Template_submission_CASA0003

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1 Coffee Road: From Commodity to Culture

1.0.1 Exploring Global Trade and Urban Networks Through Coffee

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1.2 Project Output Description

Project Output	Output Description
Project Output Files	Zip file submitted on Moodle
Project Website	Coffee Story
Github Link	meimao76/coffeestory

1.3 Individual Contributions

Task Name	Major Contributor(s)	Additional Contributor(s)	Relevant Report Section(s)
Project Concept & Thematic Design	All team members	—	Introduction (1)
Global Trade Visualisation (3D + Sankey)	Qican Weng	Shiyu Cheng	Global Trade (2)
Tokyo Map + Aoyama Submap	Xinyi Zeng	—	Urban Grounds (3.1)
Istanbul Analysis + Beyoğlu Submap	Xinyi Zeng	Shiyu Cheng	Urban Grounds (3.2)
Visual Structure & Web Design	All team members	—	Throughout (esp. 4)
Technical Debugging & Performance	All team members	All	Technical Challenges (4.4)
Scroll-based Animation & Homepage	Shiyu Cheng	—	Section 1 & 4
Final Website Deployment	All team members	—	All (via GitHub Pages)
Presentation Preparation	All team members		—
Report Writing & Editing	All team members	—	All

1.4 Introduction: Coffee as a Global Urban Perspective

Coffee is one of the most widely traded commodities in the world — but also one of the most symbolically charged. From its colonial roots in the highlands of Ethiopia to third-wave cafés in Tokyo and Istanbul, coffee travels across borders not only as a good, but as a practice, a place, and a story.

This project examines coffee as both a global flow and a local habit, exploring how trade, branding, and urban life intersect in and through this everyday object. On the international scale, coffee reveals the inequalities embedded in value chains, where production often occurs in the Global South, while most value is captured by corporate branding and consumption in the North (Gereffi et al., 2005). Yet beyond trade, coffee also mediates practices of identity, aspiration, and social differentiation in cities — what Warde (2005) calls "practice systems," enacted through daily routines and spatial habits.

Our website depicts this multi-scale geography through a series of interactive visualisations. We incorporate 3D trade flows, value chain breakdowns, and city cafe map comparisons to tell a story from the macrosystem to the micro space. Guided by theories of consumer culture (Arnould & Thompson, 2005) and informal public life (Oldenburg, 2023), we explore where global coffee flows, who benefits from its flow, and how it is lived, shaped, and visibled in urban forms.

By using data-driven narratives, scroll-based staging, and spatialised POI networks, we map not just the movement of coffee but also what it reveals about modern urban life.

1.4.1 Methodology

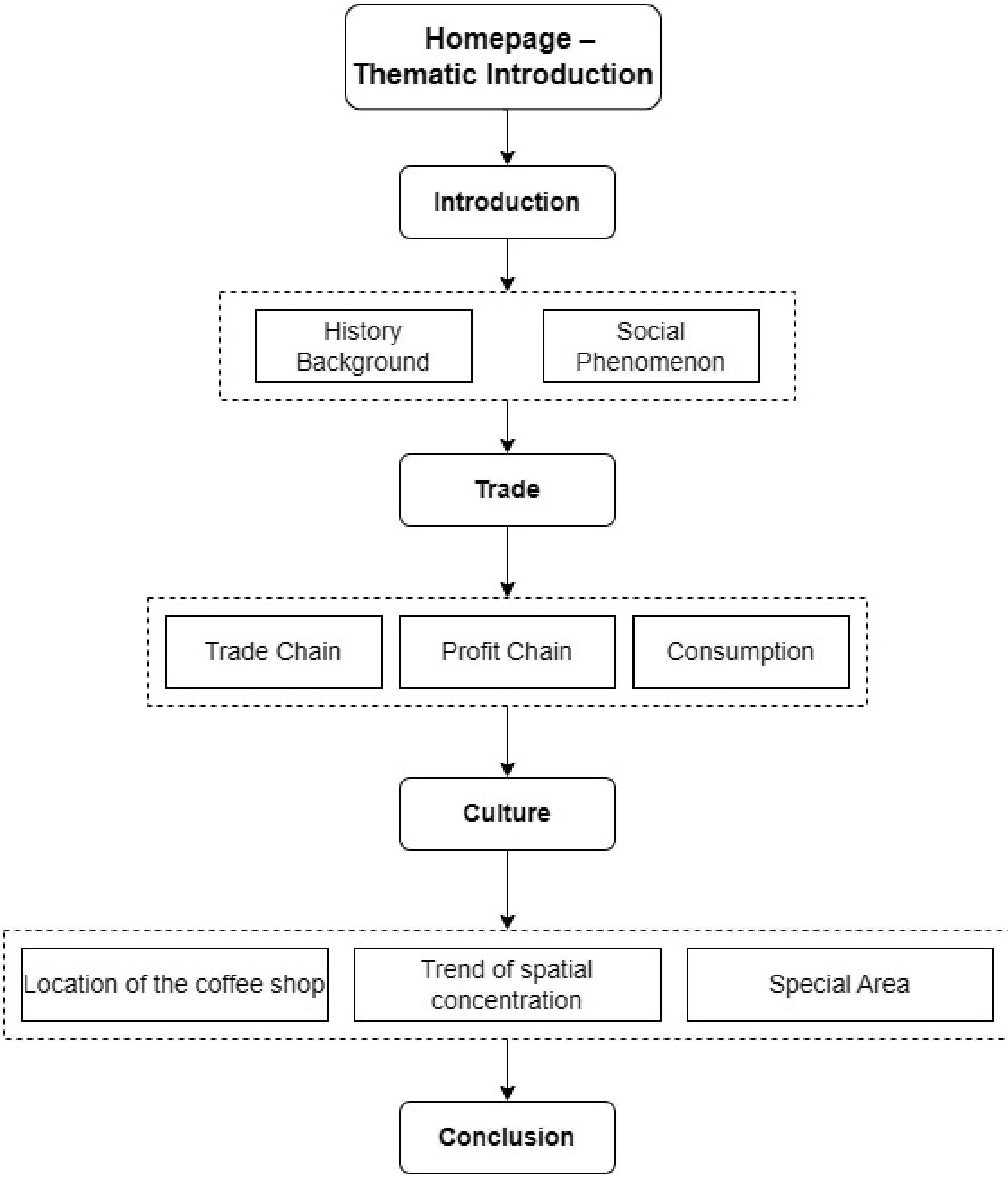
The structure of our project is designed to reflect the multi-scalar nature of coffee as a commodity and cultural form. We adopt a three-part methodological approach that combines symbolic narrative, data-driven storytelling, and spatial interaction.

