Shapley Analysis

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SSNR, Baiona | 20 June 2024

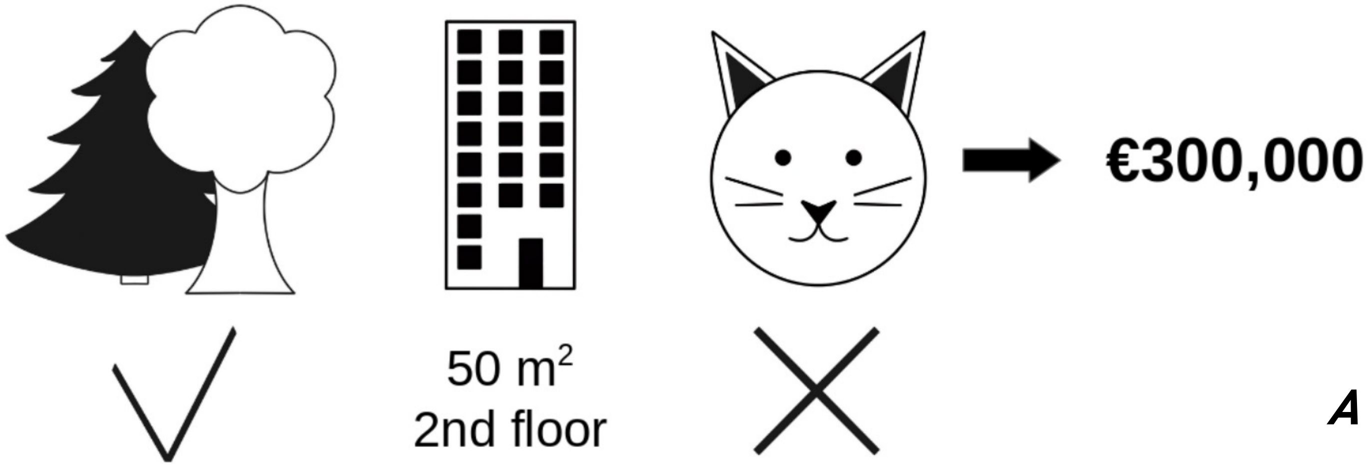
Shapley Values

Goal: Explain feature importances and individual feature values

Origin: Shapley values are a method from coalitional game theory.

“A prediction can be explained by assuming that each feature value of the instance is a “player” where the prediction is the payout.”

Example: Predict Apartment Prices | Average Prediction for all ins €310,000



Interpretable Machine Learning

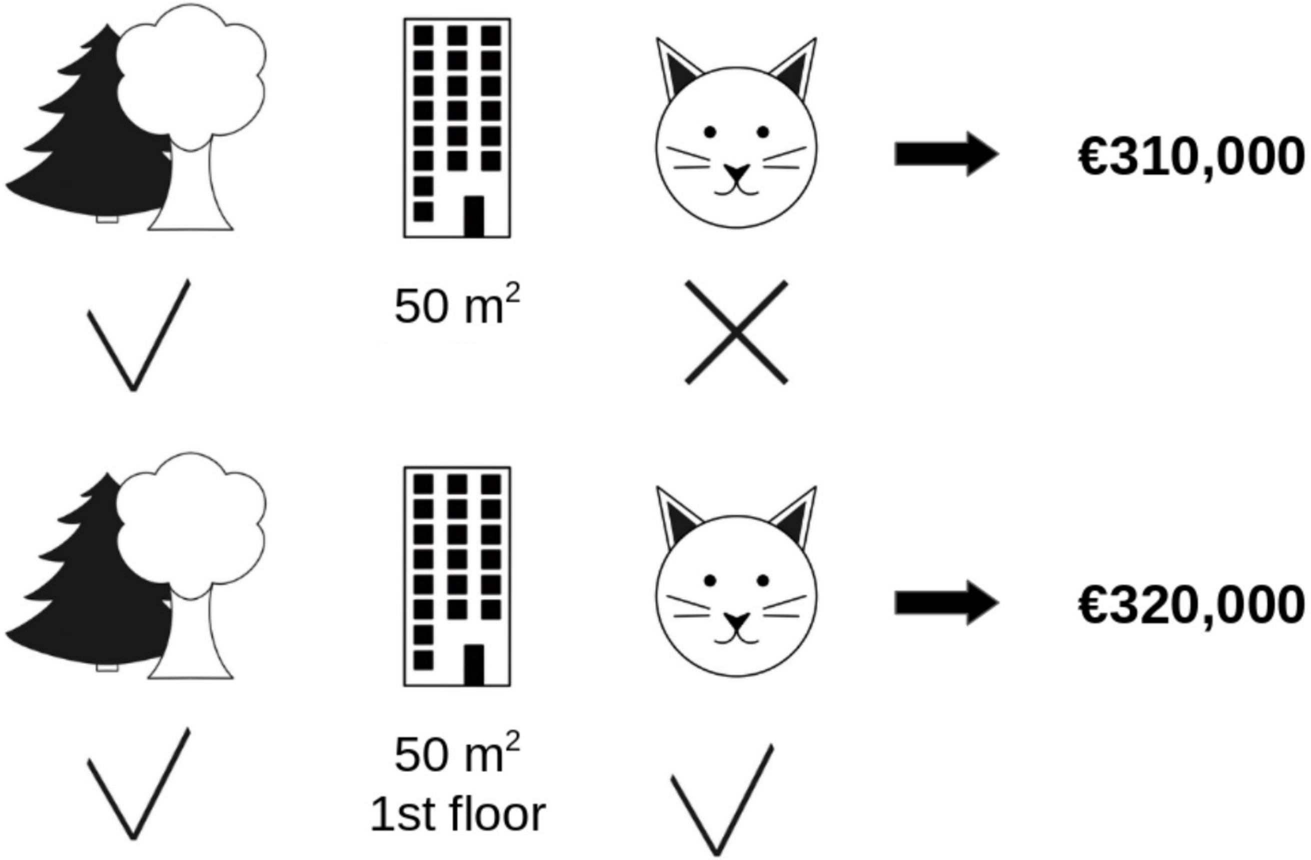
A Guide for Making Black Box Models Explainable

