Graphical Interactive Systems
Technische Universität Darmstadt

Animal Biometrics

Visual Computing Praktikum – SS 2018

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

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Outline

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

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Introduction and Motivation

Figure 1: Animal Biometrics Example

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Data Set

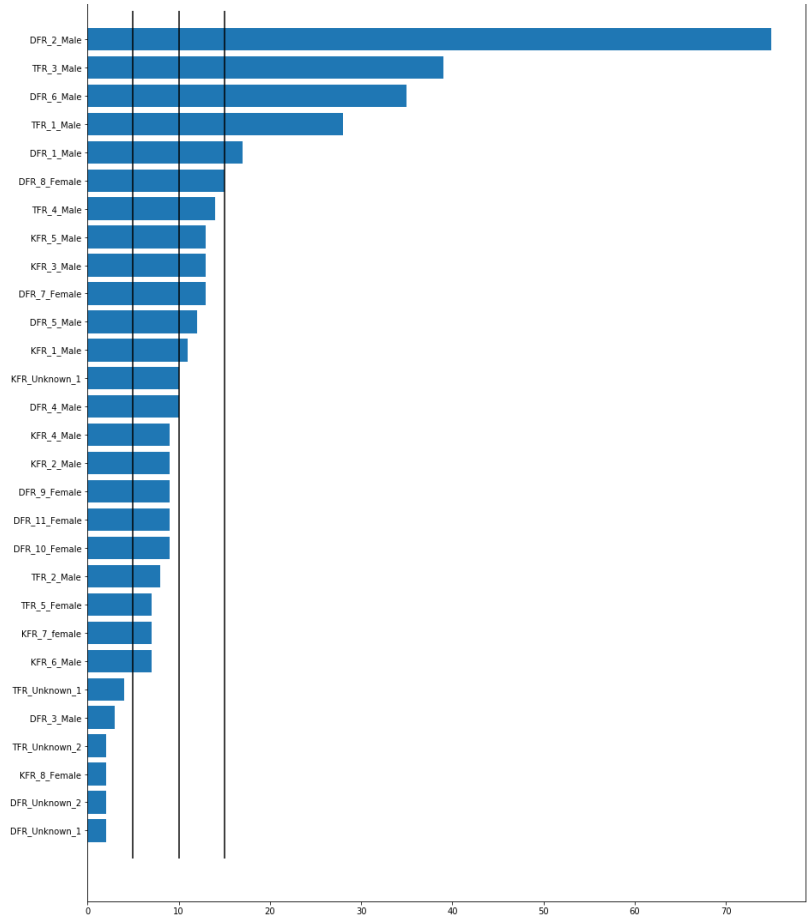


Figure 2: Data distribution of individuals data set

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

Good Example Images

Figure 3: DFR 2 male

Figure 4: DFR 5 male

Bad Example Images

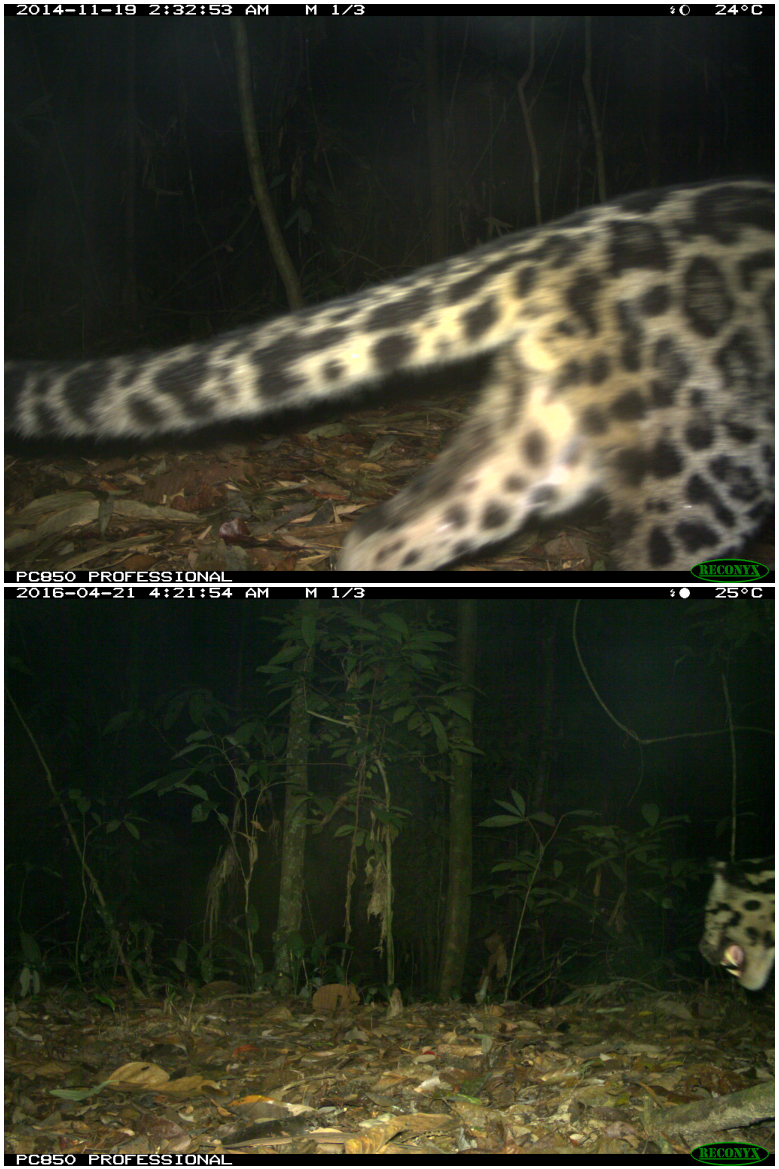


Figure 5: Bad quality training images

Architecture

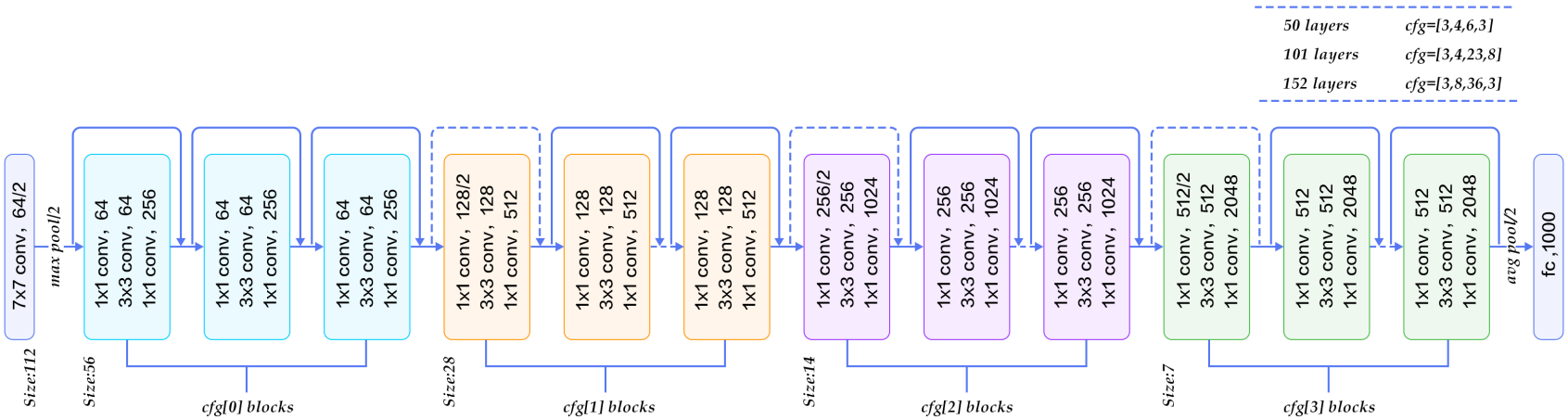
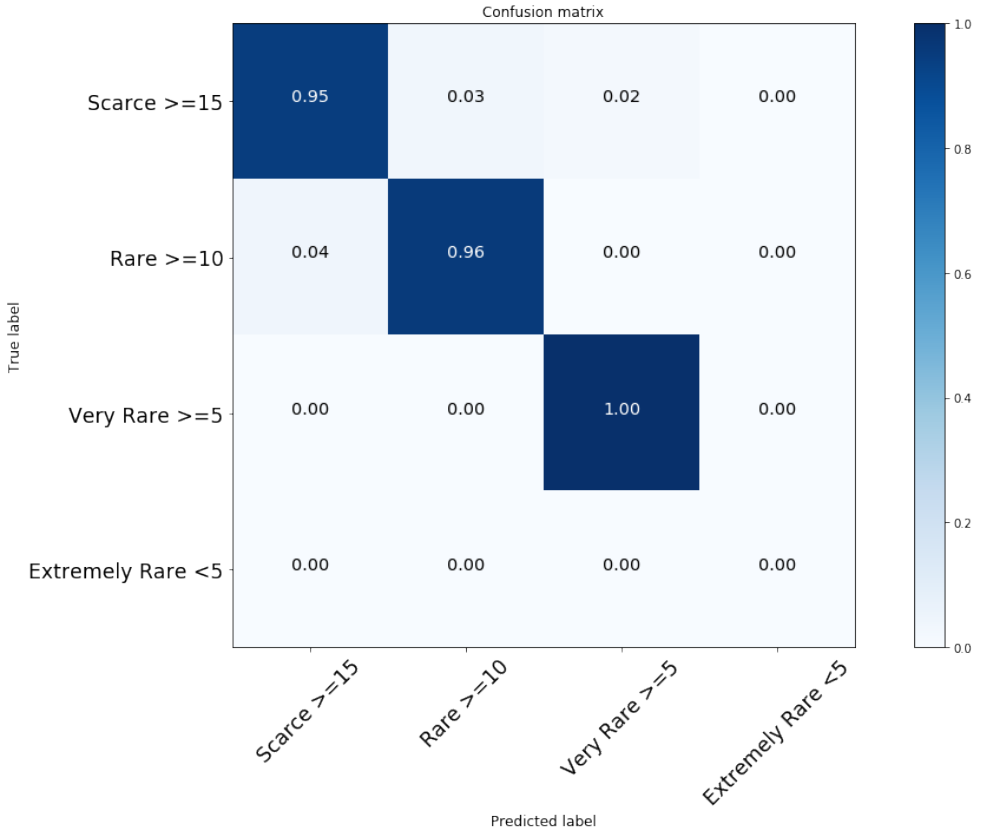


Figure 6: ResNet Architecture
[https://www.codeproject.com/Articles/1248963/Deep-Learning-using-Python-plus-Keras-Chapter-Re]

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

Scores



Test set:

