Dog Breed Identification

by CHAFEY team

deer

human

clown

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Problem Description

Task: Distinguishing dogs between 120 dog breeds

Challenge: Black-box models may provide accurate predictions, but understanding the decision-making process is crucial. Some breeds strictly resemble to each other

Consequences: Misidentification can lead to misinformation or biases impacting animal care and adoption chances

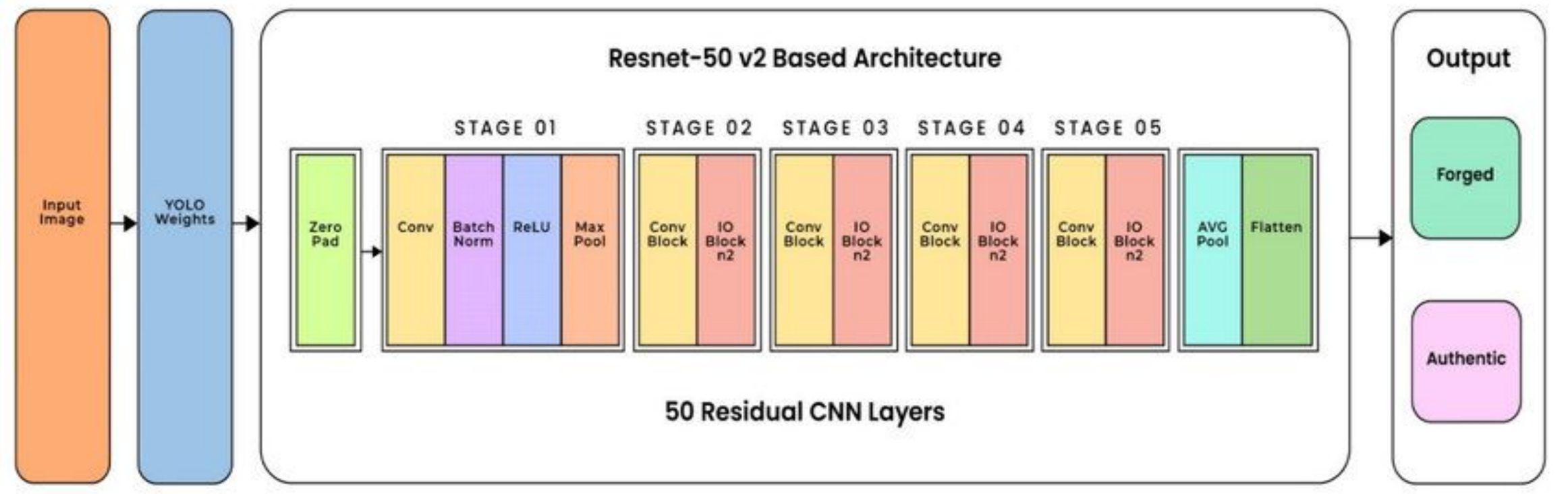
Why do we make classification?

- Veterinary scenario
- Lost dog is found
- Studies on dog populations
- Dog shows and competitions
- Owner preferences for specific breeds
- For curious pet owners
- Educational tools

How do we make a decision?

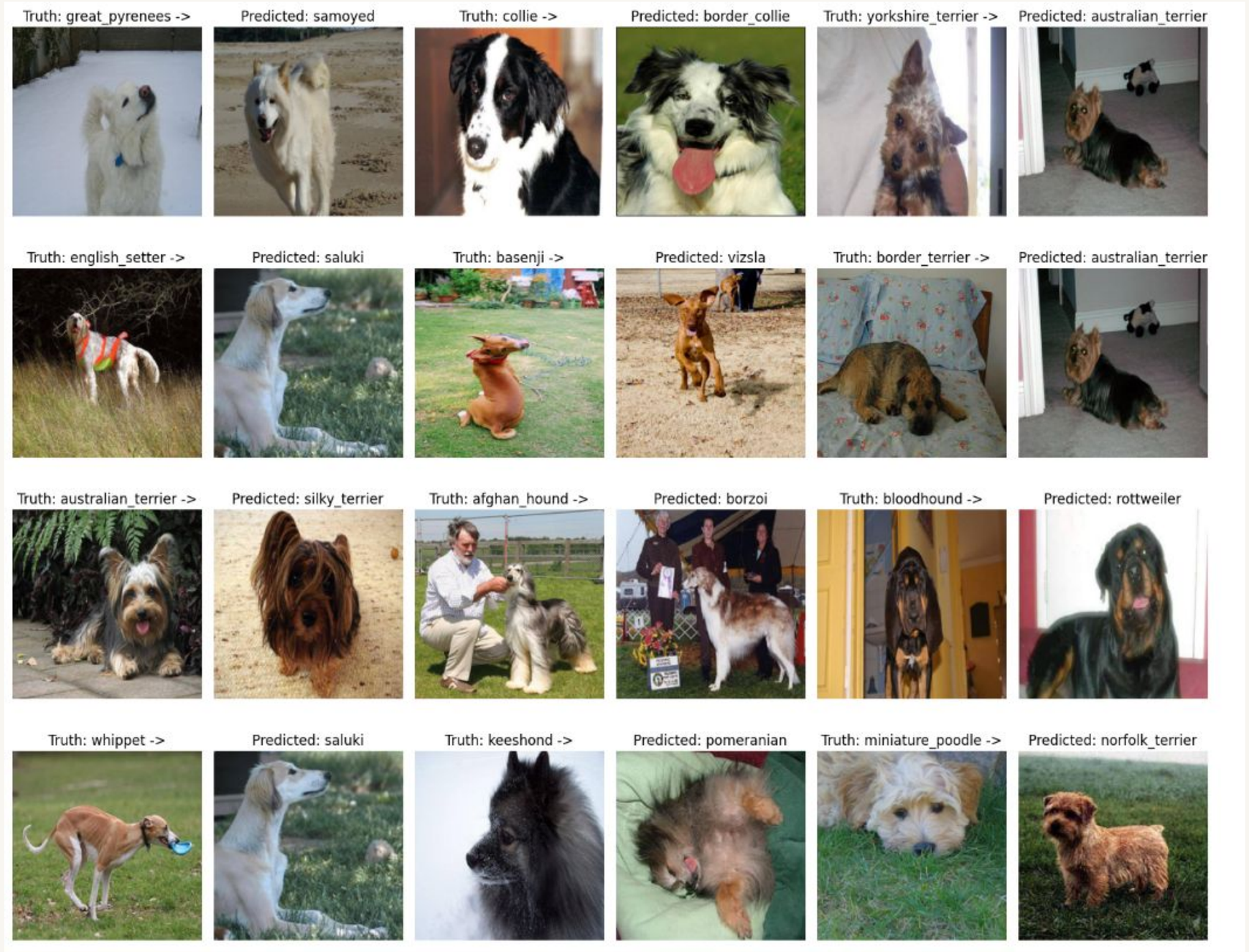
Human	**Model**
Muzzle	?
Head and ear	?
Fur and haircut	?
Size	?
Color (for subbreeds)	?

