

# Semi-Supervised Learning with Side Information for Large Scale Web Images

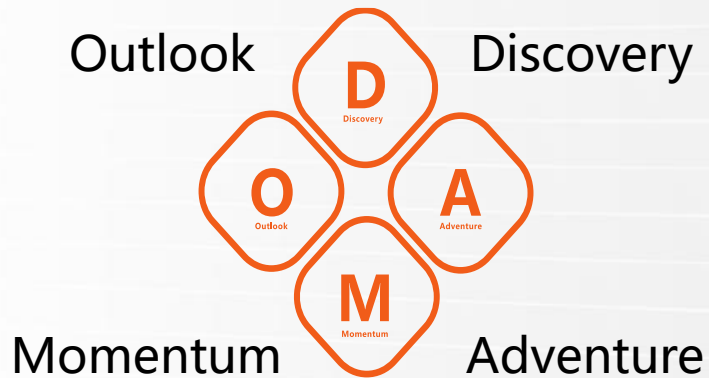
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Chenwei Xie, Yun Zheng, Yingya Zhang, Pan Pan

Alibaba Machine Intelligence Technology Lab

# Alibaba DAMO Academy



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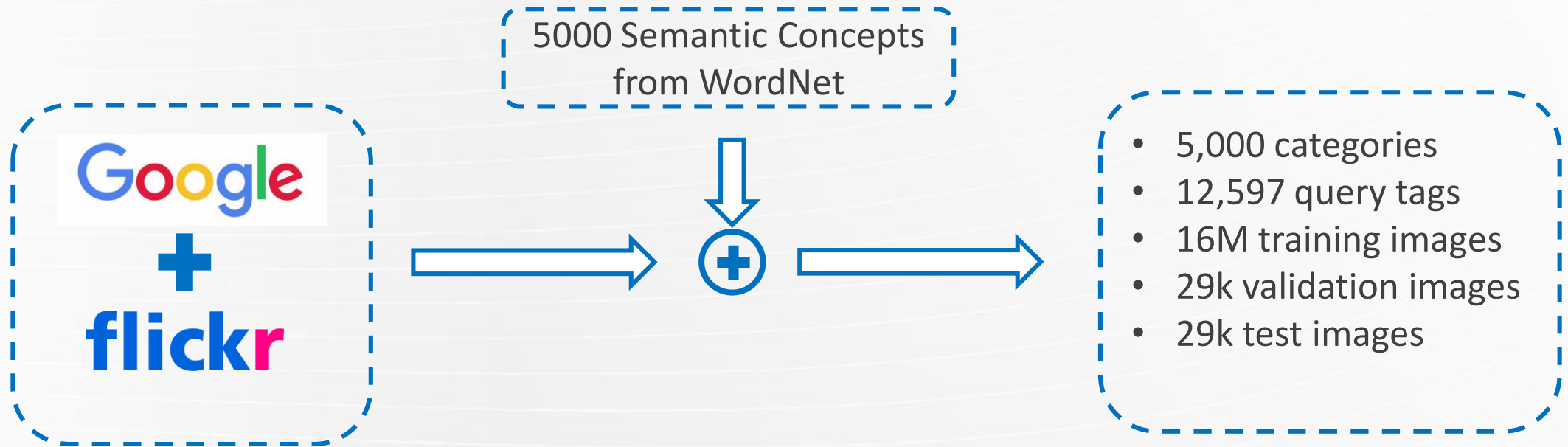
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# Outline

