

Graphical Interactive Systems
Technische Universität Darmstadt



Animal Biometrics

Visual Computing Praktikum – SS 2018

Fabian Otto
fabian.otto@stud.tu-darmstadt.de

October 14, 2018



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





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



Introduction and Motivation



3

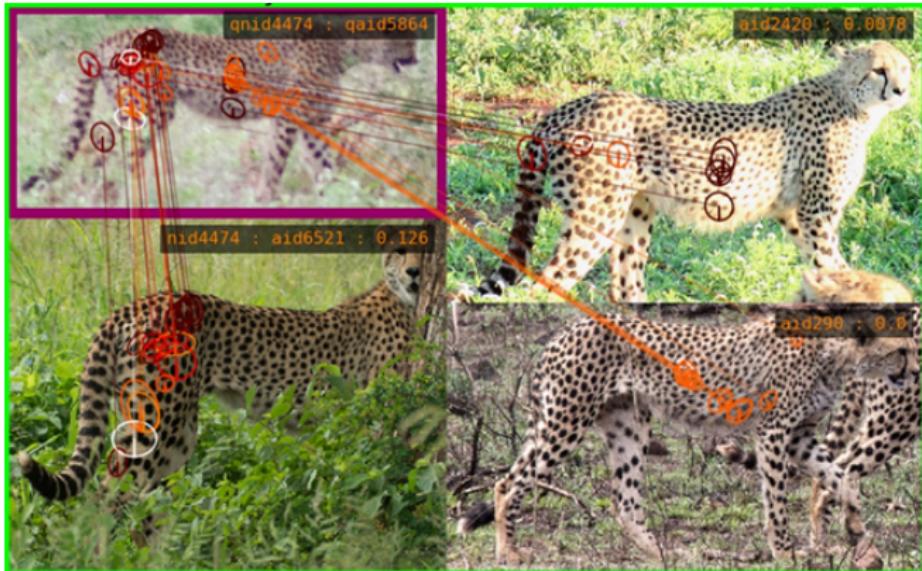


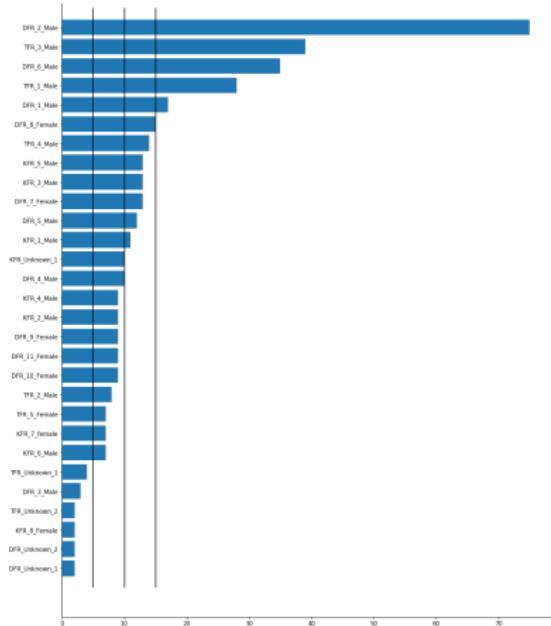
Figure 1: Animal Biometrics Example



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



Data Set



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