Black-box



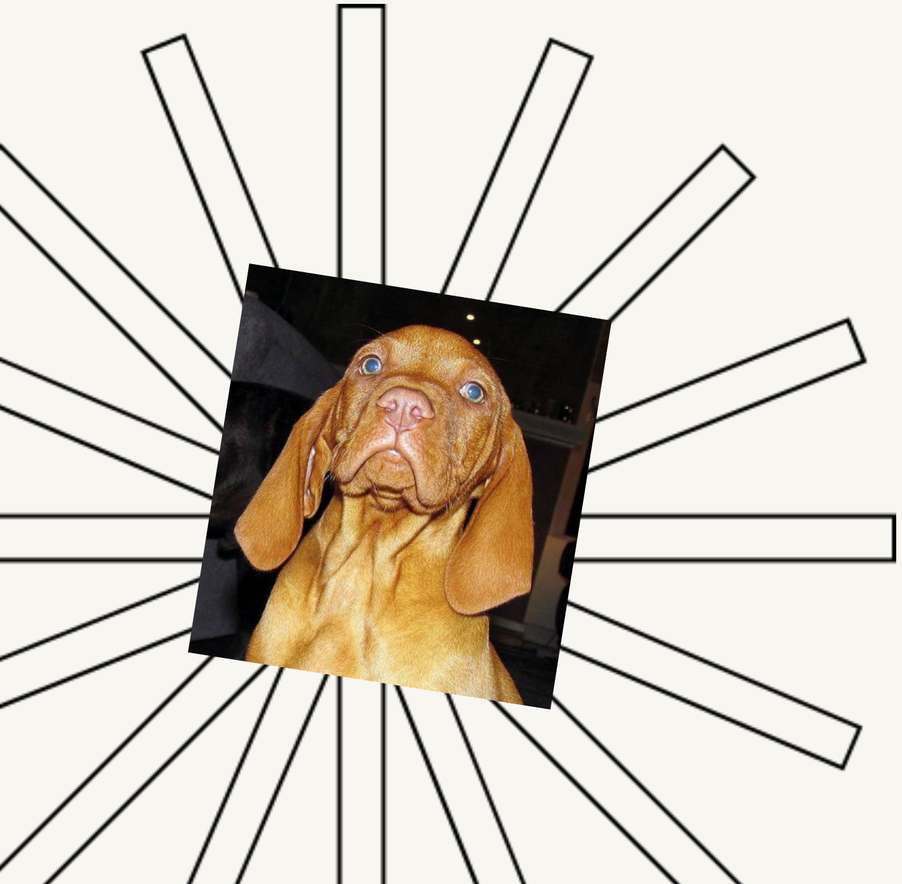
* https://www.kaggle.com/code/sadikaljarif/dog-breed-identification

Accuracy
67%


Truth: great_pyrenees ->
Predicted: samoyed
Truth: collie ->
Predicted: border_collie
Truth: yorkshire_terrier ->
Predicted: australian_terrier
Truth: english_setter ->
Predicted: saluki
Truth: basenji ->
Predicted: vizsla
Truth: border_terrier ->
Predicted: australian_terrier
Truth: australian_terrier ->
Predicted: silky_terrier
Truth: afghan_hound ->
Predicted: borzoi
Truth: bloodhound ->
Predicted: rottweiler
Truth: whippet ->
Predicted: saluki
Truth: keeshond ->
Predicted: pomeranian
Truth: miniature_poodle ->
Predicted: norfolk_terrier

Why is it misclassified?

(hypothesis)



Difficult to take into account the size of dog (e.g. toy and standard poodle)
Difficulties with the age of dogs
Similar coloring in different breeds (keeshond and pomeranian)
…

XAI methods

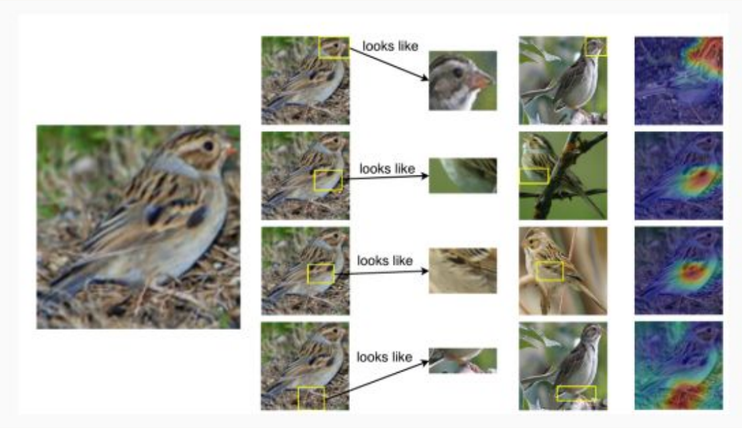
LIME

(Alexander)

