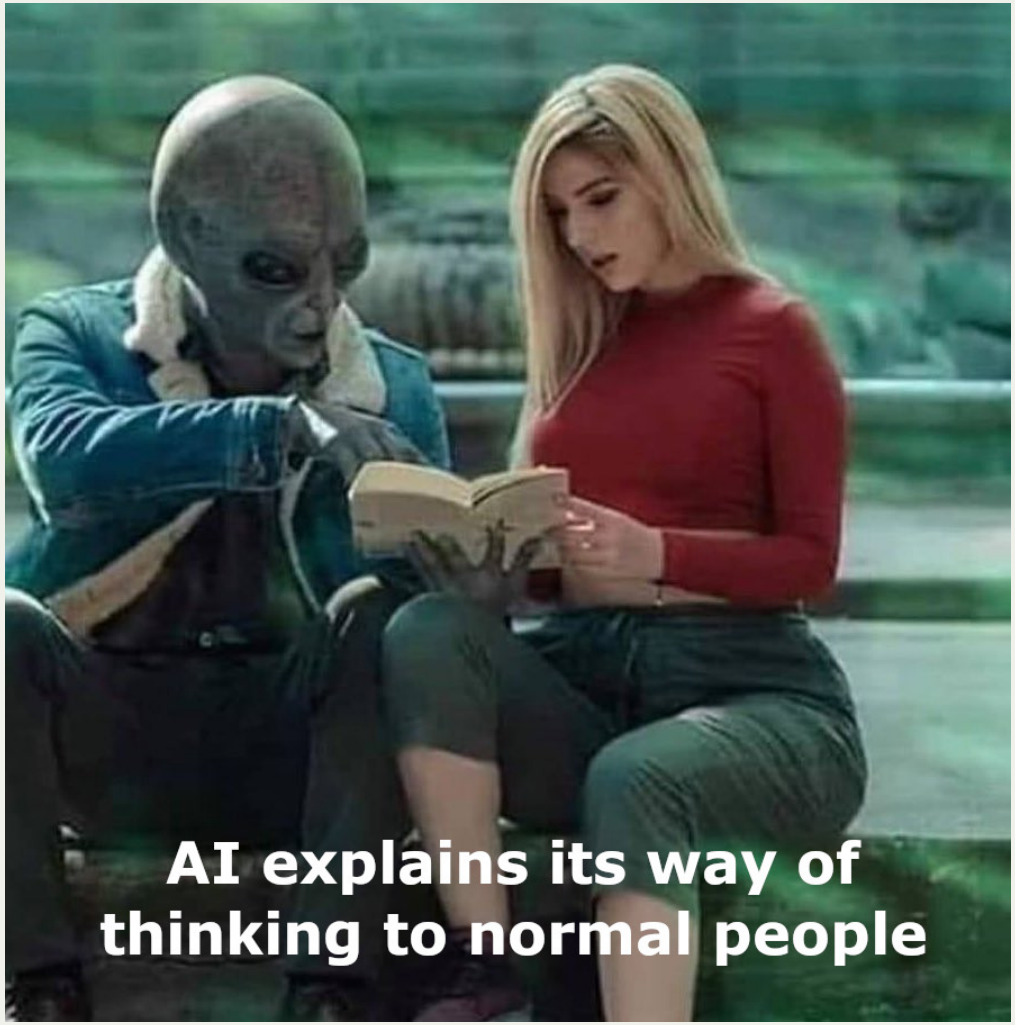
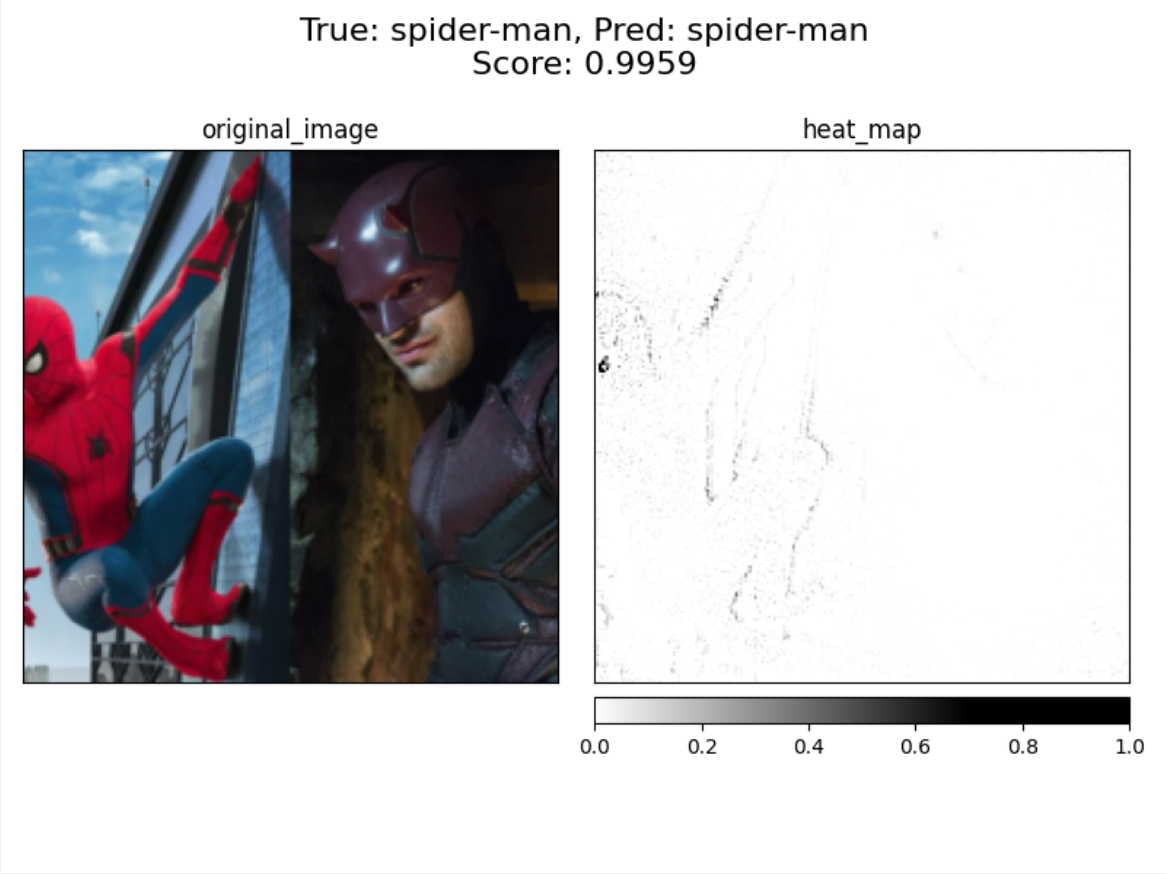
Attribution methods in interpretability of CNNs

