Grid Saliency for Context Explanations of Semantic Segmentation

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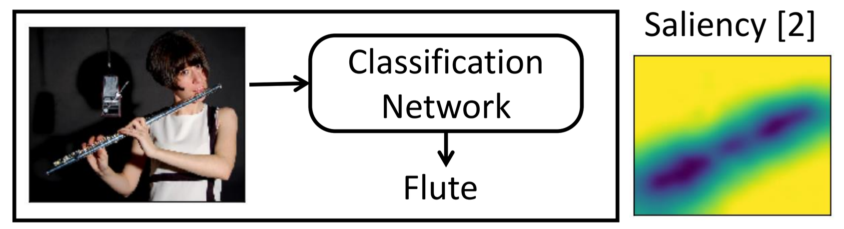
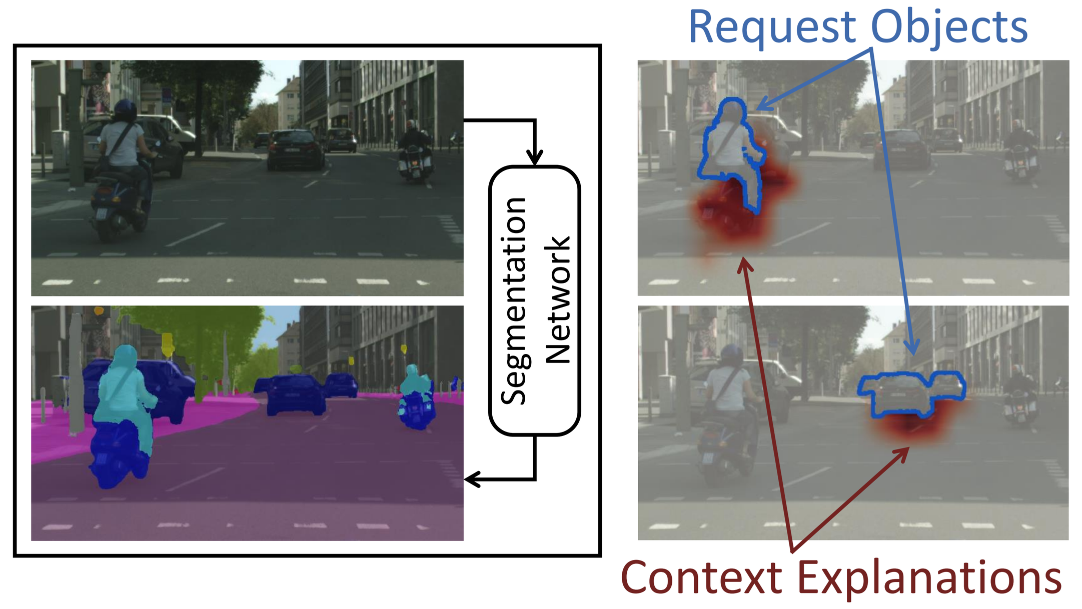
1 Motivation

Prior work: Saliency maps are used for visual explanations of neural network image classifications [1,2,3,4]