SHAP

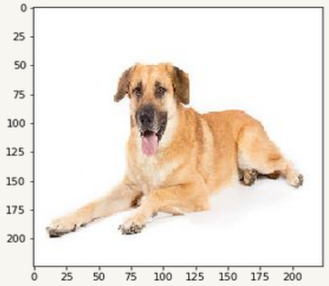
SHAP

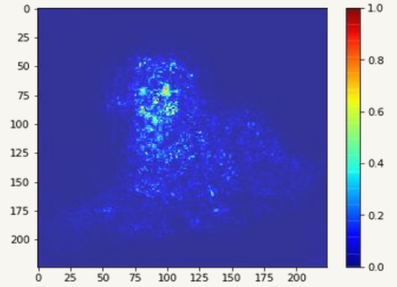
(Hamid)



Prototype model

(Chris & Florian)





Saliency map and its extensions

(Eva & Yasmine)

They could have been investigated, but fate decreed otherwise

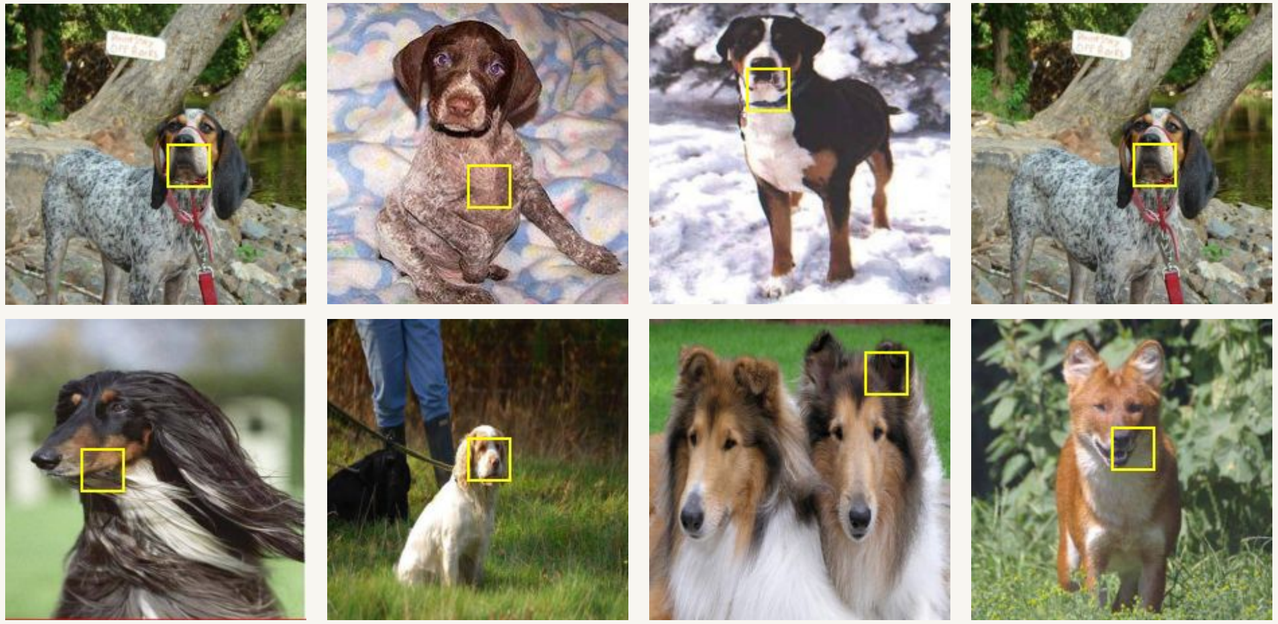
Concept based **TREPAN**

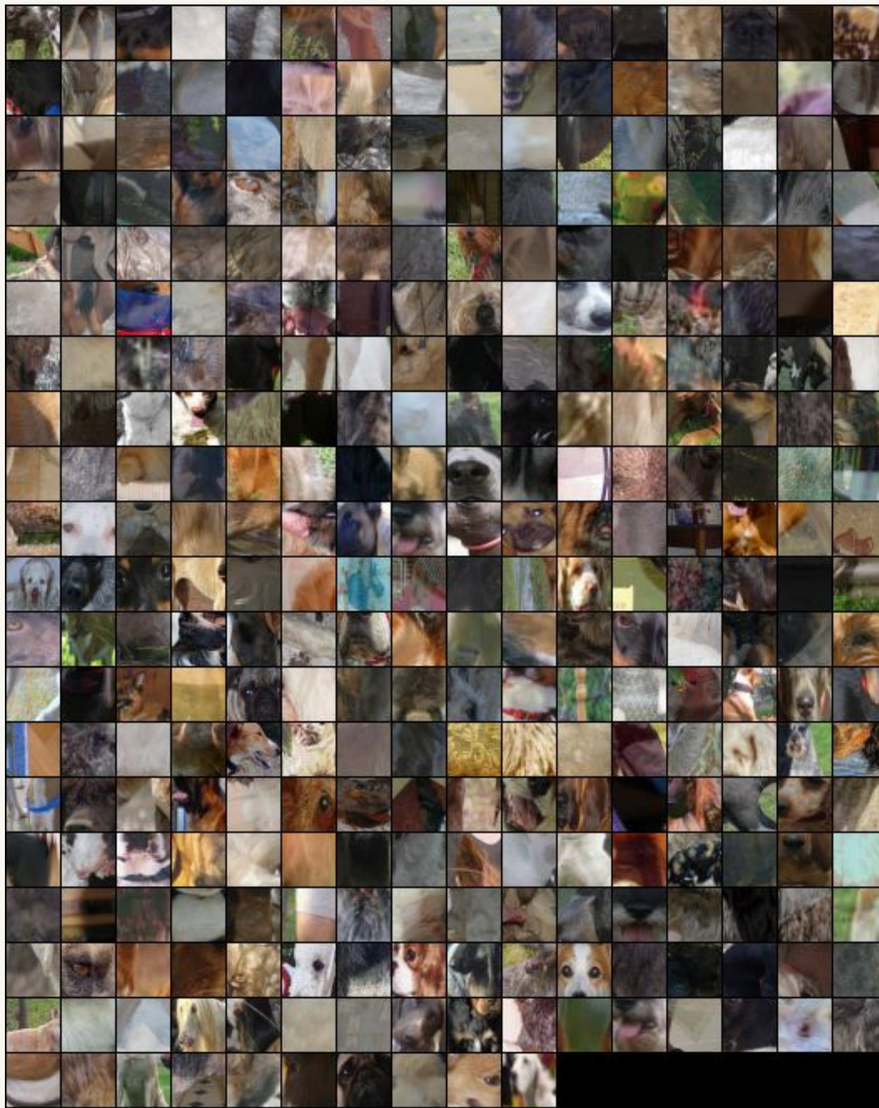
Counterfactual Images

Prototype - PIPNet

- crashed during evaluation
- had bad accuracy
- but outputs decent prototypes and examples