The home page introduces key concepts through ambient visuals and scrolling animations. The Global Trade section follows a linear narrative, using scroll-triggered transitions and 3D arc visualisations to explore macro-scale flows and value distribution. In contrast, the Urban Cultures section employs a modular map-based interface: users can actively explore spatial patterns in Tokyo and Istanbul through point-of-interest filtering, polygon selection, and interactive diagrams - reflecting the localised and exploratory nature of coffee culture.

This design logic is implemented using a consistent visualisation language, modular JavaScript components, and dedicated visualisation libraries (Globe.gl, D3.js, Mapbox GL JS, Chart.js). The diagram below outlines our workflow and toolset.

[2]:
```
from IPython.display import Image
Image(filename="flowmap.jpg", width=600)
```

[2]:



Category	Method	Tool / Library	Description
Visualisation Methods	Scroll-based symbolic introduction	Custom HTML + CSS	Shows historical and thematic spread of coffee
	3D global trade arc animation	Globe.gl + D3	Depicts origin–destination flows dynamically

Category	Method	Tool / Library	Description
	Value chain breakdown diagram	D3 Sankey	Visualises profit distribution across actors
	KDE heatmap of café clusters	Mapbox GL JS	Maps spatial intensity of café distribution
Interactive Effects	POI toggle by category	Mapbox GL `setFilter()`	Switches among Chain / Independent / Community
	Region-based polygon filter	`queryRenderedFeatures()`	Triggers chart updates on district click
	Background particle animation	Custom Canvas / CSS	Enhances homepage theme experience
	View switching (2D/3D/Flat Earth)	Globe.gl + condition logic	Adapts visual form to section context
	Linked detail pages	Modular HTML pages	Presents micro-level narratives (e.g., Aoyama)
Frameworks & Libraries	3D globe + trade network	Globe.gl, Three.js	Core of animated trade visualisation
	Flow and profit diagrams	D3.js	For Sankey, bar charts, dynamic updates
	High-resolution city mapping	Mapbox GL JS	For polygon + KDE + POI display
	Interactive charts	Chart.js	Renders café-type breakdowns

1.5 Global Trade: From Colonial Commodity to Cultural Mediator

1.5.1 Who grows, and who drinks?

In this section, we use D3.js and Globe.gl to bring our data to life. D3.js powers the histograms and Sankey diagrams, while Globe.gl creates a 3D interactive globe that lets users explore global coffee trade flows.

First, we see that most raw coffee is grown in Global-South countries—Brazil, Vietnam, Colombia, and others—while the biggest importers are in the Global-North, especially the United States, Europe, and Japan.

To show how coffee beans move, we built an animated "fly-line" map. It reveals, for example, that Colombian beans mostly go to the U.S., Indonesian beans feed European markets, and Brazil supplies both regions. Once those green beans arrive in consuming countries, they're roasted and turned into products (think Nestlé or Lavazza). Those finished goods then either stay local or move on to neighboring markets—Germany to France, the U.S. to Canada, and so on.

An interesting pattern appears when you zoom in on European trade data: some countries import a flood of green beans but then export a hefty batch of roasted coffee. That tells you immediately who's built a robust coffee-processing industry. And here's a neat detail: roasted beans weigh less than their unroasted counterparts but sell for much more per kilogram, showing that roasting and branding are where the real extra value lies.

Figure 2. Trade of Raw and Roasted bean

1.5.2 Who makes the money?

The Global Value Chain (GVC) framework shows how every step—from growing and processing to roasting and retail—adds value to a product. But the gains aren't shared equally. In coffee, most of the profit sits with roasters, distributors, and big brands, while farmers see only a tiny slice.