Figure 2: Data distribution of individuals data set

Good Example Images



Figure 3: DFR 2 Male



Figure 4: DFR 5 male

Bad Example Images

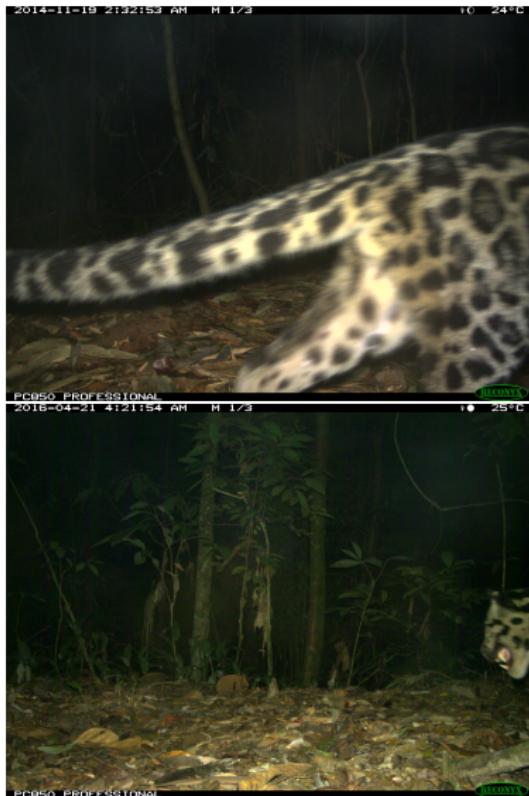


Figure 5: Bad quality training images

Architecture

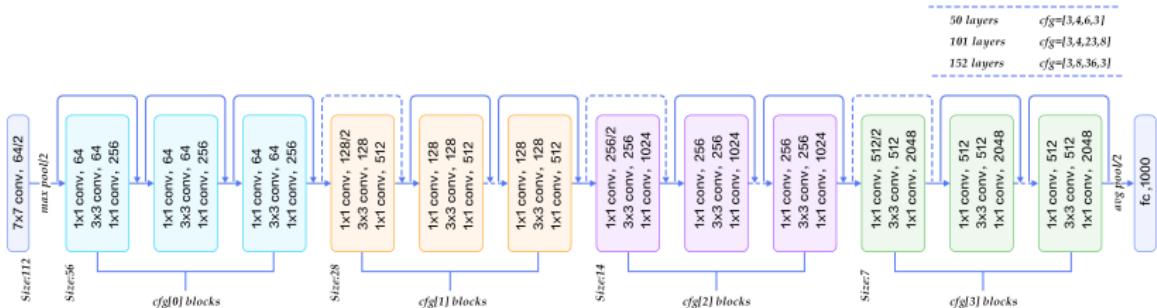


Figure 6: ResNet Architecture

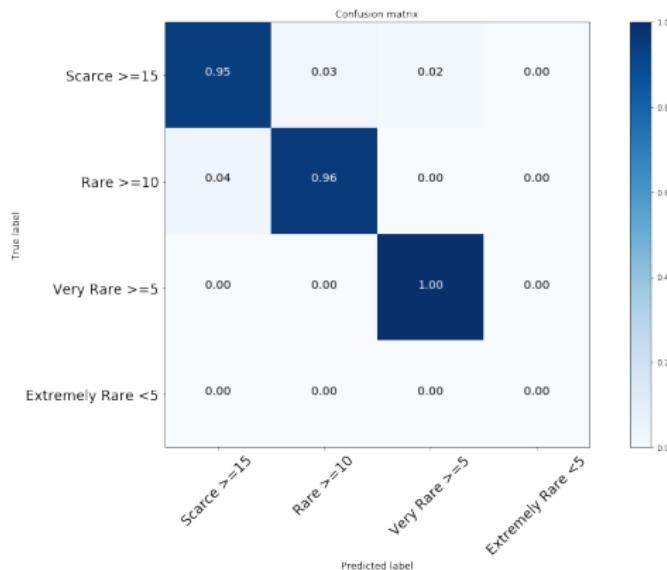
[<https://www.codeproject.com/Articles/1248963/Deep-Learning-using-Python-plus-Keras-Chapter-Re>]

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

Scores



9



- ▶ Test Accuracy: 0.91
- ▶ Avg. Precision: 0.91
- ▶ Avg. Recall: 0.91
- ▶ Avg. F1-Score: 0.90