- 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

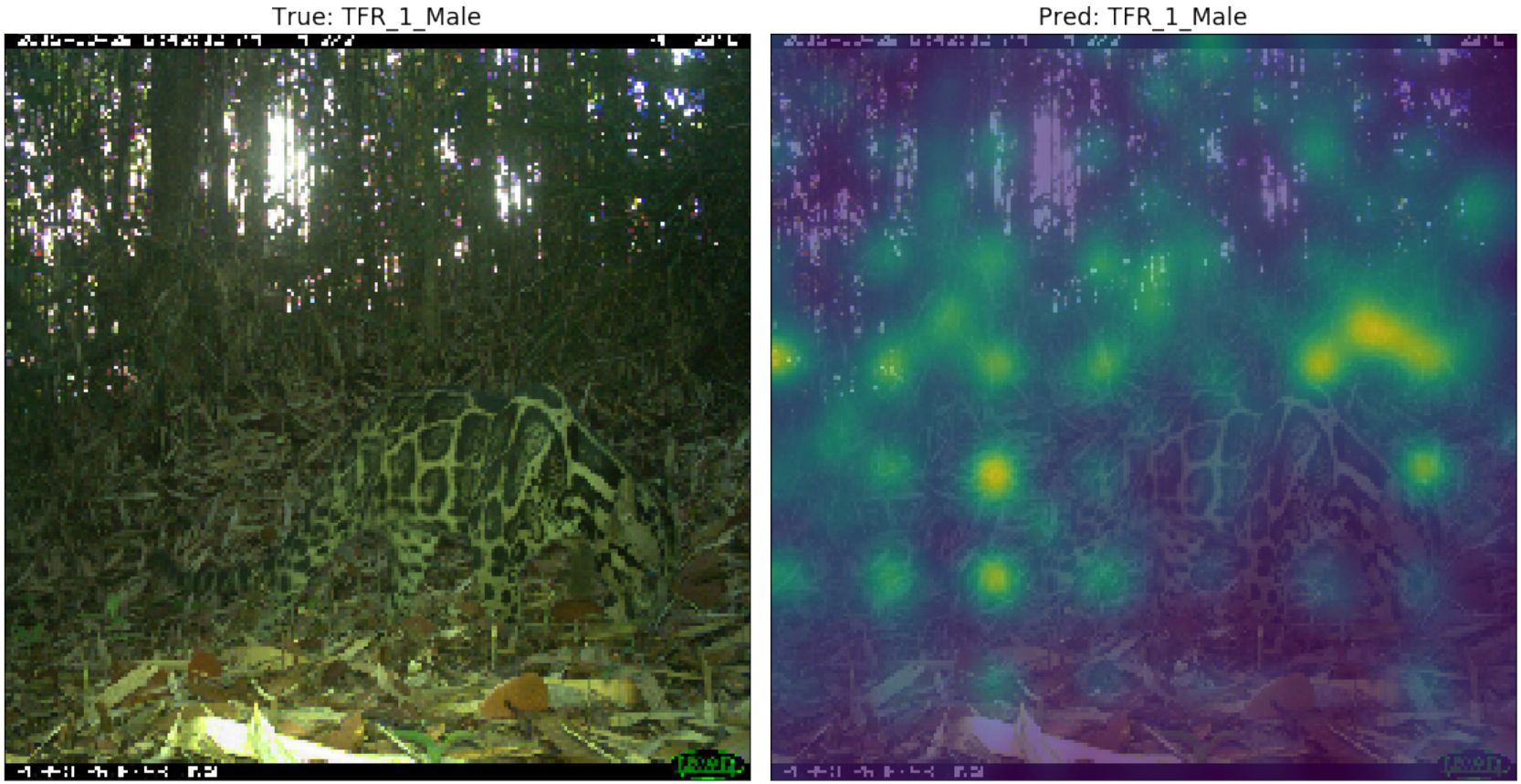


Figure 8: Network attention on background

Results

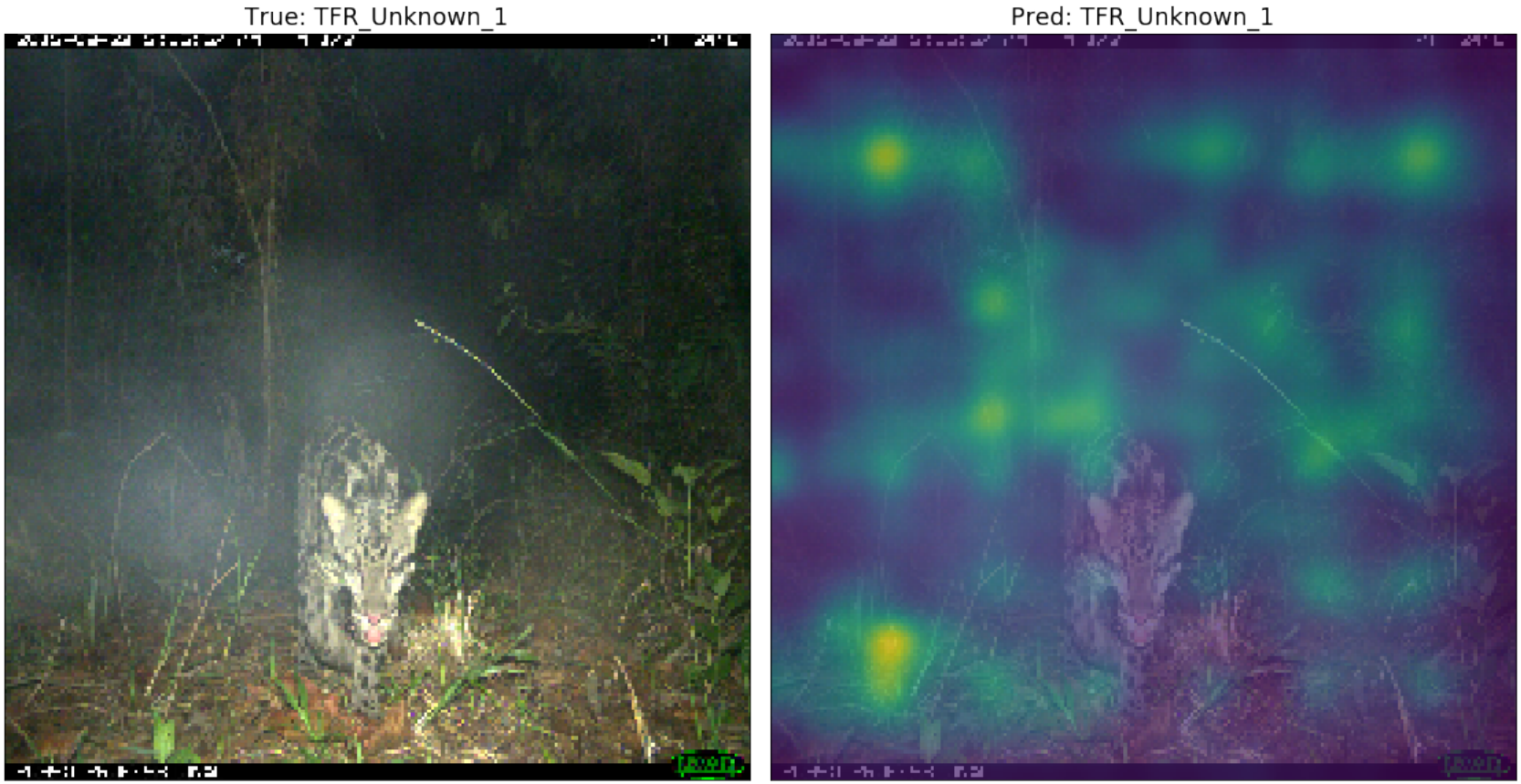


Figure 9: Network Attention on background