To make this clear, we created a Sankey diagram tracking how the price of one cup of coffee in Germany is split across Brazil's and Colombia's value chains. Hover over each flow to see volume and cash direction. The underlying study found that only about 4% of what you pay reaches the farm. On average, a farmer gets around €0.41 per kilogram of green beans, while the rest of your money goes to roasters, manufacturers, retailers—and hefty VAT and other taxes.

This uneven split highlights a core challenge of GVCs: without fair-trade schemes, cooperatives, or other interventions, farmers remain locked into low-margin stages. They supply raw materials but lack the capital, technology, and market access to move "up the chain" into processing or branding—where the juicy profits hide.

Figure 3. Trade of Raw and Roasted bean

1.5.3 Consumption is culture, too

Bourdieu's symbolic capital theory tells us that prestige and social recognition—what he calls "symbolic capital"—are just as valuable as money. It's not just owning a fancy watch or driving a jet; even something as ordinary as a cup of coffee can carry status.

We built an interactive chart showing coffee habits around the world. You can switch between total national consumption and per capita figures, and compare multiple countries at once. The U.S. leads in overall consumption, with Brazil in second—largely thanks to their big populations. But on a per-person basis the picture flips: Luxembourg tops the list at about 5.3 cups per person per day (or roughly 22 kg per year). Meanwhile, Denmark has the highest average price per cup at around $5.40—most of the priciest markets are in developed countries.

Next, on our globe view we plotted where big coffee chains got their start. Almost all the heavy hitters—Starbucks from the U.S., Costa Coffee from the U.K., Tim Hortons from Canada—hail from Global North countries. They now operate tens of thousands of cafés worldwide. Coffee-producing nations rarely create brands of similar scale. Even when they do, their café networks tend to be small and local.

According to Consumer Culture Theory (Arnould & Thompson, 2005), consumption is a key way people build and express identity. In many developed cities, coffee shops are associated with "creative professionals" and "white-collar" lifestyles. In most producing countries, however, coffee is still seen mainly as a basic drink or export crop—not yet a symbol of urban culture or social prestige. On top of that, lower disposable incomes, less urban infrastructure, and fewer specialty cafés make it harder for local consumers to join the high-end coffee scene. All of this keeps per-capita consumption in the Global South well below Global-North levels.

Figure 4. Trade of Raw and Roasted bean

1.6 Urban Grounds: Coffee as City Practice

We selected Tokyo and Istanbul as contrasting cases to explore how café geographies reflect distinct urban logics. Though vastly different in history, form, and tempo, both cities reveal how coffee is embedded in production structures, spatial rhythms, and cultural expectations.

By comparing minimalist Tokyo with textured Istanbul, we highlight how café distributions articulate local practices — not just as consumer spaces, but as spatial expressions of each city's internal network of mobility, memory, and meaning. This contrast affirms our broader theme: that coffee traces the urban network not only through global flows, but through everyday patterns of pause, movement, and identity.

1.6.1 Tokyo: Precision and Pause

In Tokyo, coffee is not loud — it is precise, minimal, and deeply integrated into the rhythms of urban life. Our visualisation explores how café typologies and spatial practices articulate Tokyo's unique blend of efficiency, ritual, and aesthetics.

We begin with a city-scale interactive map that classifies cafés into four categories: Chain, Independent, Community/Old-fashioned, and Featured. Using Mapbox GL JS, we overlay point data with a heatmap and polygon boundaries of city districts, allowing users to filter layers and examine density clusters. A dynamic bar chart updates upon polygon selection, revealing the distribution of café types in each administrative unit. This structure visualises Tokyo not only as a consumption landscape, but as a differentiated practice space.

Café distribution patterns suggest a spatial logic tied to Tokyo's functional zoning: chain cafés concentrate near major transport hubs like Shinjuku and Ikebukuro; independent cafés flourish in creative and residential areas such as Setagaya; community cafés are sparsely distributed, often found in older districts with strong neighbourhood identities. These insights resonate with Warde's (2005) concept of consumption as embedded practice — not merely an act of choice, but a routine shaped by infrastructures, mobility, and social expectations.

To deepen this narrative, we present a micro-map of Aoyama, a subdistrict along the Omotesando cultural corridor. Here, selected POIs are linked with hover-based popups, while metro stations activate buffer zones highlighting pedestrian café clusters. Aoyama's coffee network, dominated by quiet independent spaces and curated interiors, reflects the aesthetics of control, calm, and craft. This micro-network illustrates Oldenburg's (2023) "third place" not as a loud social hub, but as a subtle node of decompression within an accelerated city.

In Tokyo, coffee mediates a practice of pause — a ritualised intermission between movement and stillness, encoded not only in beverages, but in space itself.

Figure 5. Urban Page: Tokyo Interactive Map

Aoyama: Micro-network and Design Culture

Aoyama, a sophisticated and design-conscious neighbourhood on the Omotesando axis, offers a unique glimpse into Tokyo's network of micro-cafés. In this sub-page, we've selected a hand-picked selection of cafés, including Blue Bottle, Café Kitsuné and Toraya, which embody a spatial aesthetic where minimalism meets locality, blending architecture, branding and ritual.