Figure 7: Confusion matrix for finetuned
Resnet-50

Results



10

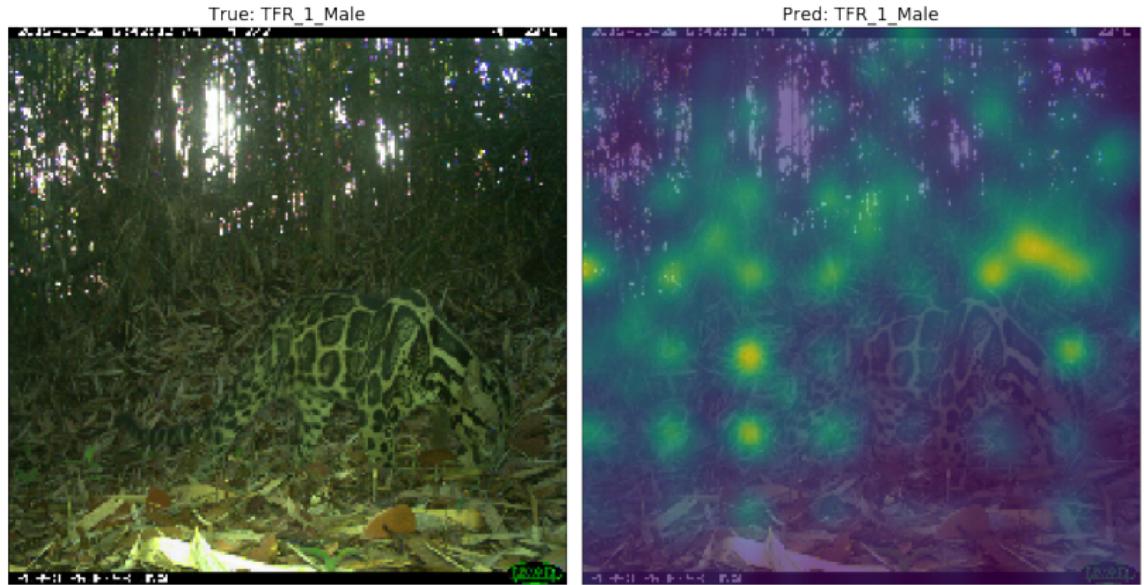


Figure 8: Network attention on background

Results



11



Figure 9: Network Attention on background

Training Process

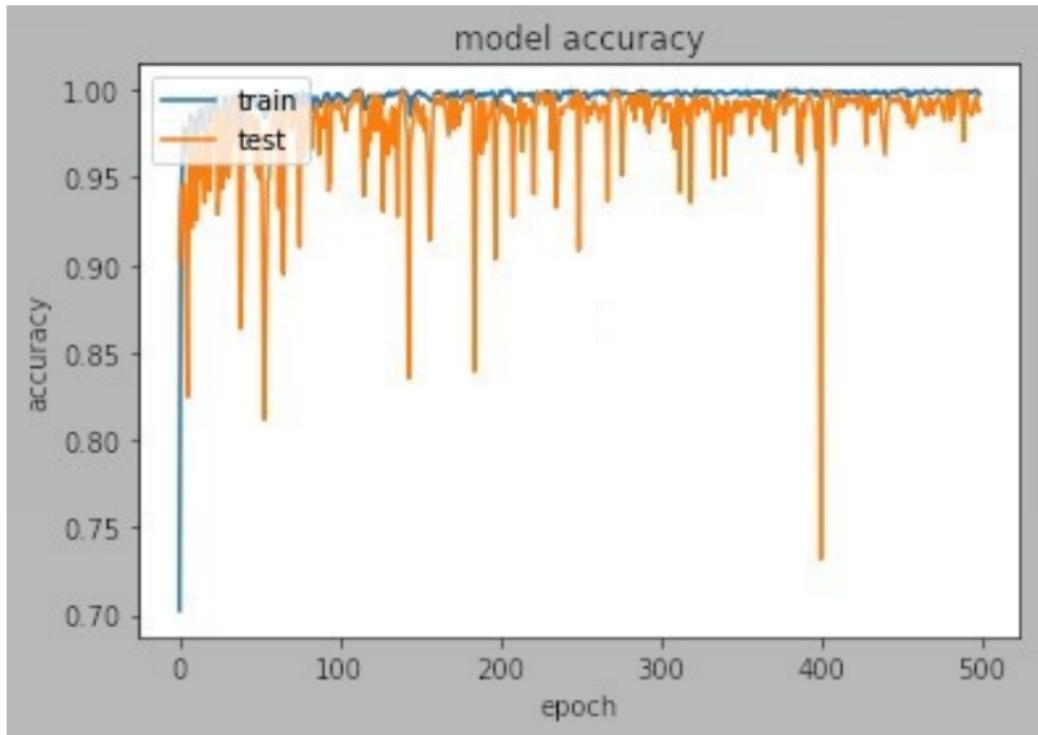


Figure 10: Accuracy during Training



Results



13

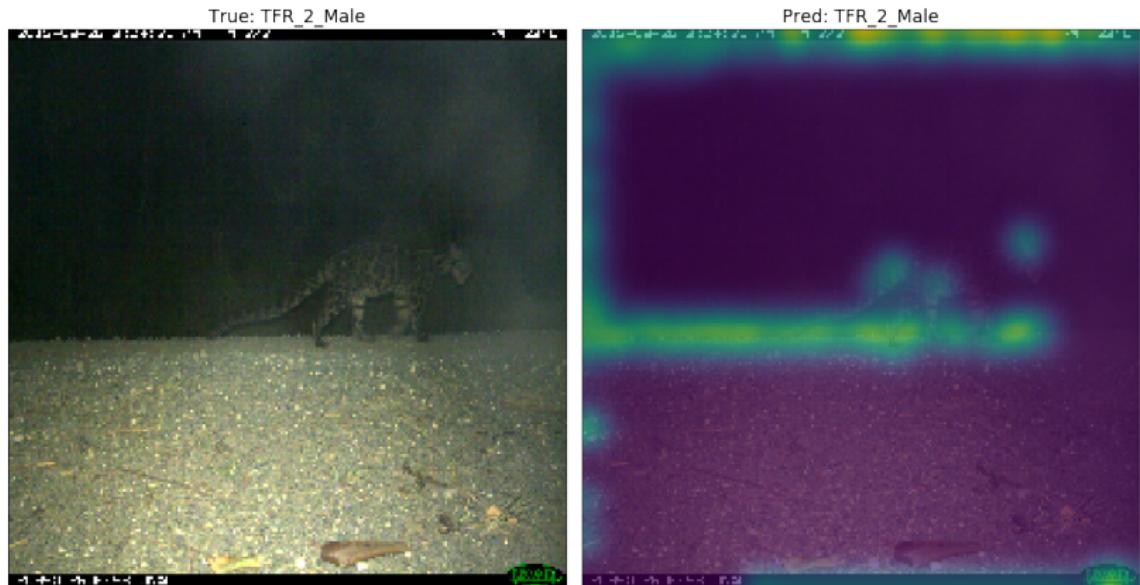


