Applying a Model-Agnostic Machine Learning method to investigate urban environmental factors Influencing social media-based hedonic well-being

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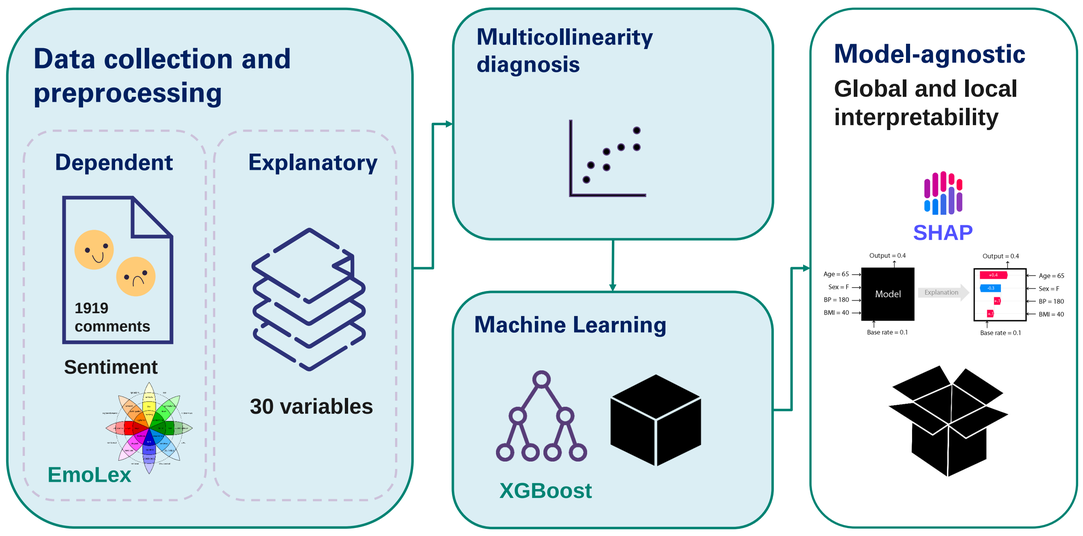
1 INTRODUCTION

While life quality improves, mental health issues rise, especially in industrialized nations (Hidaka, 2012), mainly due to urban lifestyles (Reeves et al., 2011). The transformation of urban space, alongside the digitization of society, enables knowledge about how individual well-being is influenced by the surrounding built environment (Romice et al., 2016). Content generated by internet users on social networks provides information about users and their environment (Aloufi et al., 2017).