Christoph Molnar

The Shapley value is the average marginal contribution of a feature value across all possible coalitions.

Evaluate: Cat-banned feature

If feature not in coalition: randomly draw sample from data (1^{st} floor)



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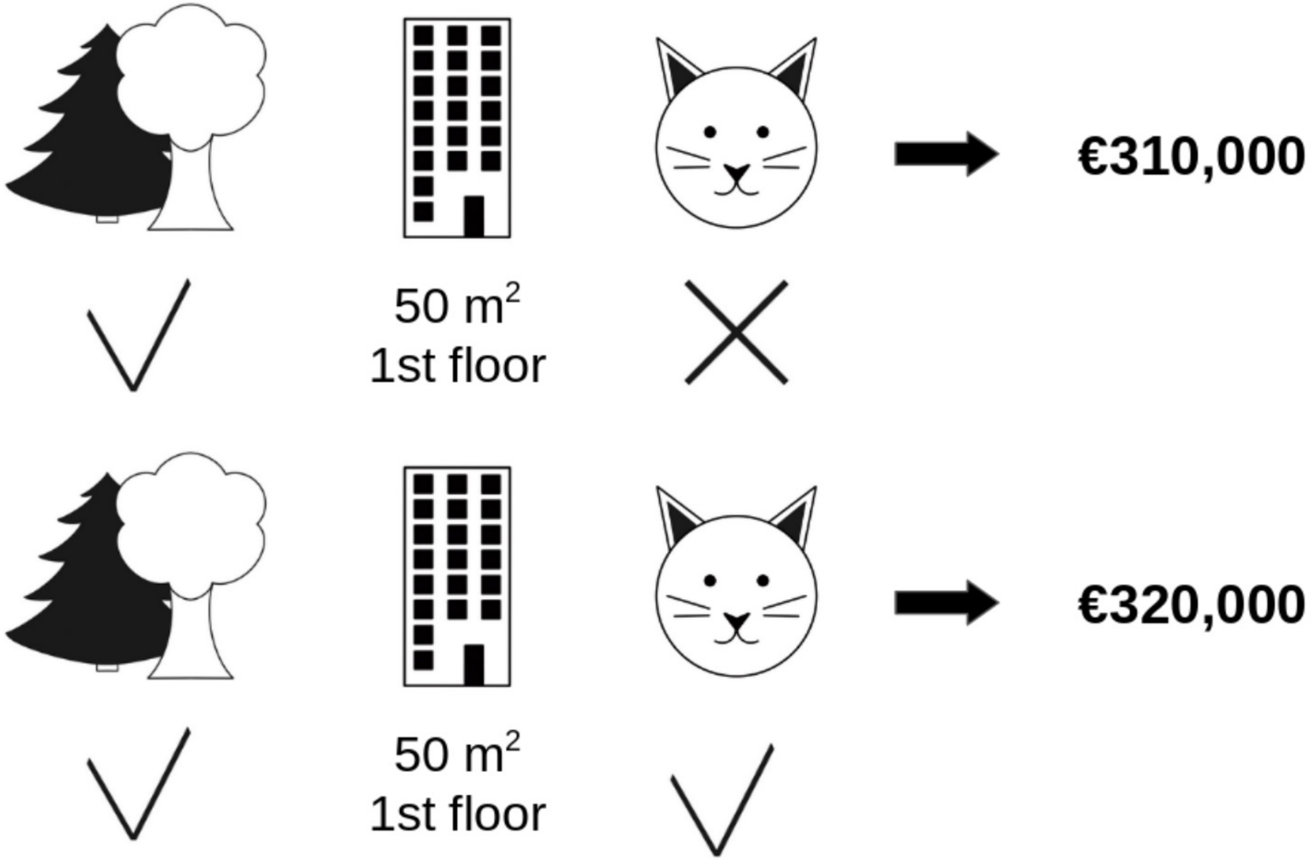
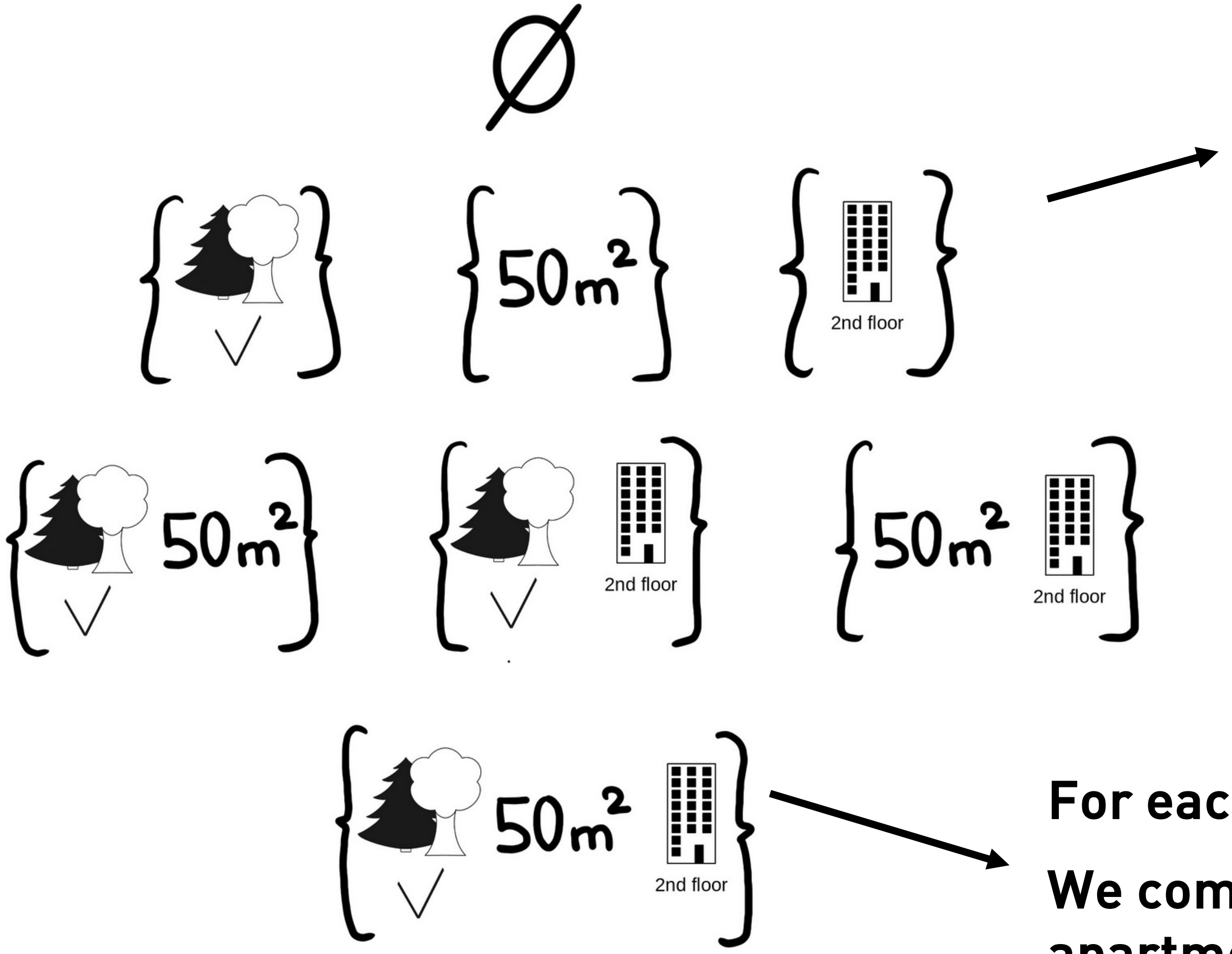


We repeat this computation for all possible coalitions.