In addition to the visual choices, we added a metro-based buffer zone analysis. Clicking on the underground icon reveals a 300 metre pedestrian cluster showing how the café fits in with the traffic and rhythm. The axial layer covers the creative spine of Tokyo, suggesting a structured cultural corridor. In Aoyama, the café is not just a stopping point, but a coordinated node in the city's design economy, lifestyle patterns, and the structure of the 'third space' (Oldenburg, 2023). This sub-network shows how consumption, space and symbolism are intertwined in the everyday urban fabric.

Figure 6. Urban Sub-Page: Aoyama Interactive Map

1.6.2 Istanbul: Layered Café Histories

Coffee arrived in Istanbul in the mid-16th century, ushered in through Yemeni ports and transformed into an Ottoman institution. From the kahvehane of divan poets and philosophers to the espresso bars of today's waterfronts, coffee here has always been more than a drink — it is an urban rhythm, a social script, and a cultural bridge across time.

Today, Istanbul's café landscape is vast and differentiated: among over 2,900 mapped cafés, independent ones dominate with 2,476 entries, far surpassing 173 chains and 322 community-style venues. This numerical pattern hints at a cultural texture that resists full corporatisation, while embracing both global formats and local expressions.

Our visualisation, built with Mapbox, reveals the spatial logic behind these types. Chain cafés cluster along the city's infrastructural spines — notably in Beşiktaş–Levent, Kadıköy, and Bakırköy — following metro lines, ferries, and commercial hubs. Their presence is tied to transit and transaction, embodying what Bookman (2014) frames as "branded sociality" engineered for speed and familiarity. In contrast, independent cafés flourish in a belt-like pattern across creative and residential zones — Moda, Nişantaşı, and Şişli — often near universities, galleries, and bohemian enclaves. These cafés, as Dolbec et al. (2022) suggest, construct "value worlds" through curated interiors, niche menus, and aestheticized routines. Community cafés, though fewer, appear regularly in the city's outer rings — Avcılar, Kartal, Pendik — sustaining slower, more localised rhythms rooted in memory and daily ties.

This typological and spatial variation mirrors Istanbul's dual urban identity — east and west, fast and slow, nostalgic and experimental. The "Beyoğlu" button invites viewers into a district where antique bookshops, jazz cafés, and tattoo parlours share narrow alleys with Syrian tea rooms — staging a conversation between the imperial and the improvised.

Unlike Tokyo, where cafés express minimalism and ritualised stillness, Istanbul's café culture is dense and expressive — a living archive where the past percolates through every cup poured.

Figure 7. Urban Page: Istanbul Interactive Map

Beyoğlu: Micro-network and Cultural Heritage

We focus on Beyoğlu for its rich intersection of culture, tourism, and contemporary urban life. As one of Istanbul's key modern districts, it hosts the Beyoğlu Cultural Route — a curated pedestrian corridor linking museums, theatres, historic buildings, and public squares. Along this axis, cafés become cultural signposts.

The cafés here are primarily independent, characterised by small-scale, locally owned shops that reflect Istanbul's layered heritage. Many specialise in Turkish coffee and traditional brewing rituals, blending architectural nostalgia with everyday hospitality. In Beyoğlu, you can even find Turkish coffee in a Starbucks, where global branding bends to local tradition — a vivid example of cultural layering.

Spatially, café distribution tightly aligns with the cultural trail, forming a walkable micro-network where each venue echoes Ottoman memory and urban reinvention. Beyoğlu's cafés are not just stops for caffeine, but curated encounters between past and present — places where storytelling, style, and spatial rhythm converge.

Figure 8. Urban Sub-Page: Beyoğlu Interactive Map

1.7 Design and Technical Challenges

1.7.1 Narrative Structure and Page Architecture

The homepage was designed to serve as a thematic prelude to the wider narrative structure of the project, requiring a balance between visual storytelling and performance efficiency. Key technical challenges centered on implementing custom animations, scroll-triggered transitions, and responsive layout control, without relying on heavy external frameworks.

Site Architecture and Navigation Logic

The webpage employs a section-based single-page architecture, augmented by dropdown navigation with internal anchor links and external HTML file routing. The navigation bar integrates dropdown-wrapper classes that support submenu access for multi-city cultural views (e.g., Tokyo and Istanbul):

[ ]:

```
<li class="dropdown">
  <div class="dropdown-wrapper">
    <a href="#section4">Culture </a>
    <ul class="dropdown-menu">
      <li><a href="urban_istanbul.html">Istanbul</a></li>
      <li><a href="urban_tokyo.html">Tokyo</a></li>
    </ul>
  </div>
</li>
```

This allows smooth transitions between macro-level thematic sections (Home, Trade, Culture) and micro-level subpages, preserving spatial context across views.

Scroll-Based Transitions and Globe Interaction

Inspired by the interactive layering of Blueyard's homepage, this site implements dynamic scroll-triggered transitions that modify both visual states and background animations. Scroll stages are computed using getBoundingClientRect() and mapped to different classList states that transform the .earth-container position, scale, and visibility.