Figure 11: Network attention on logo and time stamp

Using Bounding Boxes

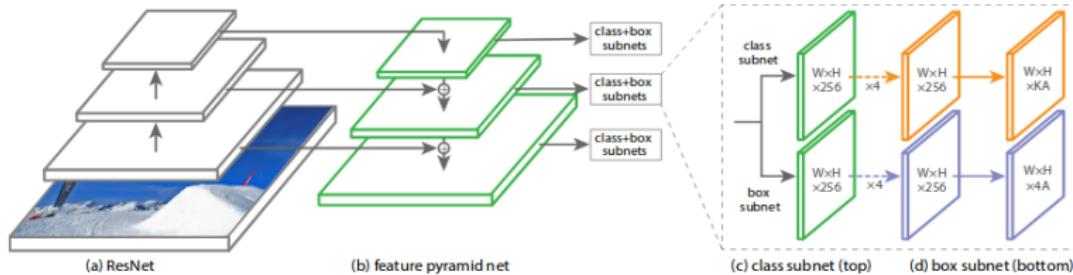
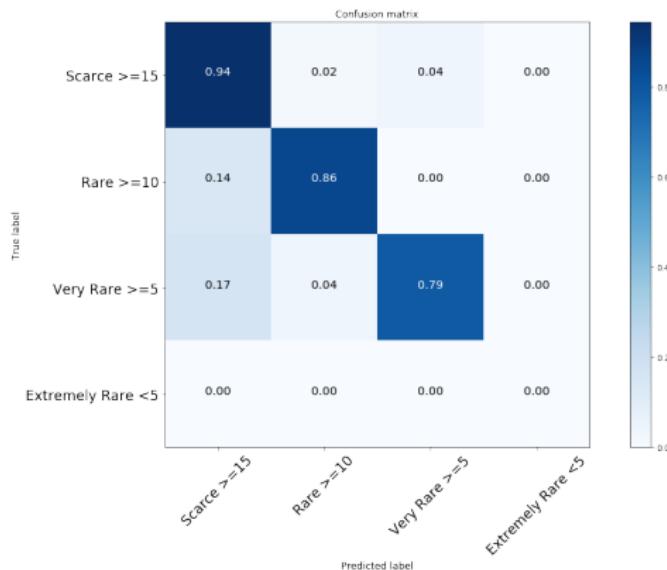


Figure 12: RetinaNet Architecture

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

Scores



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

Figure 13: Confusion matrix for finetuned RetinaNet with ResNet-50 backbone

