

The Re-ID Problem with an Animal Dataset

Team 10

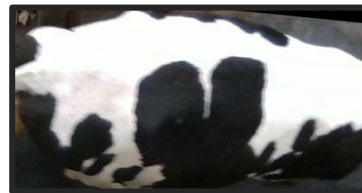
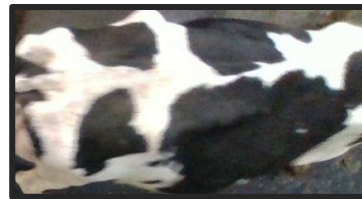
Connor Kannally
Sal Hargis





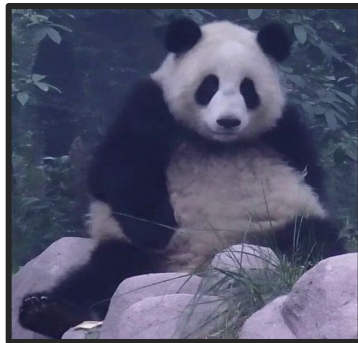
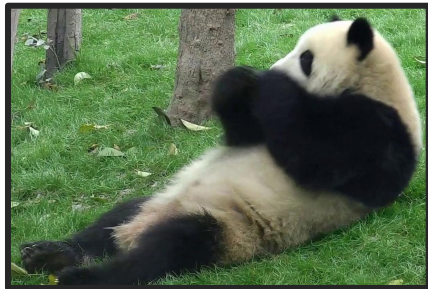
Problem Introduction and Motivation: Animal Re-ID

- Re-ID is re-occurrence of an individual animal (have you seen **this** animal before?)
- Challenging problem, individuals change over time, each individual has different viewpoints
- Species classification not sufficient for ecology studies



AnimalCLEF25 Dataset

- Multi-Species Individual Animal Identification
- More difficult to identify individuals than species:
- 10k individuals and 140k images
- Variety of animals including sea, land, and air animals
- Many different viewpoints and backgrounds (close-up or far away)



**Same
individual
“Nannan”**

Evaluation Method

Open set recognition
tests individuals NOT
in the training set

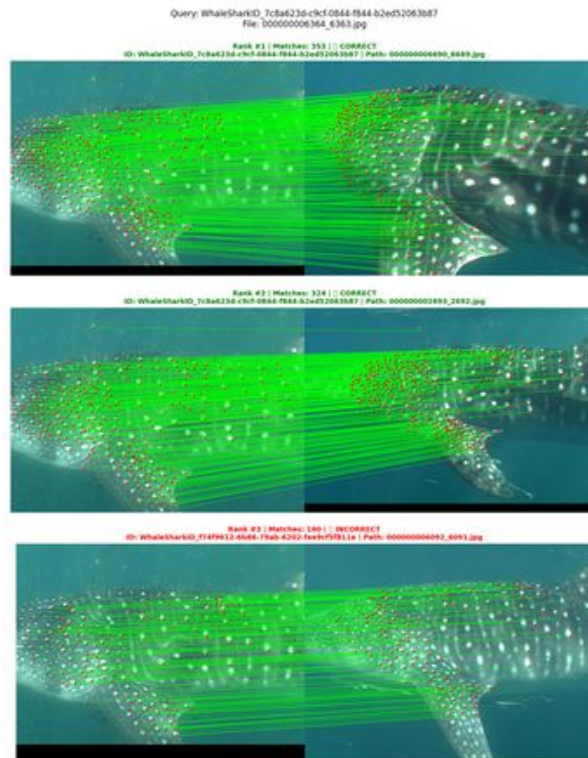
Closed Set:

- Compare overall accuracy of baseline method (Resnet50) to baseline + **LightGlue** (feature matching)
- R-1 and R-20 Accuracy

Open set recognition accuracy with:

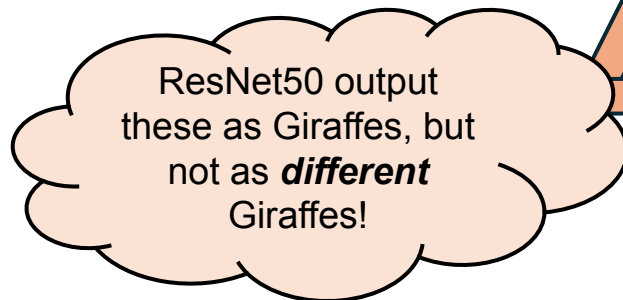
- 2000 images of individuals
- 500 images not in training set