Training Process

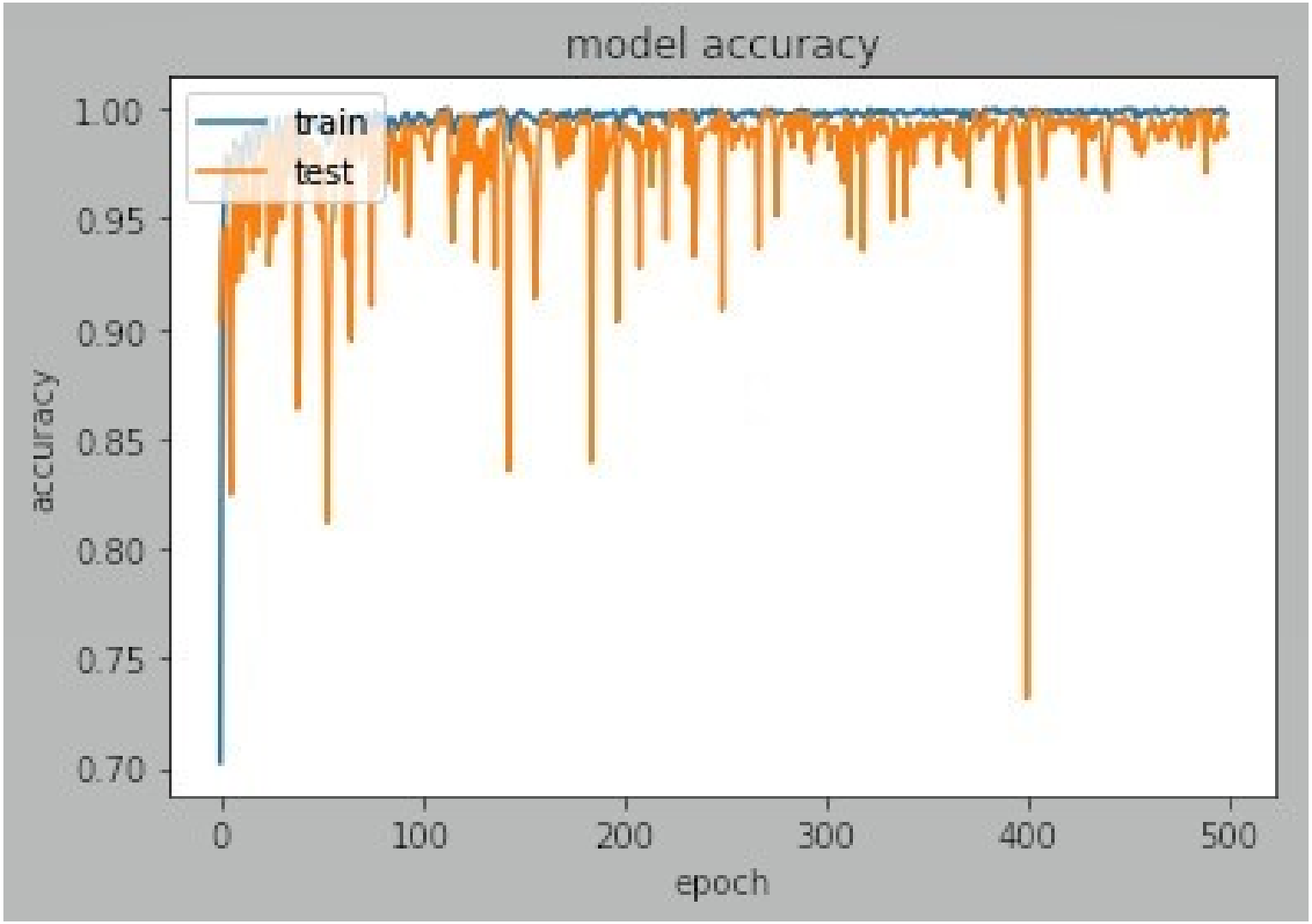


Figure 10: Accuracy during Training

Results

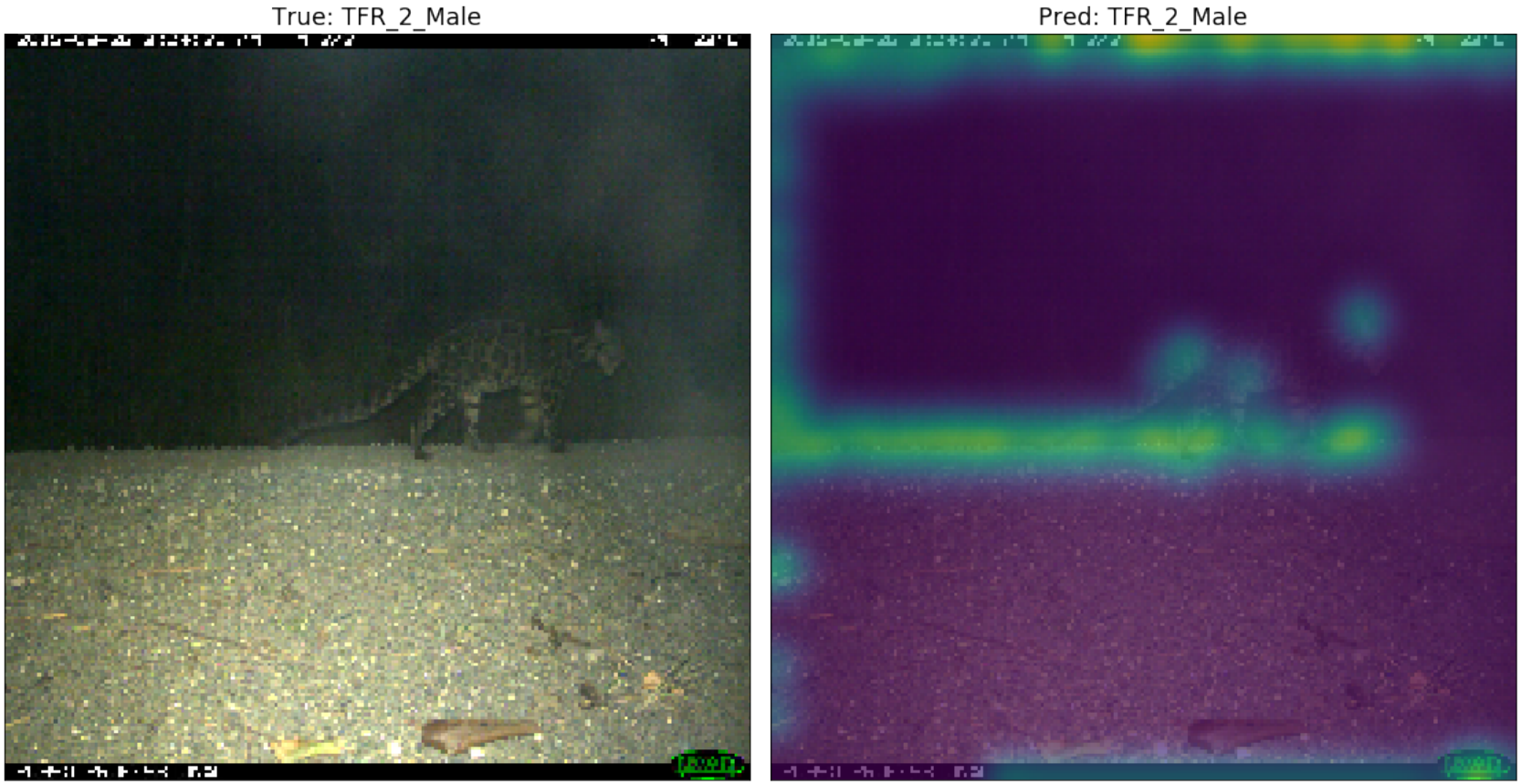


Figure 11: Network attention on logo and time stamp

