

Lab 3 (Block II): Static Data Visualization

The instruction for laboratories

Opens: 20 November 2023

Due: 15 December 2023

Introduction

The purpose of this block is to familiarize Students with advanced data visualization methods to uncover and interpret temporal patterns inherent in time series data while simultaneously exploring correlations within multidimensional datasets, specifically in 2D and 3D contexts.

Students within the block are to: find datasets on the web (if not mentioned the dataset link) according to the topic of their assigned project, prepare the data and visualize them. The result is to be a report in the form of a scientific article, according to the scheme described in the course regulations.

Projects

In this section we present projects to be done in class. One project is assigned to one group and each group is to receive one project. The group works independently. This means that:

- Each group independently selects data for visualization.
- Each group independently selects and performs data pre-processing
- Each group independently selects ways to implement the visualization.

Any overlap should be treated judiciously: of course, there may be overlapping solutions in certain places, but this should not happen with regard to: source code, appearance of charts, report text. Overlapping solutions should occur in exceptional cases, the need and occurrence of which is easily explained.

Project 1. Vibration and IMU Sensing Human Activity Dataset

Project Goal: To understand human daily activities.

Description

This project contains fine-grained human daily activity data collected by infrastructure vibration sensors and one on-wrist IMU sensor.

Students will work with a comprehensive dataset to explore the nuances of human daily activities. Their primary focus will be on using data visualization

techniques to gain insights from the data collected through infrastructure vibration sensors and an on-wrist IMU sensor. The tasks include creating various types of visualizations, such as time series plots, heatmaps, scatter plots, and 2D/3D correlation between features, to unveil patterns and trends within the dataset. By applying data visualization methods, students will develop a deeper understanding of human behavior within diverse living environments and present their findings effectively.

Link to dataset: <https://doi.org/10.5281/zenodo.6519051>

For each graph there should be a verbal interpretation of it, included in the "Results" section of the report.

Project 2: Wind Time Series Dataset

Project Goal: The data visualization tasks for this project will involve developing visualizations such as time series plots, wind speed and direction heatmaps, scatter plots and correlations to uncover patterns and trends within the wind farm's performance data. Through these visualization efforts, students will aim to enhance their understanding of wind turbine operation and identify opportunities for optimization and efficiency improvements.

Description

In the "Inland Wind Farm Turbine Data Visualization Project," students will be tasked with the data visualization (e.g., time series exploration) of a comprehensive dataset originating from a single turbine in an inland wind farm, spanning an entire year. However, it's essential to note that there are missing data points at certain time instances. The dataset includes two temporal resolutions: 10-minute data and hourly data, with the latter representing an aggregation of the former. Each resolution features data presented in three columns.

Link to dataset: <https://doi.org/10.5281/zenodo.5516538>

For each graph there should be a verbal interpretation of it, included in the "Results" section of the report.

Project 3: Energy efficiency in buildings using Machine learning models

Project Goal: Students will identify areas for energy-saving interventions and formulate recommendations based on their findings. This project emphasizes both the technical skills required for data visualization and the ability to derive actionable insights to enhance the sustainability and efficiency of smart building systems.

Description:

The time series data has been generated by Droplet sensors installed in every

room of the SMART Infrastructure Facility of the University of Wollongong. The sampling rate is set to one minute and the data is transmitted via a LoRaWAN network.

Tasks include collecting and preprocessing sensor data, conducting exploratory data analysis to uncover trends, creating informative data visualizations (e.g., time series graphs/plots).

Link to dataset: <https://doi.org/10.5281/zenodo.3935059>

For each graph there should be a verbal interpretation of it, included in the "Results" section of the report.

Project 4: Climate Change and Environmental Data Visualization

Project Goal: To highlight the temporal trends, geographical variations, and correlations within multidimensional environmental datasets.

Description:

Utilize climate and environmental datasets to visualize the impact of climate change over time. Analyze temperature trends, precipitation patterns, and other environmental variables. Create dynamic visualizations (e.g., time series plots and 2D/3D correlations) that illustrate the changes in climate indicators over the past few decades. Incorporate geographical visualizations to showcase regional variations and anomalies. Explore correlations between environmental variables and potential consequences.

For each graph there should be a verbal interpretation of it, included in the "Results" section of the report.

