APPLIED DATA SCIENCE PROJECT

UNSUPERVISED ENERGY PROFILE CLUSTERING

Politecnico di Torino

1859

Fondazione links
PASSION FOR INNOVATION

ellis
European Laboratory for Learning and Intelligent Systems

🎯 PROJECT SCOPE

⚡ **Project Focus:** Clustering analysis of household energy consumption patterns using London smart meter data

🎯 **Objective:** Discover hidden patterns in residential energy consumption to enable targeted energy efficiency interventions and inform sustainable urban planning

📊 **Dataset:** [London smart meter energy use data](#) with 5,567 households (2011-2014)

👥 **Project Stakeholders:**

- 🏛️ Local Authorities

- ⚡ Energy Providers

- 🏡 Consumers & Communities

- 🔬 Researchers

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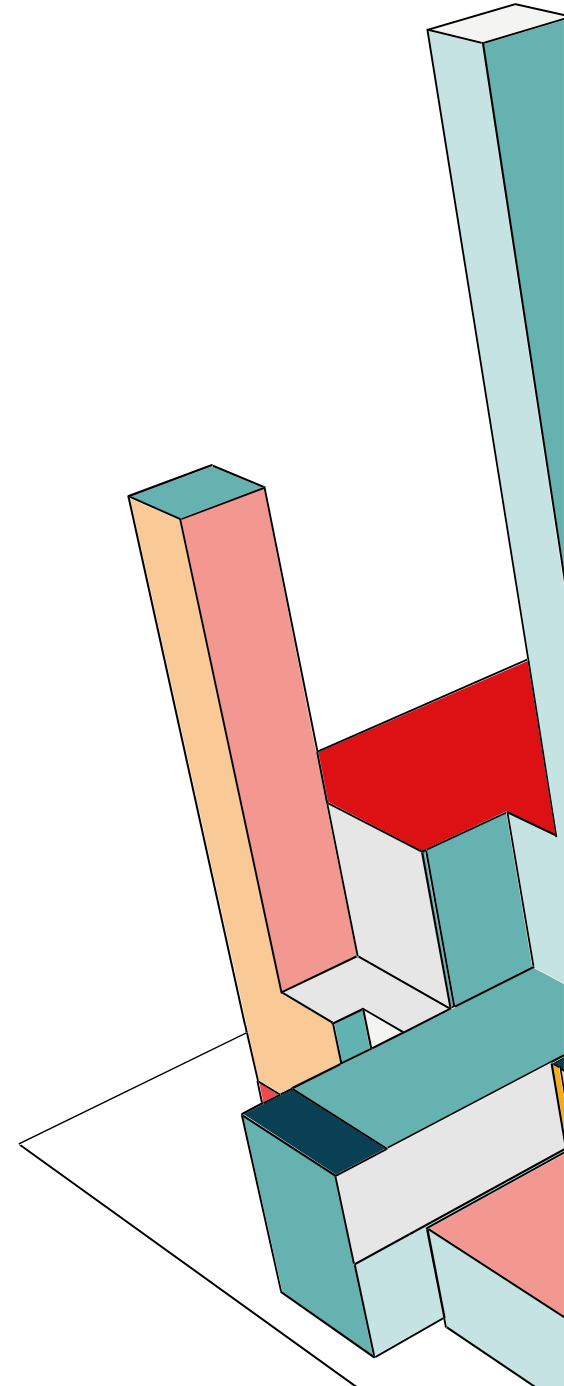
🤔 WHY CONDUCT THIS PROJECT?

🌍 Energy Challenge

- Energy consumption accounts for 60% of global greenhouse gas emissions

- Need for data-driven energy management strategies

🔬 Research Opportunities

- Understand diverse residential energy consumption patterns

- Identify households with similar energy behaviors

- Enable personalized energy efficiency recommendations

- Support smart grid optimization

📈 Expected Outcomes

- Identify distinct energy consumption profiles

- Understand temporal patterns (daily, seasonal, weather-dependent)

