

Graphisch-Interaktive Systeme  
Technische Universität Darmstadt



# Animal Biometrics

## Visual Computing Praktikum – SS 2018

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1. Introduction and Motivation
2. Problem 1: Classification of Species
  - Data Set
  - Architecture
  - Results
3. Problem 2: Classification of Individuals
  - Data Set
  - Architecture
  - Results
  - Alternative Approach
  - Finetuning for Individuals



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# Introduction and Motivation



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Figure 1: Animal Biometrics Example

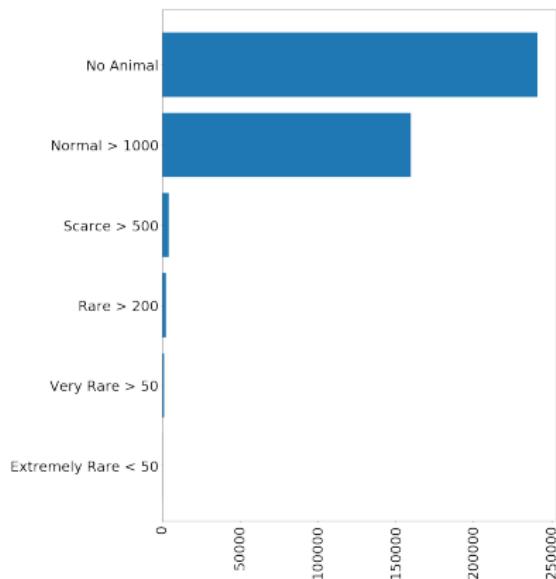
# Outline



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# Data Set



- ▶ Unbalanced data distribution (3 to 190k images per class)
- ▶ 87 classes/individuals
- ▶ Low quality images from camera traps

**Figure 2:** Reduced data distribution of species data set

# Good Example Images

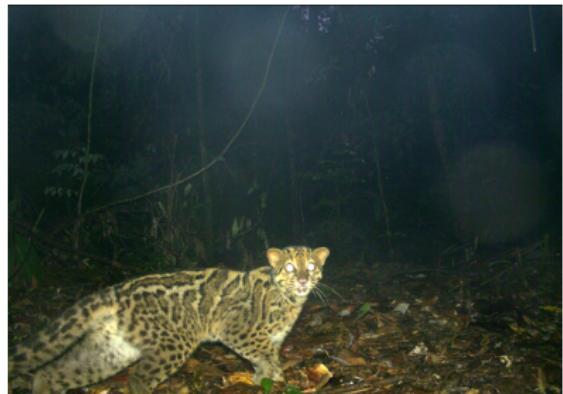


Figure 3: Marbled Cat



Figure 4: Mouse Deer



# Bad Example Images

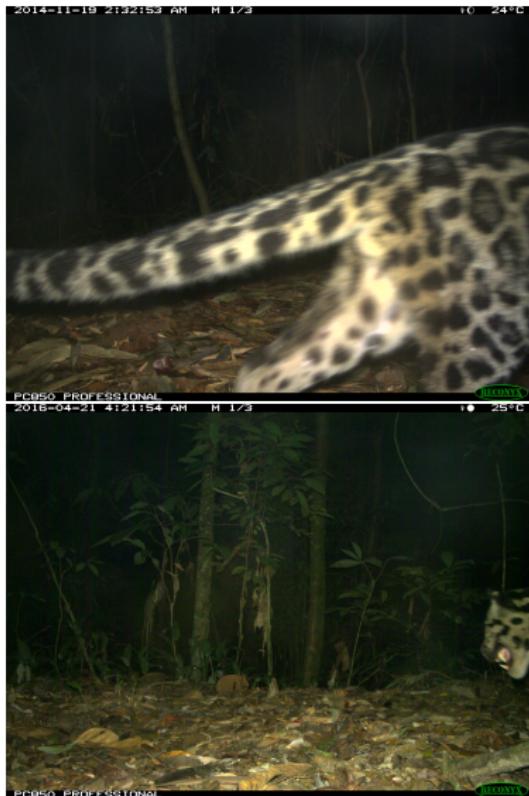
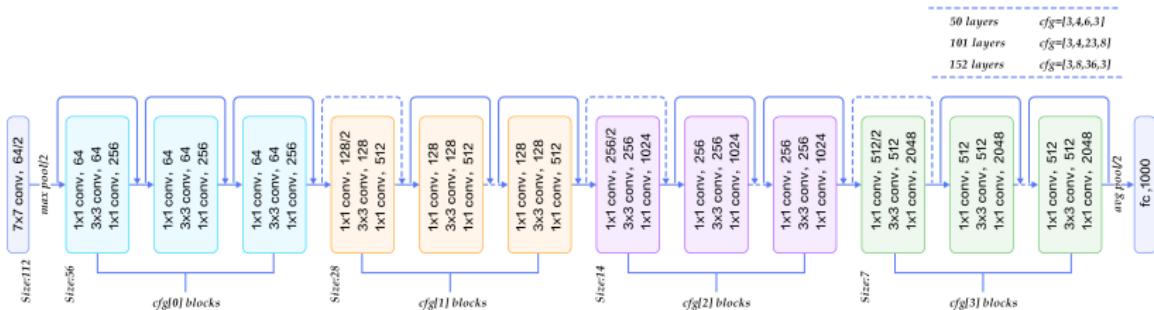