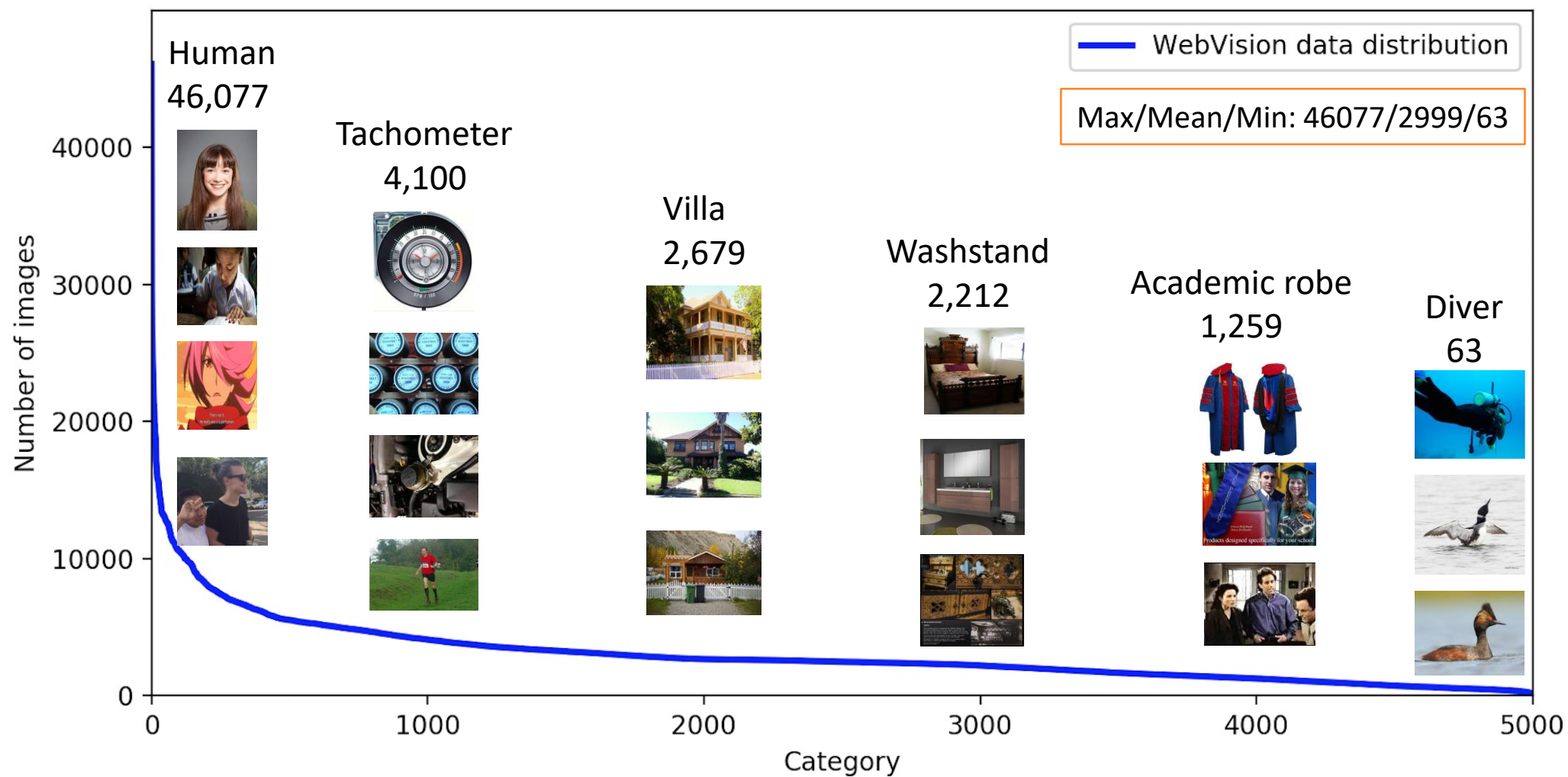
- Database
- Our Highlights
  - Establish Category Semantic Relationships
  - Two-stage Image Weighting with Side Information
  - Large Scale Training
- Summary