Author: Kemal Erdem



Source: "cell" on Twitter

Attribution example



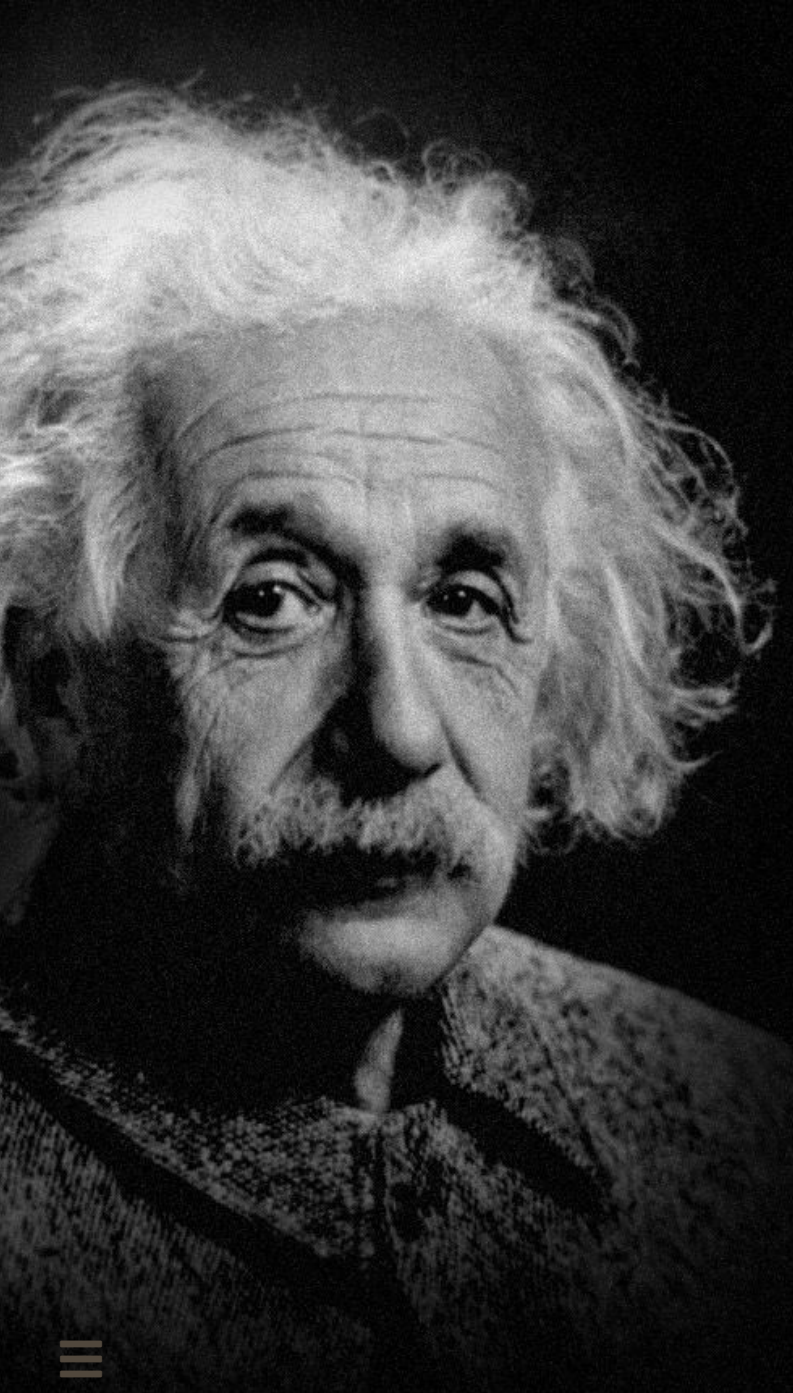
GradCAM attribution, Source: Marvel Heroes Dataset

Is that a good attribution?

GradCAM attribution, Source: Marvel Heroes Dataset

What is a problem?

- New methods are not validated
- We don't know how to compare XAI methods
- No one is checking the metrics on real data



Qualitative methods suck, just use Quantitative, they are fine...

