# VAST Challenge 2022
# Challenge 2

Matteo Arrigo  Giuseppe Galardi  Nicola Noventa

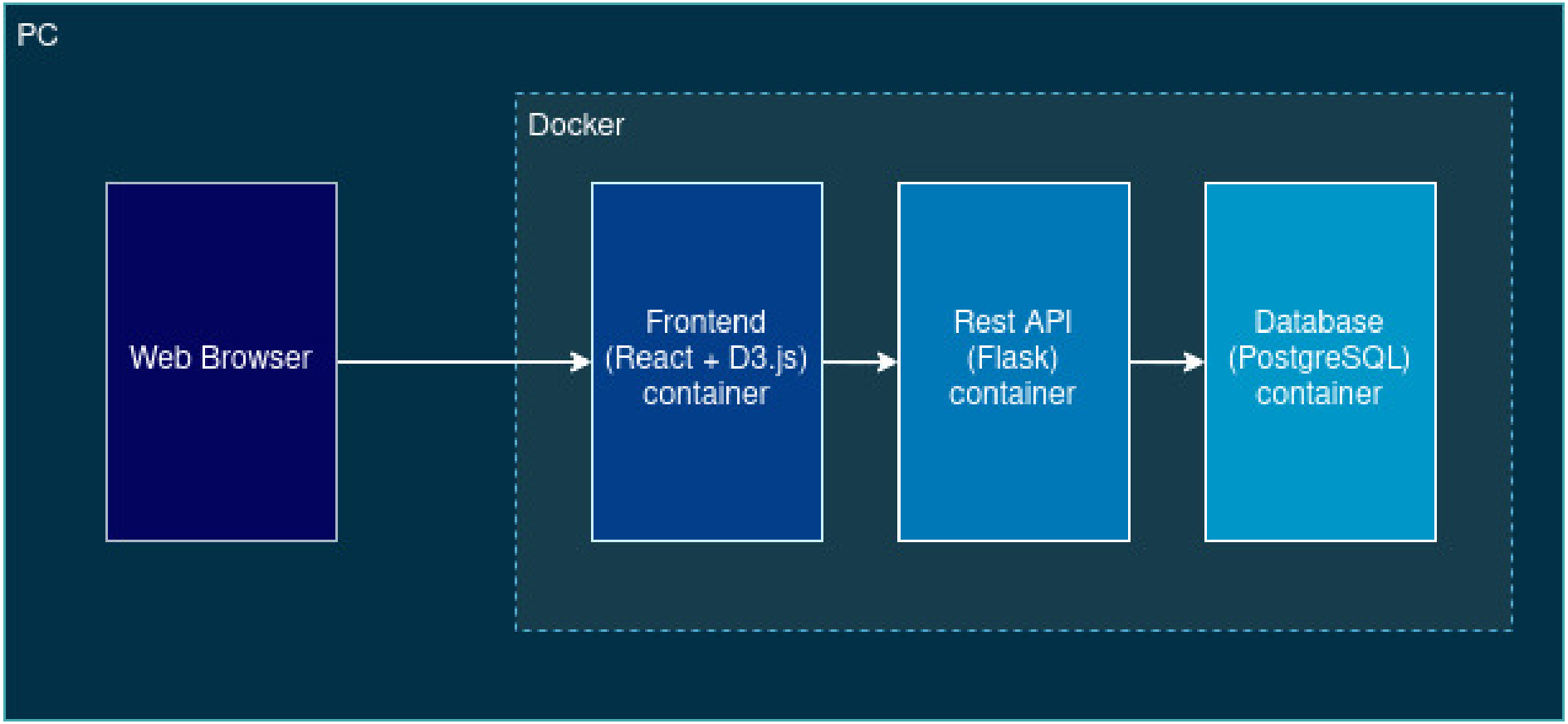
# Challenge 2: Patterns of Life

**Objective:** Use visual analytics to characterize daily routines, travel patterns, and temporal changes within the fictitious city of Engagement.

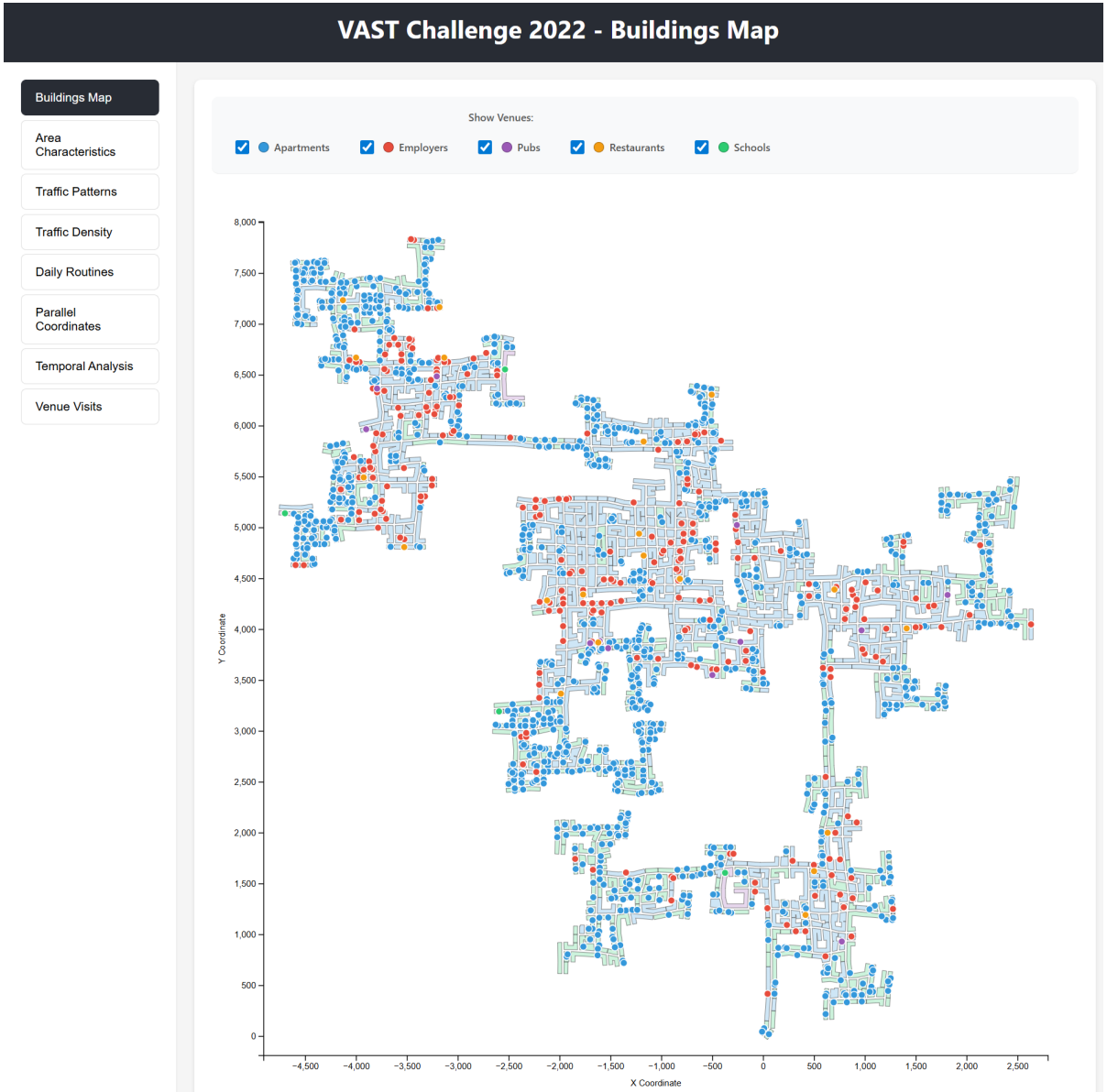
## Key Analytical Tasks

- **City Characterization:** Identify distinct areas of the city based on volunteer demographics and data.
- **Traffic & Bottlenecks:** Locate the busiest areas and identify potential traffic hazards.
- **Daily Routines:** Analyze and contrast the daily patterns of two representative participants.
- **Temporal Changes:** Examine how city patterns evolve over time and across seasons.