Project 5: Social Media Sentiment Analysis and Visualization

Project Goal: This project offers a blend of time series analysis, multidimensional data exploration, and correlation studies, allowing students to apply various data visualization techniques in real-world contexts. Depending on the students' interests, you can adjust the complexity and specific requirements of this project.

Description:

Collect and analyze social media data (e.g., Twitter) related to a specific topic or event. Perform sentiment analysis on the text data to understand public sentiment over time. Visualize sentiment trends using time series plots, sentiment heatmaps, and word clouds. Explore correlations between social media sentiment and real-world events. Create an interactive dashboard that allows users to explore and compare sentiment across different demographics or geographic locations.

For each graph there should be a verbal interpretation of it, included in the "Results" section of the report.

Project 6: Urban Mobility and Transportation Visualization

Project Goal: This project allows students to tackle the challenges of visualizing complex urban mobility data, providing insights that can inform city planning and transportation management.

Description:

Analyze datasets related to urban mobility, transportation, and traffic patterns. Explore the temporal evolution of traffic congestion, public transportation ridership, and the impact of events on commuting. Visualize the flow of traffic in different city areas, identifying peak hours and congestion hotspots. Integrate spatial data to represent transportation networks and use color-coded maps and animated visualizations to showcase changes over time. Investigate correlations between transportation metrics and external factors like weather or special events.

For each graph there should be a verbal interpretation of it, included in the "Results" section of the report.

Project 7: Sports Analytics and Performance Visualization

Project Goal: This project offers an exciting opportunity for students to apply data visualization techniques in the context of sports analytics, revealing insights that can be valuable for coaches, players, and sports enthusiasts.

Description:

Utilize sports-related datasets to analyze athlete performance, team dynamics, and game outcomes. Explore time series data related to player statistics and team performance over multiple seasons. Visualize trends in player performance, team strategies, and the impact of key events on game outcomes. Use interactive visualizations to allow users to explore player profiles, compare team statistics, and analyze the correlation between specific player attributes and team success.

For each graph there should be a verbal interpretation of it, included in the "Results" section of the report.

Project 8: E-commerce Sales and Customer Behavior Analysis

Project Goal: This project combines time series analysis with multidimensional data exploration in the context of e-commerce, providing insights into consumer behavior and helping businesses make data-driven decisions.

Description:

Dive into e-commerce datasets to analyze sales trends, customer behavior, and product performance. Explore time series patterns in sales data, identifying peak seasons and popular products. Visualize customer purchasing behavior,

such as the frequency of purchases, average order value, and customer retention rates or 2D/3D correlations between different variables.

For each graph there should be a verbal interpretation of it, included in the "Results" section of the report.

Group assignment

In the table below, please fill the: Gr. Nr (Group number), Section (1, 2, or 3), and Group participants (the names of the participants). The table should be filled out by the Teacher and then added to platform as the pdf file¹.

Rules:

1. Groups can differ in separate blocks.
2. Group participants may not be changed during the block.
3. For project that has a variant (P4, P5, P6, P7, P8) the parameters of the variants (e.g. selected country for P4) must differ, which means that the same parameter cannot appear two or more times in the table.

Nr	Project	Variants	Gr. Nr	Sec	Group participants
1.	Project 1: Human Activity				1.
					2.
					3.
2.	Project 2: Wind				1.
					2.
					3.
3.	Project 3: Energy Efficiency				1.
					2.
					3.
4.	Project 4: Climate Change # 1	Selected country:			1.
					2.
					3.
5.	Project 4: Climate Change # 2	Selected country:			1.
					2.
					3.
6.	Project 4: Climate Change # 3	Selected country:			1.
					2.
					3.
7.	Project 5: Social Media # 1	Selected media: Selected Issue:			1.
					2.
					3.
8.	Project 5: Social Media # 2	Selected media: Selected Issue:			1.
					2.
					3.

9.	Project 6: Urban Mobility # 1	Selected country:			
					1.
					2.
10.	Project 6: Urban Mobility # 2	Selected country:			3.
					1.
					2.
11.	Project 7: Sports Analytics # 1	Selected sports:			3.
					1.
					2.
12.	Project 7: Sports Analytics # 2	Selected sports:			3.
					2.
					1.
14.	Project 8: E-commerce# 1	Selected area: Selected products:			1.
					2.
					3.
15.	Project 8: E-commerce# 2	Selected area: Selected products			1.
					2.
					3.
					1.
					2.
					3.