Using Bounding Boxes

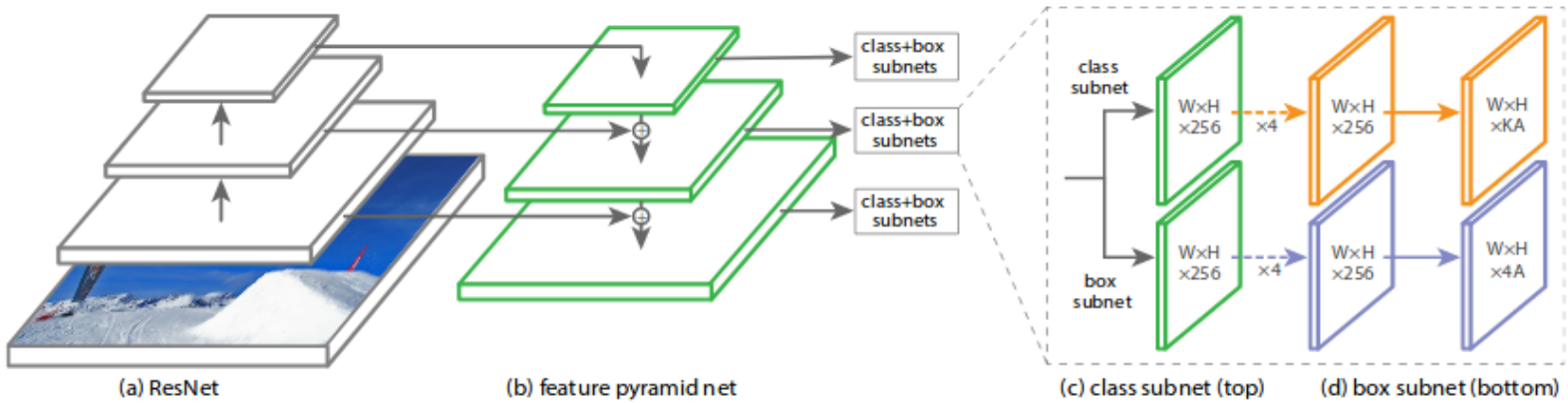
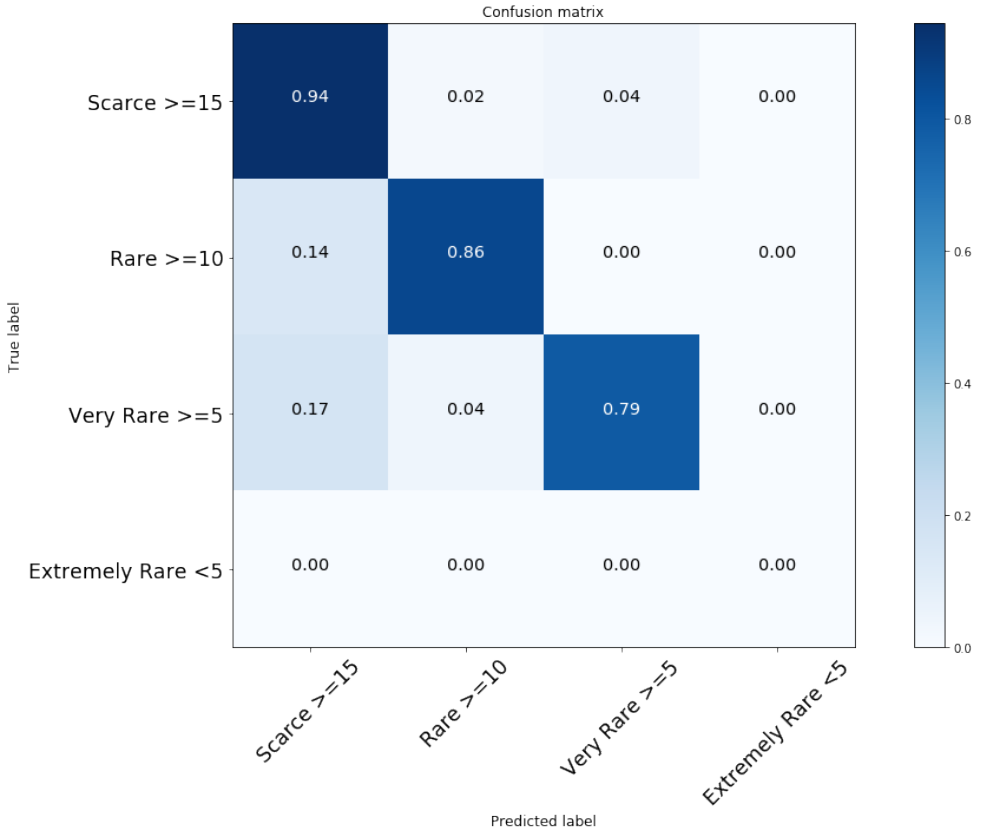


Figure 12: RetinaNet Architecture [https://medium.com/@14prakash/the-intuition-behind-retinanet-eb636755607d]