Our approach: Grid Saliencies for dense prediction tasks

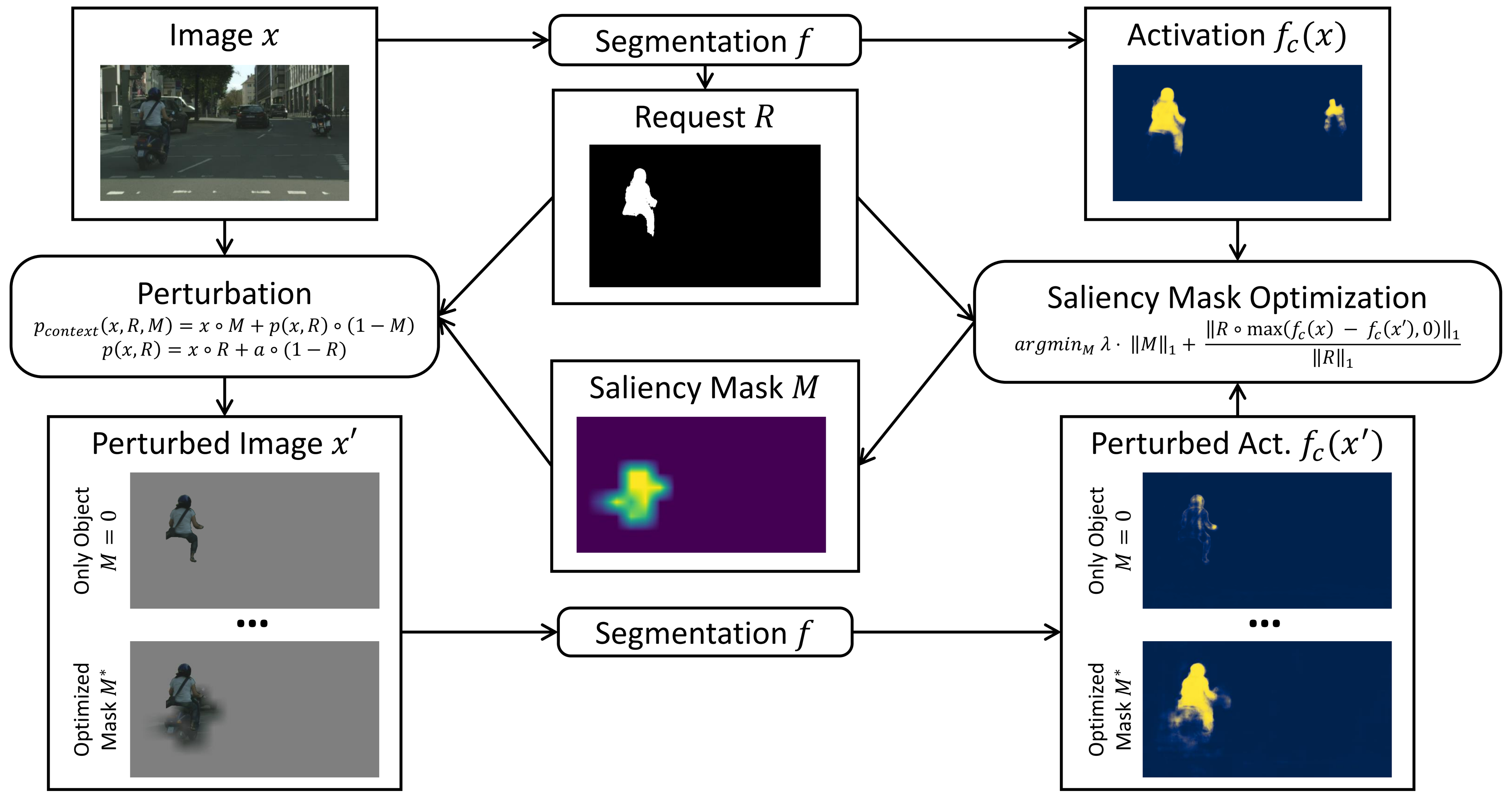
Contributions:
- Context explanations for semantic segmentation
- Synthetic benchmark
- Real-world data analysis



2 Perturbation-Based Grid Saliency

Context saliency map optimization

- Perturb as much context as possible
- Retain network predictions inside a request region