LightGlue Feature Matching with Whale Shark



Baseline Approach

- Fine-Tuning out of the box ResNet50 to the Wildlife-10k dataset
- Baseline Resnet50 on AnimalCLEF25:
 - ~**99%** accuracy for species identification (near perfect – wrong task)
 - ~**56%** for individual identification (poor performance – correct task)



Advanced Approach: Model Pipeline

Multispecies Animal Re-ID Using a Large Community-Curated Dataset

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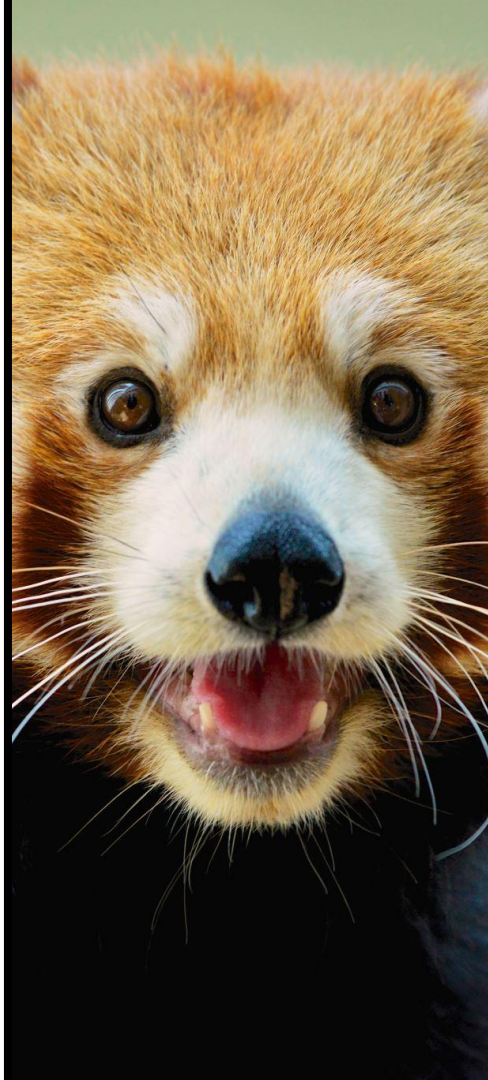
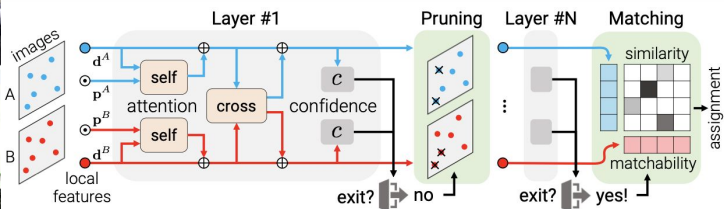
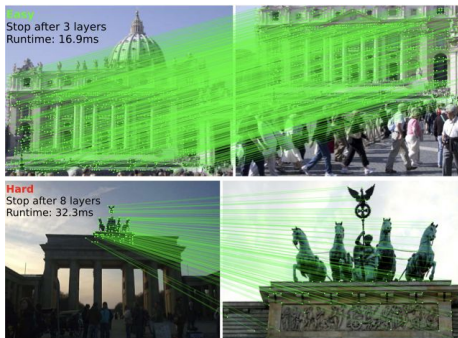
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Coarse-Grain: Top 100 candidates for each individual using:

- ResNet50
- EfficientNet-B3

Fine-Grain Ranking:
Re-Rank the top 100 with Light Glue

A Transformer for image matching



Advanced Approach: ArcFace Loss for Comparisons

- **Optimized with ArcFace Loss instead of Softmax**
 - **Softmax** only cares about separability, no mechanism to group related images together (important for Re-ID!)
 - **ArcFace** creates an embedding space where Angle = Similarity
- **ResNet50 with ArcFace Loss**
 - Embedding size: 512 dim
 - Standard baseline
- **EfficientNet-B3 with ArcFace Loss**
 - Embedding size: 512 dim
 - Optimized architecture using Wildlife-10k