# Infrastructure

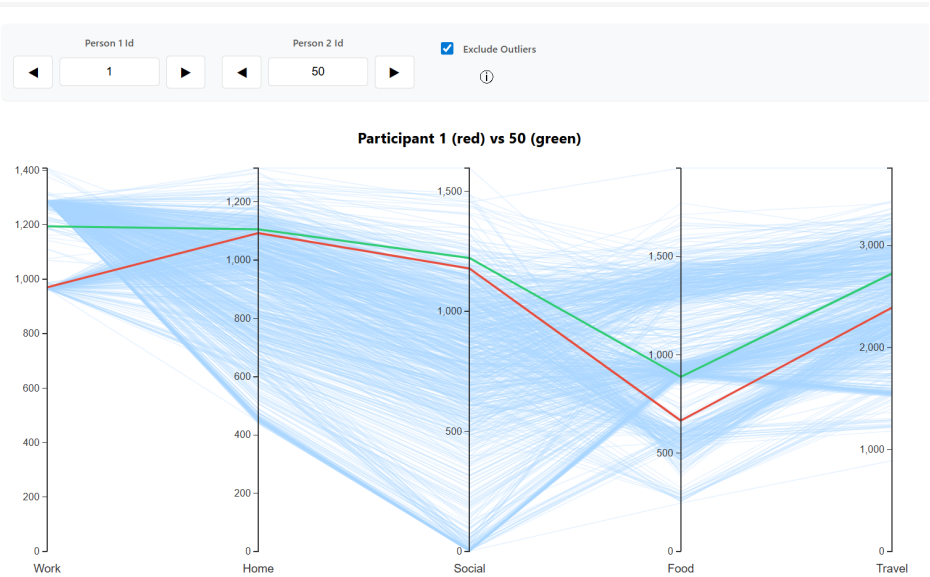


# Buildings Map




**Purpose:** Provides a spatial baseline for understanding the city's structure and serves as reference context for all subsequent visualizations.

# Parallel Coordinates Plot




**Purpose:** Baseline for multidimensional analysis across participant activity patterns

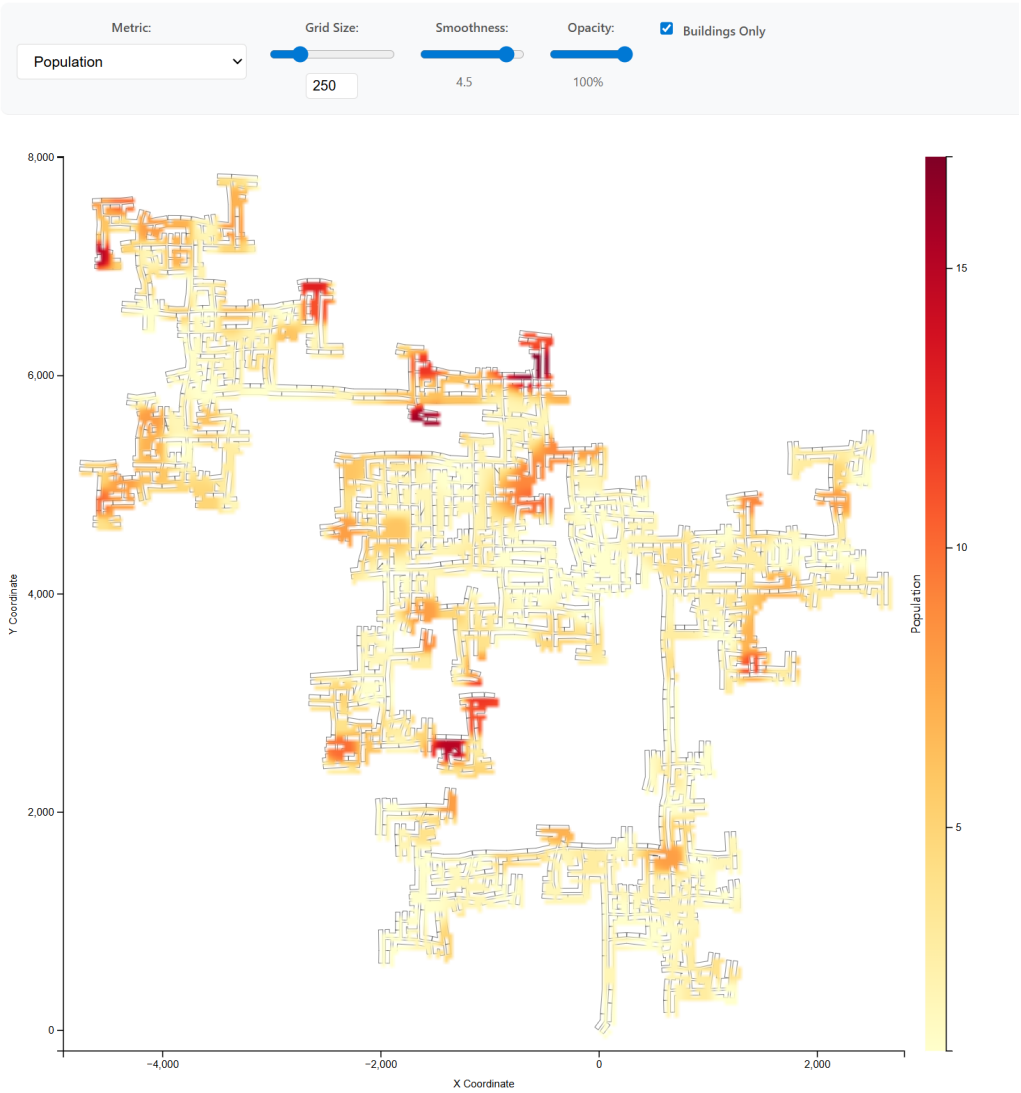
## Five dimensions

- **Work**: work-related activities, including workplace visits and work–home commuting
- **Home**: time spent at home, based on apartment venue visits
- **Social**: social and recreational activities, including pub visits and recreation-related travel
- **Food**: food-related activities, including restaurant visits and eating-purpose travel
- **Travel**: total mobility, aggregating all recorded travel activities

# Question 1

Assuming the volunteers are representative of the city's population, **characterize the distinct areas** of the city that you identify.