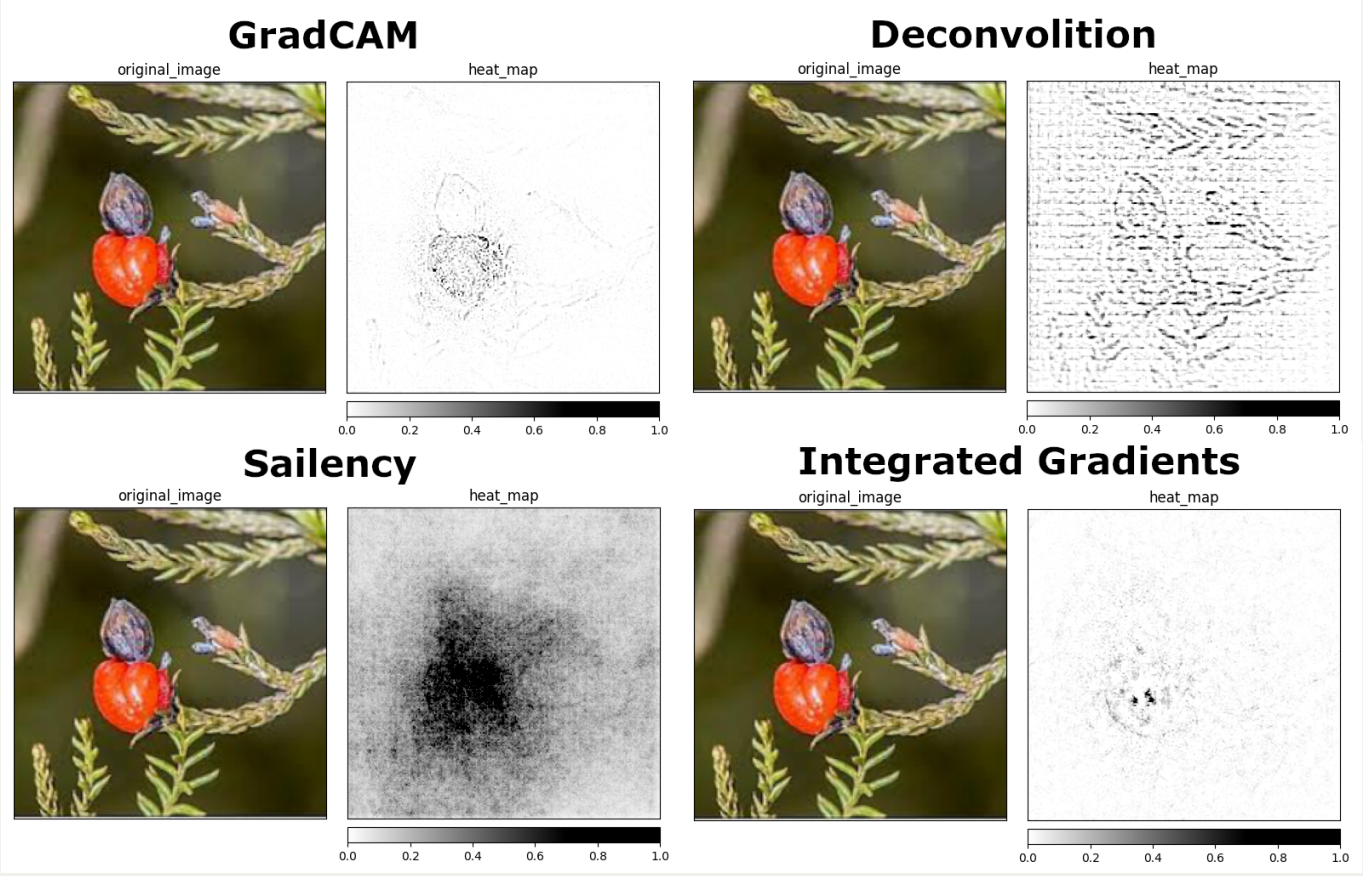
- Albert Einstein (maybe)

The goal?

The goal?

- Compare metrics (different methods, different models, different datasets)
- Check if metrics make sense (spoiler... they don't)
- Define if we're able to decide which method is better

Different methods different problems



Source: Edible plants dataset

Maybe metrics then?

On the (In)fidelity and Sensitivity of Explanations

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Only two metrics available in the most popular XAI library: Captum