Figure 5: Bad quality training images

# Architecture



**Figure 6:** ResNet Architecture

[<https://www.codeproject.com/Articles/1248963/>]

Deep-Learning-using-Python-plus-Keras-Chapter-Re]

- ResNet-50 finetuning and from scratch

# Scores

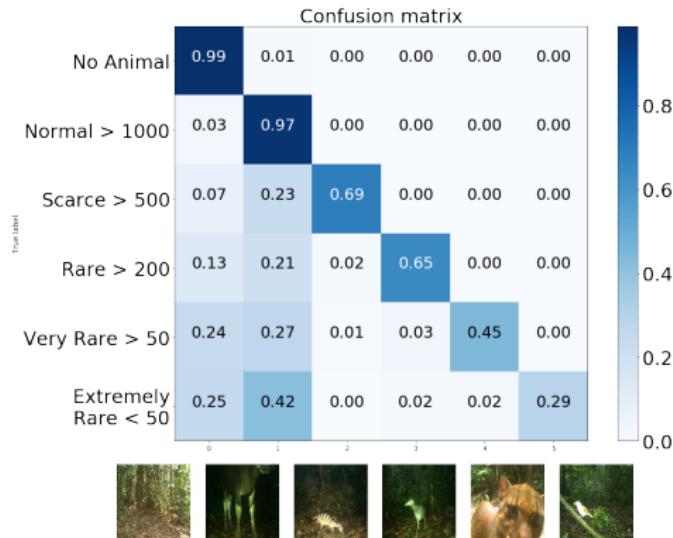


Figure 7: Reduced confusion matrix for finetuned ResNet-50

# Training Process



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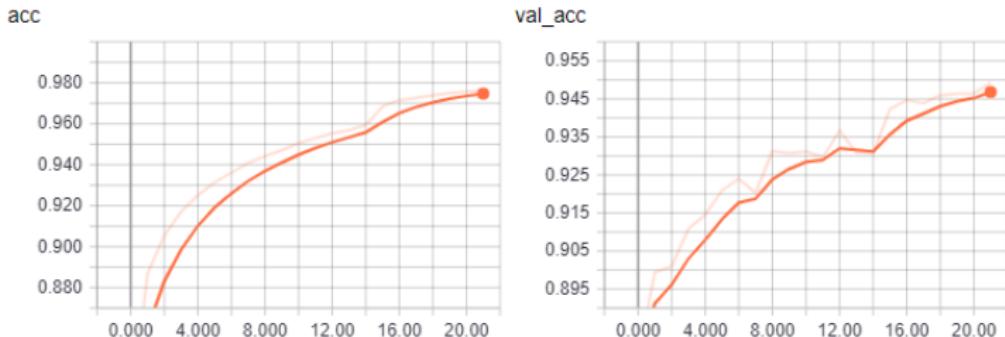