# Area Characteristics Visualization




- Reveals spatial distribution patterns of population and activity
- Shows intensity variations through color-coded heatmap visualization
- Enables comparison of different metrics (population, activity) across grid cells

# Example: Population and Housing Patterns

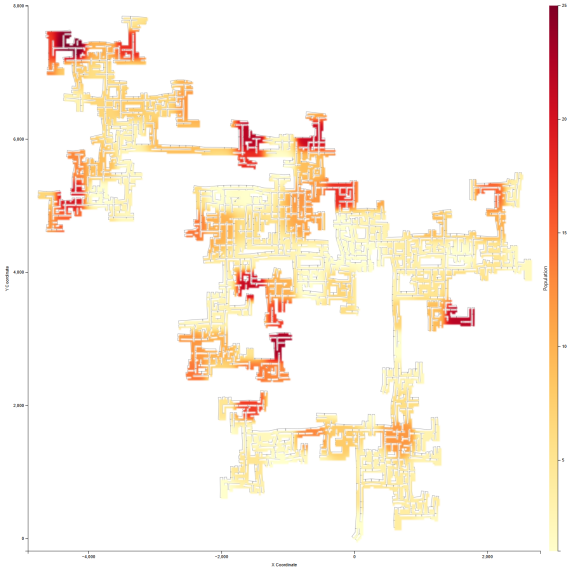


Fig.: Population Density

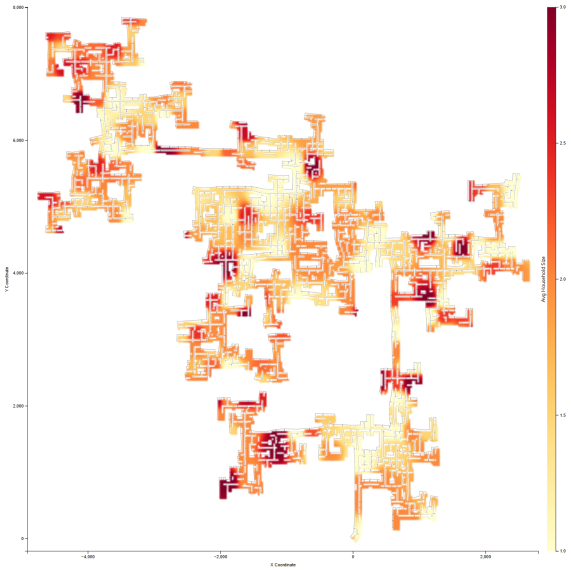


Fig.: Average Household Size

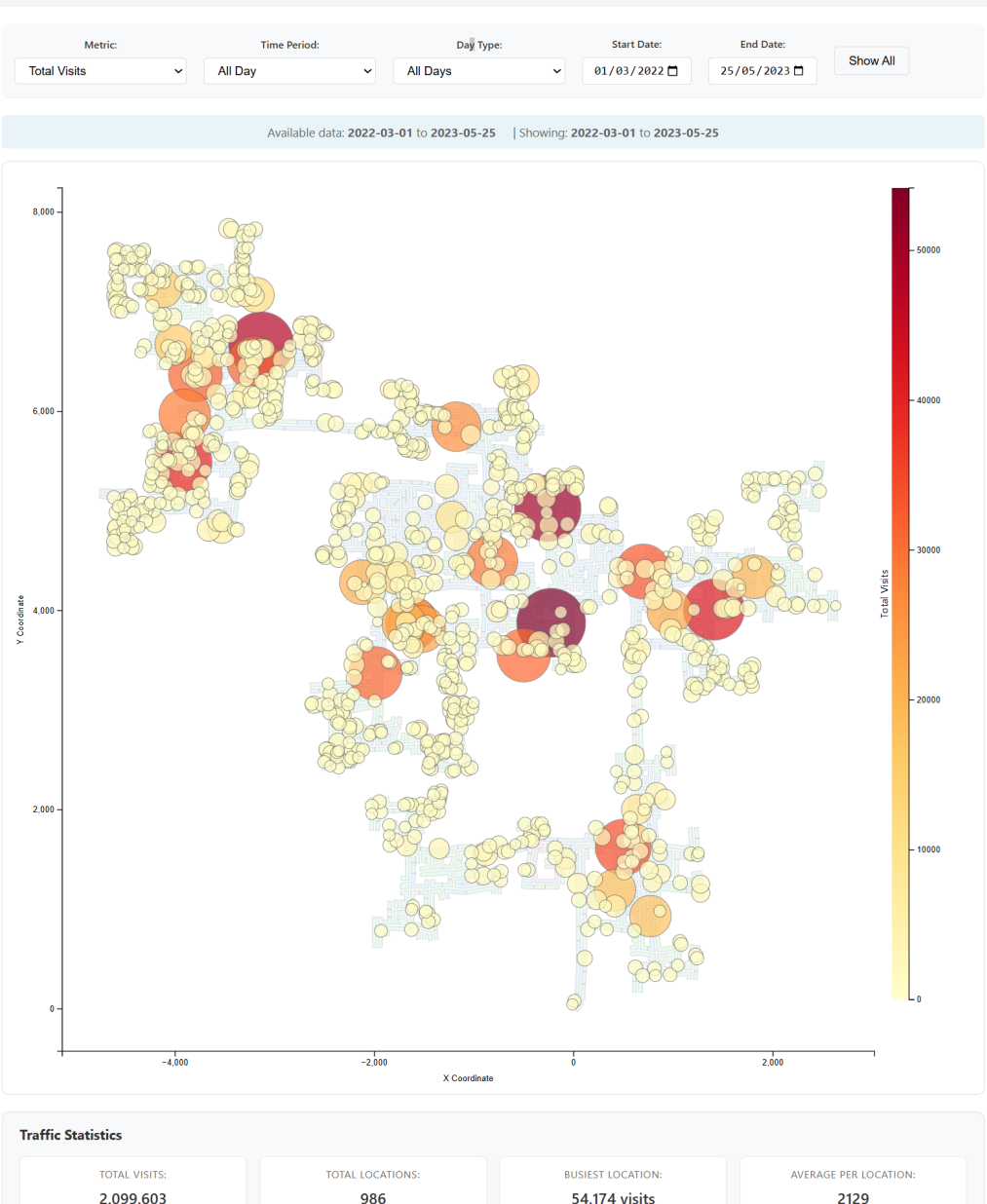
- Correlation between high population density areas and apartment building concentration.
- Larger homes correspond to lower density, while smaller homes cluster in denser areas.

# Question 2

Where are the **busiest areas** in Engagement?