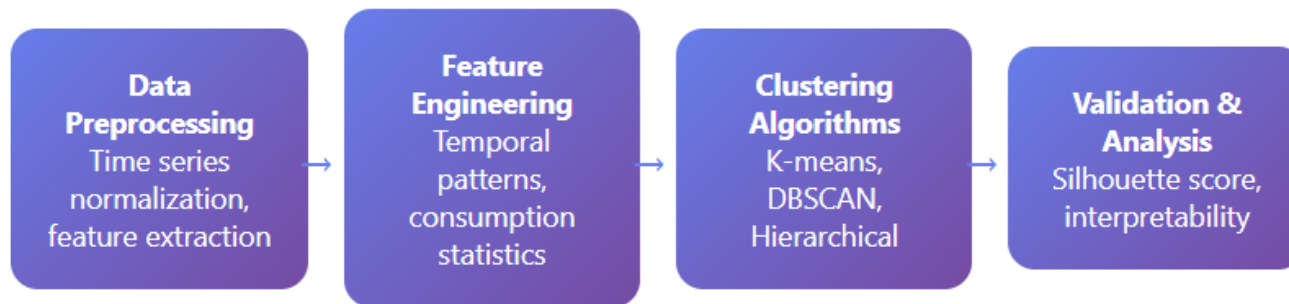- Provide insights for targeted energy interventions
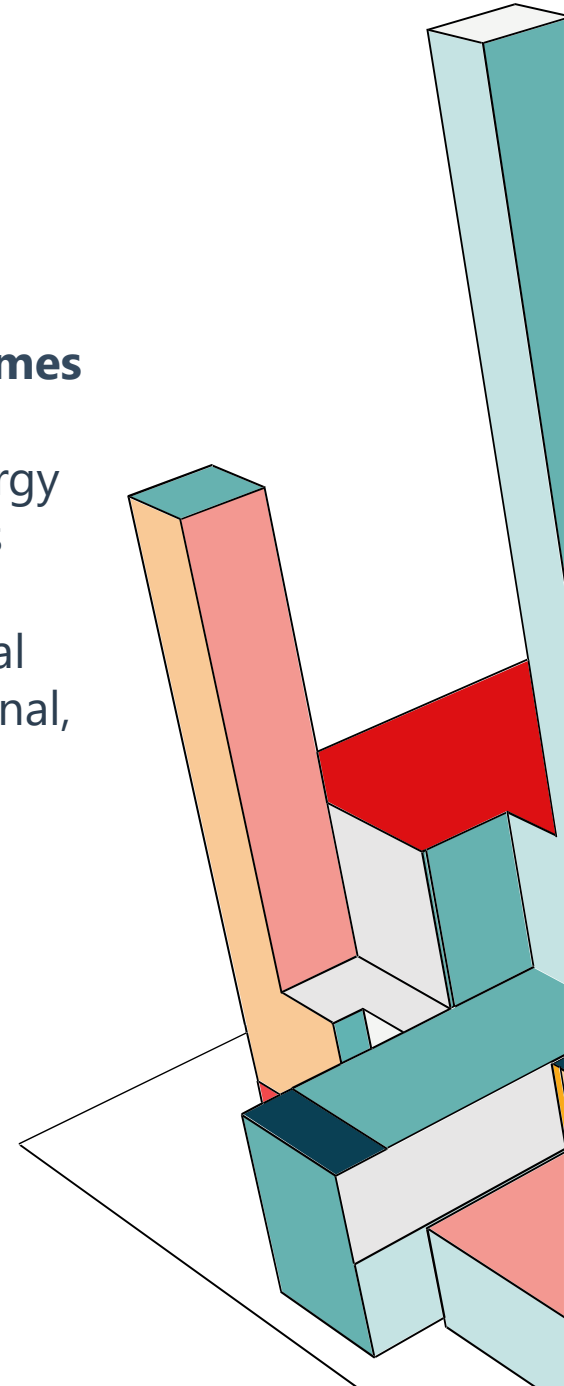
🤖 MACHINE LEARNING TASK DEFINITION

🧠 Task Type: Unsupervised Learning - Clustering

Unsupervised: Discovering hidden patterns without predefined labels

| Data Preprocessing	Feature Engineering	Clustering Algorithms	Validation & Analysis
Time series normalization, feature extraction	Temporal patterns, consumption statistics	K-means, DBSCAN, Hierarchical	Silhouette score, interpretability

🎯 Specific Objectives

-**Pattern Discovery:** Identify distinct energy consumption profiles

-**Behavioral Segmentation:** Group households with similar usage patterns

-**Temporal Analysis:** Understand daily, weekly, and seasonal variations

📊 Technical Approach

-**Data:** 5,567 households, half-hourly readings (2011-2014)
-**Features:** Time-series consumption
-**Algorithms:** K-means, Autoencoder+K-means, DBSCAN
-**Evaluation:** Silhouette coefficient, Davies-Bouldin index