# Database



# Unbalanced Data





# Side Information

## Search Engine



**Source:** google or flicker

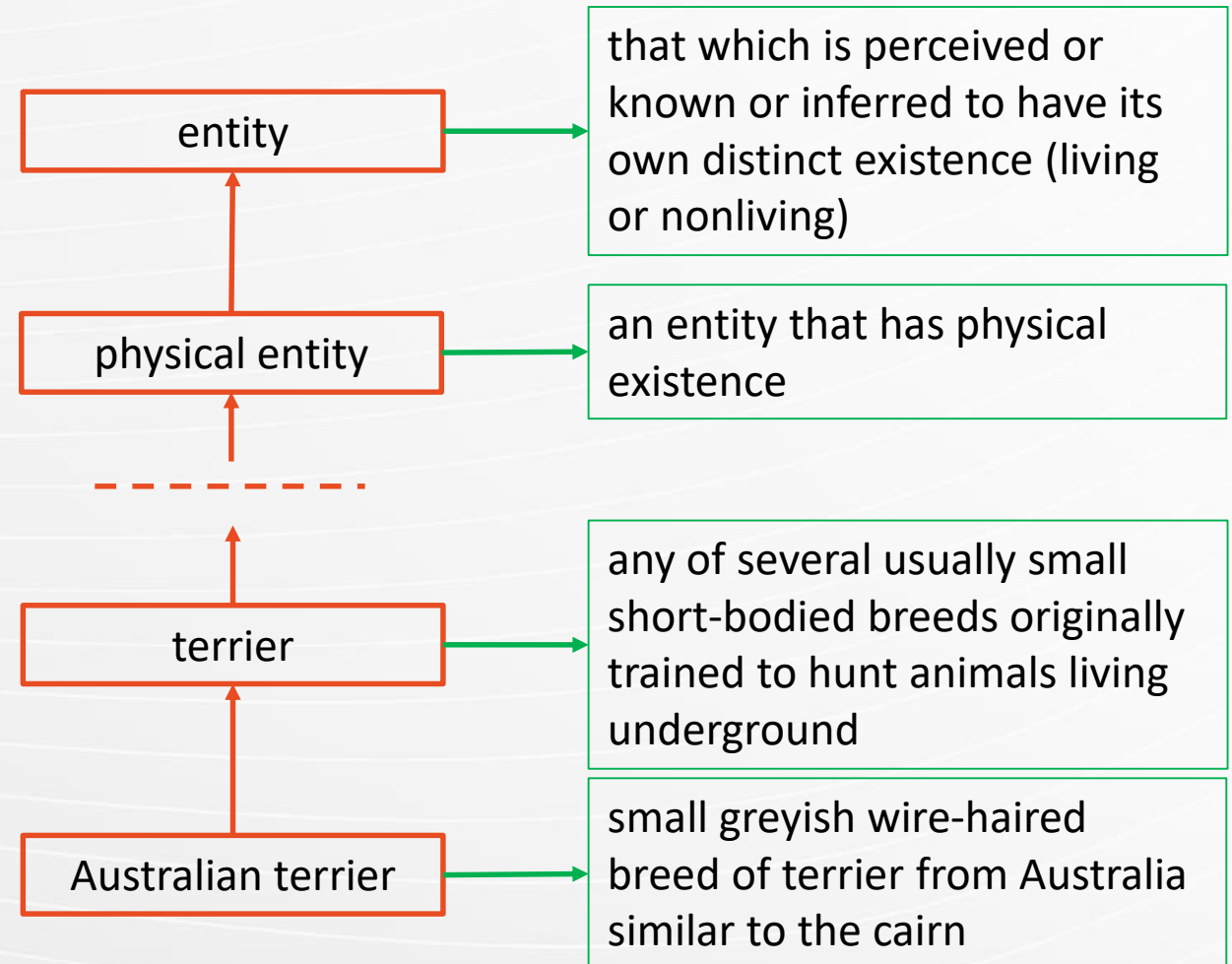
**Rank:** 1

**Description:** Four Australian Terrier Pups brought to the studio today.

**Tags:** puppies Australian Olympus terrier e500.

