University | School of
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THE AWARDS 2020
UNIVERSITY OF THE YEAR

LIME in Time-Series Classification

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WORLD CHANGING GLASGOW

Packaging Data for LIME

- Lime Tabular Explainer
- Lime Text Explainer
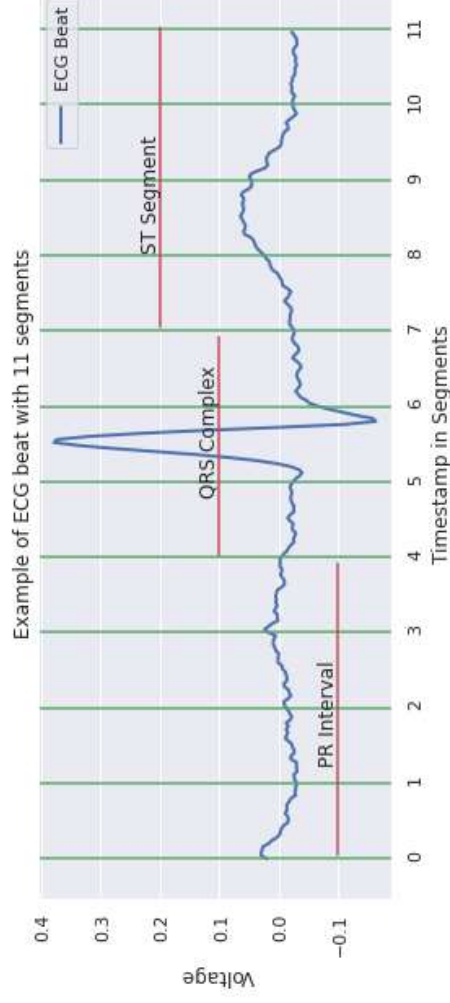- Lime Image Explainer
- Recurrent Tabular Explainer

# Packaging Data for LIME
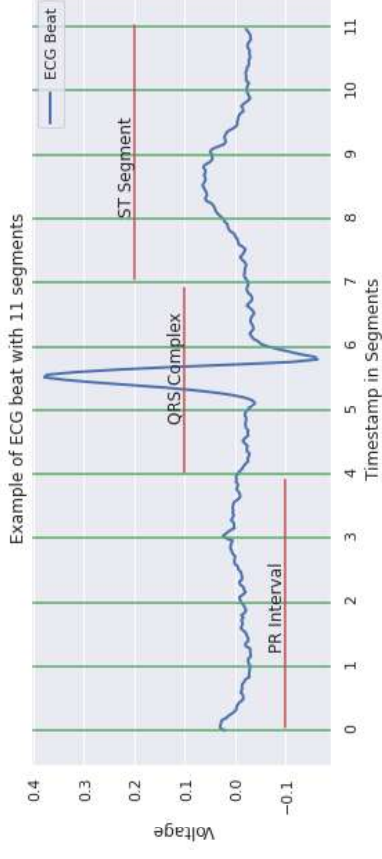
Recurrent Tabular Explainer

Lime Image Explainer

Lime Text Explainer

Lime Tabular Explainer

Example of ECG beat with 11 segments

One-hot encoded labels

Annotation	Class	Class ID	One-hot encoded
Undetermined	-	0	[1 0 0 0 0 0 0 0 0]
Normal	N	1	[0 1 0 0 0 0 0 0 0]
LBBBB	L	2	[0 0 1 0 0 0 0 0 0]
RBBBB	R	3	[0 0 0 1 0 0 0 0 0]
Premature ventricular contraction	V	4	[0 0 0 0 1 0 0 0 0]
Atrial premature beat	A	5	[0 0 0 0 0 1 0 0 0]
Fusion ventricular normal beat	F	6	[0 0 0 0 0 0 1 0 0]
Fusion of paced and normal beat	F	7	[0 0 0 0 0 0 0 1 0]
Paced beat	/	8	[0 0 0 0 0 0 0 0 1]

