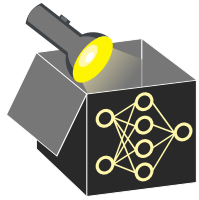
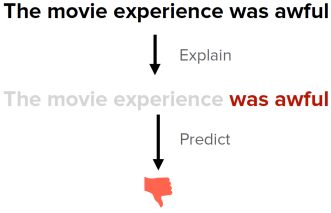
Interpretable Machine Learning



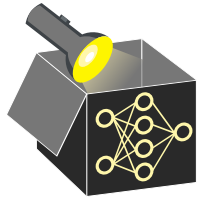
Instance-wise Feature Selection



Learning goals

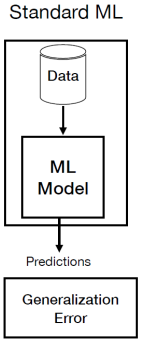
- Instance-wise feature selection
- Explain then predict models
- Optimizing using explanation data

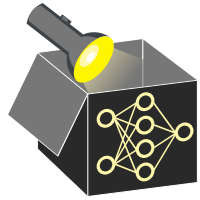
INSTANCE-WISE FEATURE SELECTION



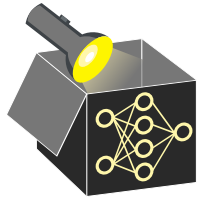
- Select a subset of features conditioned or based on the input instance
  - Two instances might not have the same feature mask
- Instance-wise feature selection similar to feature attribution — important features are selected
- Unambiguous with respect to explanation (more on that later)

INSTANCE-WISE FEATURE SELECTION - EXAMPLE IN LANGUAGE

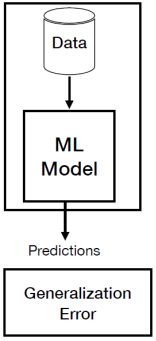




INSTANCE-WISE FEATURE SELECTION - EXAMPLE IN LANGUAGE

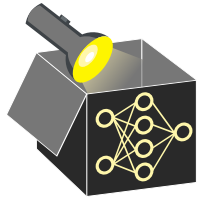


Standard ML

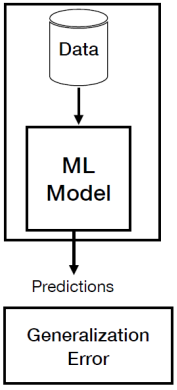


The movie experience was awful

INSTANCE-WISE FEATURE SELECTION - EXAMPLE IN LANGUAGE



Standard ML



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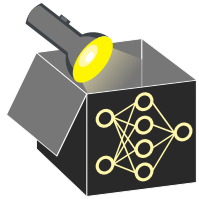
Predict

Parameterised Model

INSTANCE-WISE FEATURE SELECTION - EXAMPLE IN LANGUAGE



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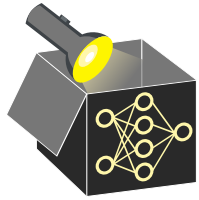
Explain

The movie experience **was awful**

INSTANCE-WISE FEATURE SELECTION - EXAMPLE IN LANGUAGE



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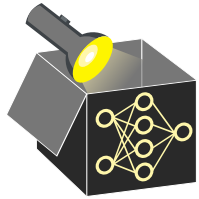
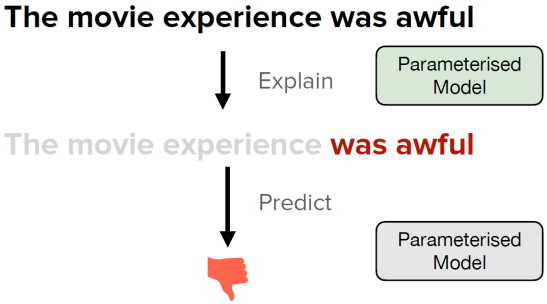
Predict

INSTANCE-WISE FEATURE SELECTION - EXAMPLE IN LANGUAGE





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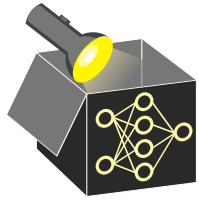

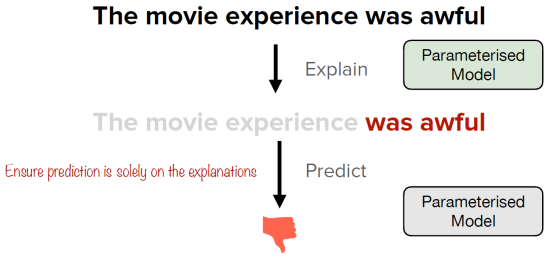

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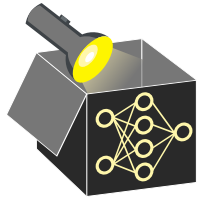
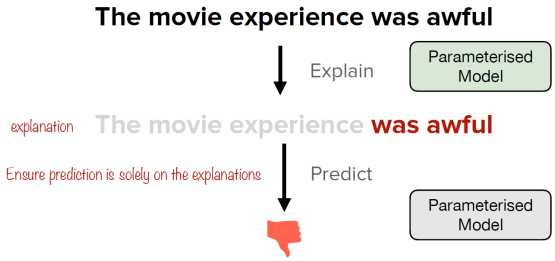
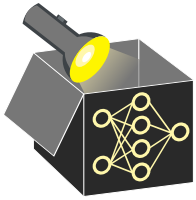




EXPLANATION DATA



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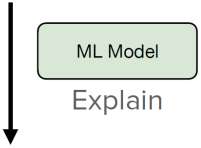

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0 0 0 1 1

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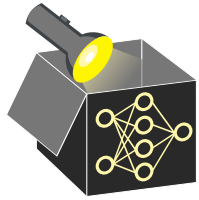

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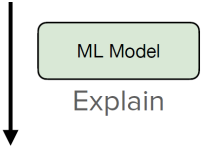

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0 0 0 1 1

$$\mathcal{L}_{\text{exp}} = \frac{1}{|S|} \sum_{i=1}^{|S|} |S_{t^i}| \cdot \text{BCE}\left(p^i, t^i\right)$$

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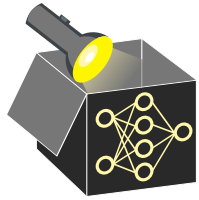

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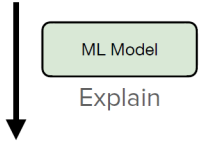

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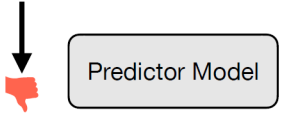
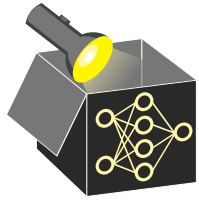


EXPLAIN THEN PREDICT USING EXPLANATION DATA



- Selecting features conditioned on individual instances results in better task performance in comparison to global feature selection
- Instance-wise feature selection has higher inherent sparsity
- The output of the feature-selection stage is the explanation
- The predictor depends solely on the masked input and therefore unambiguous with respect to explanation