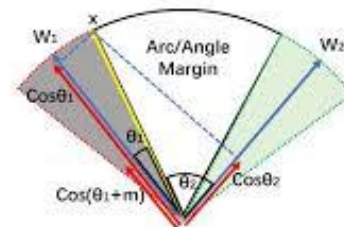


Figure 2. Geometrical interpretation of ArcFace. Different colour areas represent feature spaces from distinct classes. ArcFace can not only compress the feature regions but also correspond to the geodesic distance on the hypersphere surface.

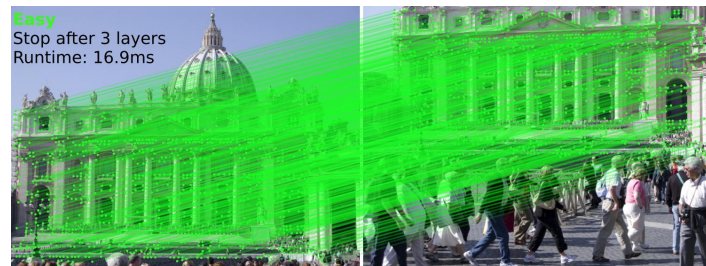
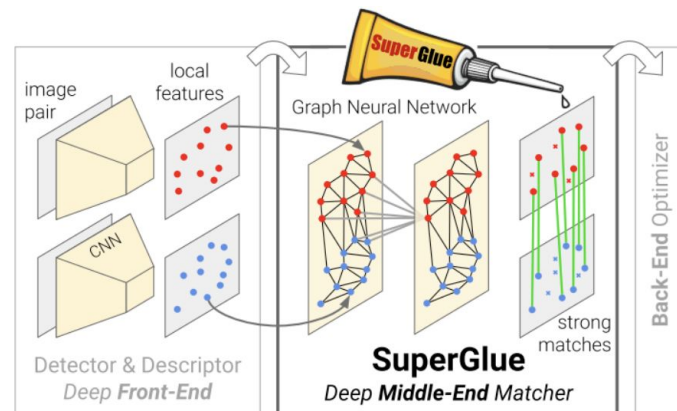
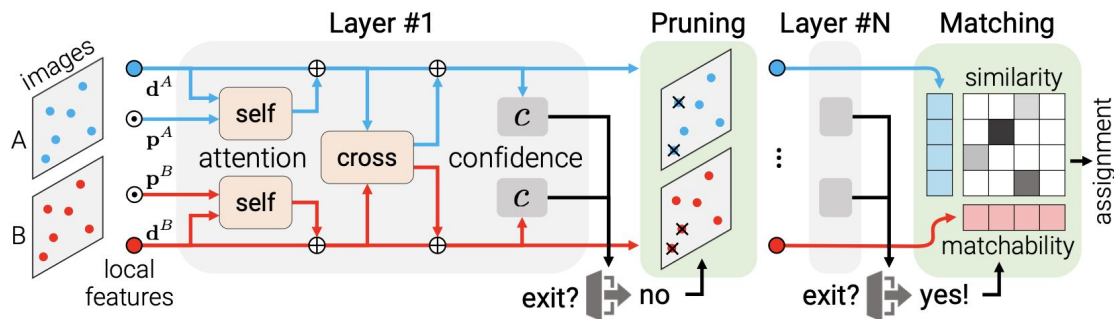
<https://arxiv.org/pdf/1801.07698>