LIME for CNN Explanations

LIME for CNN Explanations

Example of ECG beat with 11 segments
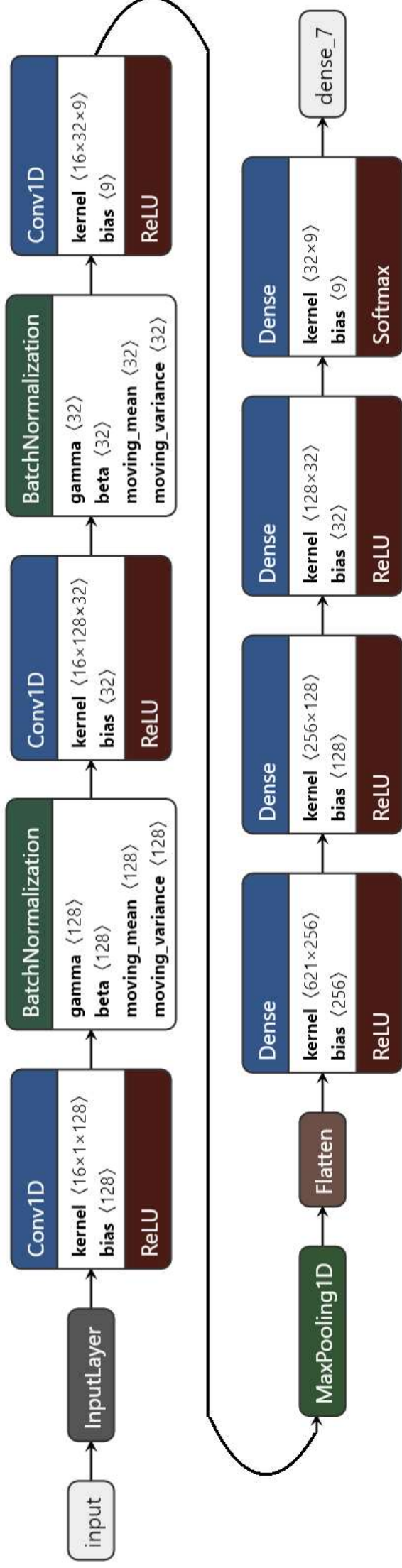
LIME weights for classifying instance of class 1 with a CNN
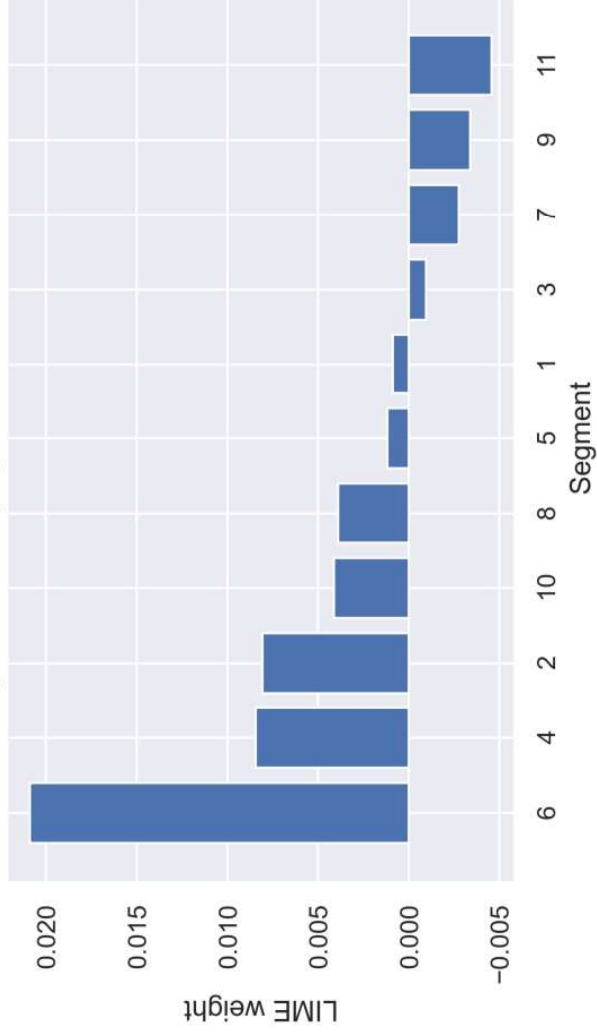
LIME weights for classifying instance of class 1 with a CNN