A key technical feature of the homepage is the earth-container element — a visual anchor that dynamically shifts position, scale, and visibility as the user scrolls. This logic is used to align visual states with narrative transitions between sections such as Origin, Trade, and Culture.

```
if (Math.abs(section3Top) < window.innerHeight / 2) {
  earthContainer.classList.add("scrolled-3");
}
```

These classes are predefined in CSS:

```
.earth-container.scrolled-3 {
  bottom: -20%;
  left: 20%;
  transform: translate(0, 30%) scale(1.2);
}
```

In parallel, the Earth switches modes via class toggles:

```
earth2D.classList.add("hidden");
earth3D.classList.add("visible");
canvas.classList.remove("hidden");
```

Each stage activates a combination of 2D/3D Earth switching, particle diffusion canvas effects, and visual cues such as expand-fade-out animations for storytelling emphasis. The structure maintains a non-linear but guided narrative path, allowing visual rhythm to echo the theme of mobility in the coffee trade.

Visual and Cultural Styling Principles

The visual language of the homepage draws from coffee aesthetics and cultural tactility. The background uses a multi-stop gradient (linear-gradient) that transitions from dark-roast browns to cream hues, evoking the roasting process and grounding the page in a warm materiality:

```
background: linear-gradient(to bottom,
#1A120D 0%, #281c11 20%, #57453b 30%, #837064 40%,
#b9a99c 50%, #e3dfd7 60%, #d5d2c9 70%, #ebebe3 80%, #b29e8e 100%);
```

The homepage features two interactive effects:

- Falling coffee beans, created via randomized DOM injection and keyframe animation
- Canvas-based particle diffusion, simulating a halo-like spatial metaphor around the rotating Earth

These are implemented without external libraries:

```
img.style.left = `${Math.random() * 100}%`;
img.style.animationDuration = `${6 + Math.random() * 6}s`;
ctx.arc(x, y, p.size, 0, Math.PI * 2);
ctx.fillStyle = `rgba(235, 223, 192, ${p.alpha})`;
```

Together, these elements establish a sensory gateway that reflects the cultural and material dimensions of coffee, while reinforcing the global-to-local thematic narrative.

Figure 9. Web-Homepage

1.7.2 Tools and Visualisation Techniques

3D

The 3D visualisation was mainly applied on the trade flow demostration. We use **Three.js** together with **Globe.gl** to build a fully interactive 3D map that supports smooth animations and click-to-view details. **D3.js** handles all data filtering and draws the accompanying histograms.

This part have three section, each section contain a 3D inerfact and a side bar. The 3D part will be share by three section, since no much data and logic change between these section. When you scroll down the sidebar, the even listener in `script.js` will detect the change and refresh the data shown on the 3d layer.

On the globe itself, we render "fly-lines" to trace coffee trade routes and a hypsometric layer to visualize brand and consumer density around the world. Because a 3D map can only display so much at once, we've added a fixed sidebar in the HTML to host explanatory text and charts. Users can click any arc or polygon on the globe to drill down into country- or route-specific data.

[ ]:
```
<figure style="text-align: center;">
  <img src="3d.png" width="80%">
  <figcaption><strong>Figure 10.</strong> 3D interface</figcaption>
</figure>
```

Urban

The Urban Culture pages (Tokyo and Istanbul) share a consistent spatial architecture built using **Mapbox GL JS** for mapping and **Chart.js** for responsive statistics. These components are embedded within modular HTML templates to ensure consistency across subpages such as `urban_tokyo.html` and `urban_tokyo_aoyama.html`.

Instead of repeating logic per page, we developed shared **JavaScript modules** for key functions, including category-based POI filtering, polygon-based aggregation, and heatmap toggling. Each map component inherits common behaviours through encapsulated function calls (e.g. `applyDistrictFilter`, `renderCafeChart`), while allowing for flexible extension at the sub-district level.

In parallel, we adopted a **component-based CSS approach** to maintain visual consistency. Sidebar cards, toggle buttons, and info panels reuse the same style classes across pages. This modularity enables us to easily scale the project by plugging new layers, cities, or interactions into the existing system without major refactoring.

1.7.3 Layer Logic and Interaction Design

home page

The homepage interaction is structured around a scroll-triggered layer system that coordinates visual states across spatial sections. Central to this is the `.earth-container`, which hosts both a rotating 2D Earth and a simulated 3D globe image, along with a canvas-based particle layer. These three layers are dynamically toggled based on scroll position, enabling immersive transitions that match the thematic narrative of each section.

The logic leverages `getBoundingClientRect()` to detect section visibility, applying semantic CSS class states such as `.scrolled-2`, `.scrolled-3`, etc., which control positioning, scale, and visibility:

[ ]:
```
if (Math.abs(section3Top) < window.innerHeight / 2) {
  earthContainer.classList.add("scrolled-3");
}
```

These states are visually mapped in CSS, enabling scene-specific behavior:

[ ]:
```
.earth-container.scrolled-3 {
  bottom: -20%;
  left: 20%;
  transform: translate(0, 30%) scale(1.2);
}
```

Visibility transitions between layers (`earth`, `earth-fake3d`, and `#coffee-halo`) are also handled in JavaScript, with fade-in/out and expansion animations timed to scroll depth. This system constructs a non-linear visual narrative where the globe metaphor evolves across sections—functioning as background, focal point, or symbolic residue depending on context.