Figure 8: Accuracy during Training



# Positive Examples



11



Figure 9: Correct attention and classification

# Positive Examples



12

True: Clouded leopard



Pred: Clouded leopard

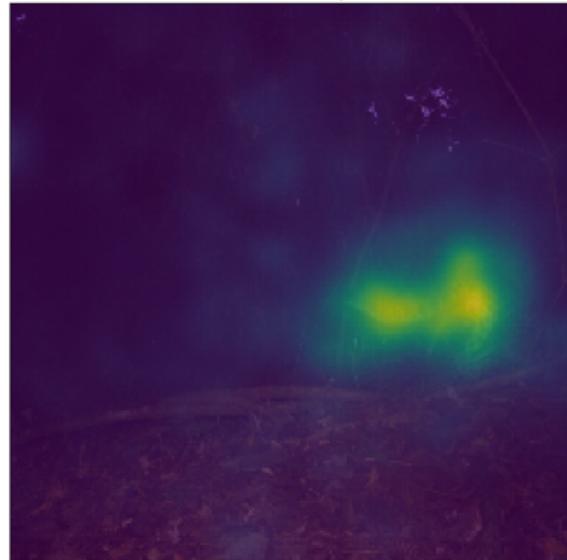


Figure 10: Correct attention and classification



# Negative Examples



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True: Crested fireback



Pred: Mousedeer

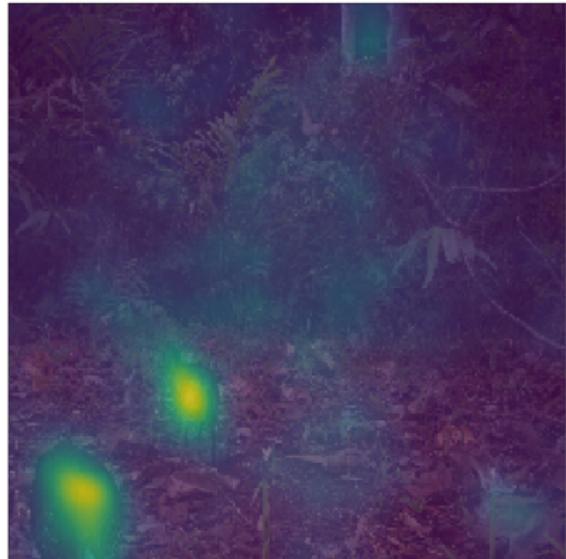


Figure 11: Noisy labels



# Negative Examples



14

True: Common palm civet



Pred: Long-tailed porcupine



Figure 12: Correct Attention, wrong label

# Negative Examples



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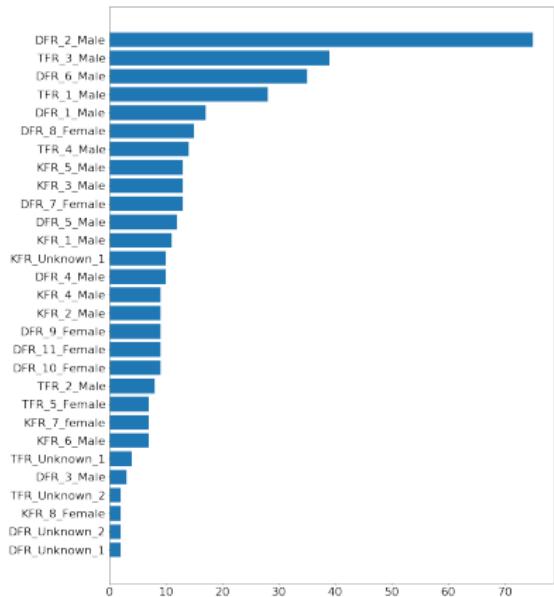
Figure 13: Mismatch because of class similarity



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# Data Set



- ▶ Unbalanced data distribution (3 to 99 images per class)
- ▶ 29 classes/individuals
- ▶ Low quality images from camera traps