-> no clear result in the end…

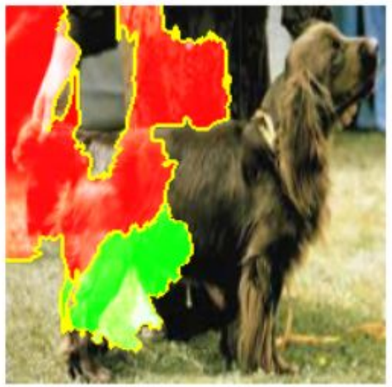




LIME

Original Image 730

LIME Explanation 730



Original Image 1125

LIME Explanation 1125

Original Image 1075

LIME Explanation 1075

Original Image 1134

LIME Explanation 1134

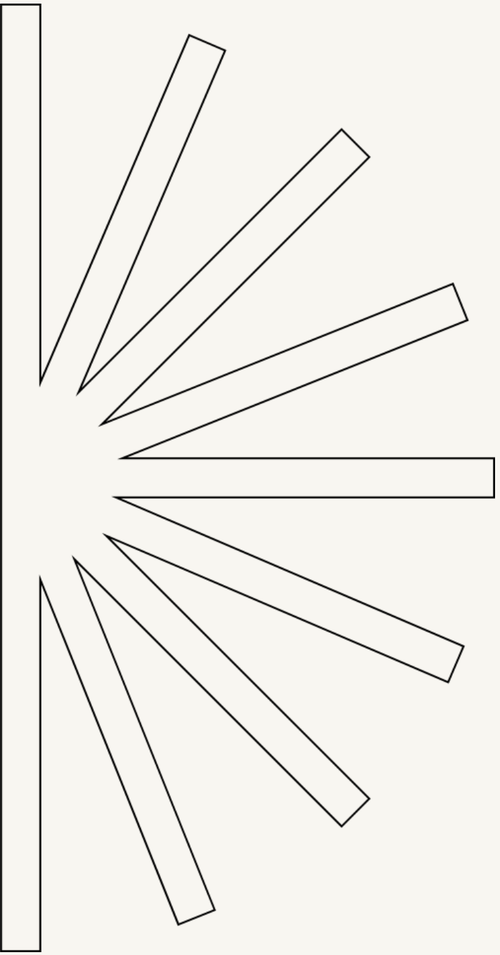
SHAP

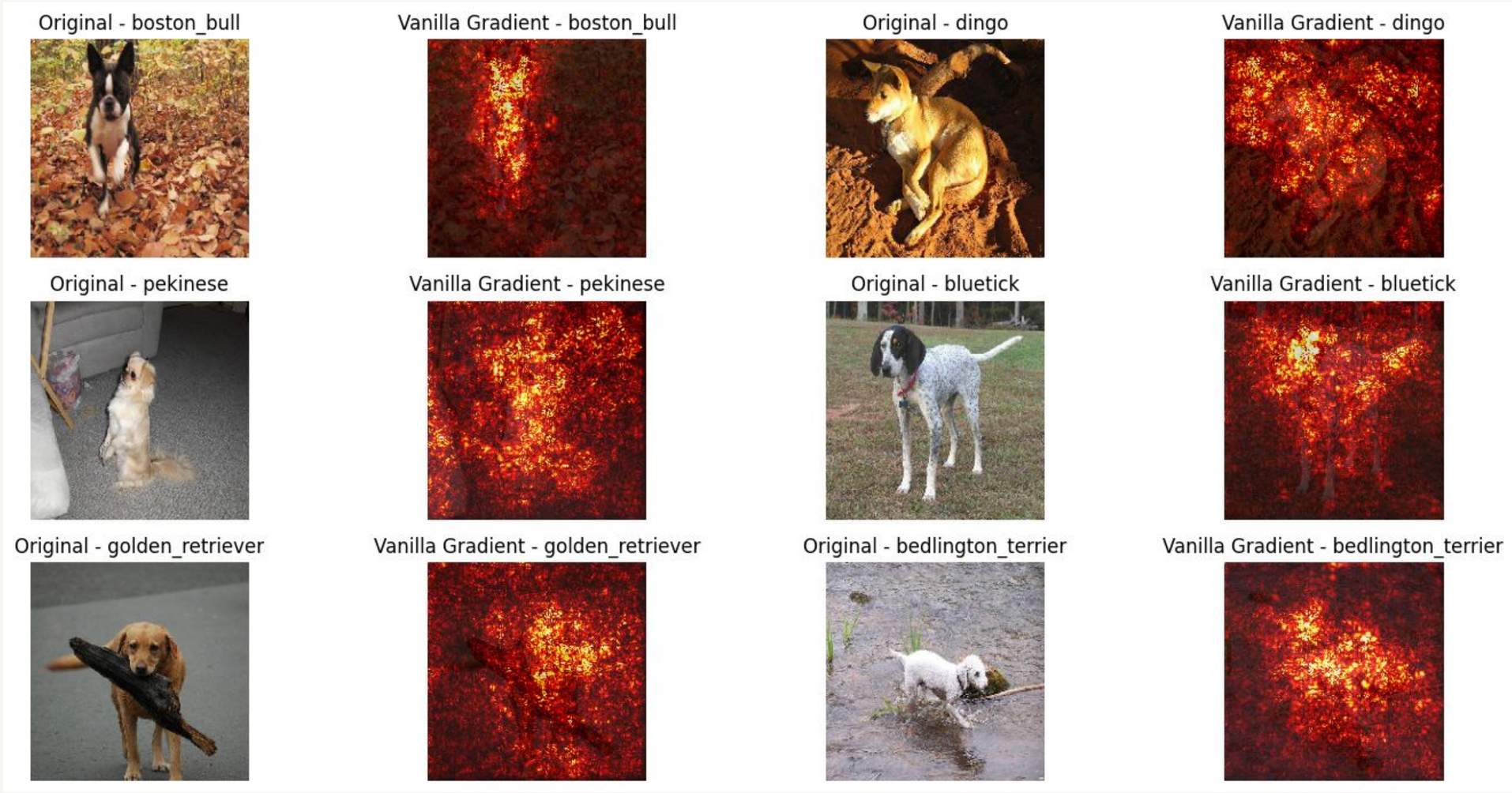

irish_water_spaniel
curly-coated_retriever
standard_poodle
miniature_poodle
−1.0
−0.5
0.0