World Trade

Under the hood, our coffee trade-flow dataset comes from Chatham House (which provides exporter, importer, commodity, and value). We enriched it by adding latitude/longitude for each location and a "tradeFlow" field (e.g. "Brazil–USA"). Globe.gl then reads those geocoordinates to draw arcs on the Earth's surface, with each line's color and width driven by attributes like commodity type and shipment volume.

In addition, we incorporated a Solidaridad study of the German coffee market's value chain to build a Sankey diagram showing how end-consumer spending flows through each segment of the chain. The diagram uses distinct colors to represent different value flows. We also leveraged data on coffee chain brands and consumption figures from the Cafely website to produce choropleth maps that, for each country, visualize both the number of chain-brand outlets and total consumption levels.

For data interaction we rely on dropdown menus and checkboxes, letting users choose the year, commodity type, or category they want to explore. For example, you might select "green beans – 2020" and then view the top five importers by either USD value or tonnage, with results instantly plotted as a histogram.

Urban Culture

The *Urban Culture* visualisation focuses on how cafés manifest social practices within urban form, particularly in Tokyo and Istanbul. This section uses **Mapbox GL JS** to build a spatially layered map that integrates point-based café data, administrative polygons, kernel density estimation (KDE) overlays, and interactive information panels.

We designed three core types of visual layers:

- **POI layer** (`cafe-poi`)
  Individual cafés are rendered as circle markers, categorised into *Chain*, *Independent*, and *Community/Old-fashioned*. The visibility of each type is controlled via checkboxes, using `setFilter()` to dynamically update the map based on user selection.
- **Heatmap layer** (`cafe-kde`)
  A smoothed KDE-style heat layer is toggled separately and can be activated by café type.

The intensity dynamically reflects POI density at current zoom levels, helping to highlight urban clustering patterns.

- **Polygon layer** (`district-polygons`)
  Administrative boundaries are used both for filtering and triggering statistics. On polygon click, we query café points within that boundary using `queryRenderedFeatures()` and push aggregated data (e.g., counts per type) to an external chart (via *Chart.js*).

In terms of interaction design, each polygon stores a unique `district_id` which is matched against café metadata. The selected polygon also triggers a change in sidebar content and text panel, linking spatial selection with narrative updates.

To manage interaction complexity, we structured the logic into modular functions:

- `toggleCafeLayer(type)` – controls POI visibility by category
- `activatePolygonFilter(id)` – applies spatial filter for selected district
- `updateChartData(features)` – aggregates point data for charts
- `resetAllLayers()` – clears current state and restores base view

Through these coordinated layers and states, we transform a static city map into a responsive cultural landscape. This enables users to "read" urban coffee spaces as expressions of daily life, rhythm, and spatial meaning — in line with Oldenburg's (2023) concept of *third place* and Warde's (2005) theory of *practice systems*.

1.7.4 Technical Challenges and Solutions

This section outlines the design architecture, interactive logic, and technical problem-solving approaches behind our visualisation system. Our website consists of multiple narrative modules — including the homepage, global trade, and urban culture — each supported by custom interaction mechanisms and tailored visual components.

To structure this chapter clearly, we divide the discussion by section (*e.g.*, Homepage, World Trade, Urban Culture). For each, we begin with a **table summarising key technical challenges and their corresponding solutions**, covering aspects such as map-layer coordination, performance, responsive design, and data communication.

Following the table, we expand on **a selection of representative challenges** using function-level explanations and code blocks. These are chosen to highlight both implementation logic and our group's approach to engineering clean, user-focused solutions within a multi-layered web environment.

Home Page

A key challenge in the homepage design was achieving stylistic consistency between 2D and 3D visual elements. To maintain visual coherence across sections, a custom-drawn 2D Earth image was paired with an artistically stylised 3D globe, both adjusted in hue and texture to align with the project's overall coffee-toned aesthetic. This ensured that transitions between narrative sections—such as from map-based exploration to animated global flows—remained fluid and thematically unified.

In terms of interaction, the homepage required synchronised scroll-based transitions for multiple layers: 2D Earth, simulated 3D globe, and canvas-based halo. This was achieved using `getBoundingClientRect()` to detect section thresholds, triggering class-based transformations that reposition, scale, and fade elements accordingly.