**Title:** Australian Terrier Pups.

## WordNet

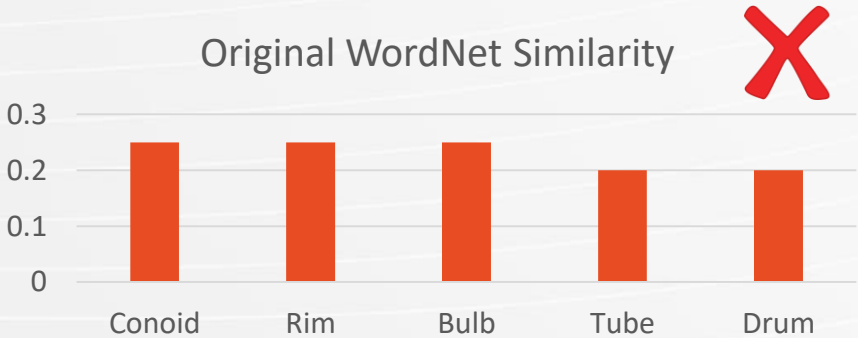


# Establish Category Semantic Relationships

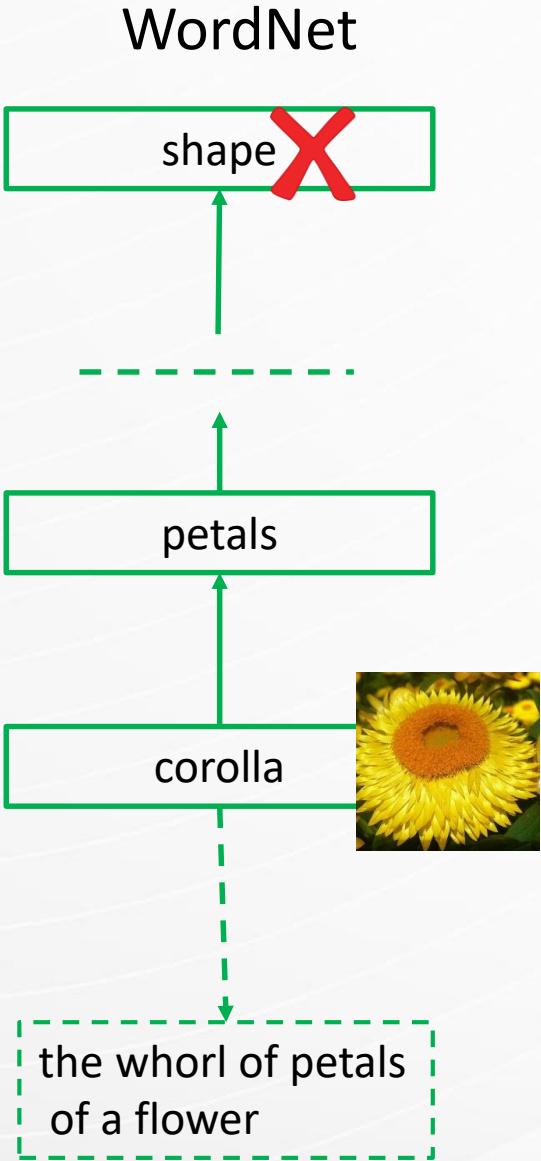
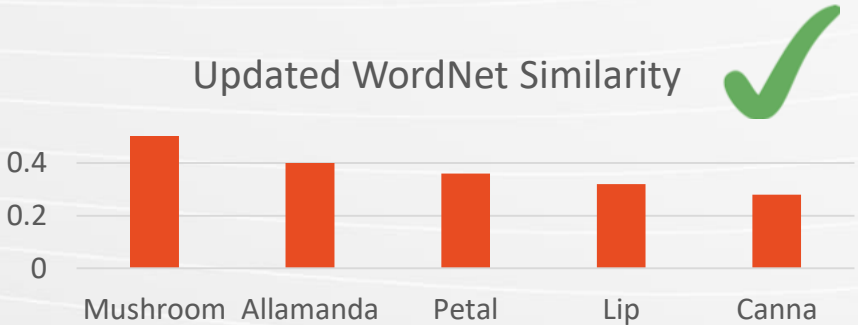
## □ Update WordNet Similarity with Bert Model