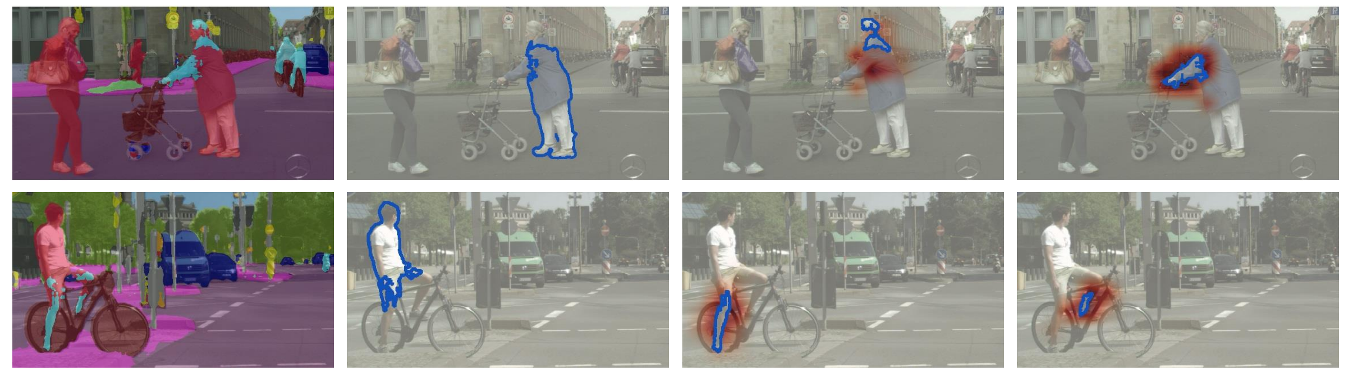


3 Grid Saliency Use Cases

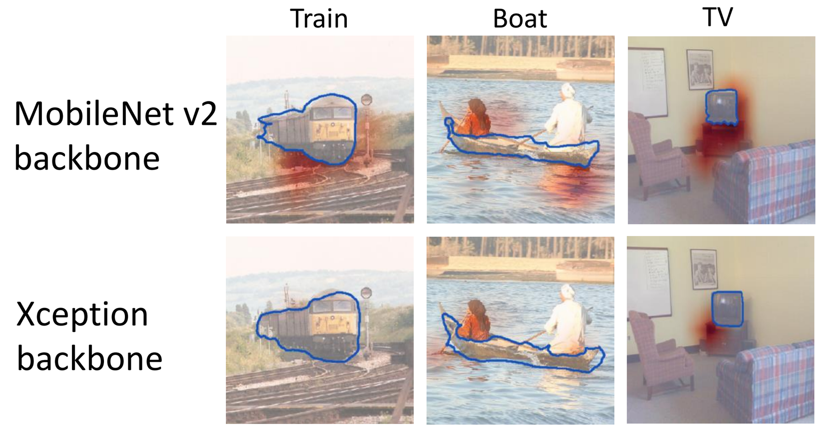
Error case analysis

Pedestrian classified as rider
→ arm pose salient

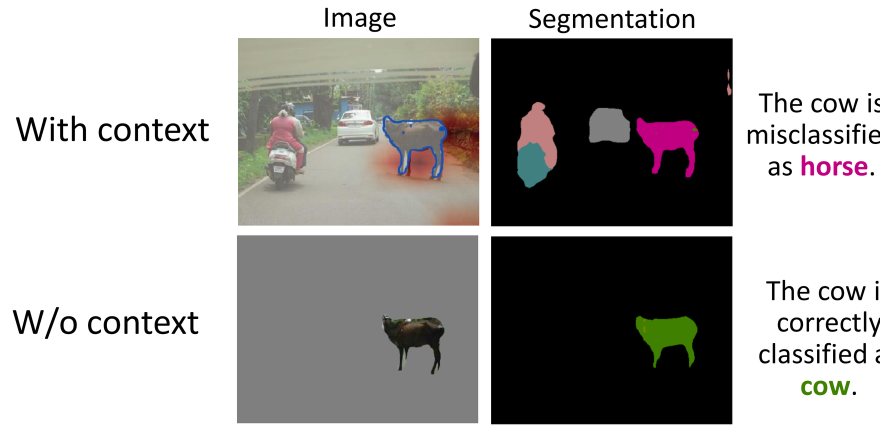
Rider classified as pedestrian
→ bicycle not salient