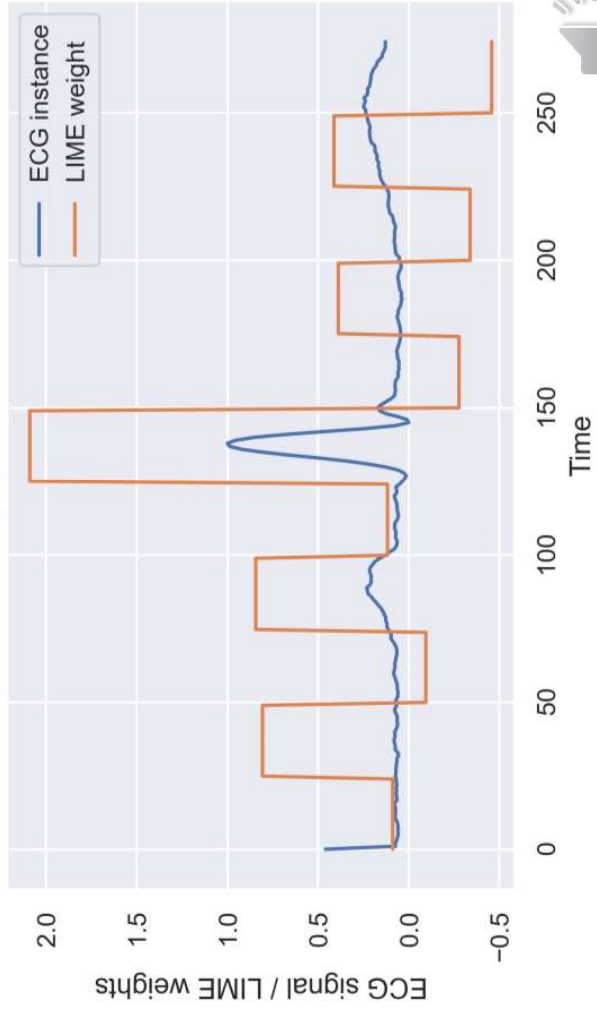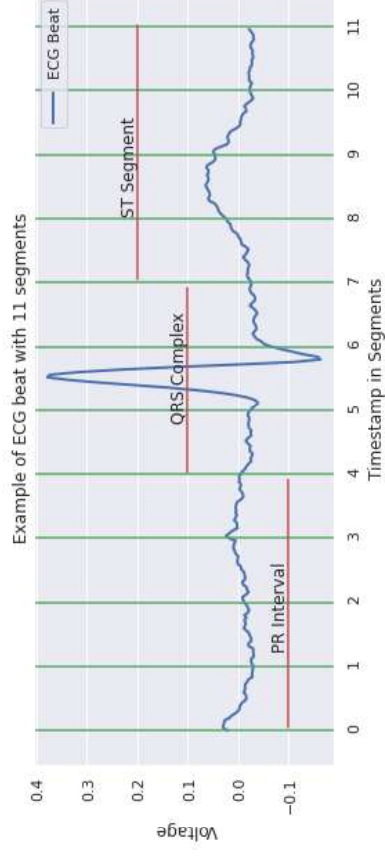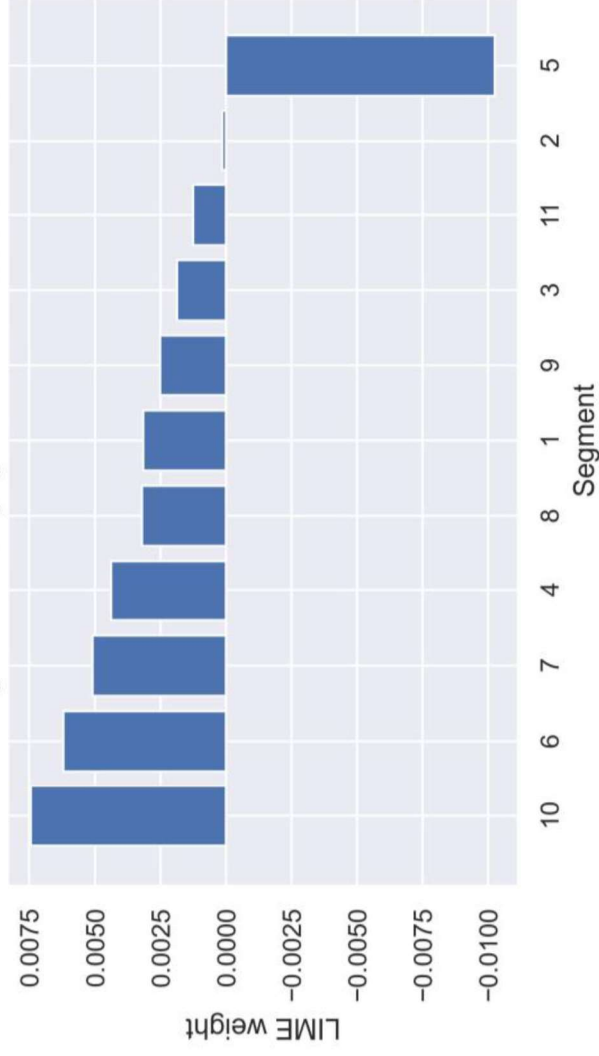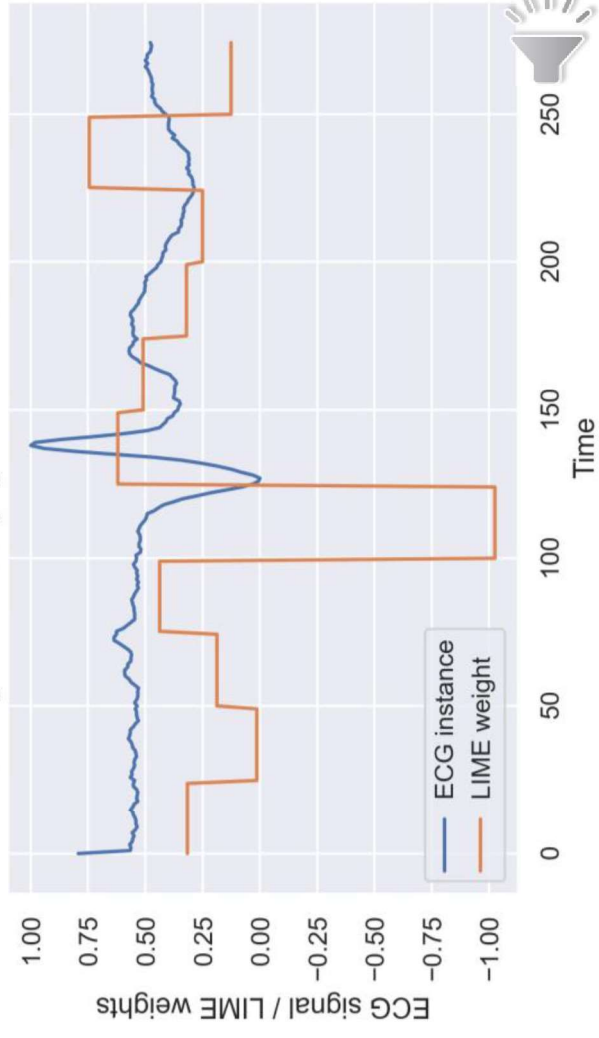
LIME for CNN Explanations
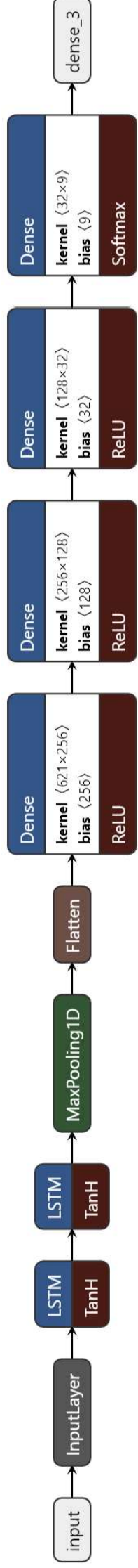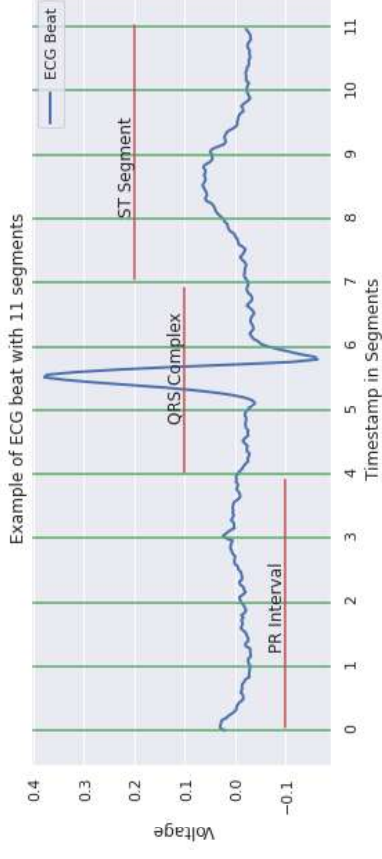