WordNet

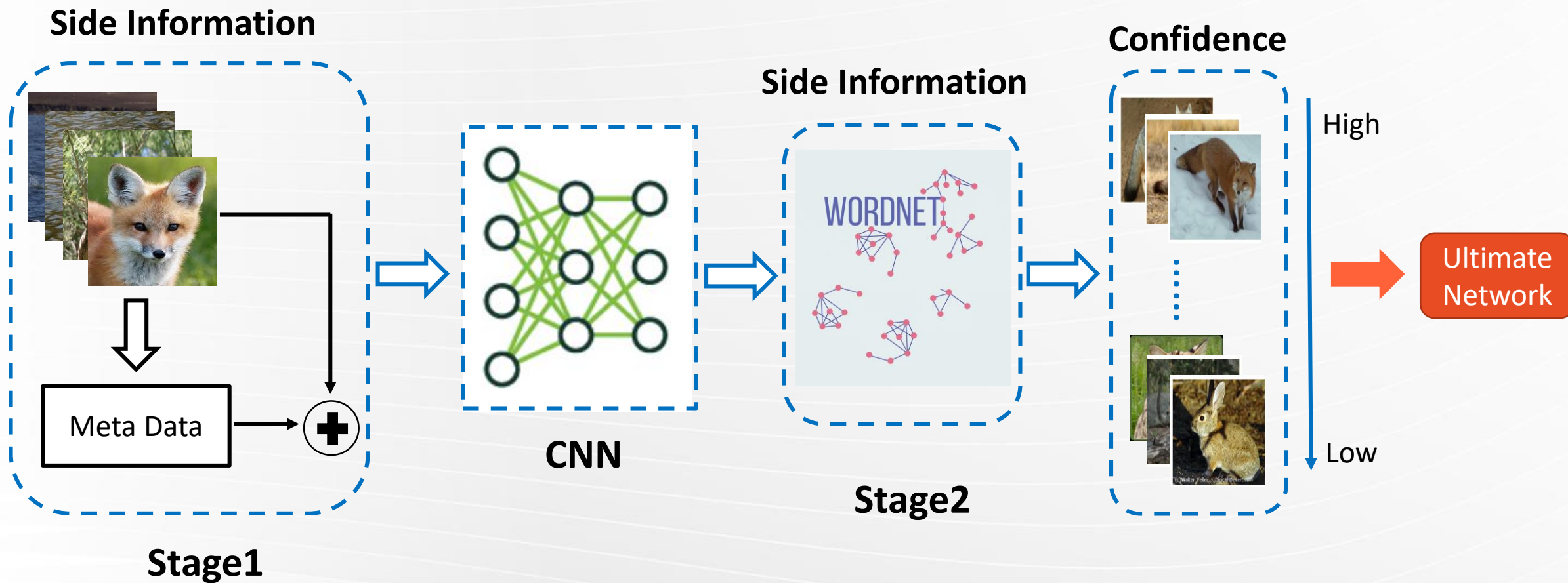


WordNet



# Two-stage Image Weighting with Side Information

## □ Framework

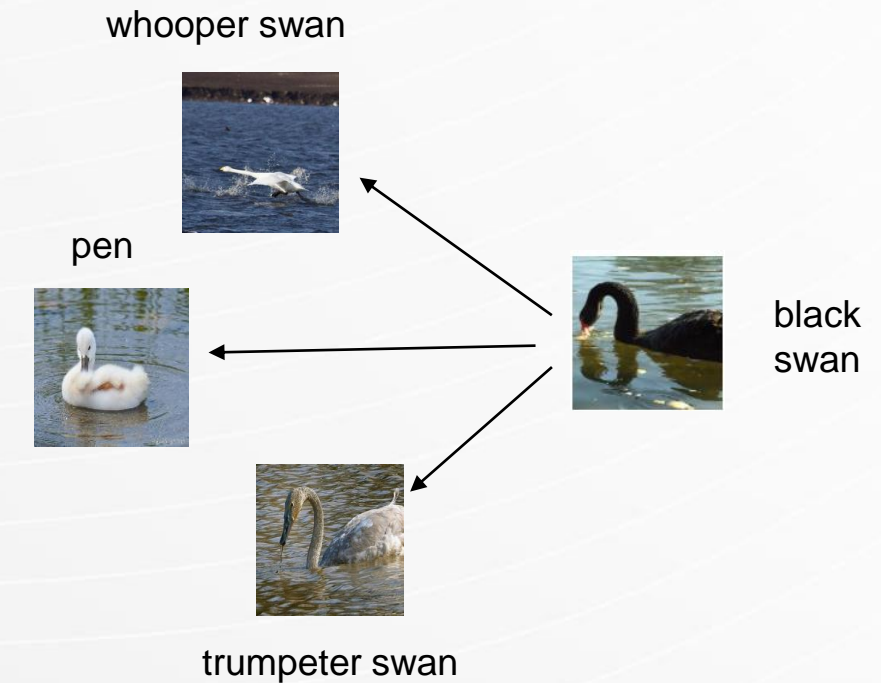




# Stage1: Image Weighting

## □ Side Information

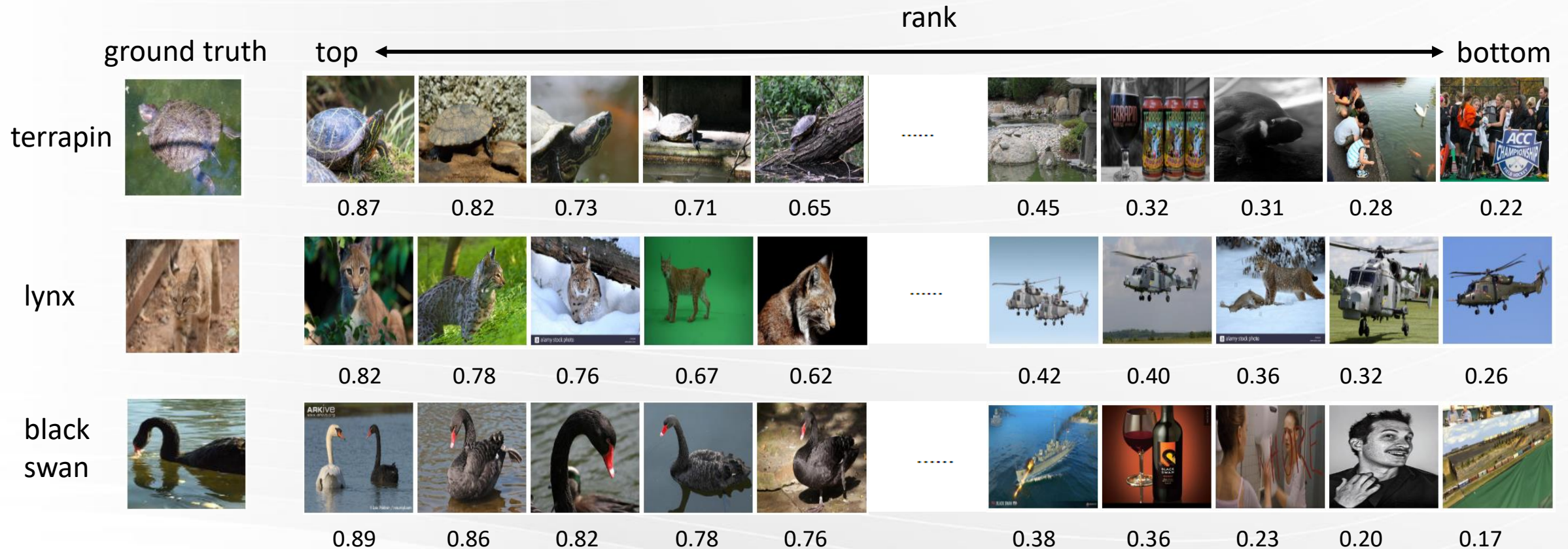
- Image Rank + WordNet KNN Categories