Architecture comparison



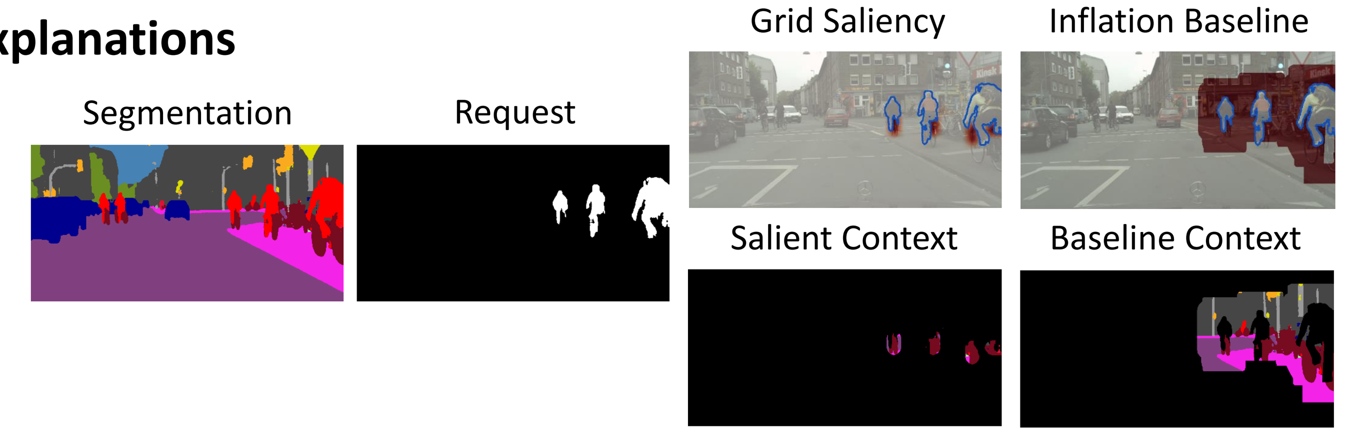
Network generalization



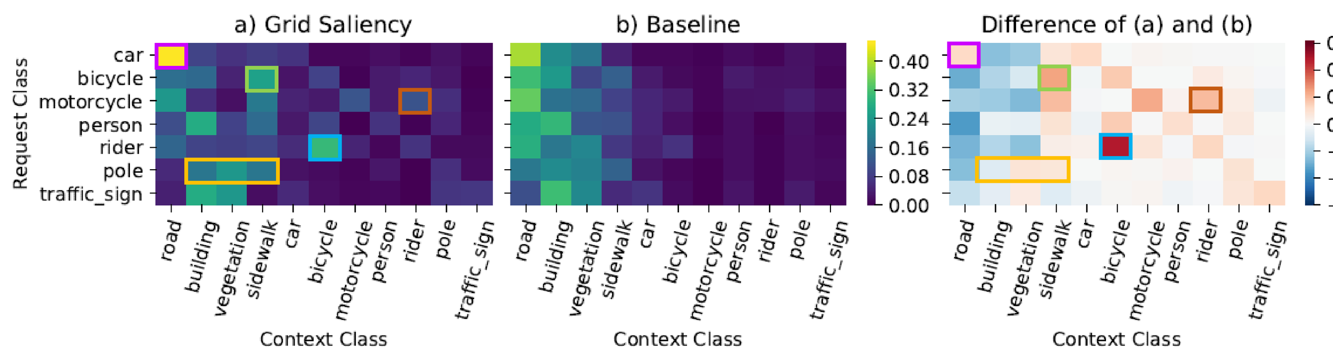
4 Context Explanations on Cityscapes

Statistics on context explanations

Relative amount of salient context pixels for different request classes



Exemplary findings:
- Road for car
- Bicycle for rider
- Vegetation for pole
- Sidewalk for bicycle
- Rider for motorcycle