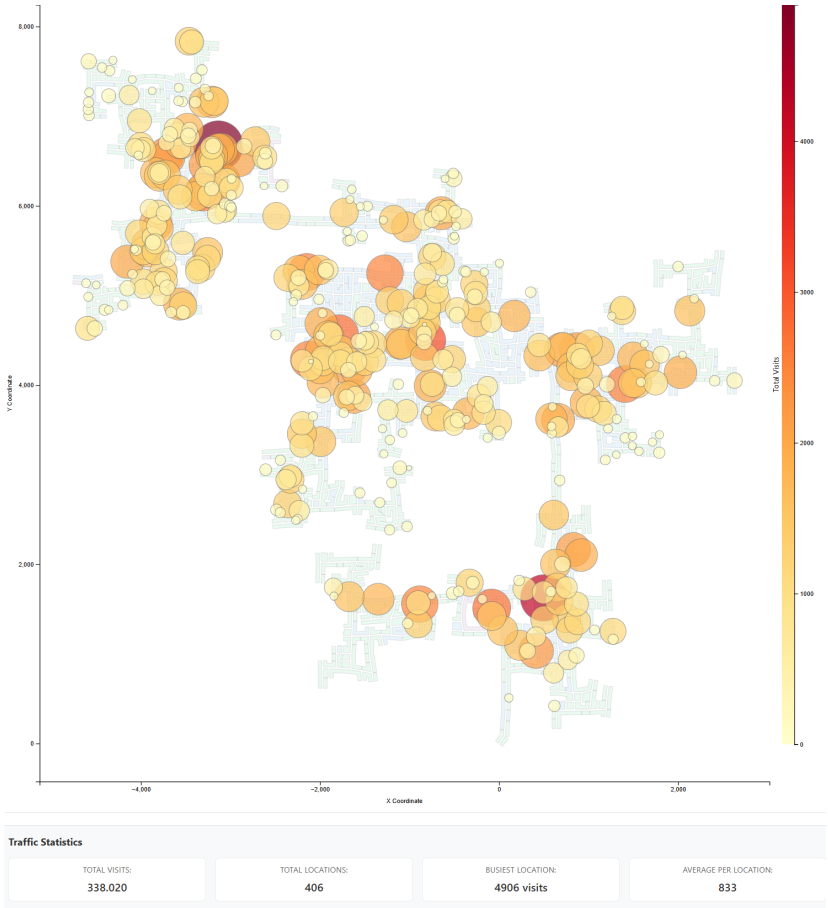
Are there **traffic bottlenecks** that should be addressed?

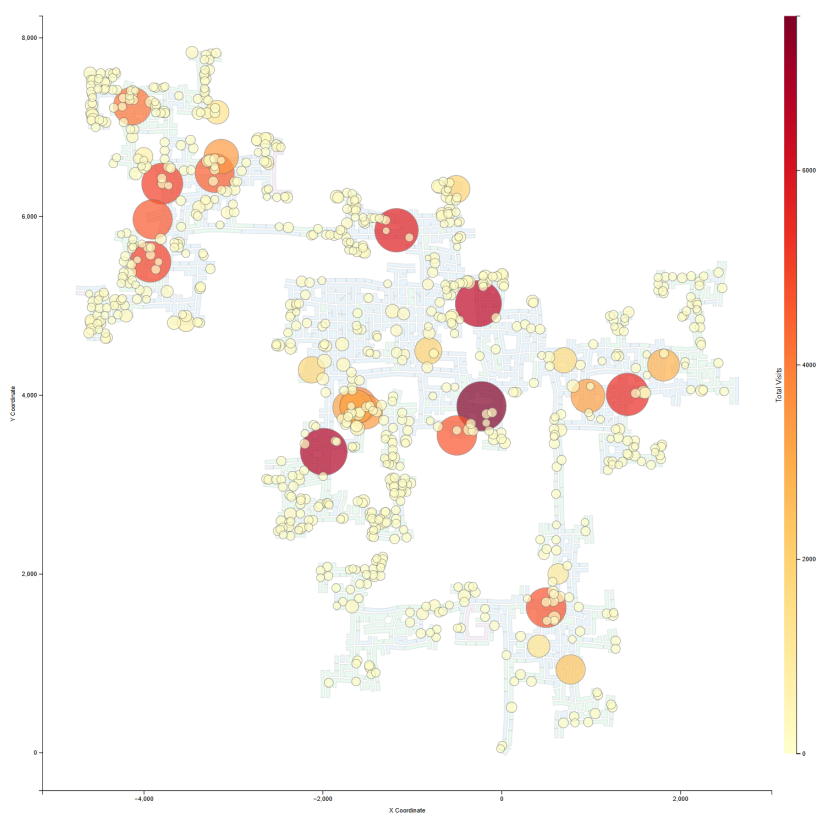
# Traffic Patterns Visualization




- Displays aggregated visit counts per location using bubble size and color intensity
- Directly identifies the busiest areas through visual emphasis
- Enables filtering by time period and day type for pattern analysis

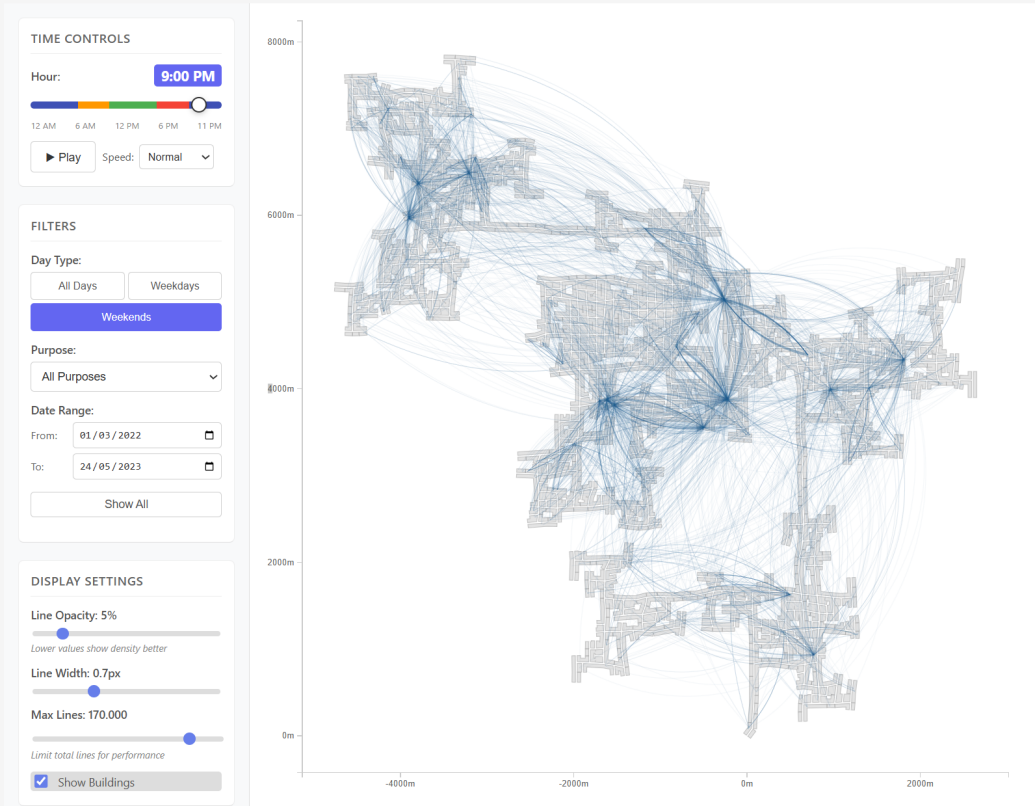
# Example: Weekday vs Weekend Traffic




Weekends feature traffic clustering around restaurants and pubs, while weekdays display a more evenly distributed, commute-driven pattern.