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

Positive Examples

Figure 14: RentinaNet attention on animal

Negative Examples

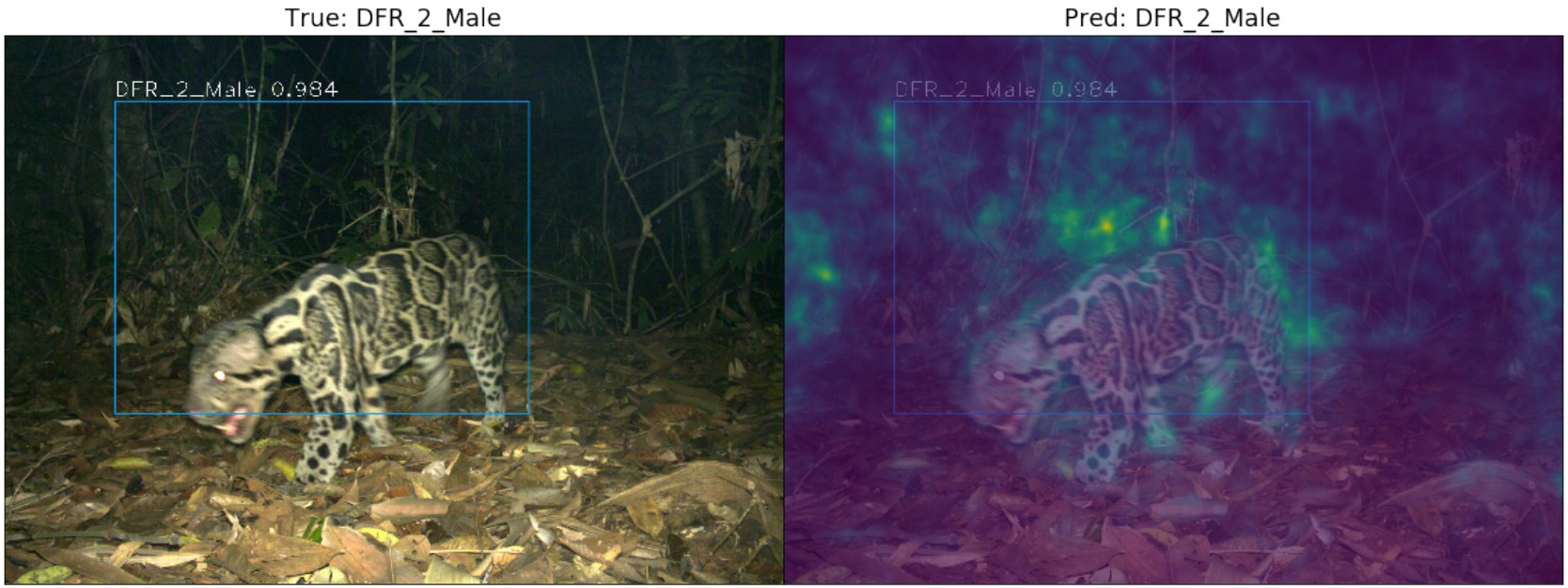


Figure 15: RentinaNet attention on background

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Data Set

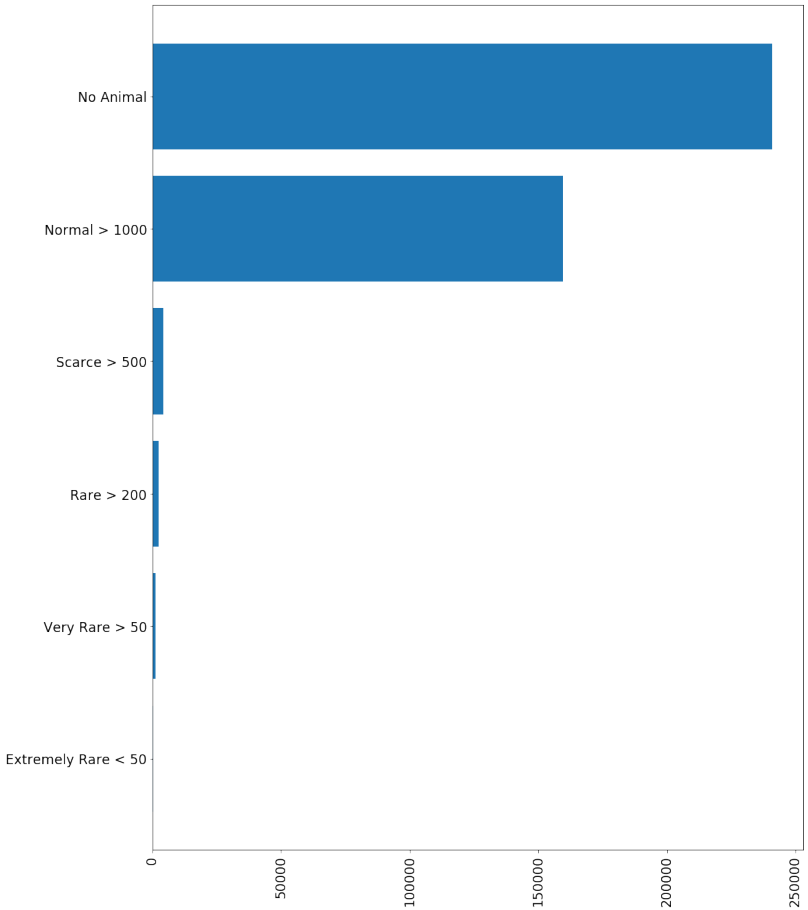

Figure 16: Reduced data distribution of species data set

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

Some Example Images

Figure 17: Marbled Cat

Figure 18: Mouse Deer

Scores

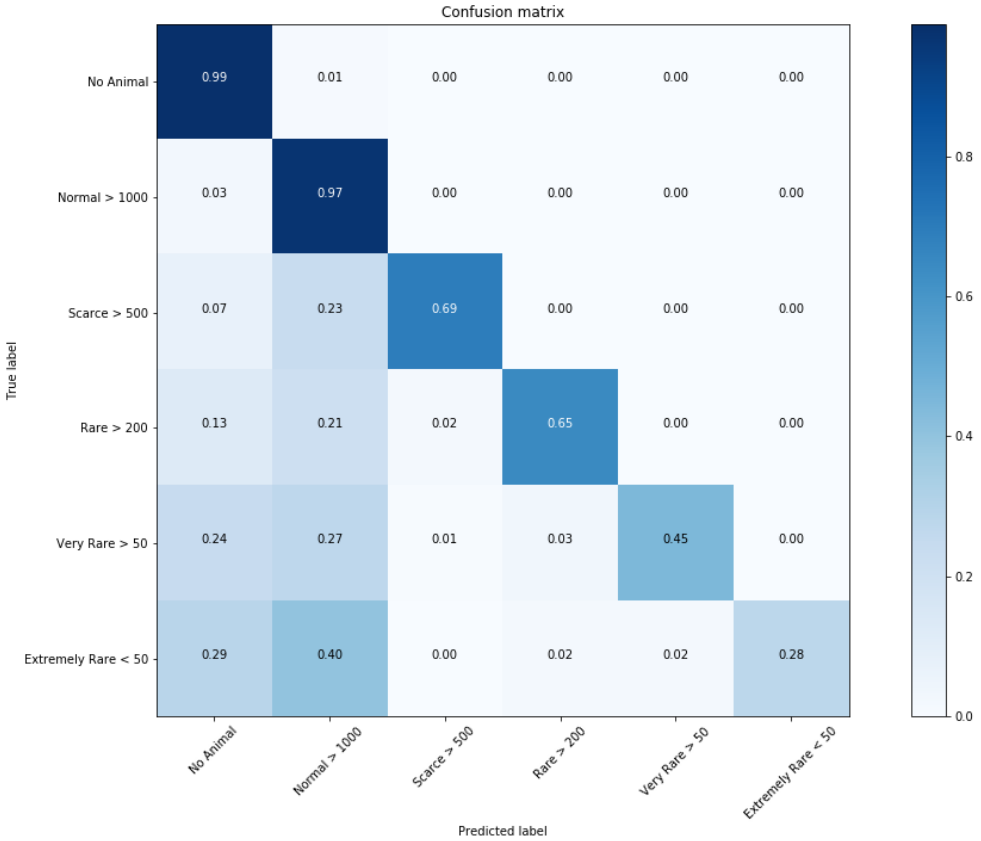

Figure 19: Reduced confusion matrix for finetuned ResNet-50

Test set:

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

Training Process

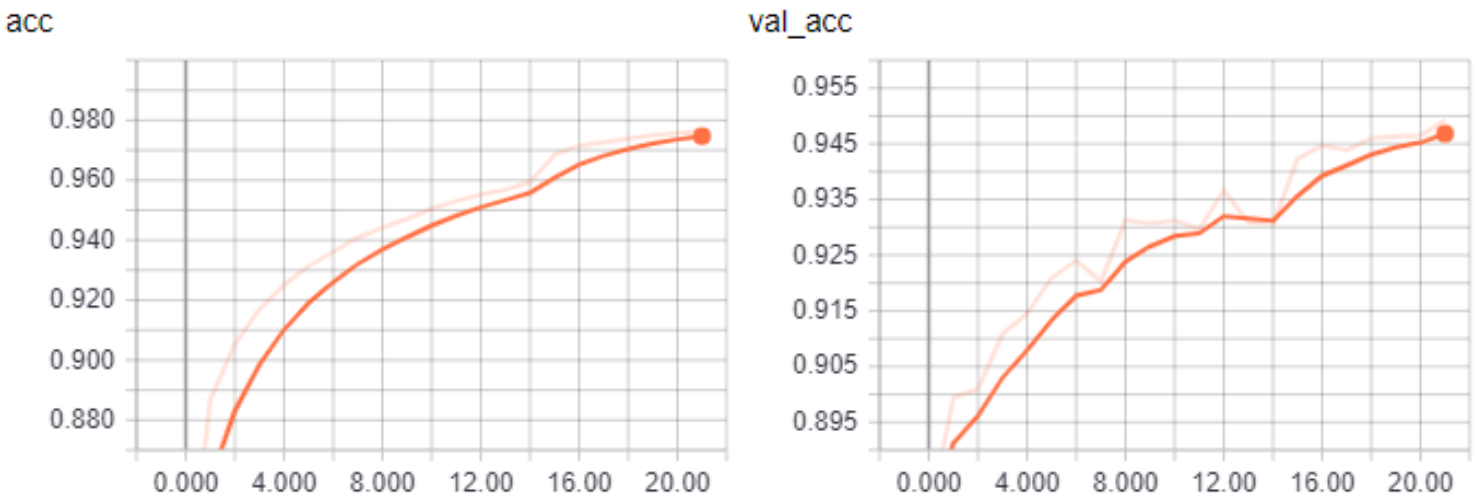

Figure 20: Accuracy during Training

Positive Examples

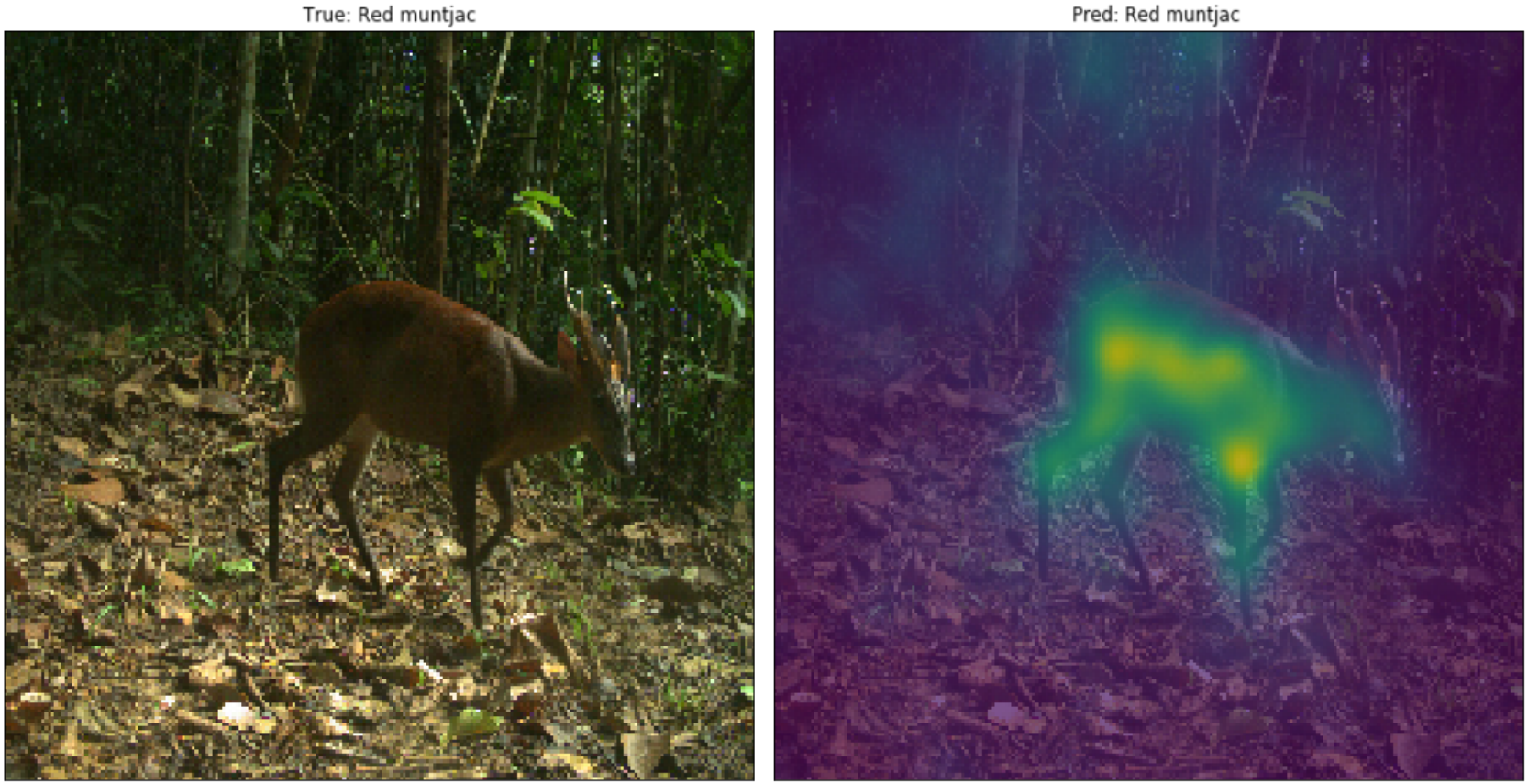

Figure 21: Correct attention and classification

Positive Examples

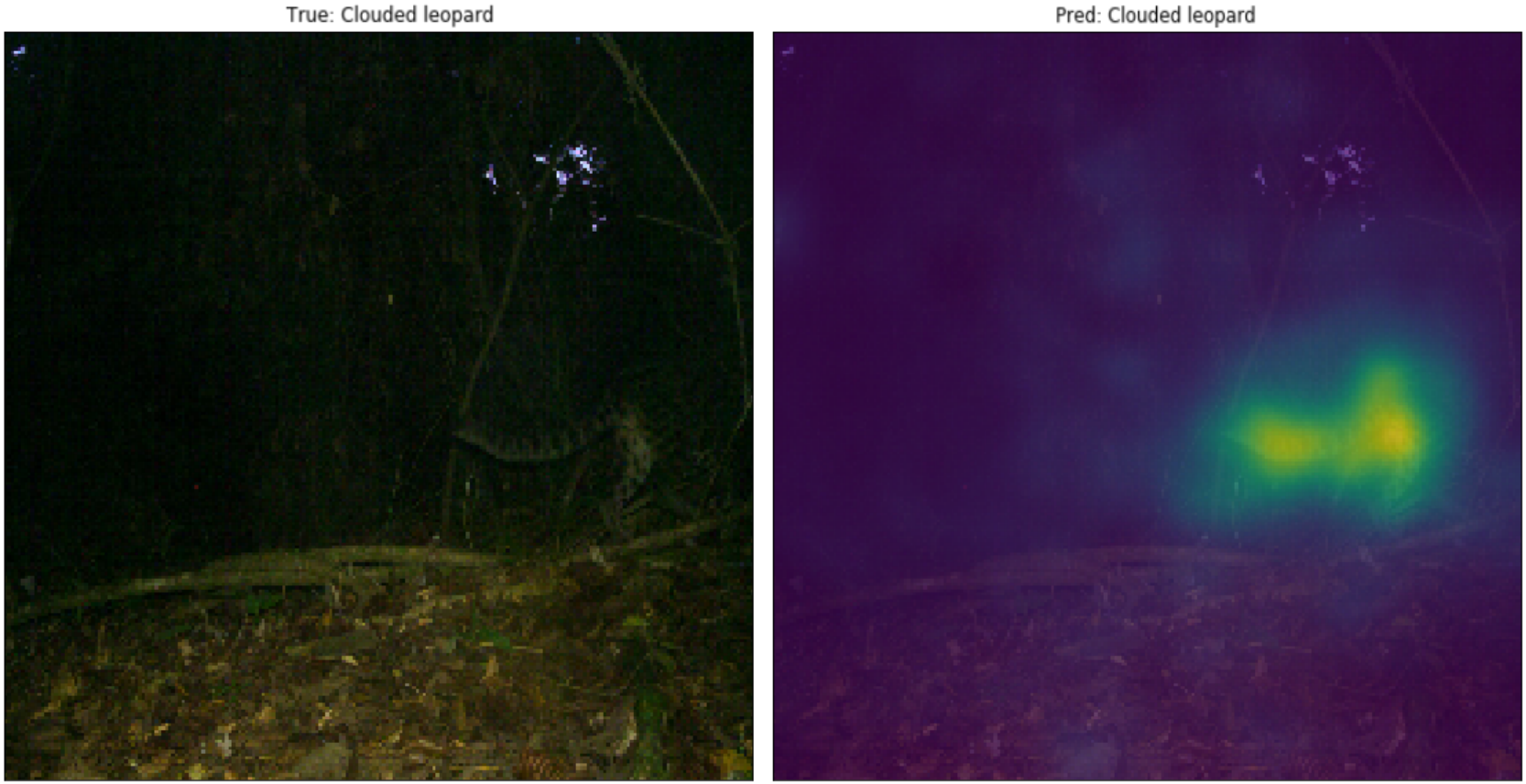