Advanced Approach: SuperGlue

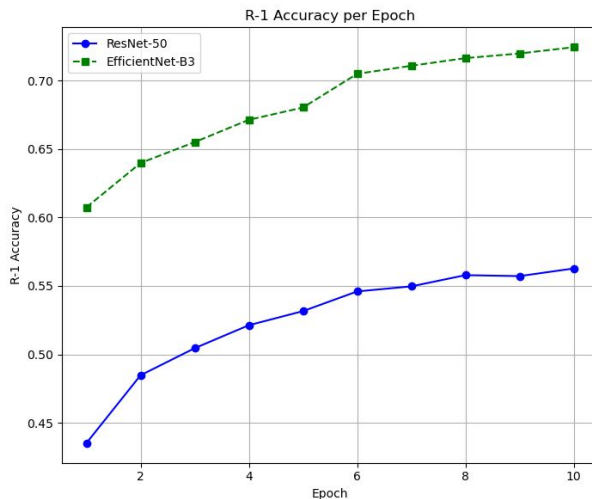
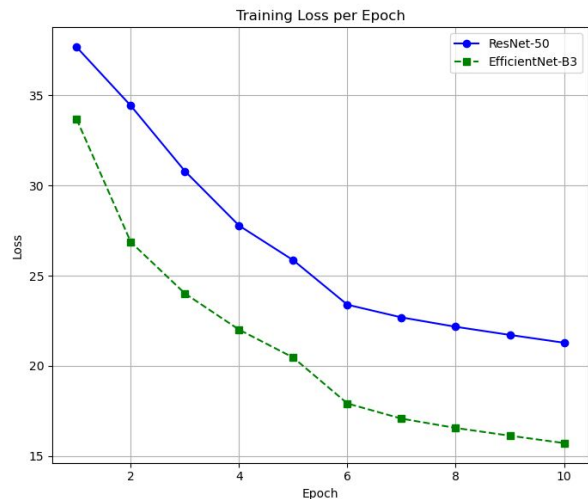
Motivation: Models like ResNet fail when the viewpoint changes (strongly impacts the image vector)

SuperGlue: Can verify identity based on strict physical markings

LightGlue: Stops early on “easy” matches to be faster



Results and Analysis: Baseline Approach (without LightGlue)



ResNet50 vs. EfficientNetB3

- R-1 Accuracy
 - ResNet50: ~56%
 - EfficientNetV3: ~72%
- R-20 Accuracy:
 - ResNet50: ~76%
 - EfficientNetV3: ~86%

ResNet50 vs. EfficientNetB3 (with LightGlue)

- R-1 Accuracy
 - ResNet50: ~64%
 - EfficientNetV3: ~71%
- R-25 Accuracy:
 - ResNet50: ~79%
 - EfficientNetV3: ~85%

Why did EfficientNetV3 go down?

- LightGlue could be looking at the background

Takeaways:

- EfficientNetV3 Accuracy higher alone than with LightGlue

Results and Analysis: LightGlue Challenge for Re-ID

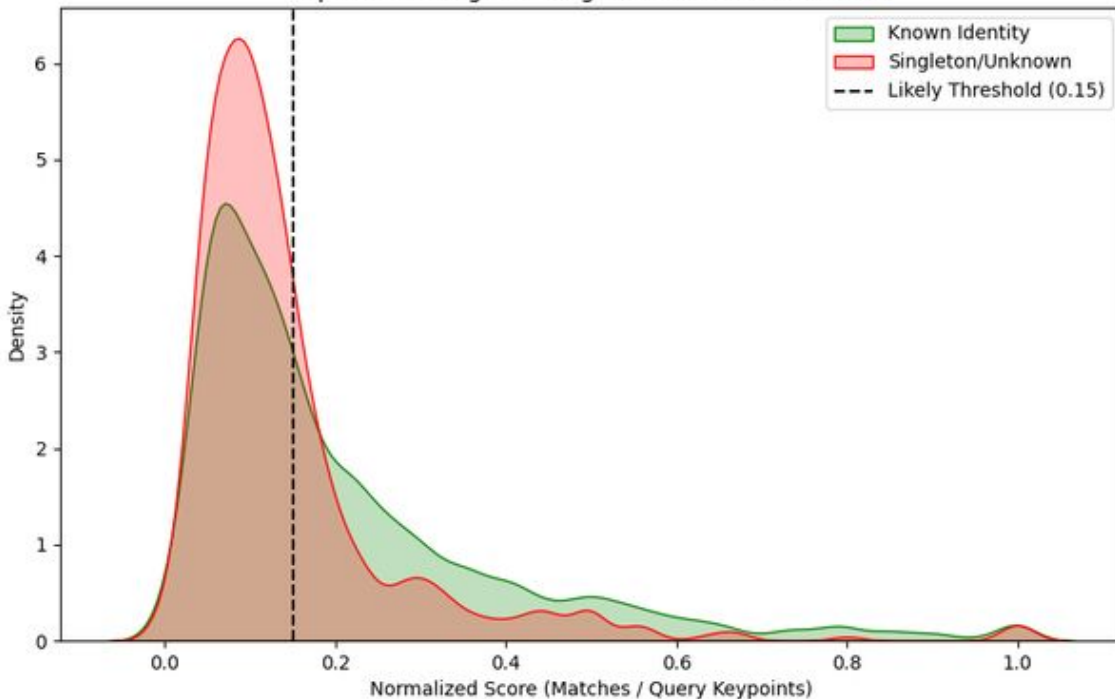
Feature Matching and Re-ID:

- Where to set the threshold for a new individual
 - No way to set a threshold to be able to distinguish between known and new individuals

Takeaway:

- LightGlue can help re-rank when accuracy of baseline model is lower
- Not sufficient for identifying new individuals (given our context)

Open Set Recognition: LightGlue Score Distribution



Workload

1-2 weeks setting up with large amounts of data prepared

3-4 weeks exploring various approaches (SuperGlue, LightGlue, Resnet50, EfficientNetV3, ViT, etc)

1 week of evaluation and analysis of approaches



Challenges



Downloading and setting up OSC remotely



Having a plan of path forward before taking time and resources to train models (time consuming)



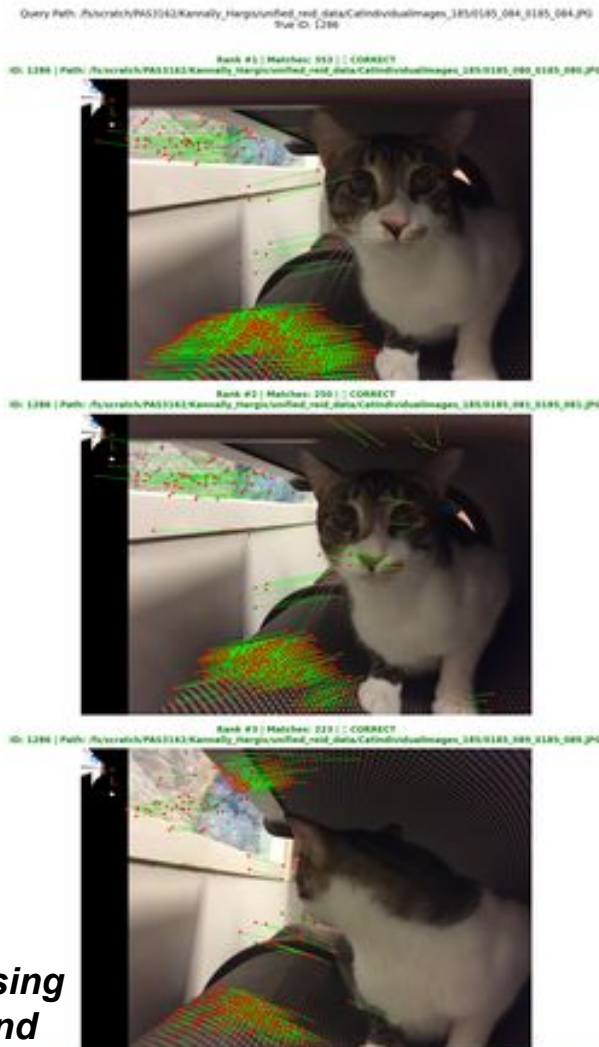
Getting a good candidate images for LightGlue (without taking too long)



Future Work

- Explore different feature matching algorithms for re-ranking
- Explore different loss functions other than Triplet and ArcFace
- **Data Preprocessing:**
 - Remove background, so the model learns only features of the individual (image segmentation)
 - Data augmentation to generate alternative and flipped views of individuals
 - A way to label the images based on view (left, right, top, etc)

*Feature matching focusing
only on the background*



Thank You!