0.5
1.0
SHAP value
1e−6
irish_water_spaniel
curly-coated_retriever
standard_poodle
miniature_poodle
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
SHAP value
1e−5

SHAP

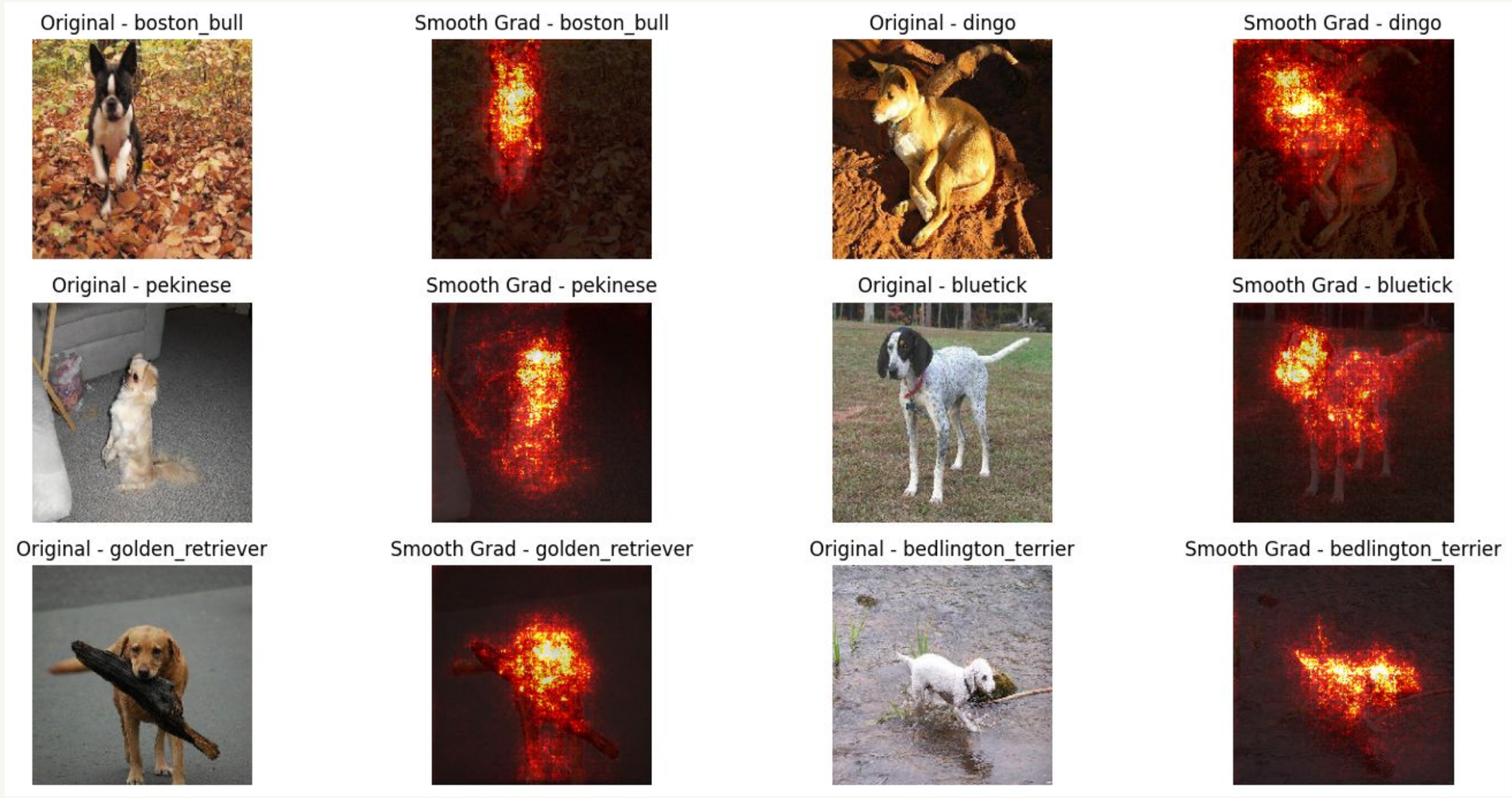

giant_schnauzer
briard
scotch_terrier
tibetan_terrier
−1.0
−0.5
0.0
0.5
1.0
SHAP value
1e−6
giant_schnauzer
briard
scotch_terrier
tibetan_terrier
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
SHAP value
1e−6