Positive Examples



16



Figure 14: RetinaNet attention on animal

Negative Examples



Figure 15: RentinaNet attention on background

Outline

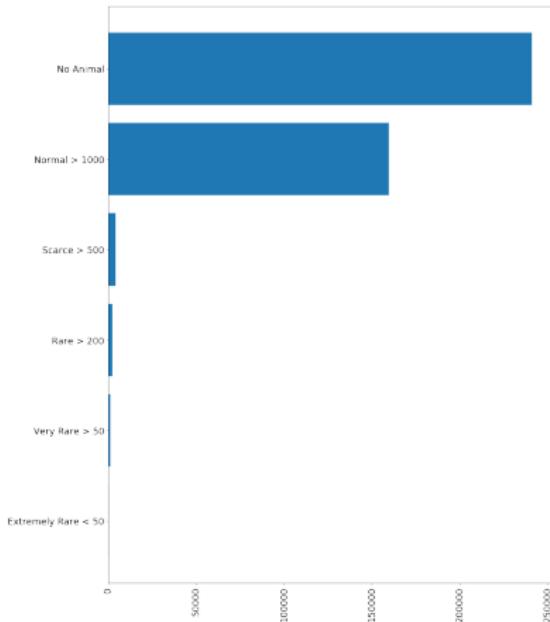


18

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



Data Set



- ▶ Unbalanced data distribution (3 to 190k+ images per class)
- ▶ 87 Classes/Species