Example of ECG beat with 11 segments

LIME weights for classifying instance of class 3 with a CNN

LIME weights for classifying instance of class 3 with a CNN

LIME for LSTM Explanations
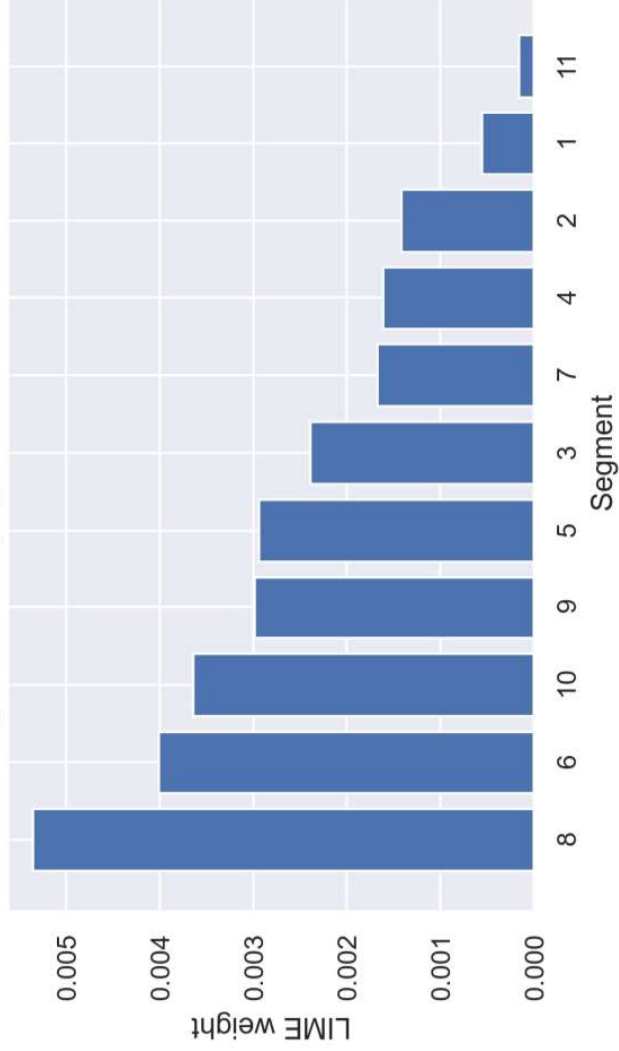
input → InputLayer → LSTM TanH → LSTM TanH → MaxPooling1D → Flatten → Dense kernel ⟨621×256⟩ bias ⟨256⟩ ReLU → Dense kernel ⟨256×128⟩ bias ⟨128⟩ ReLU → Dense kernel ⟨128×32⟩ bias ⟨32⟩ ReLU → Dense kernel ⟨32×9⟩ bias ⟨9⟩ Softmax → dense_3