Figure 14: Data distribution of individuals data set



# Good Example Images



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Figure 15: DFR 2 male



Figure 16: DFR 5 male



# Architecture

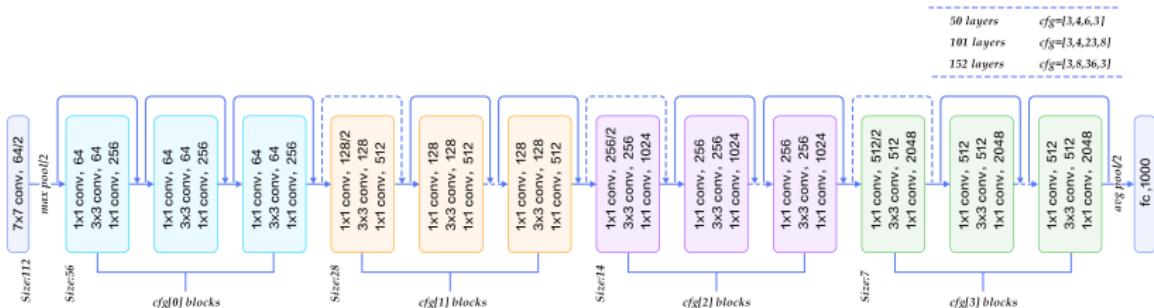


Figure 17: ResNet Architecture

[<https://www.codeproject.com/Articles/1248963/Deep-Learning-using-Python-plus-Keras-Chapter-Re>]

- ▶ ResNet-18, ResNet-34 from scratch
- ▶ ResNet-50 finetuning

# Scores



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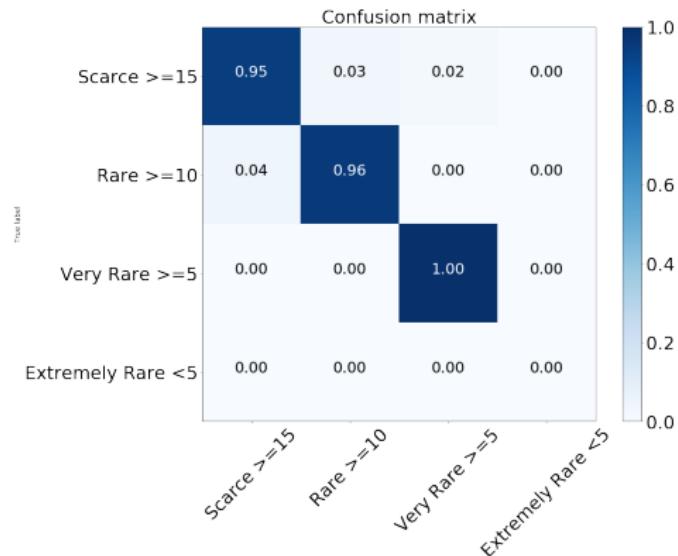


Figure 18: Confusion matrix for finetuned Resnet-50

# Results



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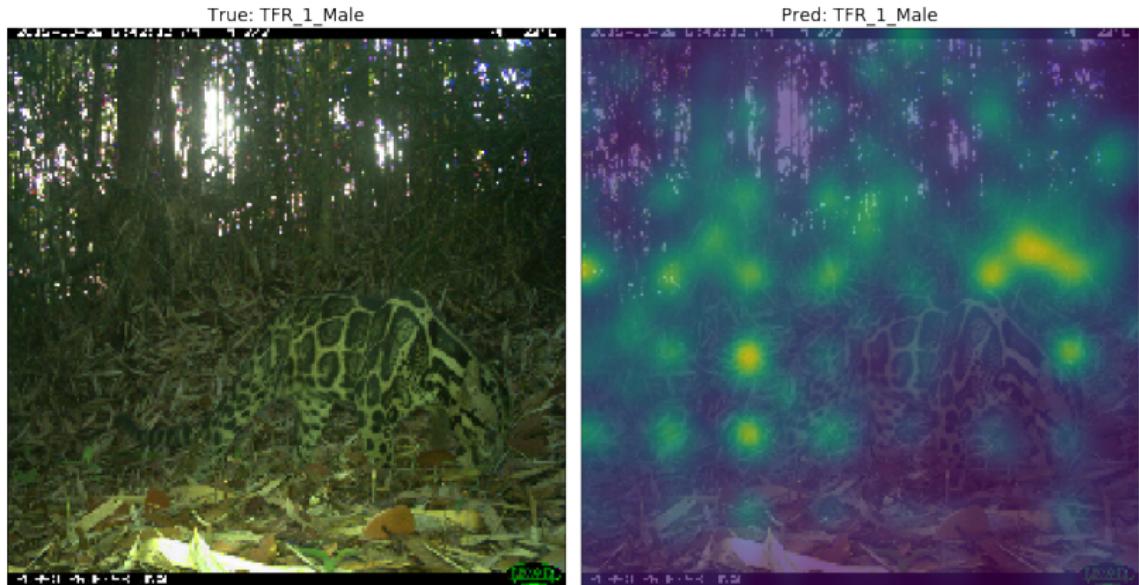