Figure 16: Reduced data distribution of species data set



Some Example Images

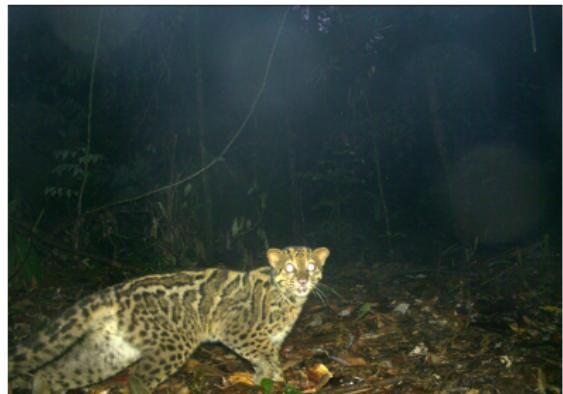


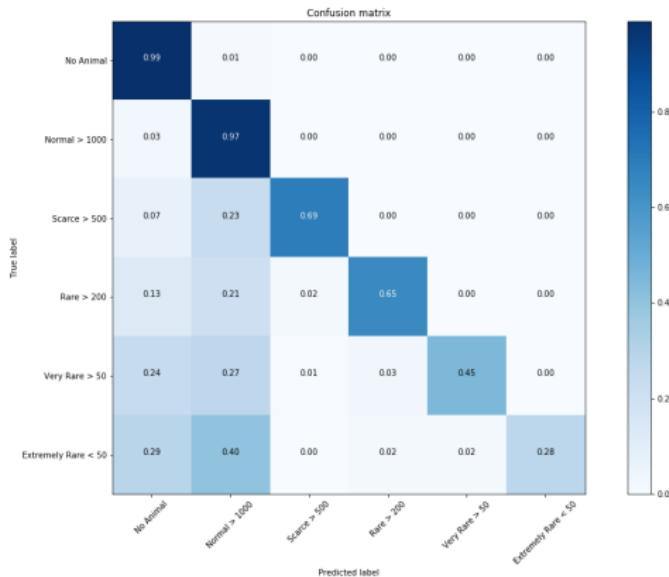
Figure 17: Marbled Cat



Figure 18: Mouse Deer



Scores



- ▶ Test Accuracy: 0.95
- ▶ Avg. Precision: 0.95
- ▶ Avg. Recall: 0.95
- ▶ Avg. F1-Score: 0.95

Figure 19: Reduced confusion matrix for finetuned ResNet-50

Training Process

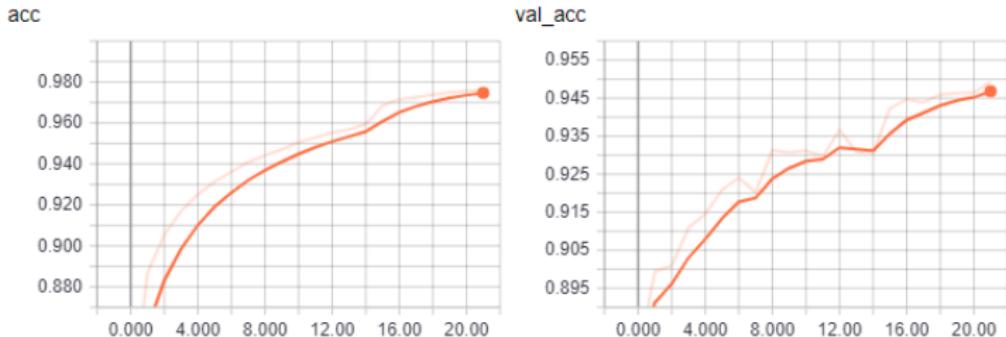


Figure 20: Accuracy during Training



Positive Examples



23

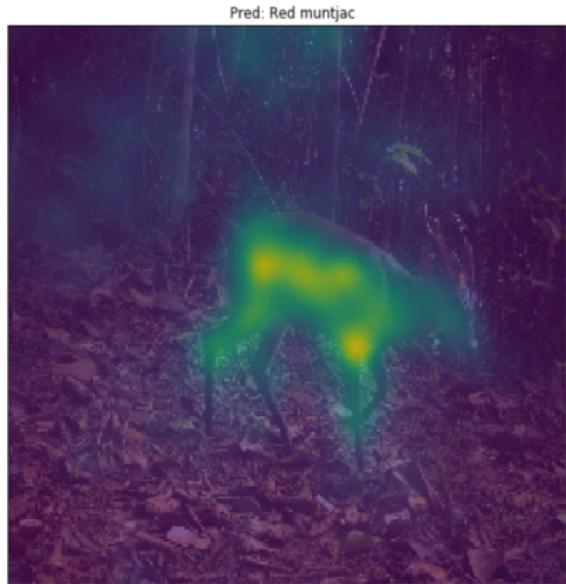
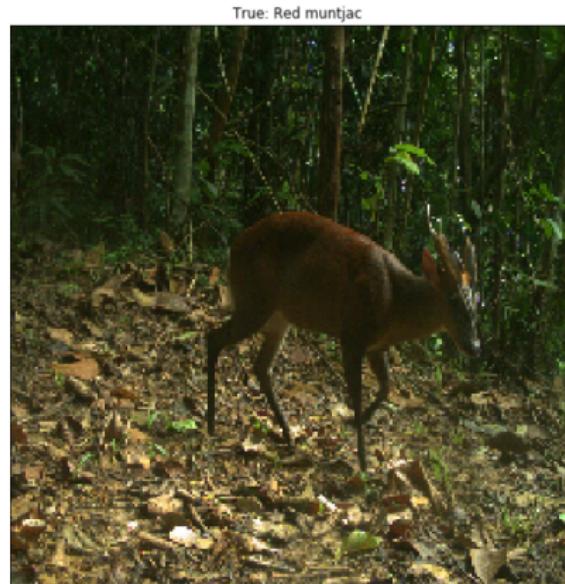