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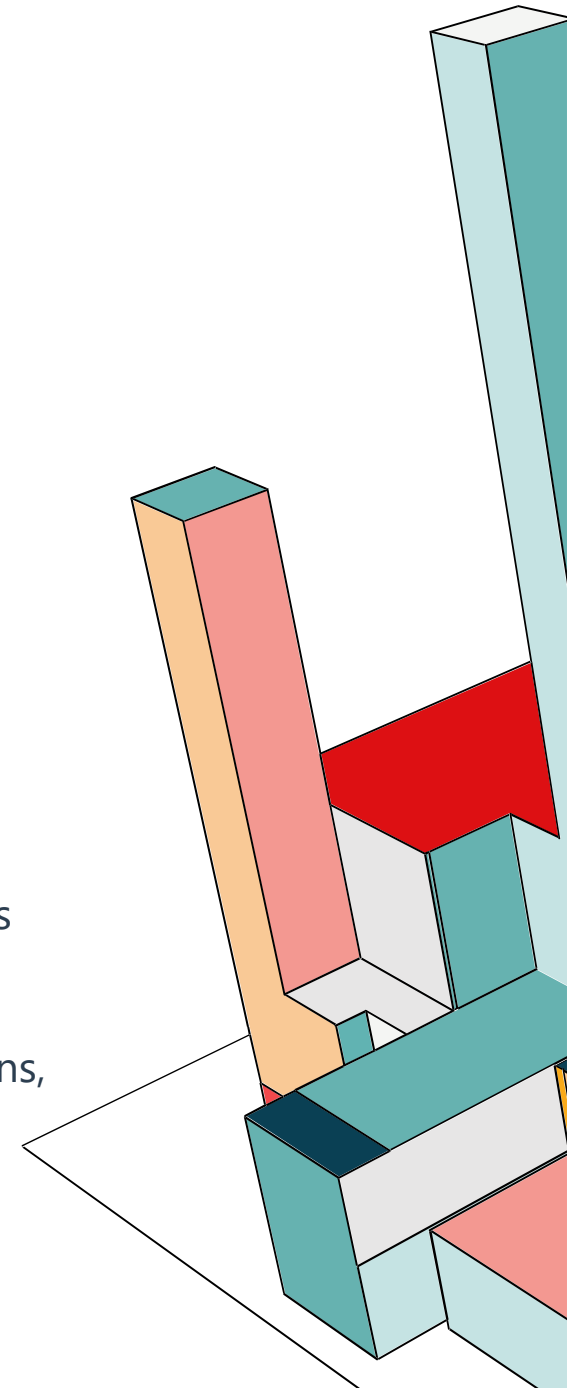
🌍 UN SUSTAINABLE DEVELOPMENT GOALS ALIGNMENT

🎯 Primary Alignment: SDG 7
"Affordable and Clean Energy"

Target 7.3: Double the global rate of improvement in energy efficiency by 2030

Target 7.1: Ensure universal access to affordable, reliable energy services

Target 7.2: Increase substantially the share of renewable energy

🌡️ Secondary Alignment: SDG 13
"Climate Action"

Energy is the dominant contributor to climate change (60% of global GHG emissions)