Figure 22: Correct attention and classification

Negative Examples

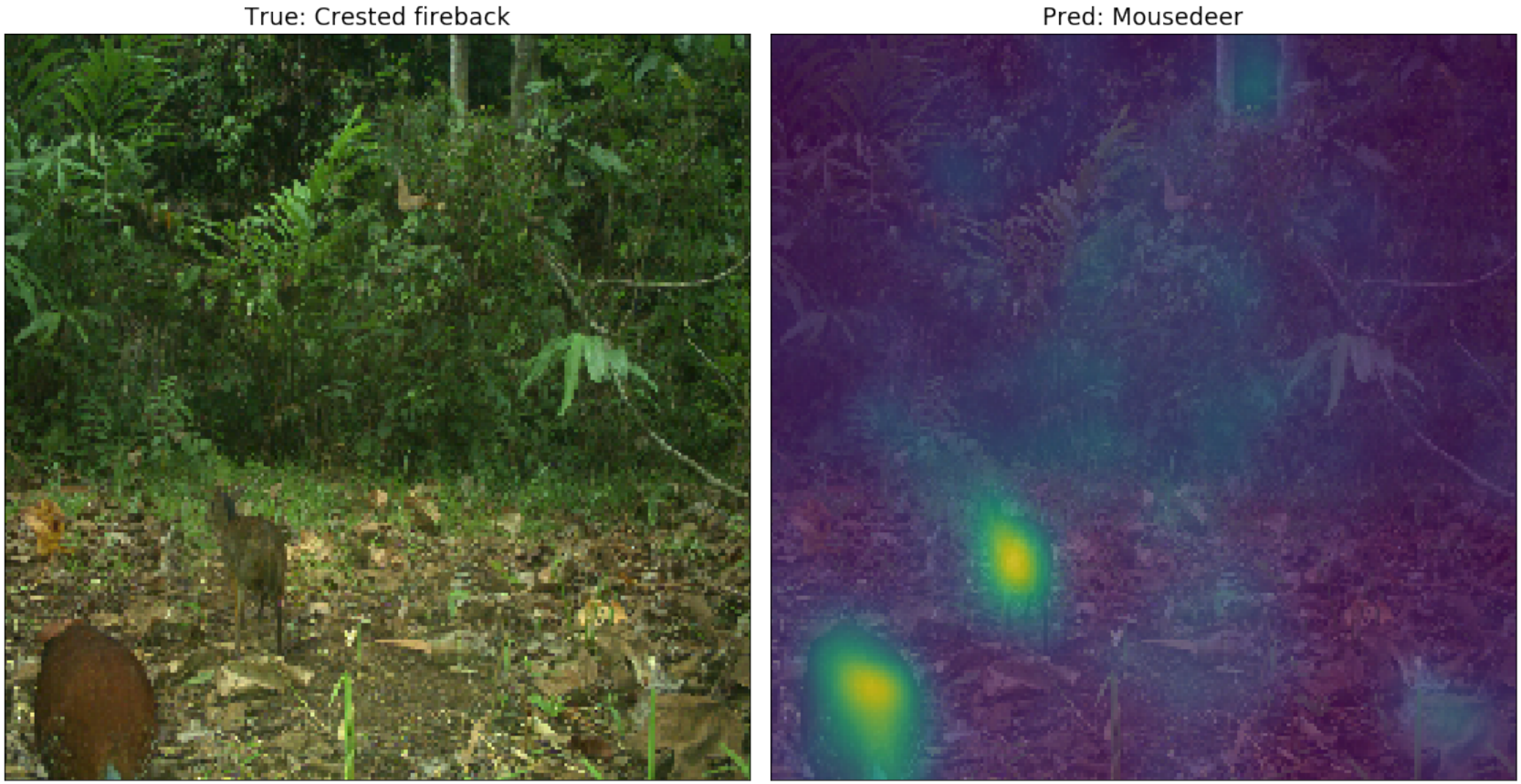

Figure 23: Noisy labels

Negative Examples

Figure 24: Correct Attention, wrong label

Negative Examples

Figure 25: Mismatch because of class similarity

Finetuning for Individuals

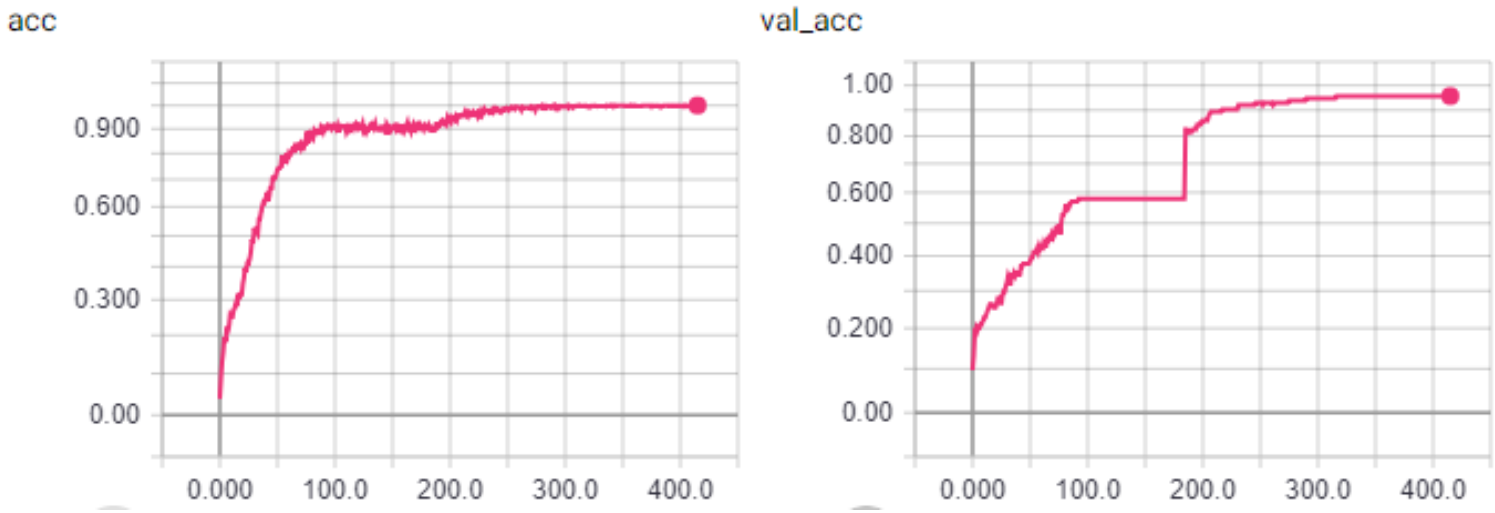