Figure 19: Network attention on background

# Results



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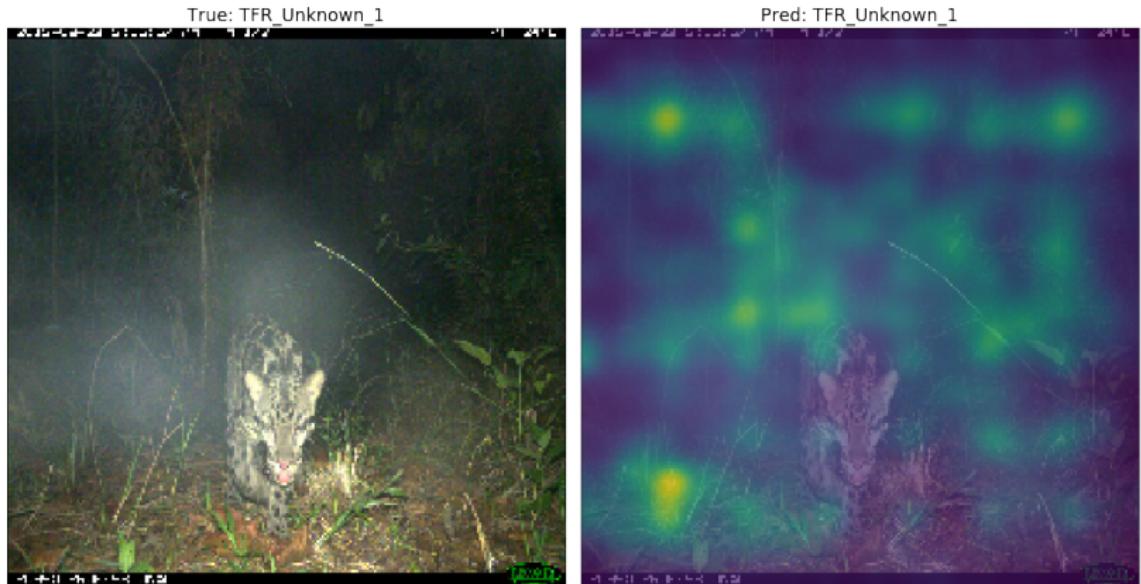