Performance constraints posed another technical hurdle. To avoid external dependencies, both the coffee bean animation and halo particle system were implemented using vanilla JavaScript and `<canvas>`. The system features lightweight memory management with alpha decay and conditional deletion:

[ ]:
```
p.alpha -= 0.005;
if (p.alpha <= 0) {
  particles.splice(i, 1);
}
```

Finally, canvas responsiveness was handled via dynamic resizing logic to ensure stability across devices:

[ ]:
```
canvas.width = earthContainer.offsetWidth;
canvas.height = earthContainer.offsetHeight;
center.x = canvas.width / 2;
```

World Trade

Enhence the Performance

Originally, we were creating a brand-new Globe.gl instance for each chapter and re-rendering every layer from scratch, which quickly overwhelmed the browser. To fix this, we refactored so that the globe is instantiated just once, on first load, with all of the data layers already in place. Then, when the user moves between sections, we no longer recreate the map—instead we simply toggle layer visibility.

[ ]:
```
//giving all section a layer state by function, when it goes to different␣
↪section, different function will be activated.
function showBordersFlows() {
  globe
    .arcsData(topData);
  selectorBox.style.display = 'block';
} //section 1 status, only arc will be shown

function showBordersOnly()
//...same as section 1 ...


// 2. map the section
const sectionActions = {
  scrollContent1: showBordersFlows,
  scrollContent2: showBordersOnly,
  scrollContent3: showFlowsOnly
};
```

```
// 3. Observer the change of section
const sidebar = document.getElementById('sidebarContent');
const observer = new IntersectionObserver(entries => {
  entries.forEach(entry => {
    if (entry.isIntersecting && sectionActions[entry.target.id]) {
      sectionActions[entry.target.id]();
    }
  });
}, { root: sidebar, threshold: 0.5 });

['scrollContent1','scrollContent2','scrollContent3']
  .forEach(id => {
    const el = document.getElementById(id);
    if (el) observer.observe(el);
  });


//4
const globe = Globe()
  .globeImageUrl('globesurface3.png')
  .backgroundColor('rgba(0,0,0,0)')

... other code for drawing earth ...

Promise.all([
    d3.json("world.geojson"),
    d3.csv("combined_tradeflow.csv"),
    d3.csv("List_of_coffeehouse_chains_3.csv"),
]).then(function([boundaryData, merged_flow, brands]) { //... code for filter, 
 ↪fly-line ...}
```

Dealing the conflict

In both Part 1 and Part 3's histograms, the filtering logic became so intertwined that the same dataset was inadvertently filtered twice. Variables holding filtered results would get re-filtered by subsequent operations, causing bars to disappear or display incorrect values.

we split data loading by section and encapsulated each chart's entire workflow—loading, filtering, aggregating, and drawing—into its own function. Every time the user switches sections, we call the relevant function afresh on the original dataset, preventing any "double filtering." Since our data is relatively small, the slight overhead from re-running the same logic is negligible compared to the benefit of guaranteed accuracy:

[ ]:
```
// Encapsulation the graph process
function renderChart(data, metrics) {
  // clean the old graph
  d3.select('#barChart').selectAll('*').remove();
```

```
  // ...the code for drawing and adjusting graph...

}

// load the data
d3.csv('coffee_consumption_cleaned.csv', d3.autoType).then(data => {
     // create a tooltip
  tooltip = d3.select("body")
  .append("div")
  .attr("class", "tooltip")
  .style("opacity", 0);
  // function for read the checkbox options
  function getMetrics() {
    const ms = d3.selectAll('input[name="sortOption"]:checked')
      .nodes().map(n=>n.value);
    return ms.length? ms
           : [ d3.select('input[name="sortOption"]').node().value ];
  }

  //Binding the change even, each time you change the option, it will read and
 ↪filter the data and render the chart again
  d3.selectAll('input[name="sortOption"]')
  .on('change', () => {
    renderChart(data, getMetrics())
    ;
  });

  // render the graph
  renderChart(data, getMetrics());
});
```

The trade flow section integrates three types of statistical visualizations: bar charts for trade flows, exporters, and importers; a Sankey diagram for value distribution; and multi-indicator bar plots for consumption. Each posed distinct interaction challenges.

The first issue involved managing mutually exclusive views within a shared chart container. This was resolved through `classList` toggling based on button clicks. A mapping logic hides inactive charts and updates only the selected dimension:

[ ]:
```
Object.values(panels).forEach(panel => panel.classList.add('hidden'));
panels[view].classList.remove('hidden');
```

Second, the data update logic needed to respond dynamically to multiple inputs—year, commodity type, and value/weight radio switches—without redundant redraws. This was handled via a unified ·updateGraphs()‘ function, which reads current filters and rerenders only the relevant view.

The most complex challenge involved the Sankey diagram. Given its multi-node, multi-layer structure, hover interactions needed to highlight both direct links and connected nodes. This was achieved by linking opacity transitions to both link and node focus:

```
[ ]: link.filter(d =>
       d.source.name === nodeData.name ||
       d.target.name === nodeData.name
     ).attr("opacity", 1).raise();
```

These solutions ensured that statistical layers remained visually distinct but contextually unified—enhancing legibility while aligning with the broader narrative logic of global coffee flows.