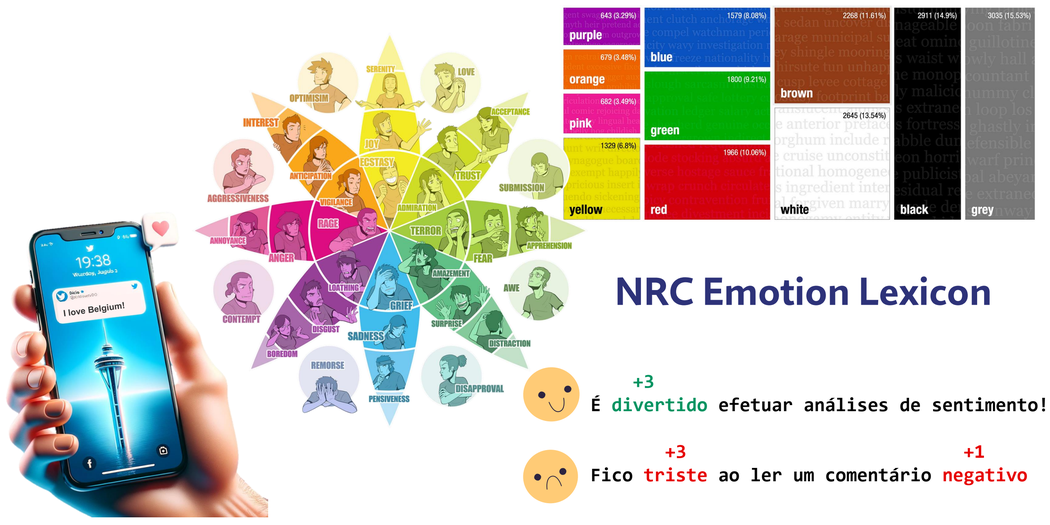
2 OBJECTIVE

- To identify which urban characteristics in the city of Lisbon affected well-being in 2019 using georeferenced comments on X (formerly Twitter) and machine learning algorithms (XGBoost).
- Generate explanations for the predictions of machine learning models using model-agnostic methods (Kernel SHAP).
- Evaluate variable importance, offering explanations both globally (what the model learned) and locally (individual predictions).

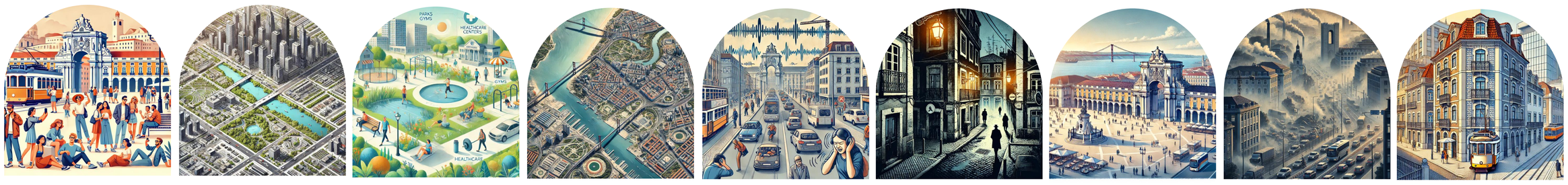
3 METHODOLOGY



4 SENTIMENT ANALYSIS

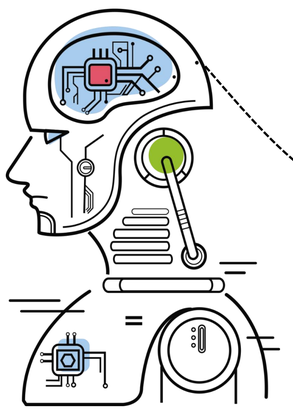


5 EXPLANATORY VARIABLES



POPULARITY	URBAN FORM INDICES	POINTS OF INTEREST	GREEN & BLUE STRUCTURE	NOISE	CRIMINALITY	STREET FRIENDLINESS	POLUTION	AGE OF BUILDINGS
Analysis of the popularity of spaces in the city (likes/km2) - **Flickr**	Relative richness, diversity, dominance, and fragmentation - **Land Use and Cover**	Determination of distance to facilities - **Lisbon City Hall**	Built Area Index, Non-Homogeneous Characteristics Difference Index, Water Index - **WorldView-2**	Use of the Global Noise Map (Lden) of Lisbon - **Lisbon City Hall**	Identification of the most unsafe areas based on crime density - **Public Security Police**	Determination of global solar radiation and street width - **Lidar**	Calculation of the daily average (9-19h) of pollutant emissions: PM10, NO2, and O3 - **Portuguese Environmental Agency**	Determination of the average weighted age of buildings - **National Statistics Institute**