# Stage1: Image Weighting

## □ Side Information

- Image Rank + WordNet KNN Categories



# Stage2: Image Re-weighting

## ■ Side Information

- WordNet category semantic relationships

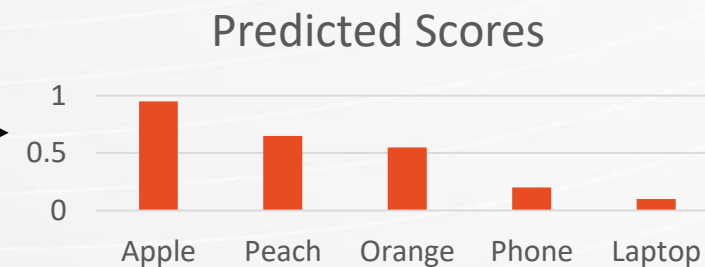
## ■ Motivation

- Predict scores of good sample should reflect label relation, eg Apple fruit

Apple



Classification Model

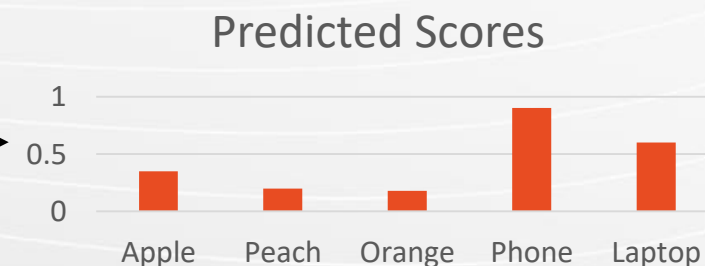


Good

Apple



Classification Model



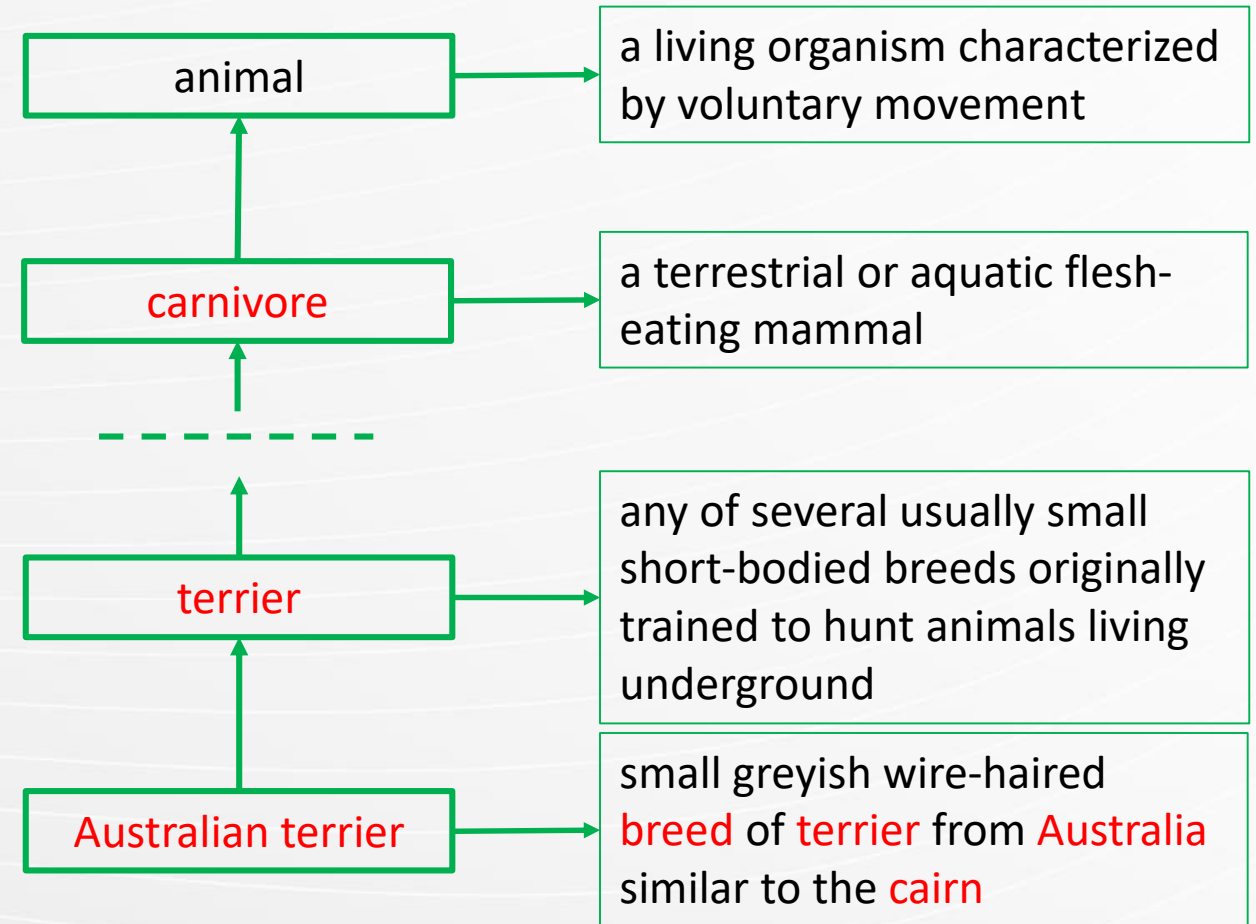
Noise



# Stage2: Image Re-weighting

- ❑ Keywords extraction
- ❑ Text feature matching between predictions and the ground truth
- ❑ Text matching score  $s(x_i)$  re-weight samples:


























