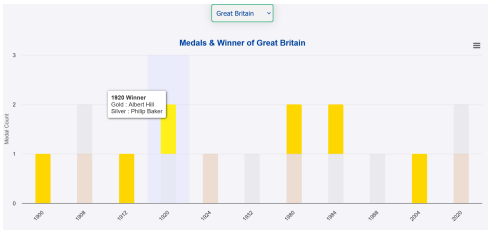

Figure 8: Medals - History final result

2.3 Race Strategies

In Milestone 2, we defined a less abstract and more practical solution to attain the previous goal of categorizing the tactics of 1500 metre Olympic Finals: to understand and categorize race strategies and tactics by analyzing split times and going through the strengths and weaknesses of each strategy and the context in which they succeed or fail. To do so, we started by using the split times gathered for all finalists at the 2020 Men's 1500 metre Olympics. We quickly realized that while some of the strategies mentioned below were represented by some of the 2020 athletes, we would have to dig deeper in order to find true examples of each of our tactical categories. Thus, we decided to extend the strategic analysis of split times to the 2016 Men's 1500m metre Olympic Finals as well. The 2016 race was special, with one of the slowest winning times of 1500 metre Olympic history, it was the perfect race to analyze for a tactical approach. One improvement could have been to add the 2019 World Championship 1500 metre Finals, where Timothy Cheruiyot demonstrated his superior physical fitness by front-running the entire race, leaving all his competitors far behind and eventually winning the race. I want to thank my close friend who is also

a 1500 metre athlete Moritz Ebbeskotte for this suggestion.

As seen in Figure 14, the four main pacing strategies we derived were the following:

- The **sit and kick** strategy has a slow start, transitions into an even pace, and finishes with a fast sprint. It works well for anaerobically gifted runners with more core strength than their opponents.
- The **negative split** strategy has a slow start and a gradual speed increase until the end. This is a relatively safe strategy for more aerobic runners, the light progressive speed increases will not affect them as much as for less aerobic competitors.
- The **front running** strategy has a fast start to gap others and stop drafters, then transitions into an even pace. This strategy is mostly used by clear favorites who believe they can win with their sheer physical fitness, but is also used for aerobic runners that do not want to risk their race on the last 400 metres.
- The **even pace** strategy maintains an even pace throughout the entire race with no significant speed variations. This is typical for a middle-of-the-pack runner, when boxed in among a large group of competitors, this is the natural thing to do.

It is important to note that, in general, the first and last laps are much faster than the others and that the penultimate lap is often slightly slower.

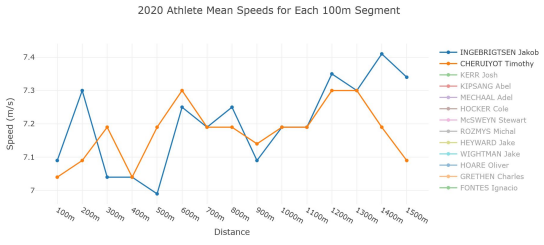

Figure 9: Visualized Speeds - Jakob Outkicks Timothy

Finally, in milestone 3, we decided to use the previously mentioned Men's Olympic Finals split times from 2016 and 2020 to generate a visualization tool showing the split speeds per 100m as well as the ranks per 100m for all athletes in these races. Then we explored the most relevant datapoints and set the focus to only show the line plots deemed as representative of our explained racing strategies. These datasets were chosen and used because of their public availability here and here. We combine split speed plots with split ranks because often mean split speeds to not render a complete image of a race, neither does the ranking but using them together grants a more accurate representation of the race. If we solely look at mean speeds per split, we cannot always tell who is in front of who, we only see who is going faster for a given distance interval. On the other hand, solely observing the rank plot only tells us where an athlete is placed relatively to the other runners, not how far in front or behind he is nor if he is accelerating or the rest of the field is decelerating. By viewing these plots together for a same race, we can truly see relative (rank) and objective (speed) race progression for any given athlete. A further improvement would be to extend the split time data to the next Paris 2024 1500m Olympic finals, with the showdown between the favourite Jakob Ingebrigtsen, the reigning Olympic champion, and the challenger Josh Kerr, the reigning world champion.

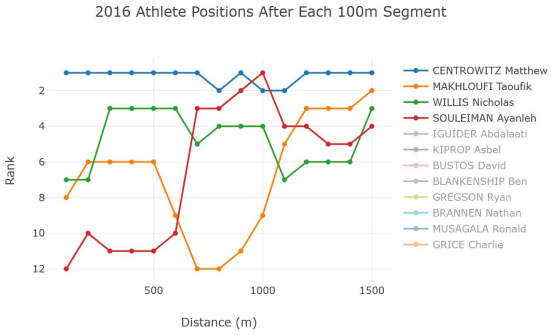

Figure 10: Visualized Ranks - 2016, A Tactical Finish

3 Challenges and decisions

Explain challenges that you faced and design decisions that you took.