Saliency mapc

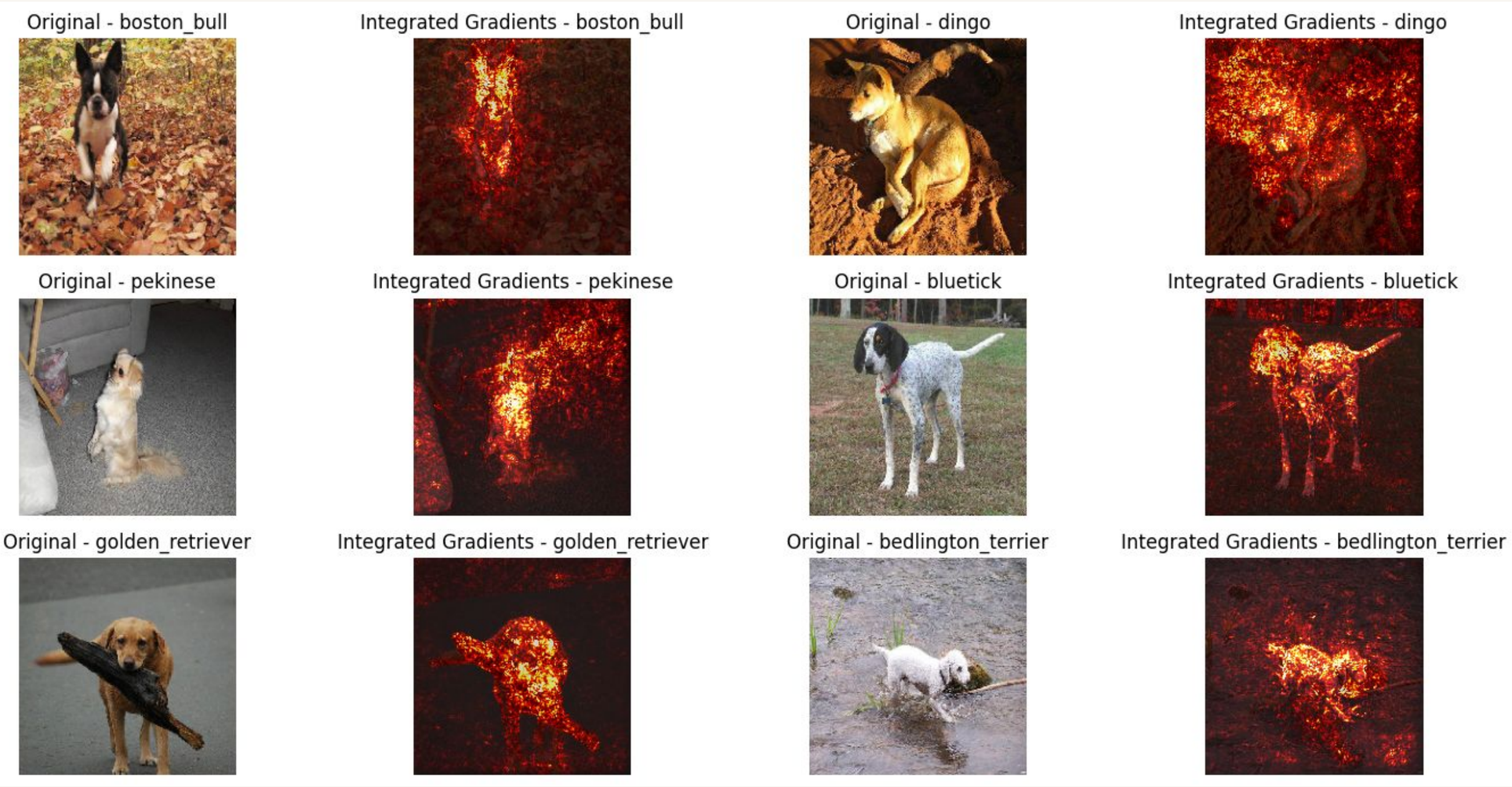


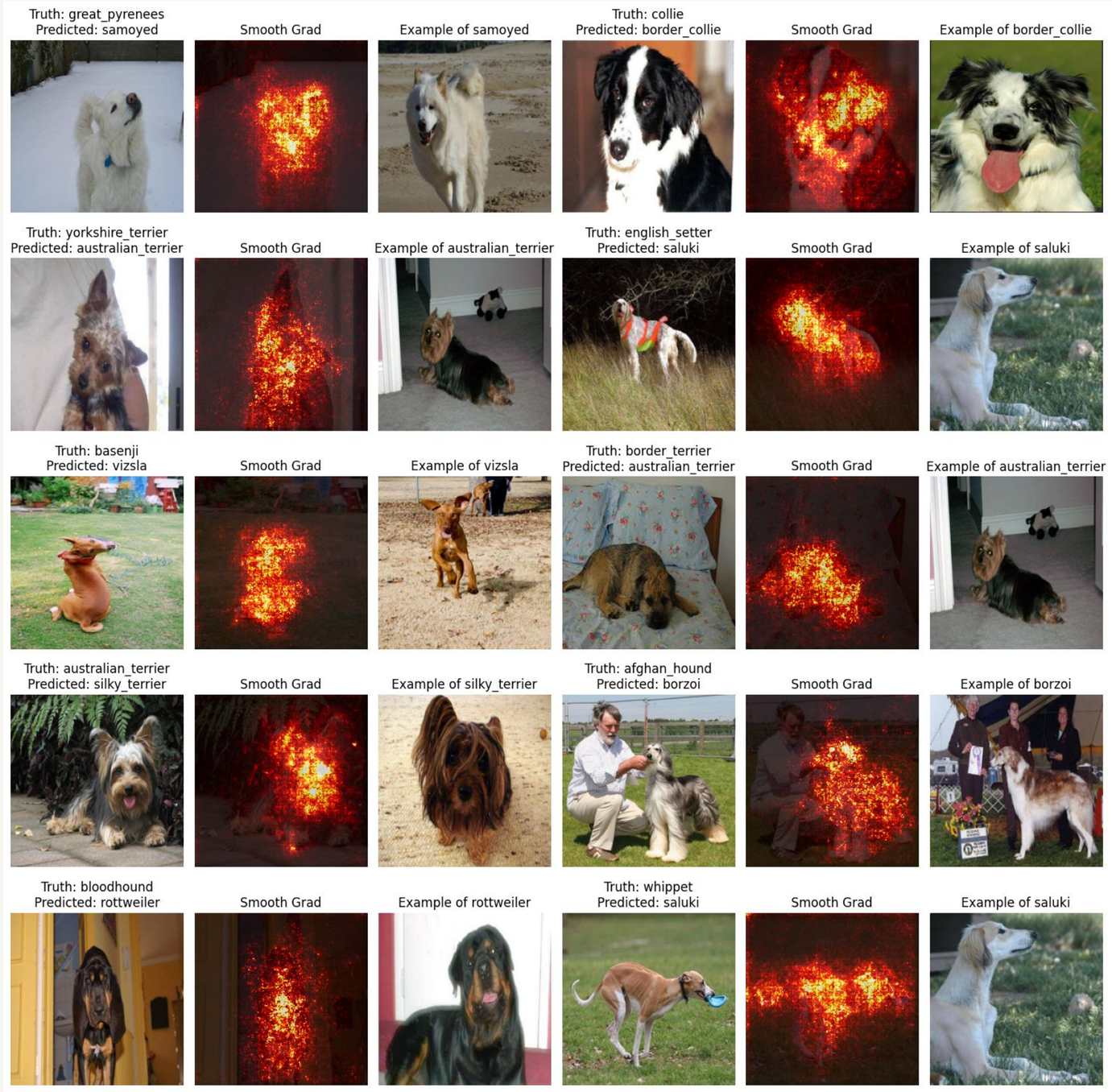


SmoothGrad

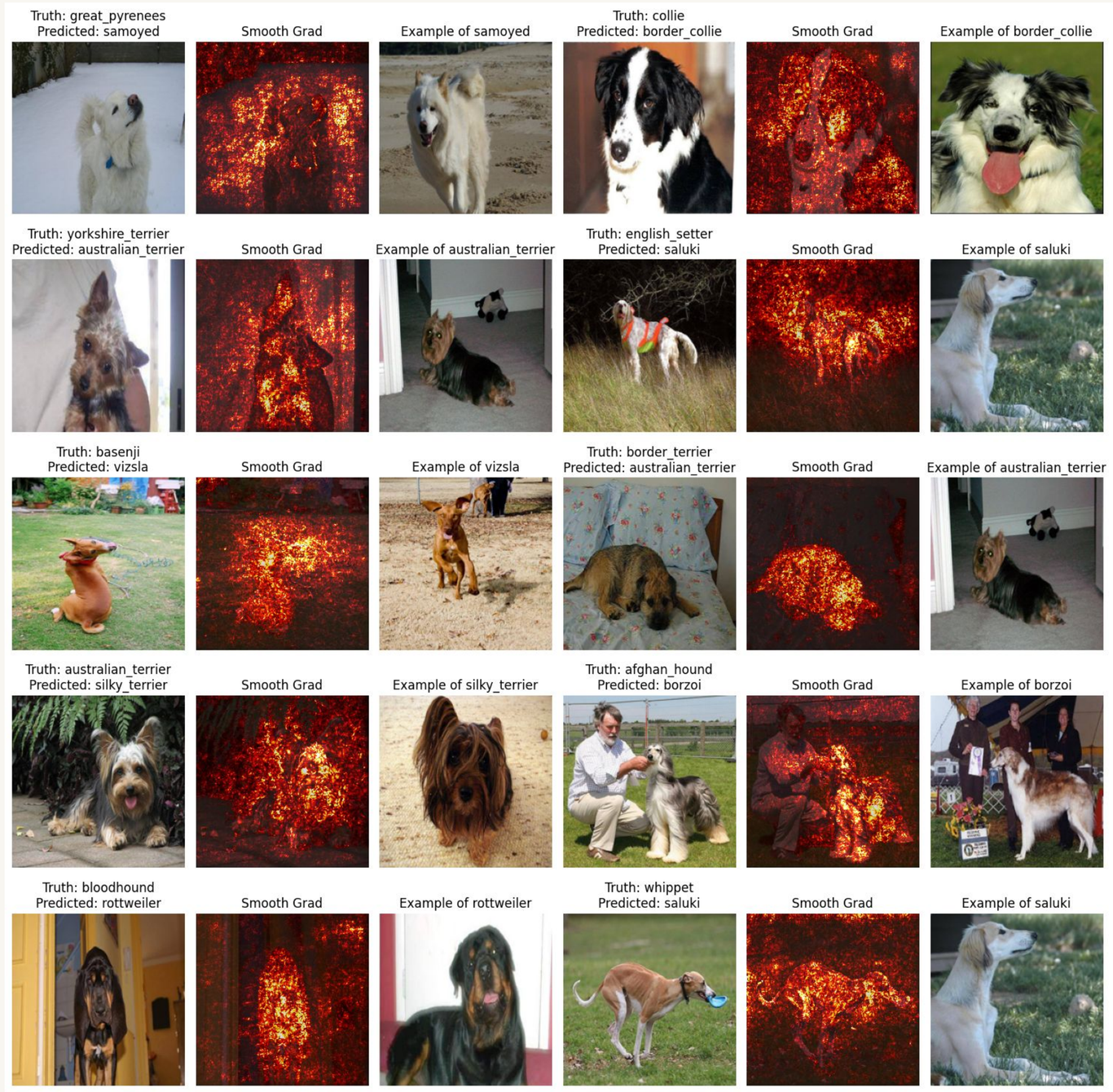

Original - boston_bull
Smooth Grad - boston_bull
Original - dingo
Smooth Grad - dingo
Original - pekinese
Smooth Grad - pekinese
Original - bluetick
Smooth Grad - bluetick
Original - golden_retriever
Smooth Grad - golden_retriever
Original - bedlington_terrier
Smooth Grad - bedlington_terrier