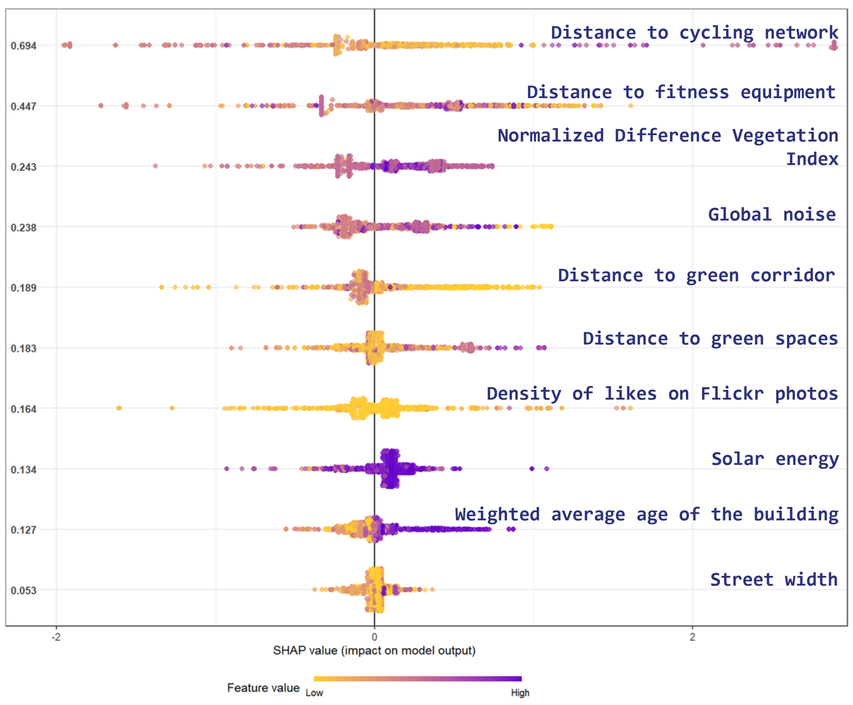
6 MODEL-AGNOSTIC



Machine Learning
A subfield of artificial intelligence (AI), successfully overcoming the limitations of empirical and conventional statistical methods (A. R. Lima et al., 2015).

Model-agnostic
An interpretation method that provides explanations of machine machine learning behavior (Molnar, 2019).

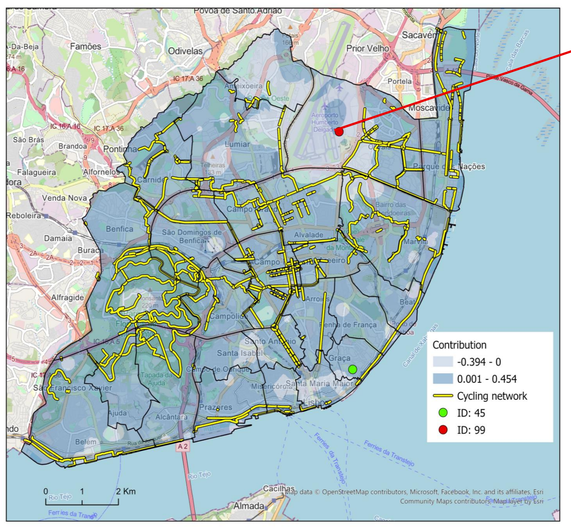
7 GLOBAL RESULTS

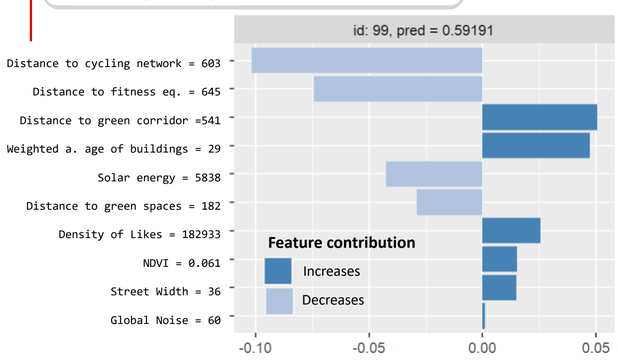


SHAP Summary Plot

8 LOCAL RESULTS

Kernel SHAP





9 CONCLUSIONS

Machine learning models are advantageous for policymakers, as they provide information that can guide decision-making.

Model-agnostic methods, especially those based on game theory (SHAP), play a crucial role in this type of analysis.

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