Figure 20: Network Attention on background

# Training Process



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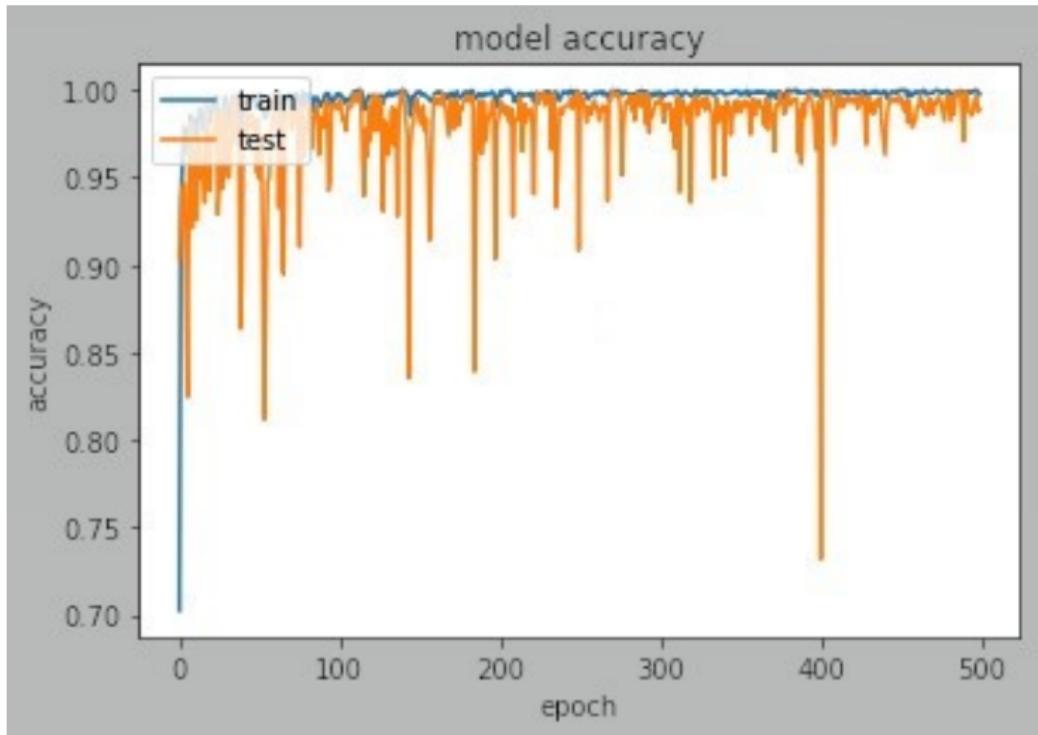


Figure 21: Accuracy during Training

# Results



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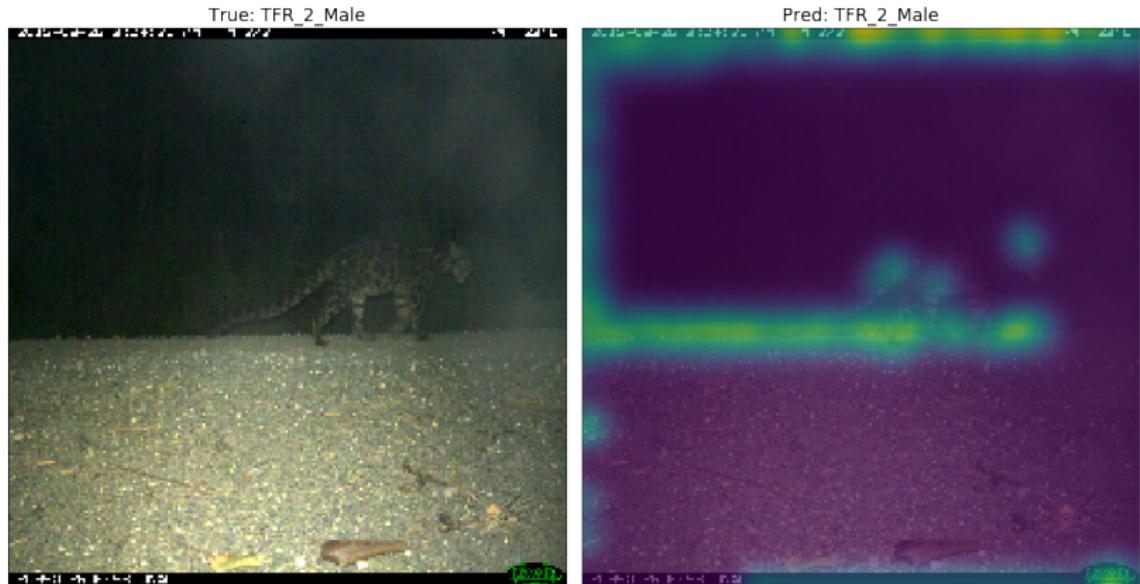