LIME for LSTM Explanations
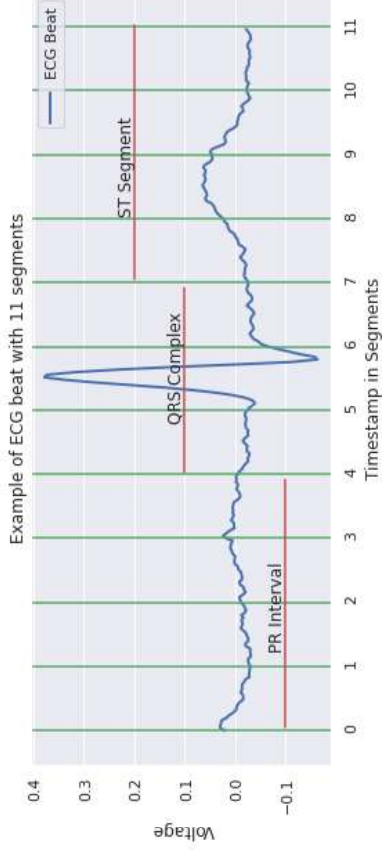

Example of ECG beat with 11 segments

LIME weights for classifying instance of class 3 with an LSTM

LIME weights for classifying instance of class 3 with an LSTM

LIME for LSTM Explanations

Example of ECG beat with 11 segments
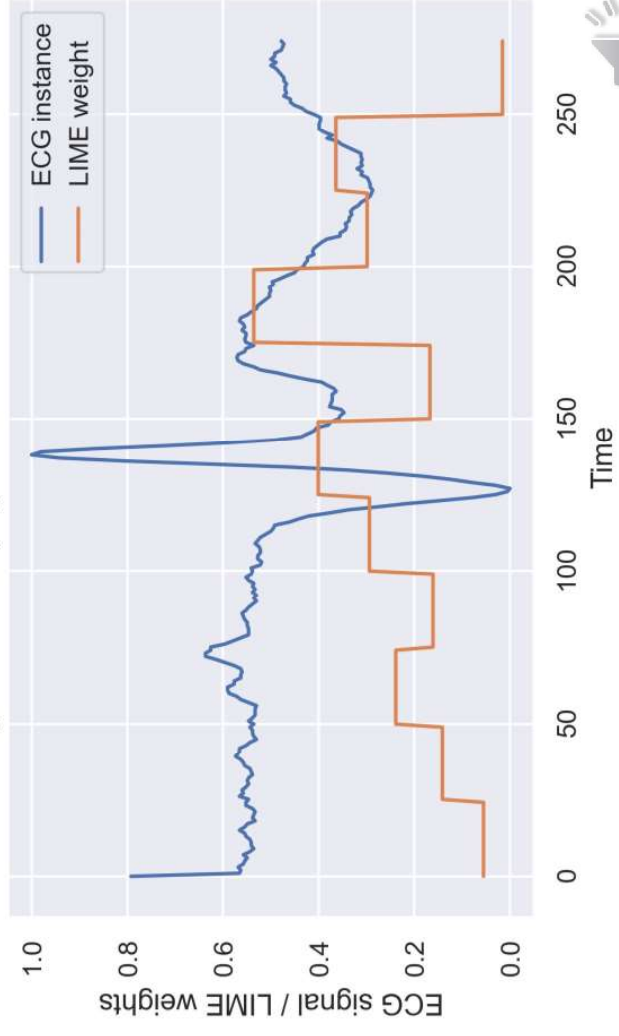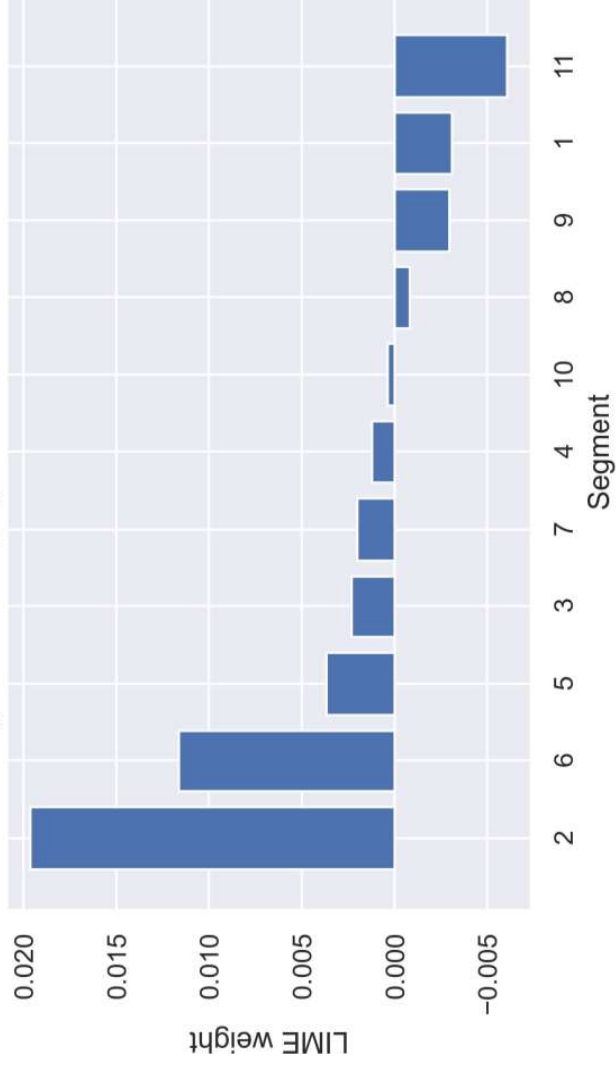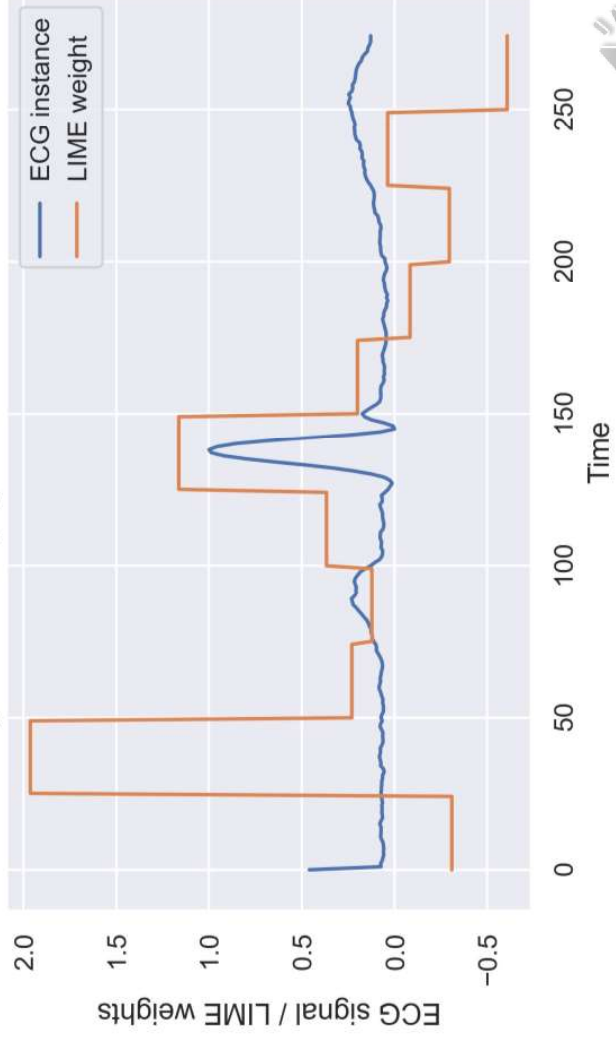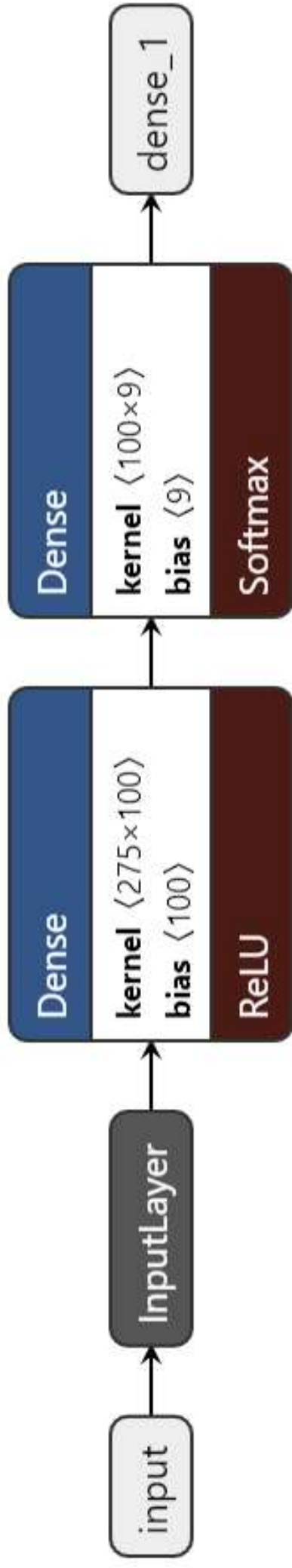