# Traffic Density Visualization




- Visualizes movement flows between locations over time
- Reveals primary connectivity patterns
- Shows temporal dynamics with playback controls
- Identifies potential bottlenecks through edge density

# Esampe: Afternoon Convergence

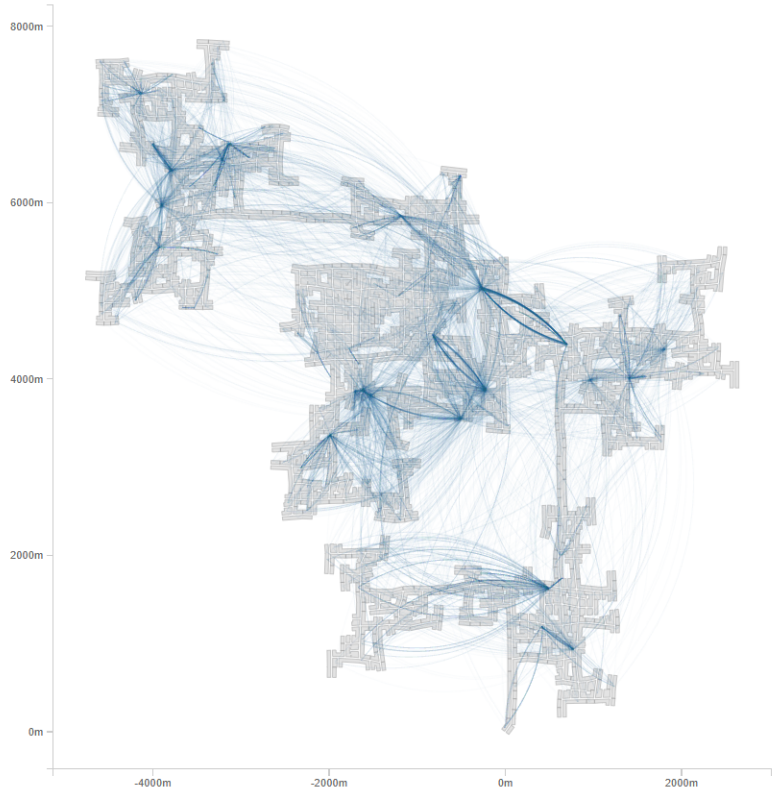



Fig.: Weekend afternoon flows (strong clustering)

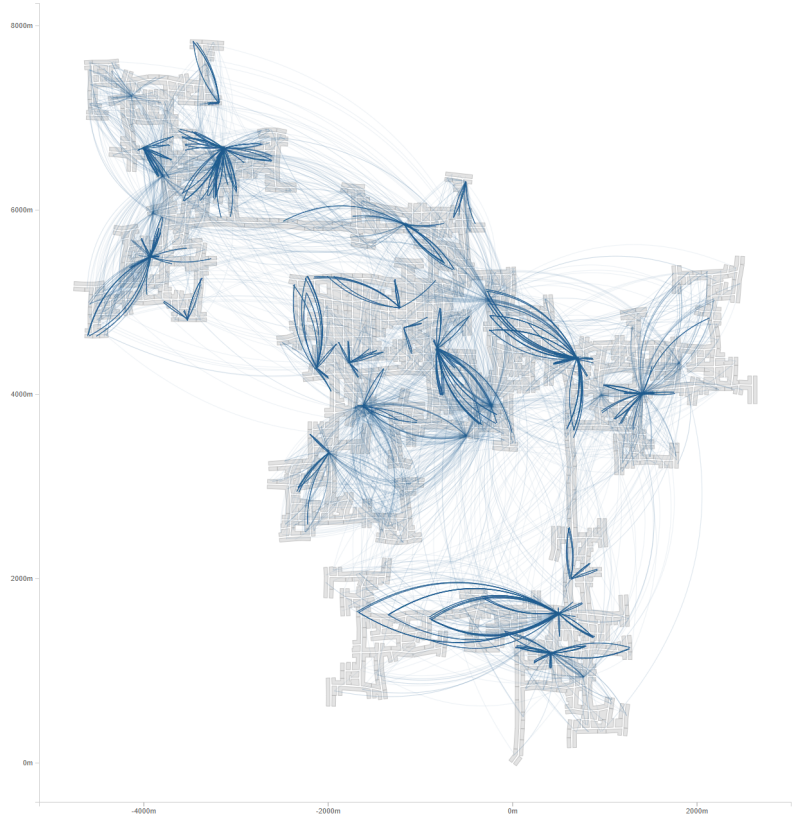


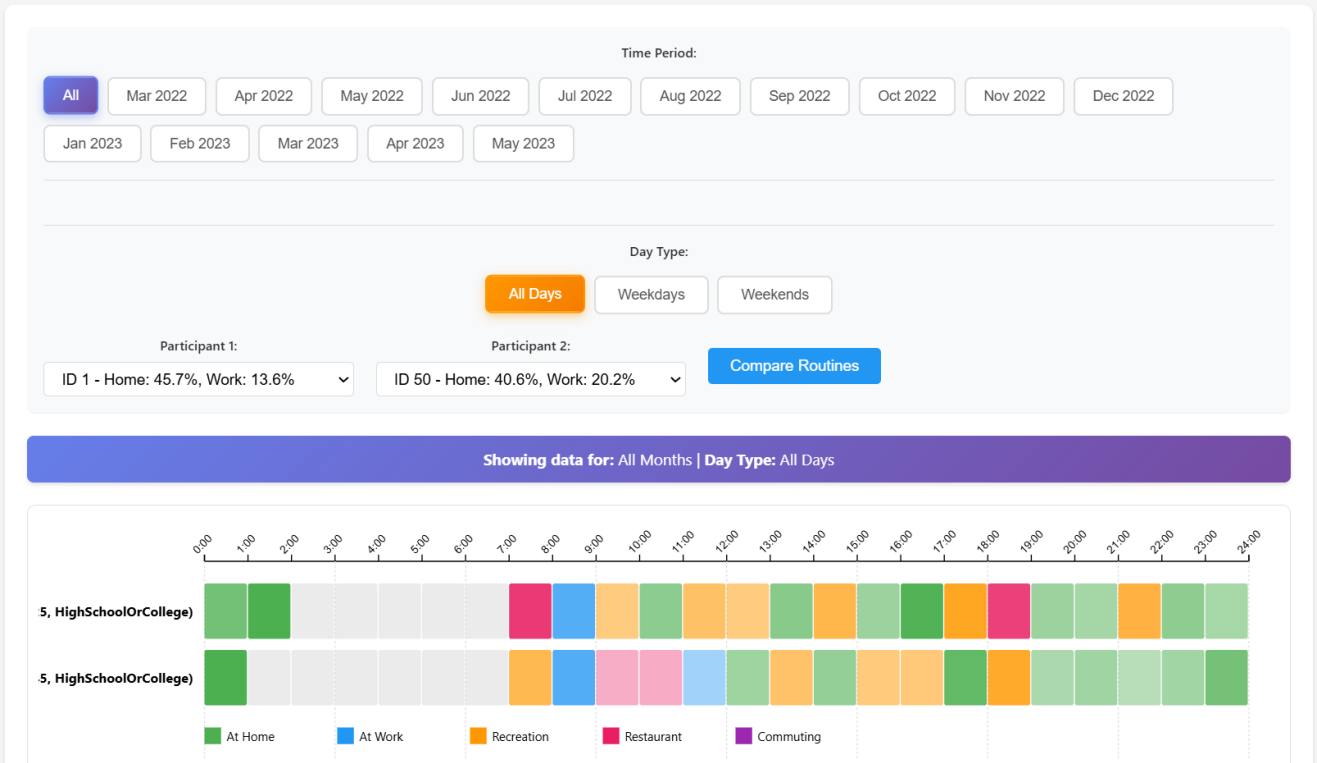

Fig.: All-days 1 PM flows (persistent attractors)

# Question 3

Participants have given permission to have their daily routines captured.