Figure 22: Network attention on logo and time stamp



# Using Bounding Boxes

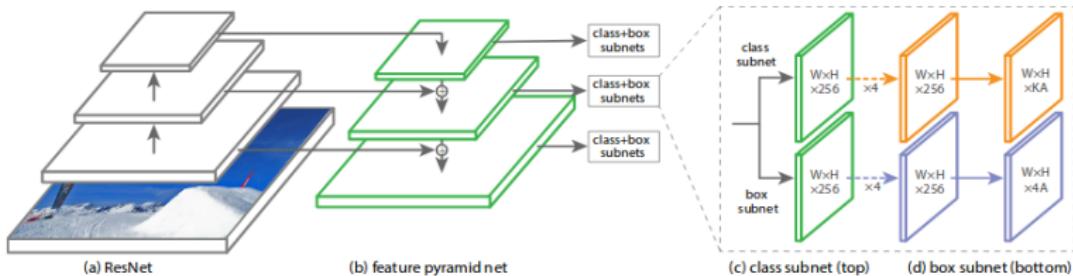
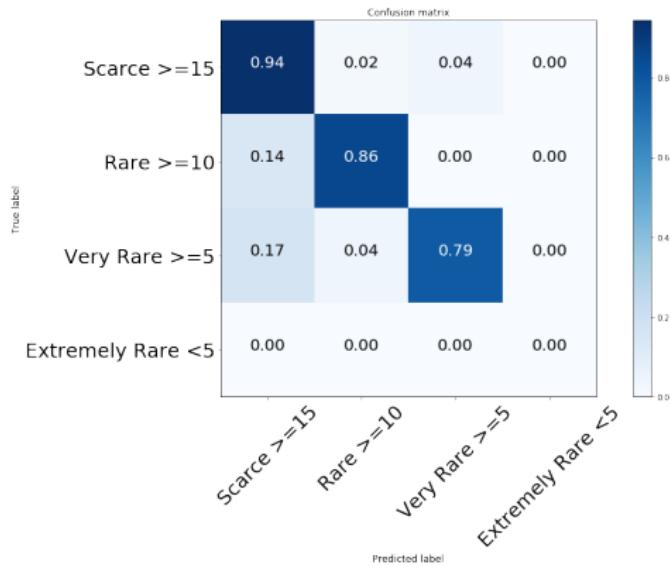


Figure 23: RetinaNet Architecture [<https://medium.com/@14prakash/the-intuition-behind-retinanet-eb636755607d>]

- ▶ One stage detector with similar performance as Faster R-CNN
- ▶ Main improvement: Focal Loss
- ▶ Manual annotation of bounding boxes required

# Scores



## Test set:

- ▶ Accuracy: 0.86
- ▶ Avg. Precision: 0.87
- ▶ Avg. Recall: 0.86
- ▶ Avg. F1-Score: 0.85

Figure 24: Confusion matrix for finetuned RetinaNet with ResNet-50 backbone



# Positive Examples



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Figure 25: RentinaNet attention on animal

# Negative Examples



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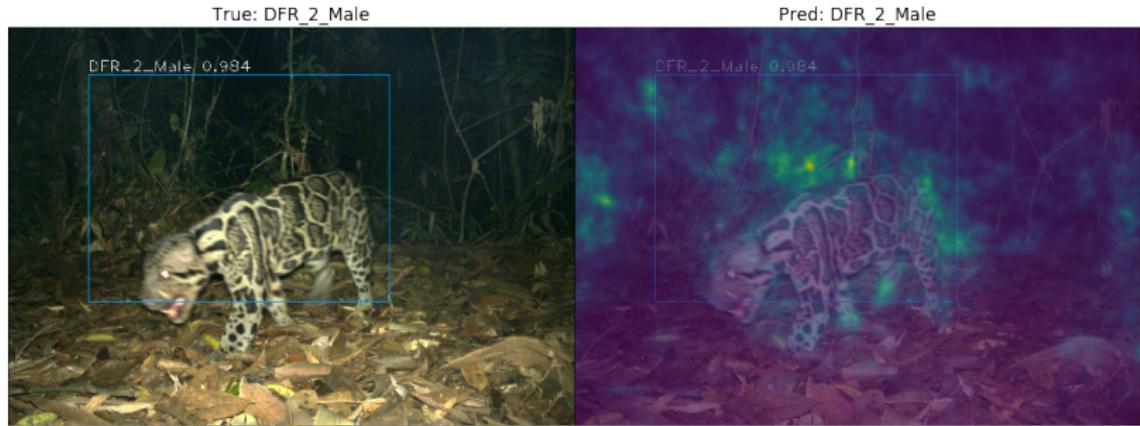