Unintuitive intuition behind the Infidelity

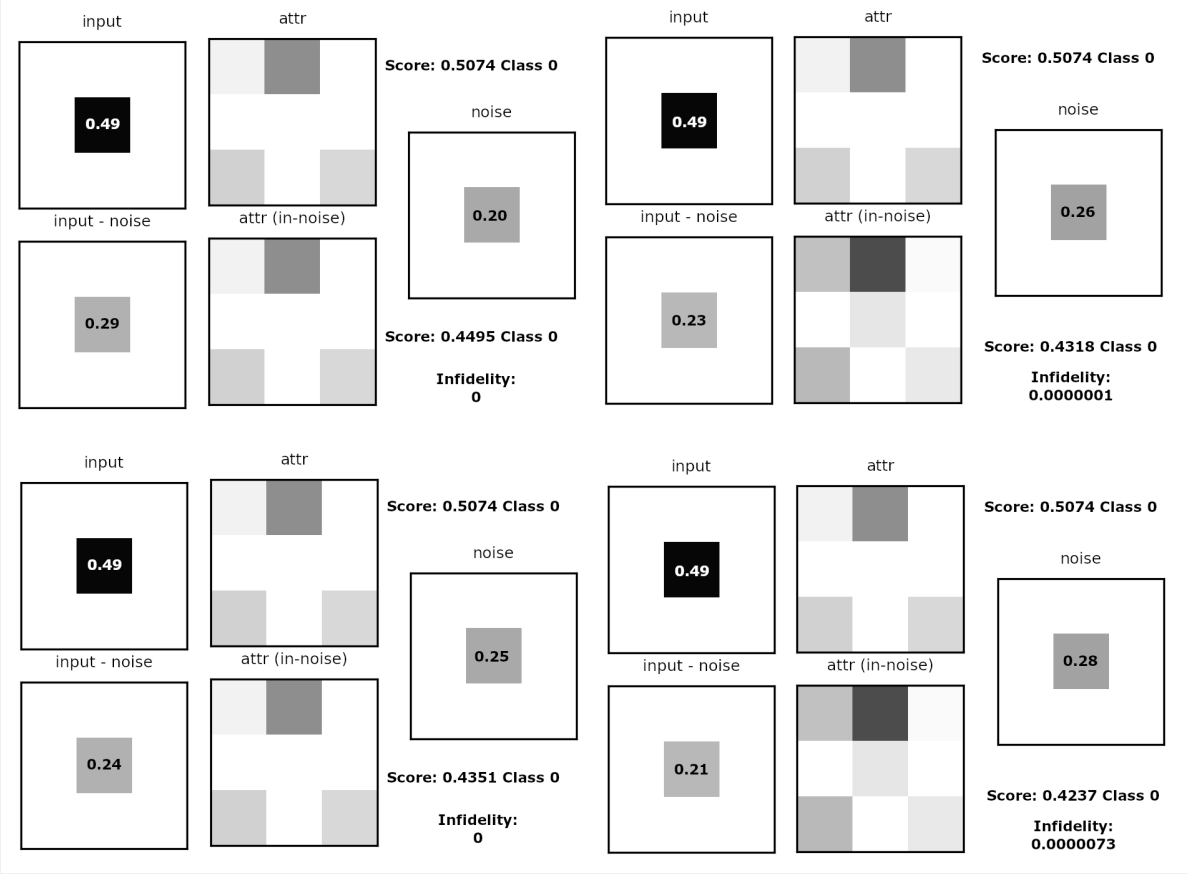
$$\text{INFD}(\Phi, \mathbf{f}, \mathbf{x}) = \mathbb{E}_{\mathbf{I} \sim \mu_\text{I}} \left[\left(\mathbf{I}^T \Phi(\mathbf{f}, \mathbf{x}) - (\mathbf{f}(\mathbf{x}) - \mathbf{f}(\mathbf{x} - \mathbf{I})) \right)^2 \right]$$

$$\Phi^*(\mathbf{f}, \mathbf{x}) = \left(\int \mathbf{I}\mathbf{I}^T d\mu_\mathbf{I} \right)^{-1} \left(\int \mathbf{I}\mathbf{I}^T IG(\mathbf{f}, \mathbf{x}, \mathbf{I}) d\mu_\mathbf{I} \right)$$

$$\text{IG}(\mathbf{f}, \mathbf{x}, \mathbf{I}) = \int_{t=0}^{1} \nabla \mathbf{f}(\mathbf{x} + (t-1)\mathbf{I})$$

Infidelity calculation, Source: On the (In)fidelity and Sensitivity of Explanations

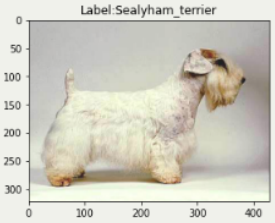
Actual intuition behind the Infidelity

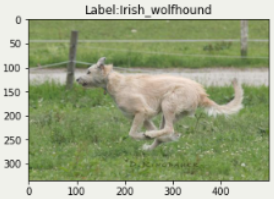


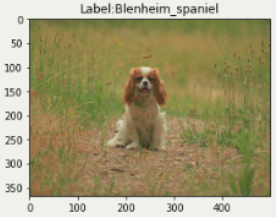
Sample infideilty calculations for different noises.