Figure 21: Correct attention and classification

Positive Examples



24

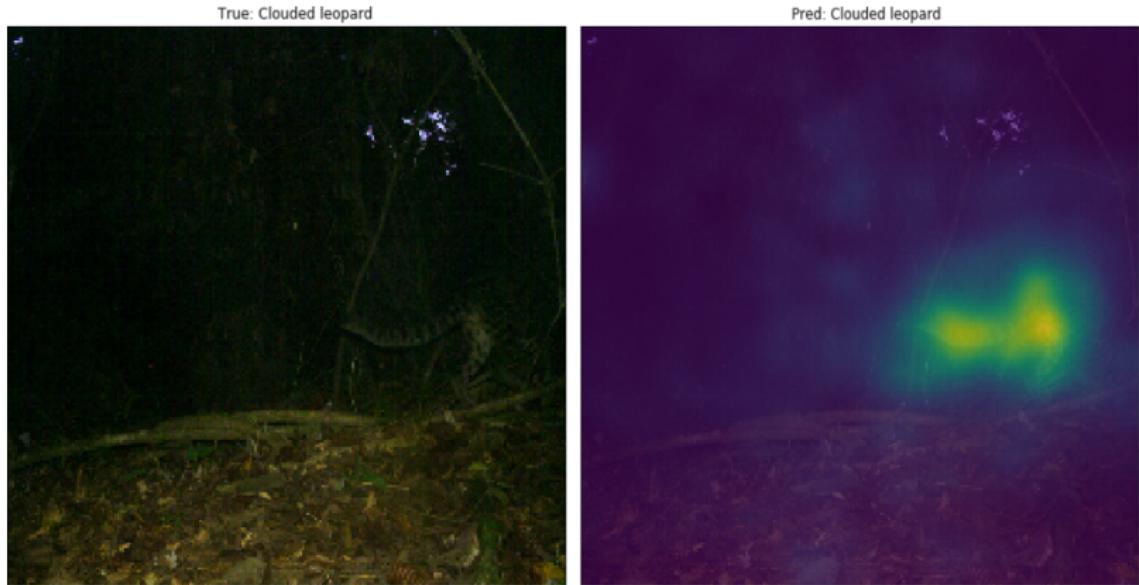


Figure 22: Correct attention and classification



Negative Examples



25

True: Crested fireback



Pred: Mousedeer



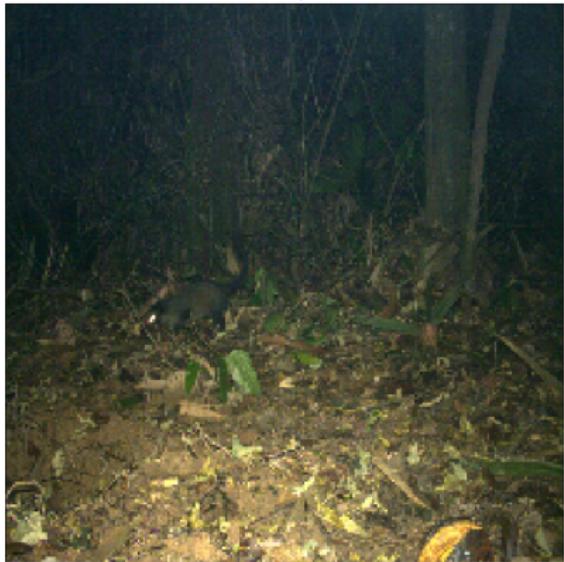
Figure 23: Noisy labels

Negative Examples



26

True: Common palm civet



Pred: Long-tailed porcupine



Figure 24: Correct Attention, wrong label