Figure 26: RentinaNet attention on background

# Finetuning for Individuals

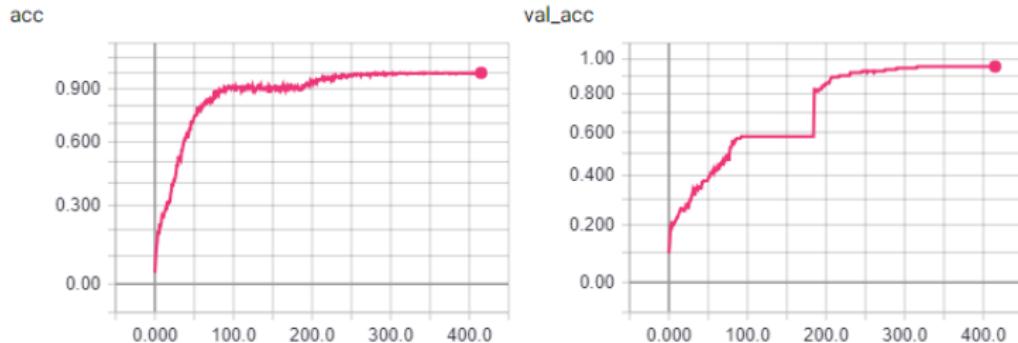


Figure 27: Accuracy during training

# Network Attention



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Figure 28: Network attention after finetuning final dense layer

# Network Attention



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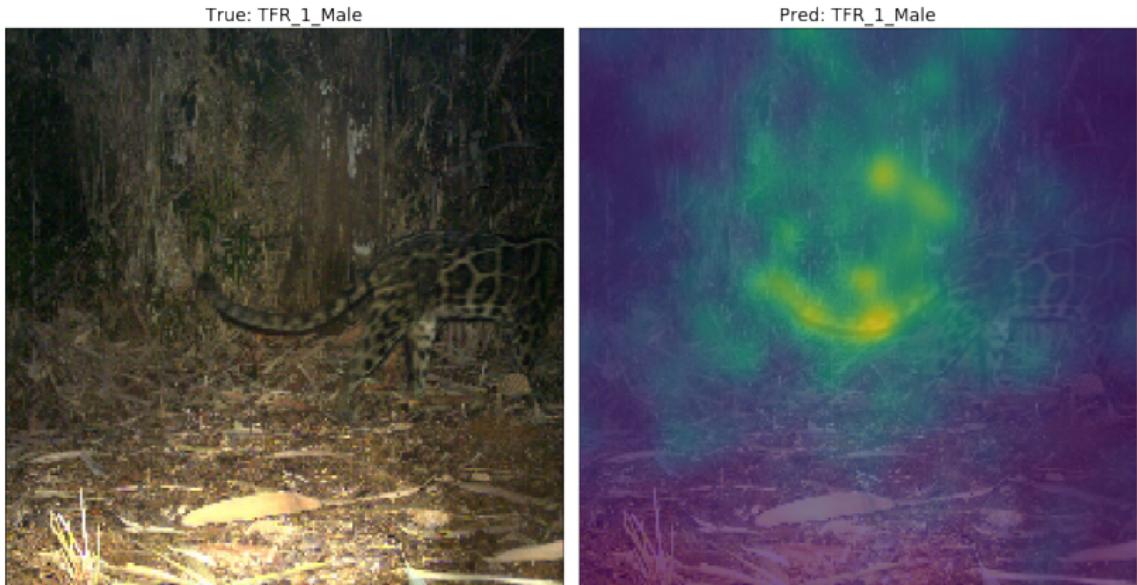


Figure 29: Network attention after finetuning complete ResNet-50



Thank you for listening



**Questions?**