Optimize energy consumption to reduce carbon footprint

Support climate adaptation through efficient energy systems

🔗 Additional SDG Connections
SDG 11: Sustainable Cities - Urban energy planning and smart infrastructure
SDG 1: No Poverty - Address energy poverty through targeted interventions
SDG 9: Innovation - Advanced data analytics for energy infrastructure
SDG 12: Responsible Consumption - Optimize energy consumption patterns
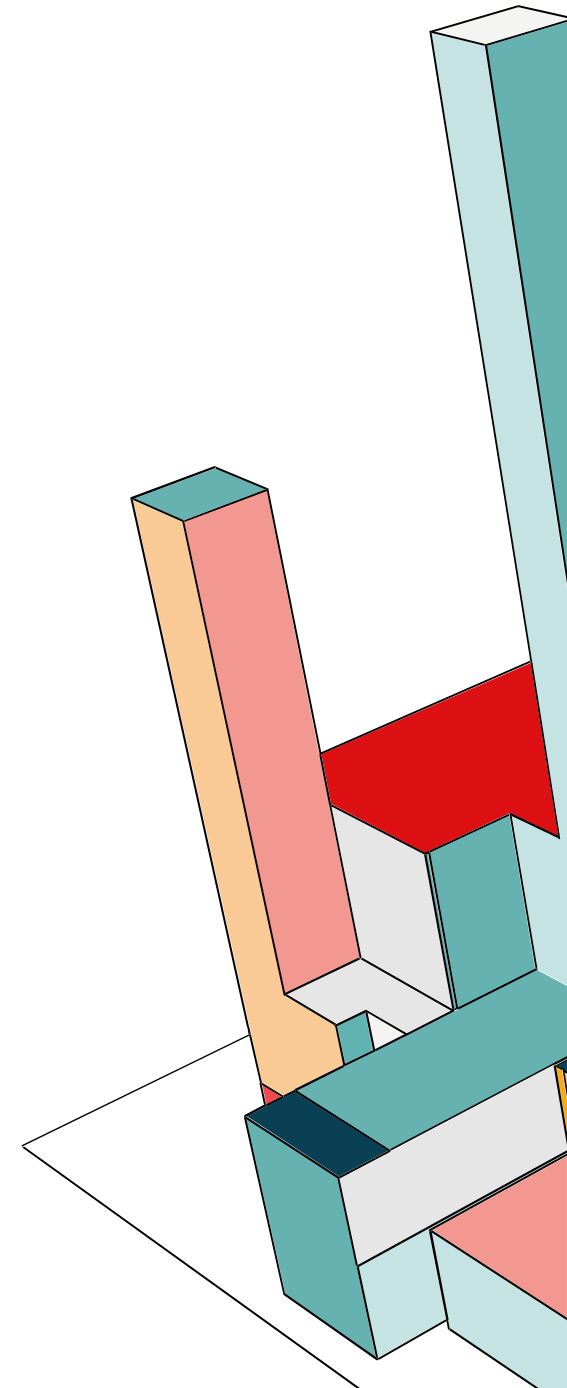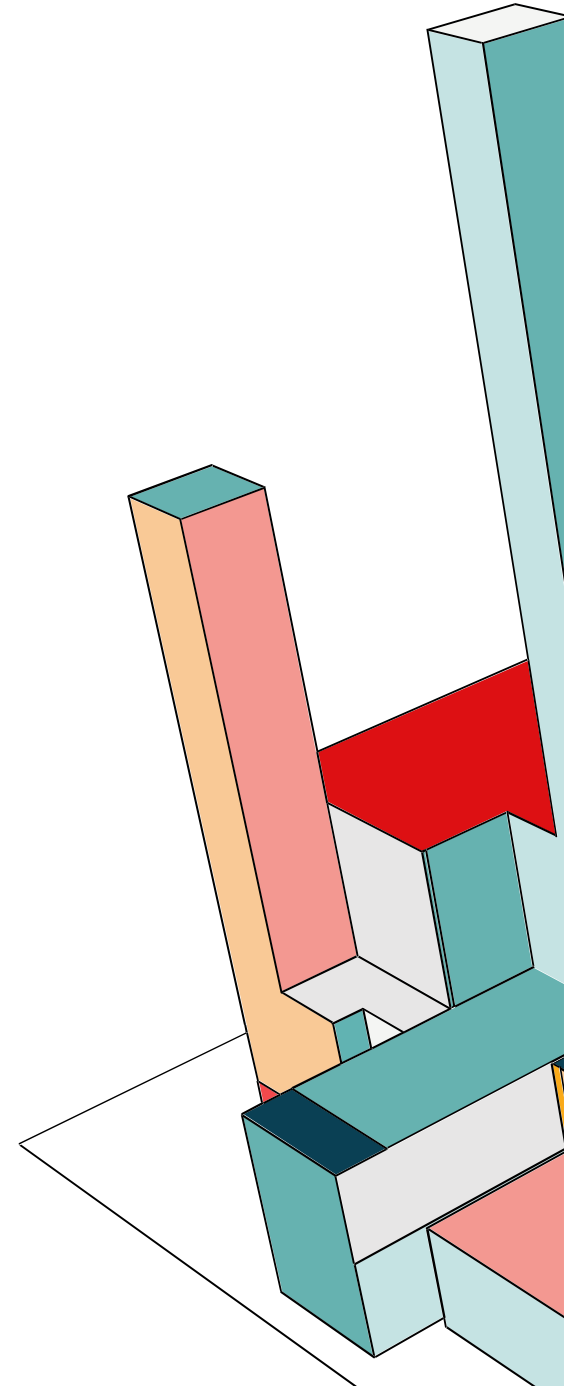
NOTES AND CHECKS FOR THE COMPANY

LIGHT MENTORING

Mentors

- Marco Galatola (marco.galatola@linksfoundation.com)
- Stefano Bergia (Stefano.bergia@linksfoundation.com)

Weekly one-hour calls with students for the whole duration of the semester

Feel free to reach out via **Slack** or **email** at any time for any questions or doubts

POLICY

- Both project descriptions and implementations will be part of a repository group published on GitHub

- The repositories will be public unless requests from the organization that will be discussed

- Ideally, the projects should be conceived open from the design