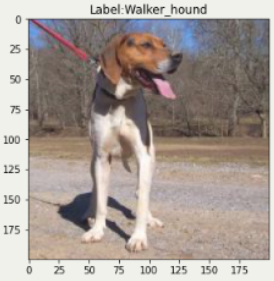
Datasets

Stanford dogs

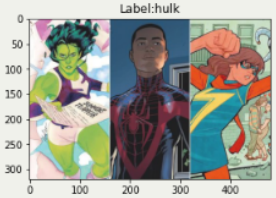


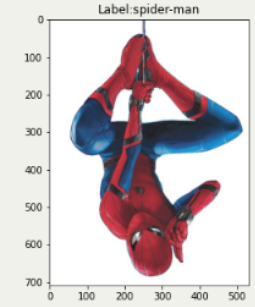


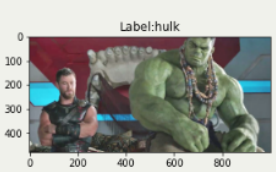


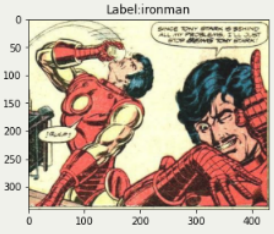


Marvel Heroes

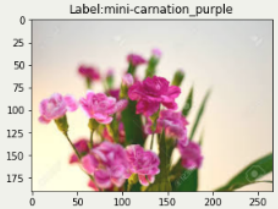


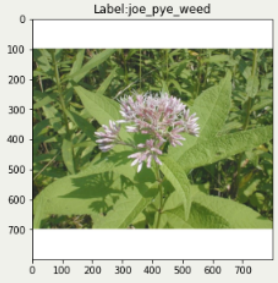


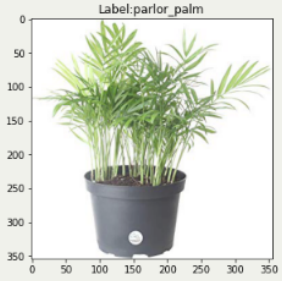


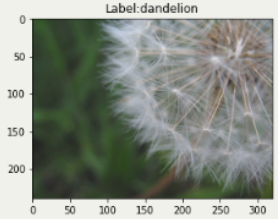


Plants 99

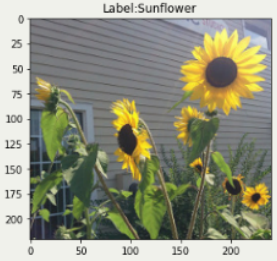


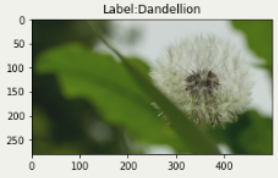


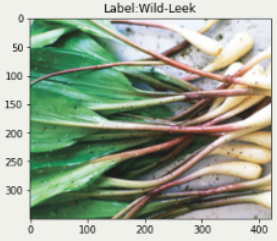




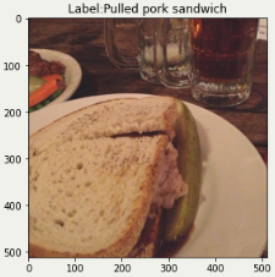
Edible wild plants

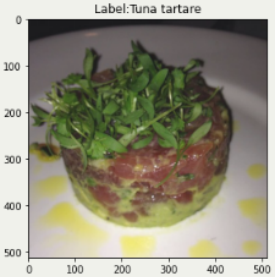


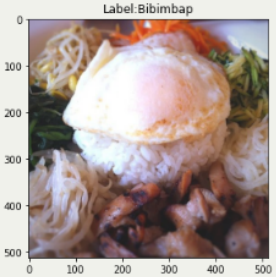




Food 101







Experiments

Models

- ResNet18 (arxiv, 1512.03385)
- EfficientNetB0 (arxiv, 1905.11946)
- DenseNet121 (arxiv, 1608.06993)
- Each with 20%, 40%, 60%, 80% and 100% train data splits
  Total of 75 trained models

Methods

- Saliency (arxiv, 1312.6034)
- Deconvolution (arxiv, 1311.2901)
- Guided Backpropagation (arxiv, 1412.6806)
- Guided GradCAM (arxiv, 1610.02391)
- Maybe more...

Work Split

- **Phase 1**: Publication on Infidelity and Sensitivity as a method to compare XAI solutions (almost done)
- **Phase 2**: Master's Thesis which combines Phase 1 and additional work on the XAI methods

Bibliography

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- A Benchmark for Interpretability Methods in Deep Neural Networks, 2018 (arxiv, 1806.10758)
- SAM: The Sensitivity of Attribution Methods to Hyperparameters, 2020 (arxiv, 2003.08754)

Thanks

"There's no such thing as a stupid question!"

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GH repo: https://github.com/burnpiro/xai-correlation