Feature values of features not in the coalition are filled with random feature values from the dataset.

For each coalition:

We compute the predicted apartment price with & w/o feature *cat-banned* and take the difference.

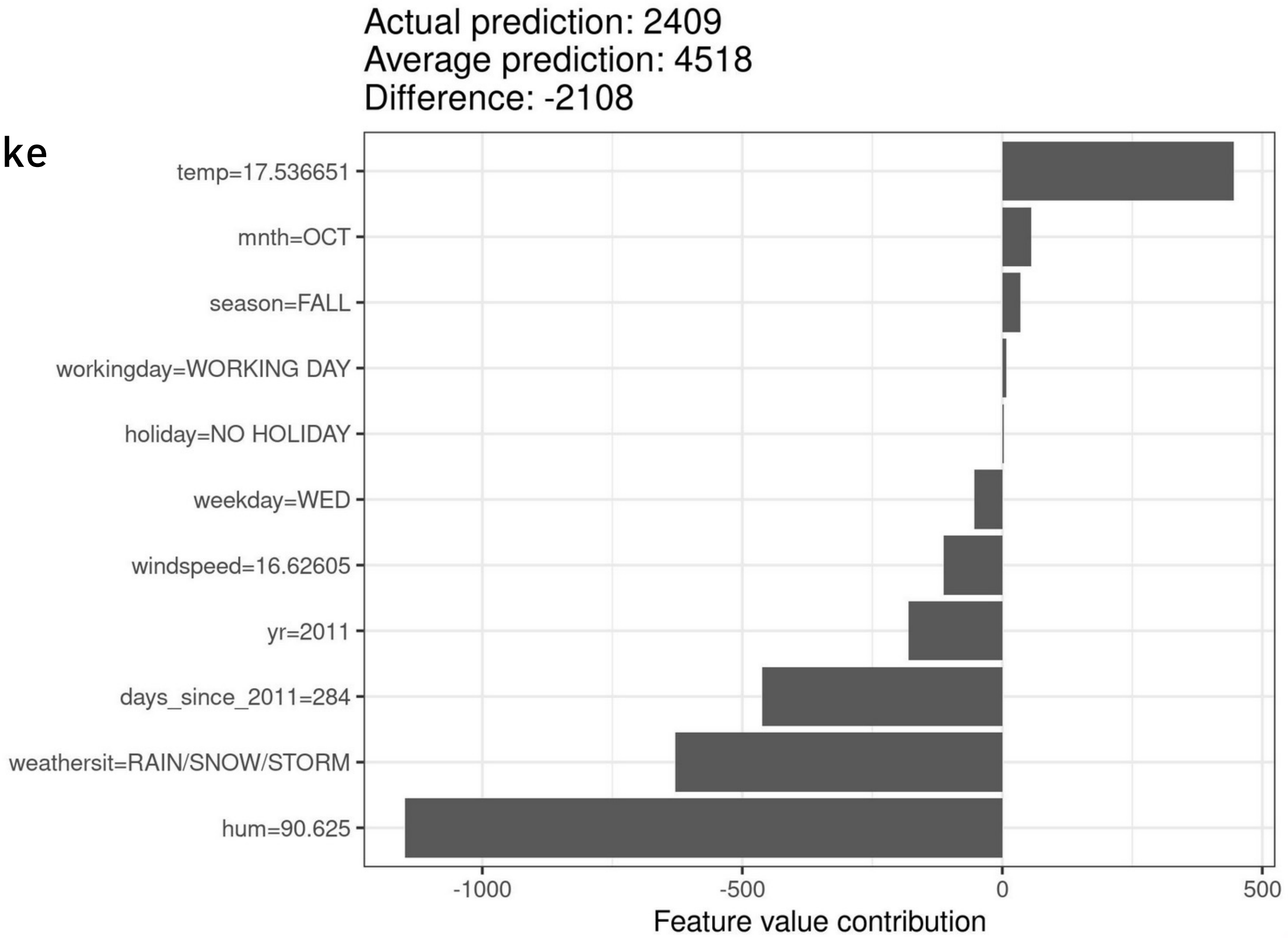
Example: Bike rental dataset (Random Forest model)

Prediction for one day: Day 285

Weater & humidity lead to a decrease in bike rentals

$$\phi_j(val) = \sum_{S \subseteq \{1,\ldots,p\} \setminus \{j\}} \frac{|S|!\,(p - |S| - 1)!}{p!} \left(val\left(S \cup \{j\}\right) - val(S)\right)$$

$$val_x(S) = \int \hat{f}\,(x_1, \ldots, x_p) d\mathbb{P}_{x \notin S} - E_X(\hat{f}\,(X))$$



TUTORIAL

Thank you!