3.1 Country Times

There were two big challenges that were faced here : data and structure

For the first issue, at first glance, it seemed that the data we had was enough to create this visualisation. However, further work showed that using only the times achieved by gold medalists would not be sufficient. Finding a dataset with the race times for all finalists in this Olympic event since its

creation was unsuccessful. The middle-ground that we found was a dataset that had the podium results from all Olympic Track and Field Events, from 1896 to 2016 (Olympic Track & Field Results). Unlike other datasets, this one contained the times achieved by the podium athletes, for both men and women. This allowed us to create a race bar chart that made sense, and although we do not have the data for every country during every event, we are still able to convey the information that we wanted. After some data cleaning and processing, we were good for the visualisation, or so we thought.

Designing an intuitive and informative time-series chart required careful consideration of visual design principles. Since our bar chart showcases two different parameters, time and medals, we could not find a similar graph to build upon. It had to be conceived from scratch. We also had to ensure that both information we wanted to show were clearly and easily understandable. Leveraging d3.js, JavaScript's functionalities and their optimisation for web-integration, we implemented animations to show changes in performance over time, making the visualization more engaging. Interactive controls were added to allow users to further explore the data by year, and gender, providing a deeper level of interaction and exploration. A medal count was also included via icons, allowing users to keep track of both the time improvement, but also the wining teams for each year.

3.2 World Medals & News

Finding a complete data set for women was difficult because websites often only display men's data. We also tried to avoid redundancy with other visualizations by searching for information other than running times. Because none of what we found was either complete or interesting enough, we limited ourselves to the number of medals won. Although we now had more data, we were also careful not to overload the visualization, as too much information can be confusing and the main message of the visualization will get lost. We preferred to show less detail while displaying the medals distribution over the disciplines to keep the comparison message between the different performances.

The message transmission was not limited to the dataset but also how it looked. We need to find a color gradient for the map that respects the visual aspect of the website but also transmits the information correctly. It was easier for the medal's detail, we could reuse their color so the viewer easily gets the message because he already associates those color with the medals. Initially, we considered placing the bar chart below the map, but this resulted in a tiny map that was difficult to view, everything was confusing. Therefore we adapted the position of the map on the left part of the screen, so there was some place for the bar chart, and we obtained a visually more coherent result. Our goal was to create attractive visualizations that encourage interaction. To achieve this, we added hover animations while passing on the countries of the bar chart, so the user only sees what he is interested in. It also solved the problem of having too much data at once on our screen. We added buttons to facilitate navigation and ensure a smooth user experience.

After some research, we chose to use the Highcharts library because it is complete and adapted to get the best visual outputs. However, it was sometimes difficult to find the right parameter to change to get the desired output. There are a lot of default values (like the name of the variable on which is based the color gradient), making it even less obvious what parameters must be adapted.

3.3 Race Strategies

As explained in the sketch development section, one of the challenges we faced when designing plots was how to best represent the race progression of athletes. As we have seen, it does not suffice to solely represent either the mean split speeds nor the split rankings which is why we decided to combine them both for the 2016 and 2020 1500 metre Olympic Finals' split results. Combining these two metrics posed several challenges. The data from both races varied in structure and were both initially simple PDF documents. We resorted to data extraction using our python skills. This allowed us to create consistent visualizations across different races.

Another challenge we had to face was the information overload on the plots, showing the ranks and speeds of all finalists in the same two plots was unclear and too much information to garner meaningful conclusions from our visualizations. This is why we focused on setting the spotlight on a subset of runners whose strategies corresponded to the previously described tactical categories.

4 Sketch Development

Reuse the sketches/plans that you made for the first milestone, expanding them and explaining the changes

4.1 Country Times

Our initial sketch for the time-series bar chart was a simple bar chart illustrating race times for a few selected countries. While functional, this design lacked the ability to show trends over time or provide interactive exploration. The final version was a fully animated time-series bar chart. We added dynamic elements that allowed users to observe changes in performance over time as well as interactive features such as slider controls, enabling users to filter the data by year and gender. This comprehensive and engaging design offered a detailed and intuitive view of performance trends.