Urban Culture

Challenge	Solution
Layer conflict and unintended click triggers Clicking on overlapping layers (e.g. polygon vs. POI) triggered incorrect responses	Used `map.queryRenderedFeatures(e.point, { layers: [...] })` to explicitly filter for intended layer targets and manage click priority
Filter state mismatch after fast toggling Layer and chart updates fell out of sync when users toggled filters quickly	Centralised current filter logic in a `currentPolygonFilter` variable; all layer and chart updates referenced this state
Chart.js rendering fails on first load Bar chart does not appear or mis-sizes when polygon is first clicked	Wrapped `chart.render()` or `chart.resize()` inside `setTimeout(..., 400)` to ensure DOM readiness before rendering
KDE heatmap toggle lags or appears unresponsive Especially when combined with POI filtering	Debounced filter updates using a timeout throttle, and isolated `setLayoutProperty` from intensive `setFilter()` updates
Aoyama metro buffer click conflicts with axis interaction Two clickable layers overlapped (buffer zones vs axis line)	Used `queryRenderedFeatures()` with distinct layer filters to check which geometry was clicked, prioritising metro logic
Mobile layout caused overlapping panels and clipped maps Sidebar covered map elements or cut off charts	Used CSS `@media` queries to shift from side-by-side `grid` to top-bottom `flex` layout on small screens (<768px)

Resolving Click Conflicts Between Layers

One of the most common issues we faced in Urban Culture was overlapping clickable layers. In Aoyama, for example, users could click either on the metro buffer or on the axis line. Without filtering, both triggers responded simultaneously.

We solved this by using `map.queryRenderedFeatures()` with an explicit `layers` parameter to determine exactly which layer the user clicked:

```
[ ]: map.on('click', (e) => {
       const features = map.queryRenderedFeatures(e.point, {
         layers: ['metro-layer', 'axis-line']
       });
```

```
  if (features.length) {
    const clickedLayer = features[0].layer.id;

    if (clickedLayer === 'metro-layer') {
      renderBufferZone(features[0]);
    } else if (clickedLayer === 'axis-line') {
      showNarrativePanel(features[0]);
    }
  }
});
```

Managing Filter State with `currentPolygonFilter`

When users filtered POIs and clicked between districts, the layers sometimes went out of sync. We centralised state handling through a global variable currentPolygonFilter, which all update functions referenced:

[ ]:
```
let currentPolygonFilter = null;

function activatePolygonFilter(id) {
  currentPolygonFilter = id;

  map.setFilter('cafe-poi', ['==', ['get', 'district_id'], id]);
  updateChartData(getPointsInPolygon(id));
  updateInfoPanel(id);
}
```

This architecture avoided race conditions and maintained a clean state flow across the chart, info panel, and POI map.

Handling Chart Rendering Errors

Chart.js occasionally failed to render properly when triggered by the first polygon click — often due to the chart container not being visible yet. Our fix used a minimal `setTimeout` delay to defer rendering until the container was fully loaded:

[ ]:
```
setTimeout(() => {
  chart.data = formattedData;
  chart.update();
}, 400);
```

This ensured consistent rendering without overcomplicating the layout logic.

Summary

In the Urban Cultures section, we adopted a modular and defensive coding strategy - resolving interaction conflicts through explicit queries, managing state globally, and ensuring visual consistency through rendering control. These choices allowed us to scale across multiple urban environments (e.g. Tokyo and Istanbul) while maintaining a responsive and consistent user experience.

1.8 Conclusion: A Global Network in a Cup

This project set out to explore how coffee, as both a global commodity and cultural object, reveals the networks that shape our cities and everyday lives. Through layered visualisations — from trade flows and value chains to micro-level café distributions — we found that coffee operates as a mediator between global systems and local practices.

It encodes rhythms of modern urban life: efficiency and ritual in Tokyo, hybridity and heritage in Istanbul. Cafés are not just points on a map; they are third places (Oldenburg, 2023), practice sites (Warde, 2005), and social anchors that reflect broader cultural structures. By mapping where coffee is grown, consumed, and experienced, we exposed spatial asymmetries and symbolic differentiations often hidden in plain sight.

Our use of narrative-based, interactive visualisation offered both expressive power and design challenges. The integration of theory and code demanded balance — between clarity and complexity, structure and openness. Still, the digital medium allowed us to blend data and storytelling into an exploratory platform.

Future iterations could incorporate real-time data, crowd-sourced café experiences, or comparative city modules. But fundamentally, this project reaffirms that even a simple drink like coffee can visualise the global through the local — one map, one street, and one story at a time.

1.9 Data Sources

Name	Type	Time	Content	Link
United States Department of Agriculture	Trade / Production	2018–2022	Coffee import/export volume and value	USDA
FAOSTAT – Crops and Livestock Products	Production Statistics	2018–2022	Coffee production by country	FAO
Gross revenue from coffee production in Brazil	Economic Indicator	2013–2024	Revenue trends over time	Statista
Brazil Coffee – Supply Chain Data	Supply Chain	2018	Traceable export chain info	Trase
Cafe POI	POI Dataset	2024	Global café locations and metadata	OSH
MAPBIOMAS Collections	Land Use / Satellite	2018–2022	Land cover change in Brazil	Mapbiomas
Resource Trade Earth	Global Trade	2022	Coffee trade flows by value	Chatham House
City Boundary Data	GIS / Urban	2024	Administrative boundaries	via OSMnx

1.10 References

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