Negative Examples



27



Figure 25: Mismatch because of class similarity

Finetuning for Individuals

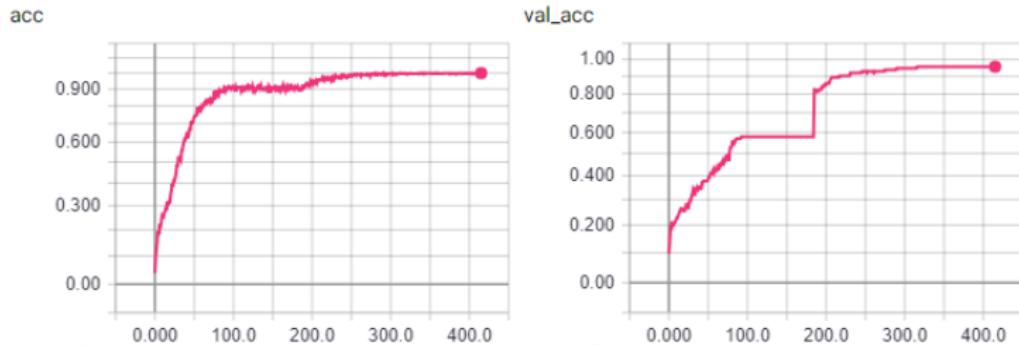


Figure 26: Accuracy during training



Network Attention



29



Figure 27: Network attention after finetuning final dense layer

Network Attention



30

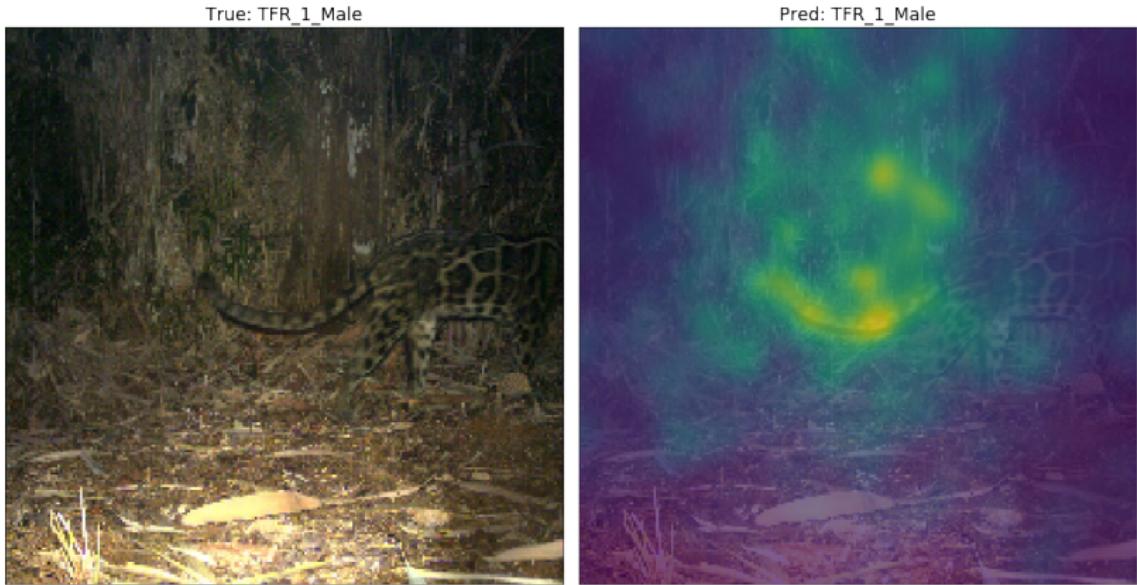


Figure 28: Network attention after finetuning complete ResNet-50



Thank you for listening



Questions?