Figure 26: Accuracy during training

Network Attention

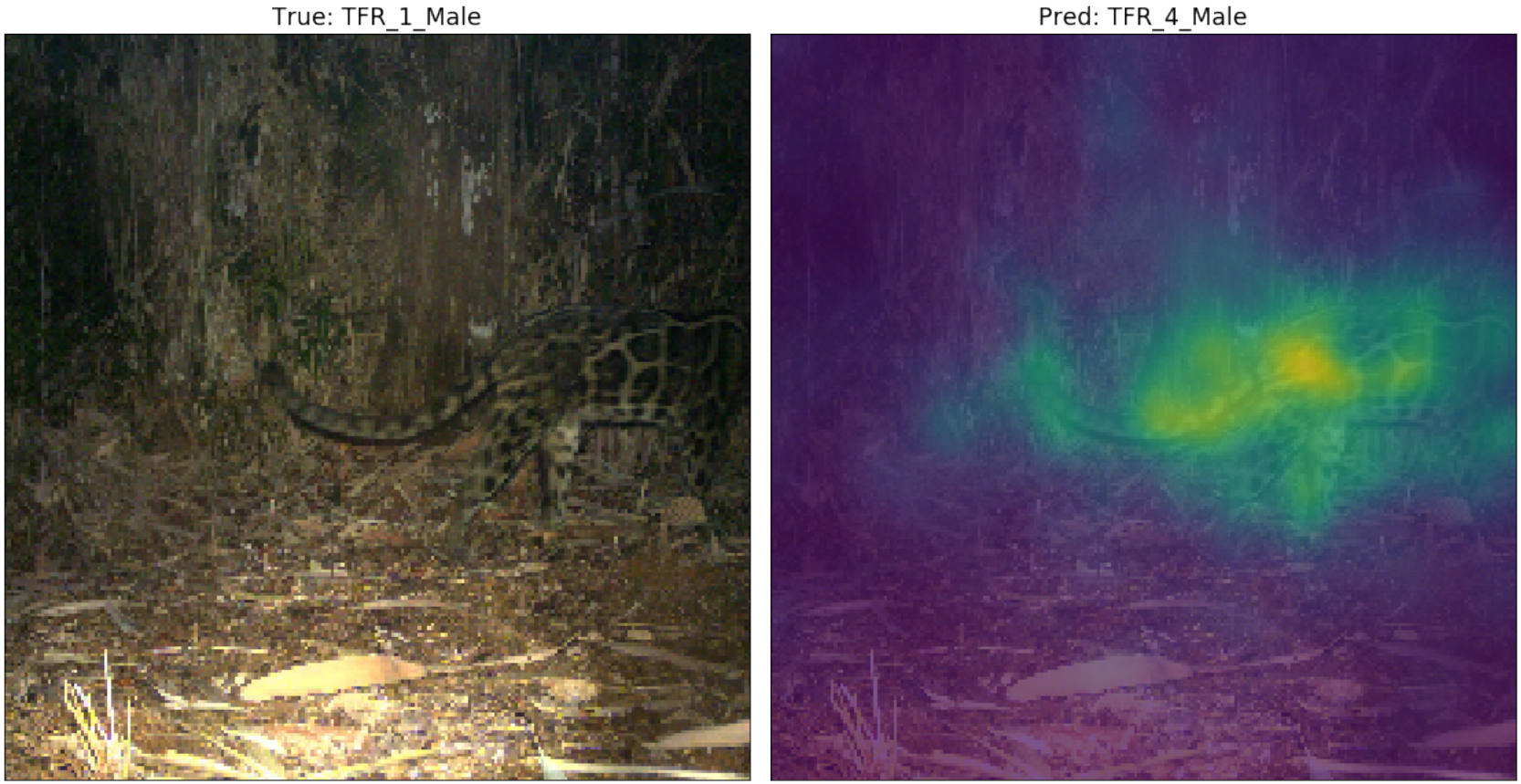

Figure 27: Network attention after finetuning final dense layer

Network Attention

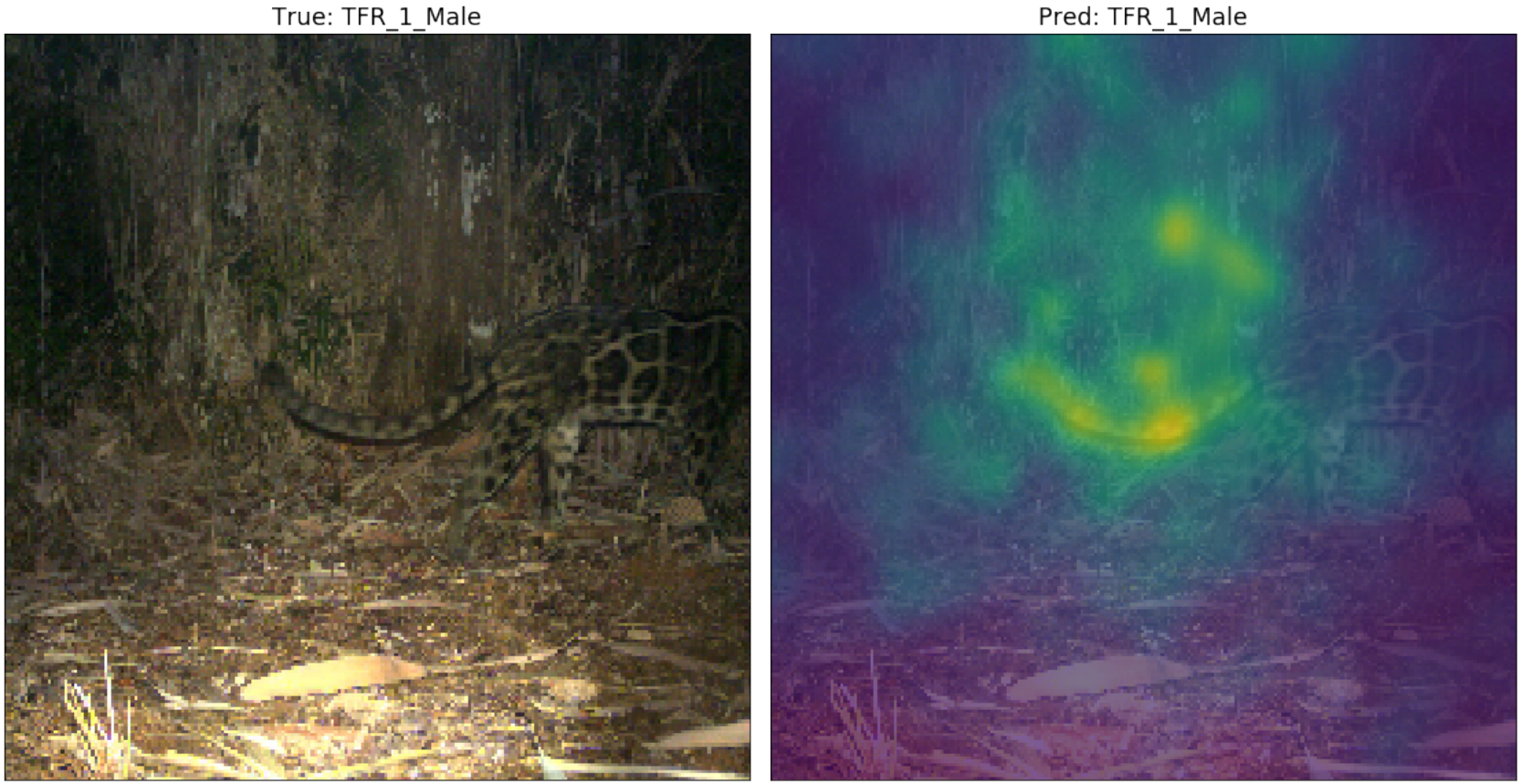

Figure 28: Network attention after finetuning complete ResNet-50

Thank you for listening

Questions?