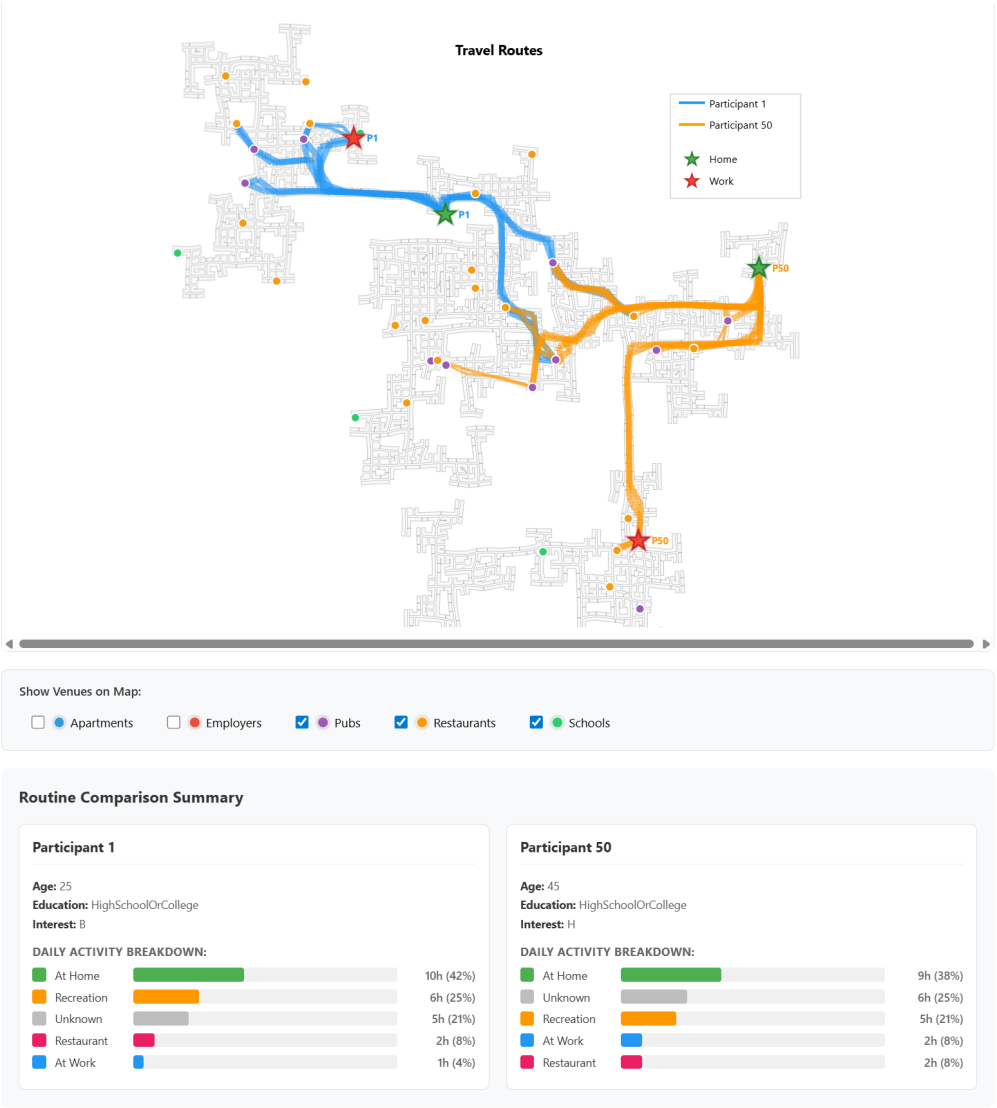
Choose **two different participants** with different routines and describe their **daily patterns**, with supporting evidence.

# Daily Routines: Timeline Visualization




- Displays hour-by-hour activity breakdown for each participant
- Color-coded activity categories make routine patterns immediately visible
- Supports direct comparison of daily routines between two participants
- Time-based filtering enables analysis of specific periods or day types