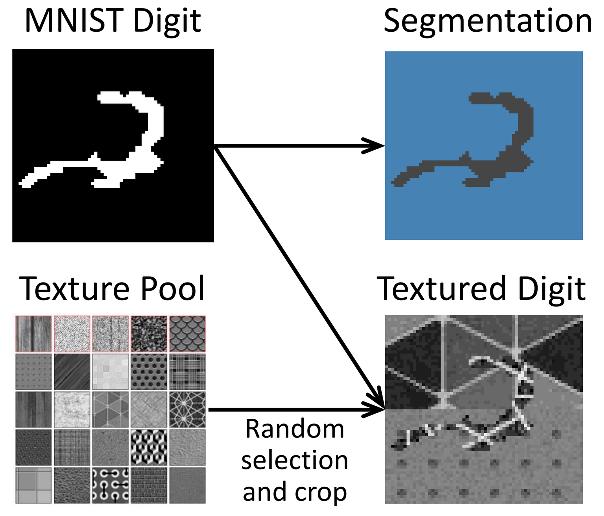


Examples of context explanations

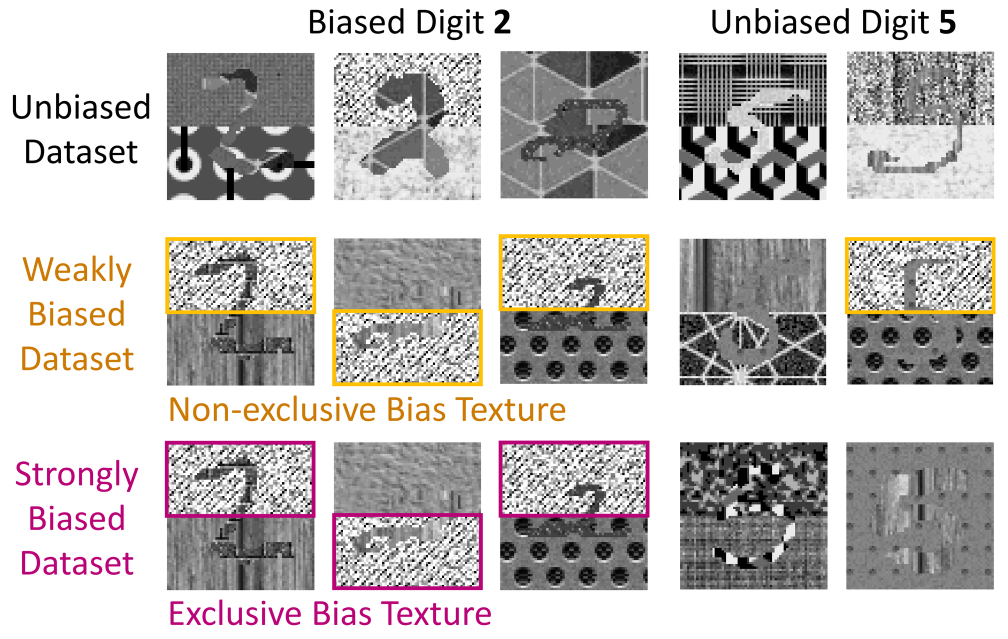
5 Synthetic Data for Benchmarking Saliencies

Generation of the dataset with induced bias

MNIST digits are combined with random fore- and background textures

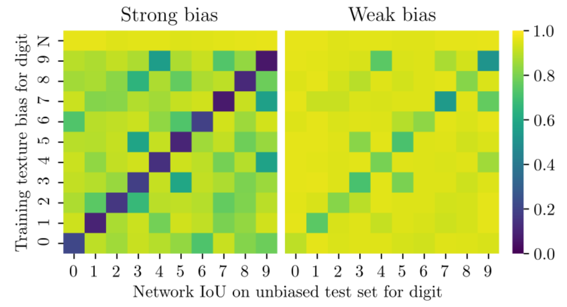


Context bias is induced into the dataset by choosing the same background texture for a specific digit

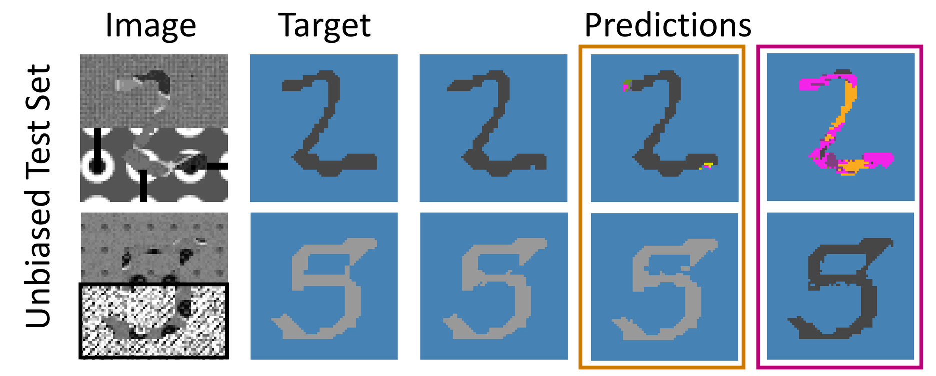


Has the network picked up the bias?