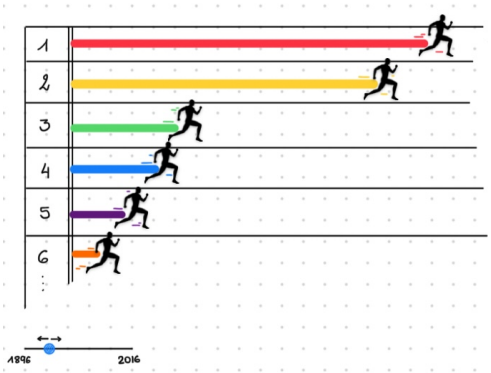

Figure 11: Race Chart - Comparing Times Across Time

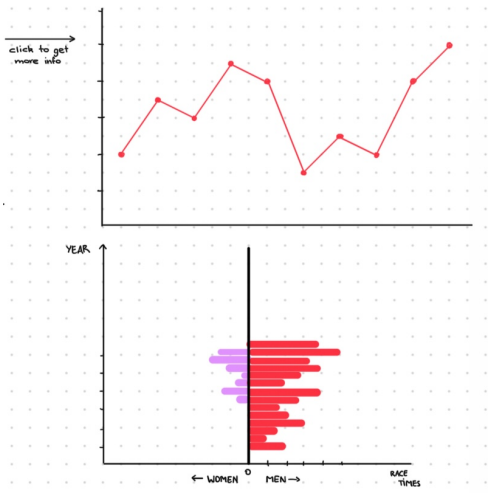

Figure 12: Race Chart - Comparing Times Across Time

4.2 World Medals & News

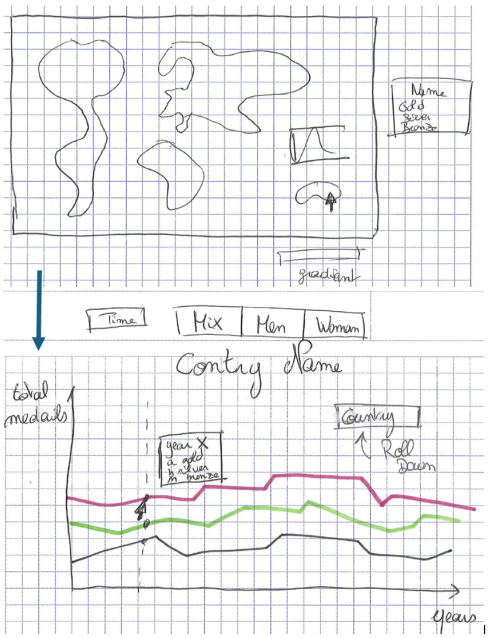

Figure 13: Medals - Medals distribution over history

In the first milestone, we wanted to show the total number of medals won in 1500m Olympic category. It would have the click-on option on the country, to see the details of their evolution over the years, like if there is a drastic change since women started to participate, the influence of external events (war, financial crisis...). As previously mentioned, because of the lack of data we decided to adapt it to the total number of medals in different running disciplines with the details when the country is clicked on. Another chart will display the number of medals won over the years, but country by country, that you can choose through a small menu.

4.3 Race Strategies

In milestone 1, we started by wanting to categorize tactics of Olympic 1500 metre races, referencing the following example paper "Women's 1500m Time Analysis – 2017 IAAF World Championships". That paper included the mean speeds for each 100 m segment for the top eight athletes in heats, semi-finals, and finals for the women's 2017 1500m World Championships. The advantage that paper provides is the data quantity supplied: we get to display 6 races for the same event and year. In contrast, our paper only focuses on Olympic Finals, which can be justified by the fact that different strategic dynamics are at play in a final versus in a heat. The best runners will focus on qualifying

while expending the least energy possible: the goal is not to win a heat but a final. We also decided to represent all runners of the final, rather than solely considering the top 8.

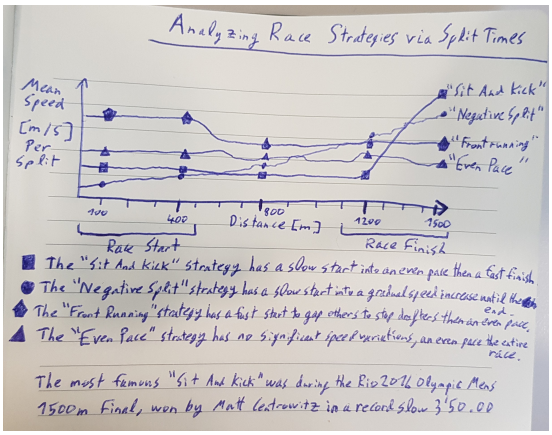

Figure 14: Split Speeds - Tracking Speeds Over Splits

For clarity and simplicity, we dealt with the information overload of showing all athletes by only showing the line plots for specific athletes that show racing strategies we'd like to explain and represent on our website, whilst keeping the option to display the other runners if necessary.

5 Workload balance

Peer assessment: include a breakdown of the parts of the project completed by each team member.

5.1 Elisa

Elisa created extracted and cleaned the extra data for the athlete's time performance. She created the race bar chart from scratch, ensuring it effectively visualizes the chronometric performance trends of the top-14 countries across various sporting events. She also edited and finalized the screencast video, highlighting the interactive features and insights provided by the visualization.

5.2 Laetitia

Laetitia designed the site's front page, as well as the world medals page, with all research about the different disciplines, and the home page with the latest race news. She also took care of the coherence between the different pages, and the transition between them, whether through animations, color codes, or interactive buttons, and she also managed the structuring of the files.

5.3 Paul

Paul focused on the following webpages: Race Strategies, Home and Team. He was the main contributor for the overall website CSS styles, the scroll reveal javascript element animations, the background images, the basic structure of the process book report, the website and its subpages. He coordinated the internal team deadlines as well as finding, extracting and cleaning the primary data source and reference papers.

References

Olympic Track & Field Results. Results from all Olympic Track and Field Events, 1896 - 2016. [link].