Machine Learning for Energy Efficiency Prediction

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Objectives

Develop Practical Machine Learning Skills: Equip participants with hands-on experience in developing machine learning models, from data preprocessing through to model evaluation, specifically tailored for energy efficiency in buildings.

Bridge Disciplines: Foster interdisciplinary collaboration by combining architectural principles with computational techniques, emphasizing the importance of data science in sustainable architecture.

Promote Sustainable Design: Encourage students to understand and address the environmental impacts of building design by providing them with tools to analyze and predict energy performance.

Empower Decision-Making: Enable participants to create predictive models that can assist in design optimization, retrofitting decisions, and environmental policy-making for sustainable urban planning.

Address Real-World Challenges: Provide a platform for students to tackle real-world issues like climate change by developing solutions that contribute to reducing the carbon footprint of buildings.

Methodology

Data Collection and Preparation: Use publicly available datasets on building energy performance, with guidance on cleaning, preprocessing, and understanding the significance of architectural attributes in energy consumption.

Feature Engineering and Selection: Teach participants how to identify and engineer relevant features (e.g., building materials, window-to-wall ratio, insulation properties) that are critical for predicting energy efficiency.

Model Selection and Training: Introduce participants to various machine learning models, such as linear regression, decision trees, and gradient boosting, explaining the strengths and limitations of each for energy performance prediction.

•Model Evaluation and Validation: Guide students on model evaluation techniques using metrics like Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and R-squared, ensuring they can assess model accuracy and reliability effectively.

Interdisciplinary Application: Conduct collaborative sessions where architecture students and computer science students work together to interpret model predictions, discuss sustainable design implications, and explore architectural strategies for

energy efficiency.

Real-World Application and Case Studies: Provide case studies on energy-efficient buildings and retrofitting strategies to contextualize model predictions, emphasizing the impact of design choices on sustainability outcomes.

Final Project: Participants will apply their knowledge to a capstone project, creating a predictive model for a hypothetical or real building. They will analyze results, propose energy-saving design adjustments, and present their findings.

Conclusions

The workshop successfully integrates machine learning with sustainable architecture, highlighting the potential of data-driven insights in transforming the building industry. Participants gain a comprehensive understanding of how machine learning can be applied to real-world environmental challenges, specifically targeting energy efficiency and carbon footprint reduction in urban development.

Through this interdisciplinary approach, students leave equipped with both technical and analytical skills necessary to tackle sustainability issues within the architectural field. This foundation empowers participants to make data-informed decisions, helping to shape a future where urban spaces are both innovative and environmentally responsible.

Overall, this workshop not only enhances students' technical competencies but also broadens their perspective on the vital role of technology in sustainable design. The knowledge and experience gained can serve as a stepping stone for further exploration into green building technologies, fostering a new generation of professionals dedicated to sustainable urban planning and design.



Workshop Process Image



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