Test a potentially biased network on an unbiased dataset



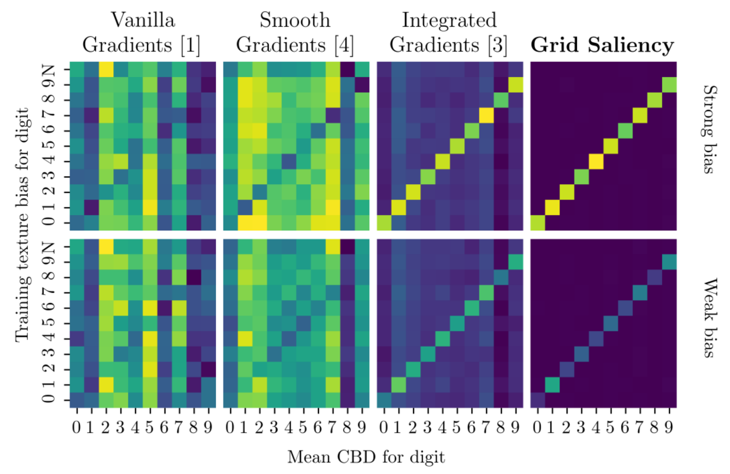
Drop in segmentation IoU for biased digits
→ Network has picked up the bias



towards digit **2** on the noisy texture

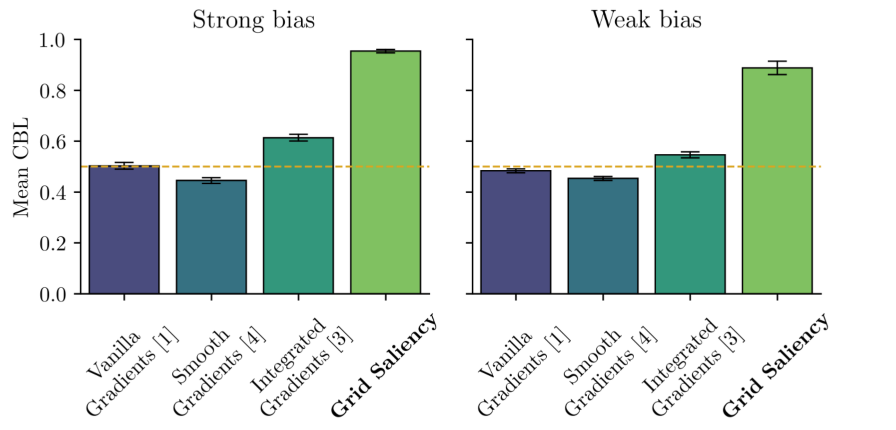
Can the saliency detect biased samples and localize the bias?

Measure $CBD = \frac{salient\ context}{context}$ averaged over 5 bias textures and 5 datasets



High grid saliency on biased digits
→ Biased samples can be detected

Measure $CBL = \frac{biased\ salient\ context}{salient\ context}$ averaged over 10 bias digits, 5 bias textures and 5 datasets



High grid saliency on biased context
→ Bias can be localized

6 References

[1] Simonyan et al. Deep inside convolutional networks: Visualising image classification models and saliency maps. In International Conference on Learning Representations, 2013.

[2] Fong et al. Interpretable explanations of black boxes by meaningful perturbation. In Proceedings of the IEEE International Conference on Computer Vision, 2017.

[3] Sundararajan et al. Axiomatic attribution for deep networks. In International Conference on Machine Learning, 2017.

[4] Smilkov et al. Smoothgrad: removing noise by adding noise. arXiv:1706.03825, 2017.