LIME weights for classifying instance of class 1 with an LSTM

LIME weights for classifying instance of class 1 with an LSTM

LIME for MLP Explanations

input_

InputLayer

Dense	
kernel ⟨275×100⟩	
bias ⟨100⟩	
ReLU	

Dense	
kernel ⟨100×9⟩	
bias ⟨9⟩	
Softmax	

dense_1

LIME for MLP Explanations

Example of ECG beat with 11 segments

LIME weights for classifying instance of class 1 with an MLP

LIME weights for classifying instance of class 1 with an MLP

LIME for MLP Explanations

Example of ECG beat with 11 segments

LIME weights for classifying instance of class 3 with an MLP

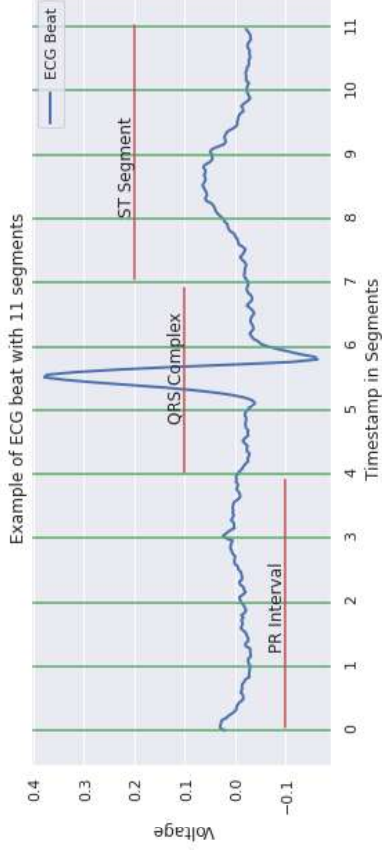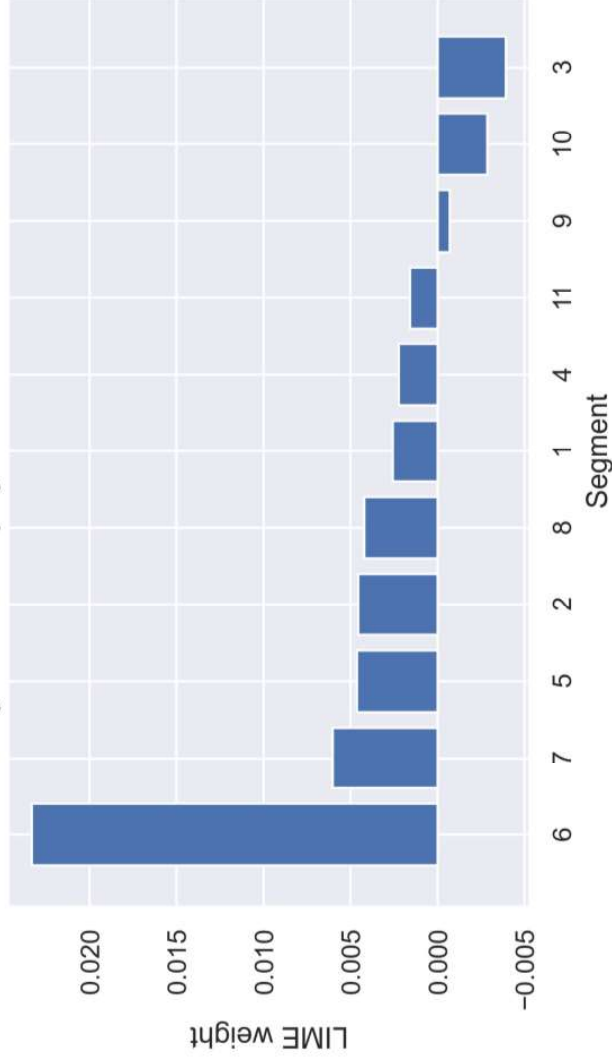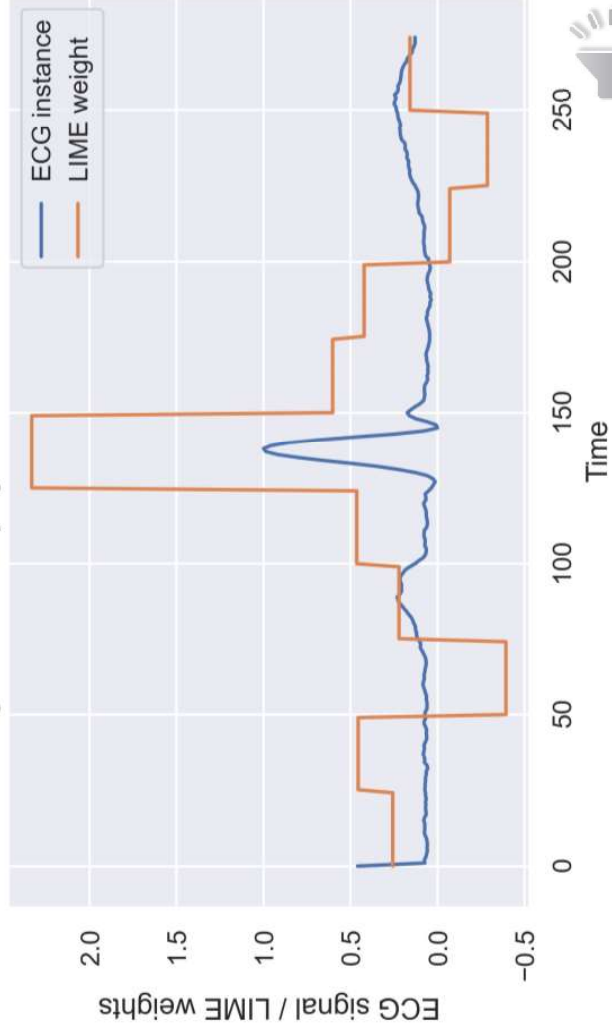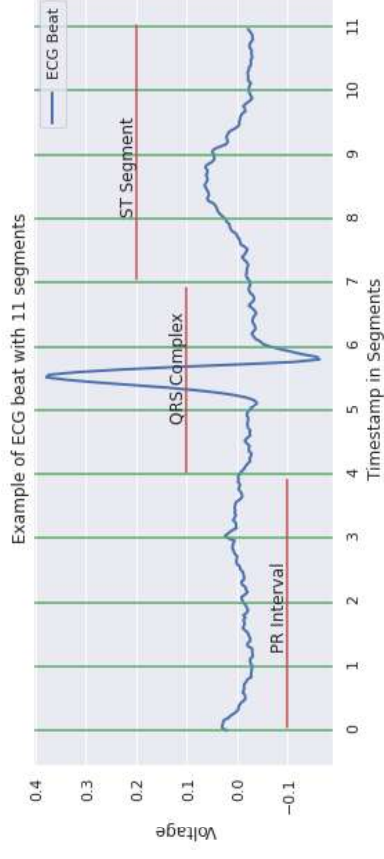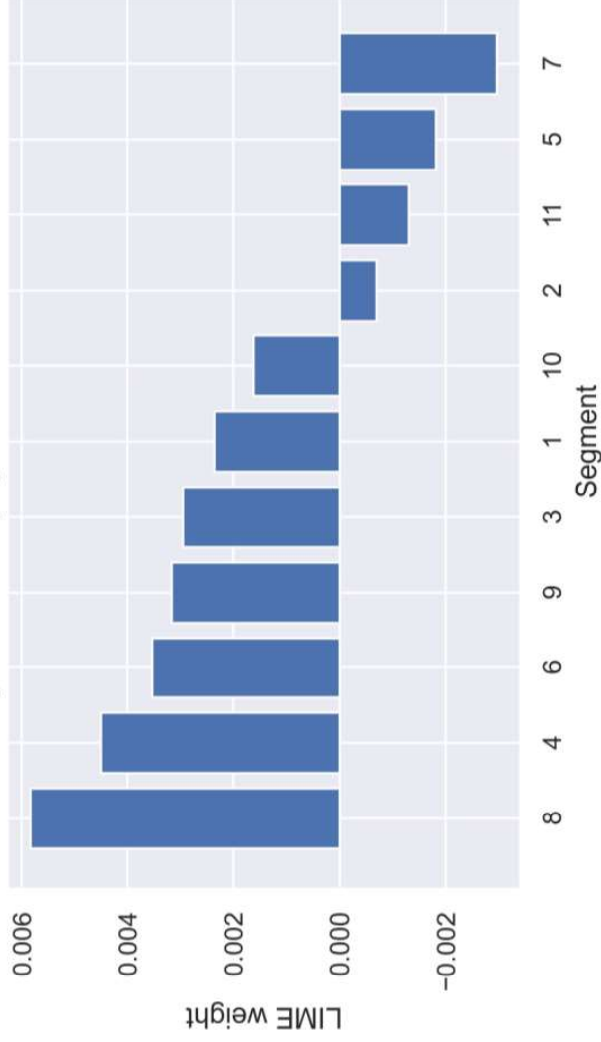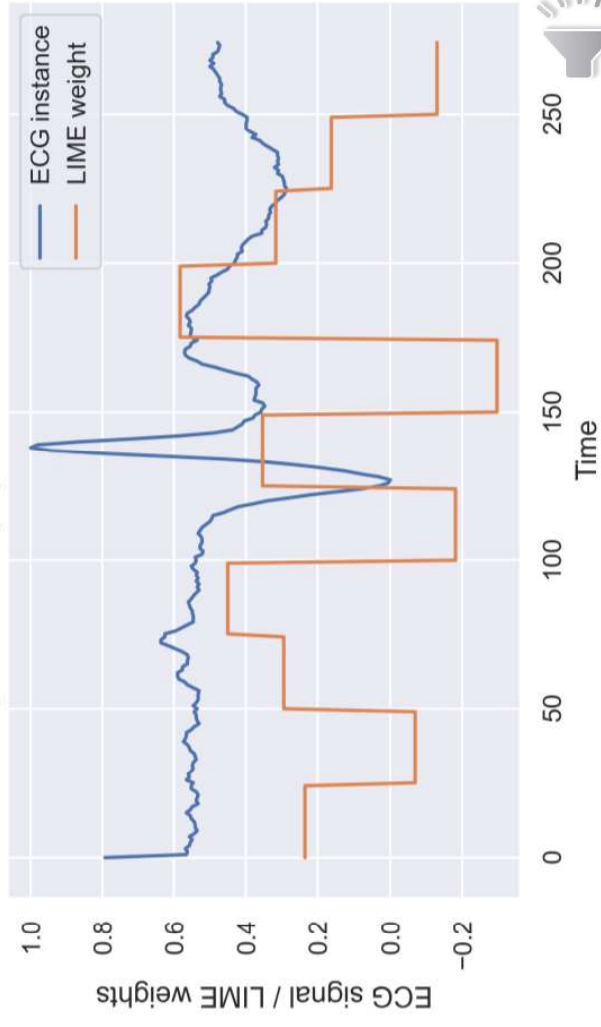
LIME weights for classifying instance of class 3 with an MLP

Summary

- Generally, LIME explanations agreed that the QRS complex contributes significantly to the prediction across all models.

- LIME local explanations may disagree with each other for similar points (robustness)

- LIME can also provide negative contributions, which they also indicate significant importance

References

- Ribeiro et al. 'Model-Agnostic Interpretability of Machine Learning', ICML Workshop on Human Interpretability in Machine Learning, 2016.

- Neves et al. 'Interpretable heartbeat classification using local model-agnostic explanations on ECGs', Computers in Biology and Medicine, 2021.

- Alvarez-Melis et al. 'On the Robustness of Interpretability Methods', ICML, 2018.