Integrated Gradient





Explanations for misclassified instances (SmoothGrad)



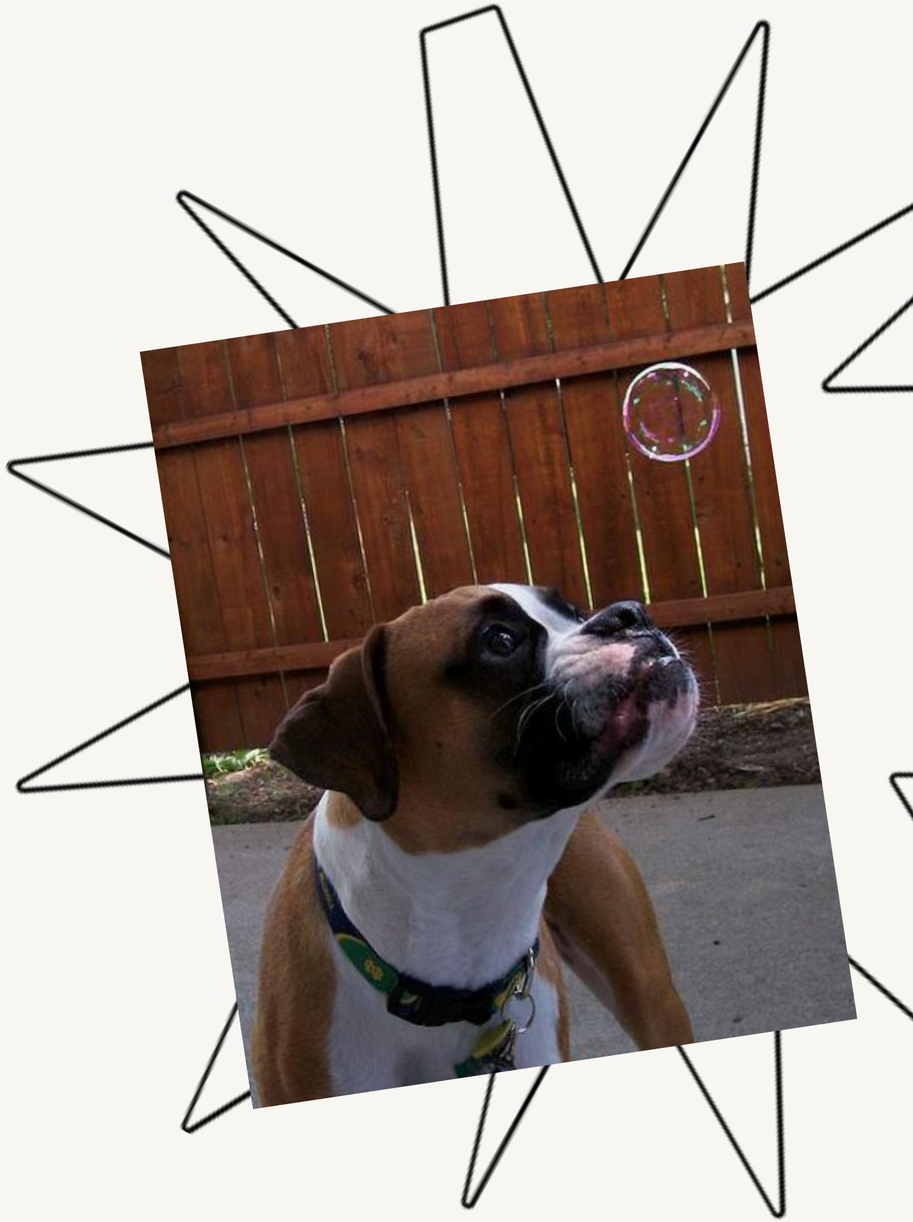
Explanations for misclassified instances (Integrated Gradient)

How do we make a decision?

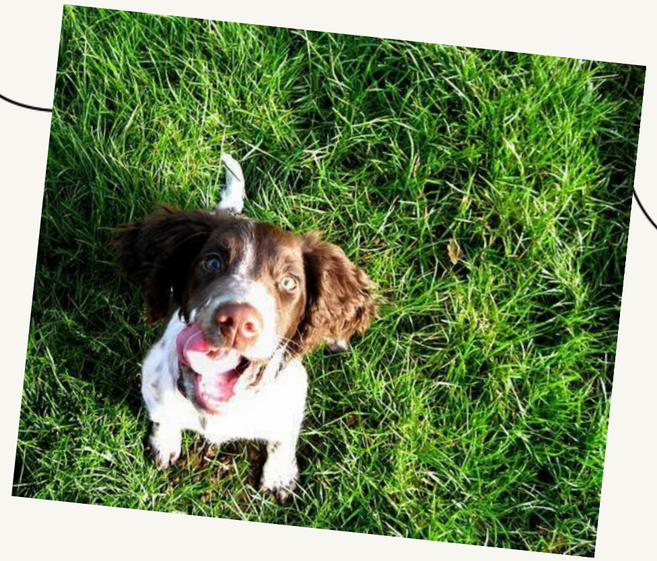
Human	**Model**
Muzzle	Color
Head and ear	Head (Ear,Eye,Muzzle)
Fur and haircut	Background/Other Objects
Size	Shape
Color (for sub breeds)	Fur and haircut

Observations for improvement

- Work with dogs’ sizes and fuzziness
  - e.g.: object detection and cropping beforehand
- Combine Subreeds (and subclassify separately)
- Collect more data for every breed
  - Augmentation
- More domain specific models
- Use other tools and information



Conclusions



- Quality of black-box model is relevant for the quality of explanations
- Prototype, CAV etc. are time consuming to create
- Saliency map works better in its extensions Integrated Gradient, SmoothGrad
- Gained some knowledge about dataset and model improvement

Thank you