# Daily Routines: Travel Routes Visualization

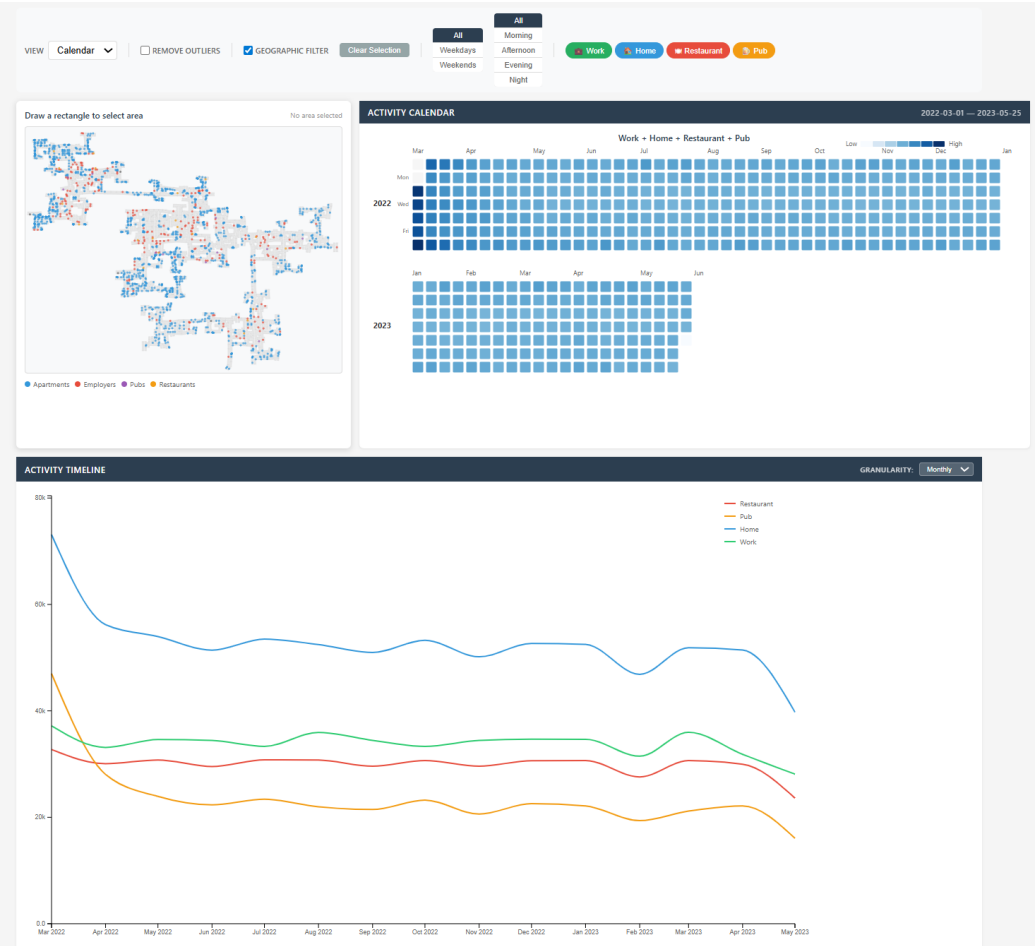



- Maps actual geographic movements and key locations (home, work)
- Shows spatial patterns and travel distances
- Reveals routine differences through distinct route networks
- Activity breakdown summary provides quantitative support

# Question 4

Over the span of the dataset, how do **patterns change** in the city?

# Temporal Analysis: Activity Calendar




- Calendar heatmap shows activity intensity for every day in the dataset
- Geographic filtering enables location-specific temporal analysis
- Timeline chart reveals long-term trends and seasonal variations
- Activity type filtering identifies how different venue categories change over time

# Example: Residential vs Working Areas

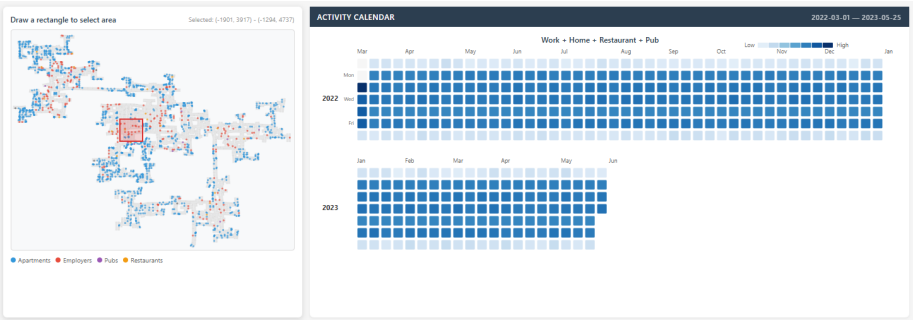



Fig.1: Working area – morning activity

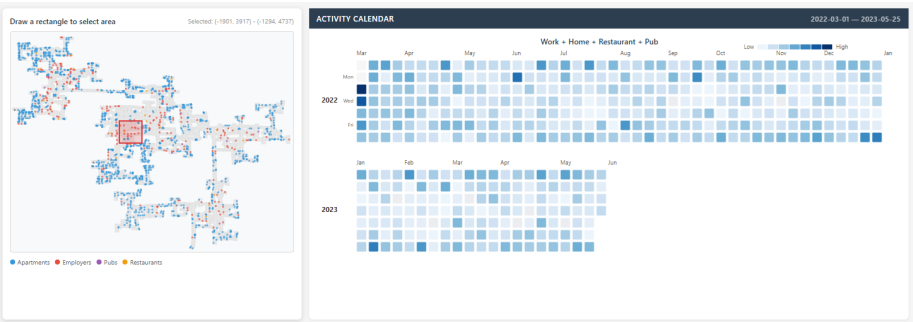



Fig.2: Working area – evening activity

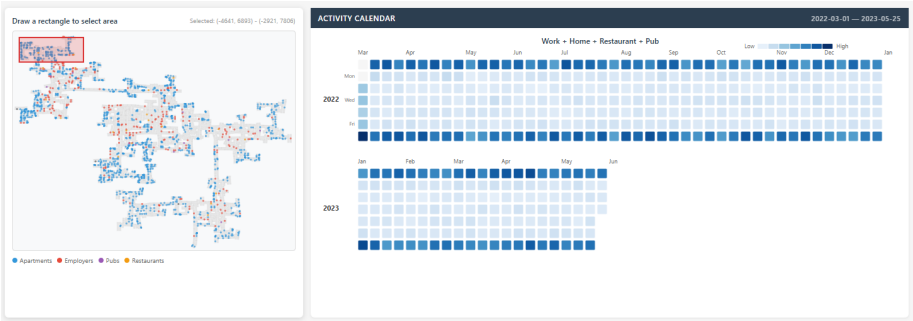



Fig.3: Residential area – morning activity

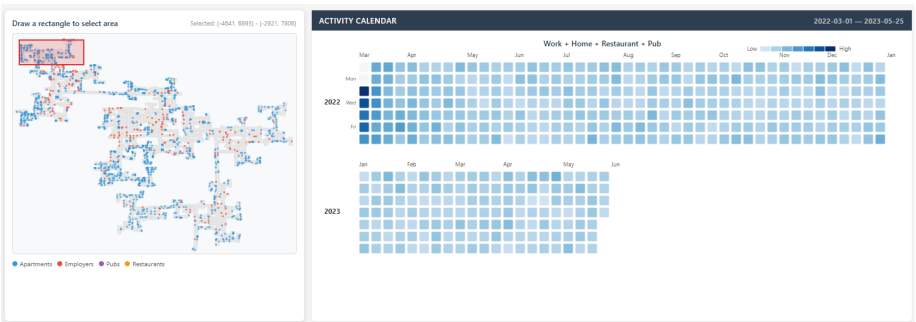
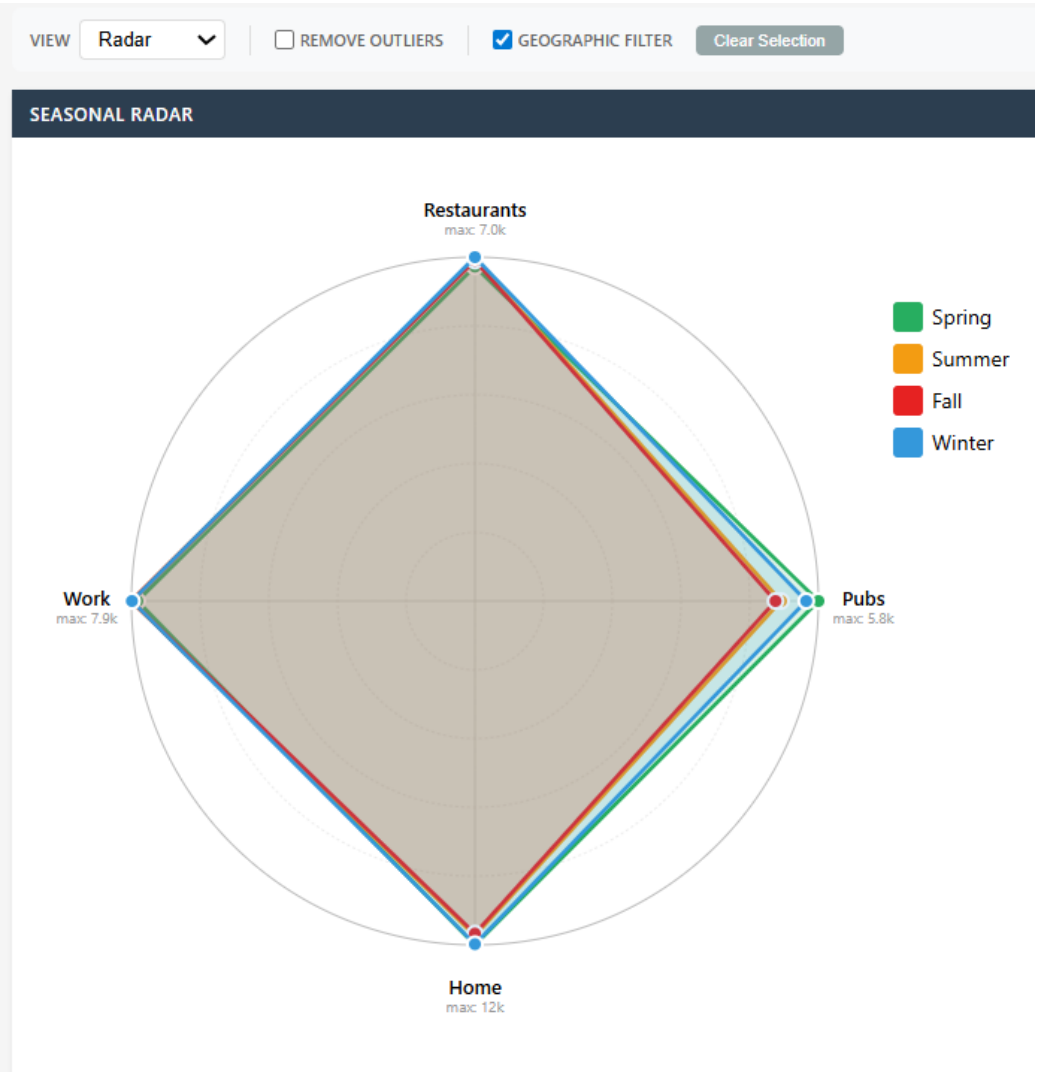


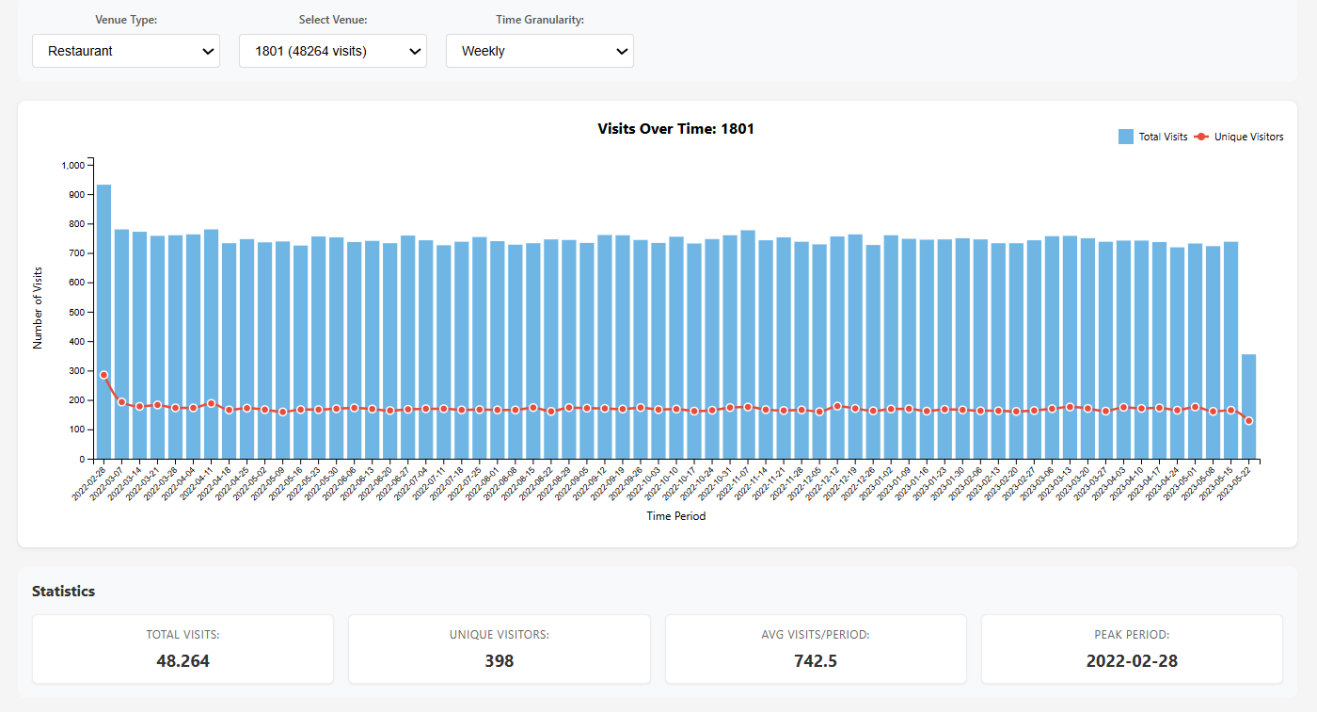

Fig.4: Residential area – evening activity

# Seasonal Comparison: Radar Chart




- Multi-dimensional view shows how different activity types change seasonally
- Overlapping polygons enable direct visual comparison between seasons
- Reveals seasonal preferences and behavioral shifts in the city

# Venue Visits Over Time




- Tracks visit patterns for specific venues across the full dataset timespan
- Multiple time granularities (daily, weekly, monthly) reveal trends at different scales
- Displays both total visits and unique visitors to distinguish recurring from new traffic
- Summary statistics highlight peak periods and changes in venue popularity over time

# Conclusions: Strengths

- The most effective visualizations are those addressing **bottlenecks** (Question 2). These charts clearly highlight **actual bottlenecks** within the city, and the applied **filters** make it possible to observe how they **evolve throughout the day**.
- The **comparison between two participants** and their routes (Question 3) is also a strong point. As discussed in the report, this visualization enables an **effective comparison** between participants with **different profiles and daily routines**.
- The **heatmap** provides a **clear and intuitive** way to highlight **areas of interest** across the city.

# Conclusions: Limitations

- We experimented with several visualizations to identify **seasonal or monthly patterns**. For example, we expected a **decrease in work-related activities** during the **summer period**, but our analysis did not reveal such trends.
- To improve **efficiency**, some visualizations rely on **aggregated data tables**. While beneficial for performance, this choice may **limit the discovery of fine-grained temporal patterns**.
- Due to **time constraints**, we were not able to perform **advanced statistical analyses** on the data (e.g., **clustering**, **dimensionality reduction**).

# Work Division

**Matteo Arrigo**

- Frontend
- Question 1, 2
- Project Presentation
- Project Report

**Giuseppe Galardi**

- Backend
- Infrastructure and Setup
- Video Presentation

**Nicola Noventa**

- Frontend
- Question 3, 4
- Project Presentation
- Project Report

# Thank You

Questions?