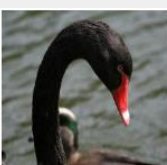

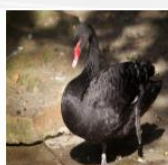



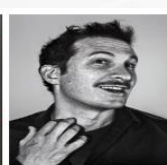

$$L_{weighted}(x_i) = s(x_i)L_{ce}(x_i)$$



# Stage2: Image Re-weighting

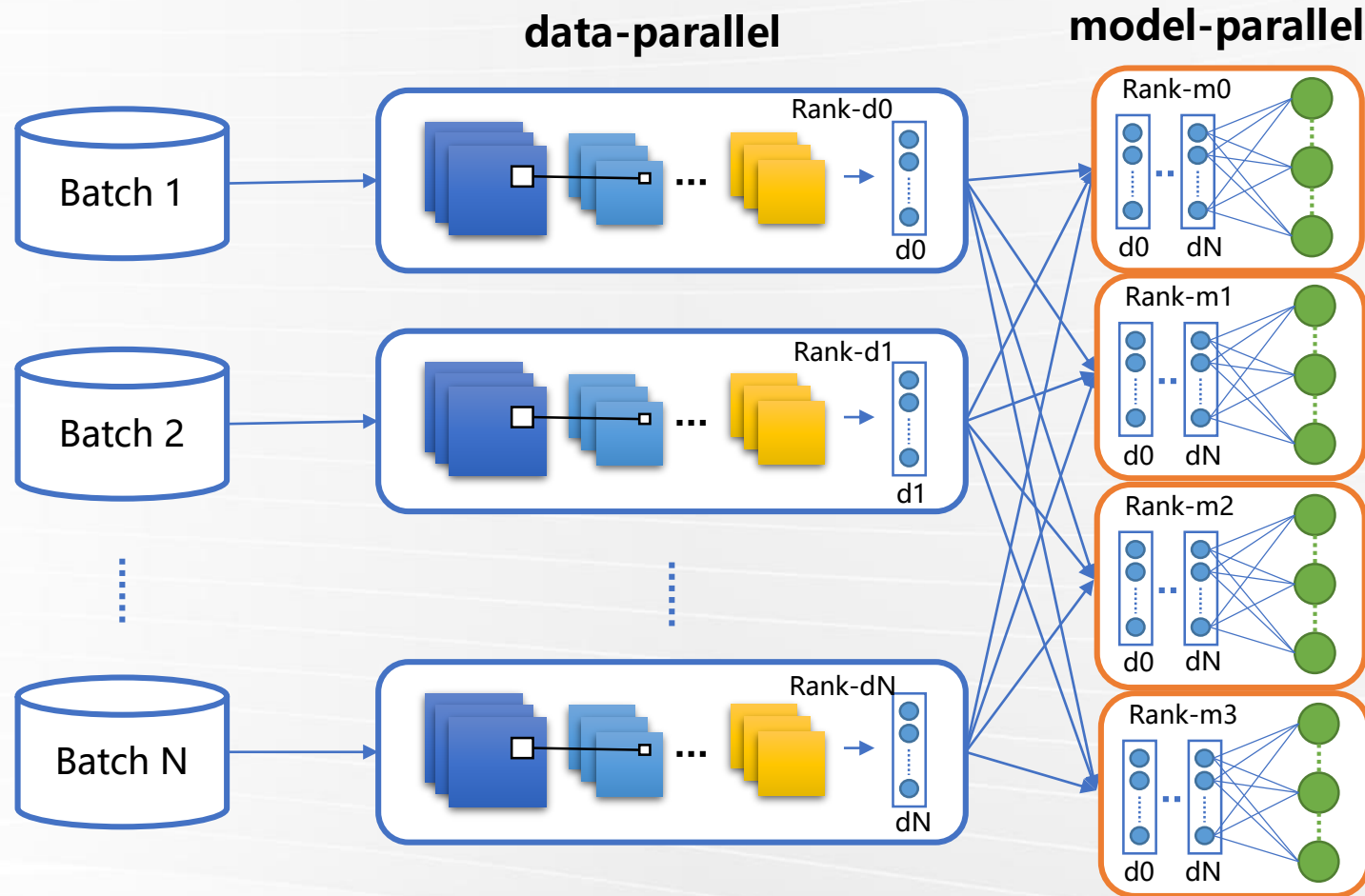
## □ Effectiveness

- Noisy image's weight is greatly reduced

terrapin		 0.95	 0.95	 0.80	 0.9	 0.86	.....	 0.15	 0.10	 0.4	 0.0	 0.0
lynx		 0.90	 0.95	 0.90	 0.90	 0.85	.....	 0.08	 0.06	 0.0	 0.0	 0
black swan		 0.95	 0.95	 0.90	 0.85	 0.90	.....	 0.12	 0.10	 0.0	 0.0	 0.0

# Large Scale Training

## □ Hybrid Parallelization, Large Scale Categories



- Hundreds of GPUs
- Pipeline optimization and better convergence algorithm
- Classification up to 1 Million+ categories



# Experiments

ResNeXt101 Validation Accuracy

<b>Input 224*224</b>	Top1	Top5
Baseline	51.05	74.94
+ Stage1	55.05	77.86
+ Stage1 + Stage2	55.56	78.15
<b>Input 320*320</b>		
+ Stage1 + Stage2	55.97	78.65

# Experiments



SE-ResNeXt101 Validation Accuracy

<b>Input 224*224</b>	Top1	Top5
Baseline	51.42	75.26
+ Stage1	55.22	78.00
+ Stage1 + Stage2	55.57	78.34

SENet154 Validation Accuracy

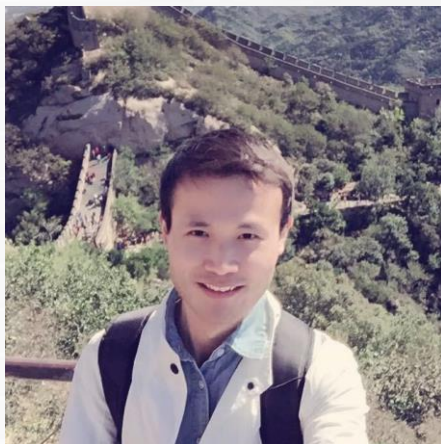
<b>Input 224*224</b>	Top1	Top5
Baseline	52.90	76.52
+ Stage1	56.55	79.00
+ Stage1 + Stage2	56.87	79.61
<b>Input 320*320</b>		
+ Stage1 + Stage2	57.09	79.77

# Summary

- ❑ Establish Category Semantic Relationships
- ❑ Two-stage Image Weighting with Side Information
- ❑ Large Scale Training
- ❑ Train Diverse CNNs from Large-scale Web Images



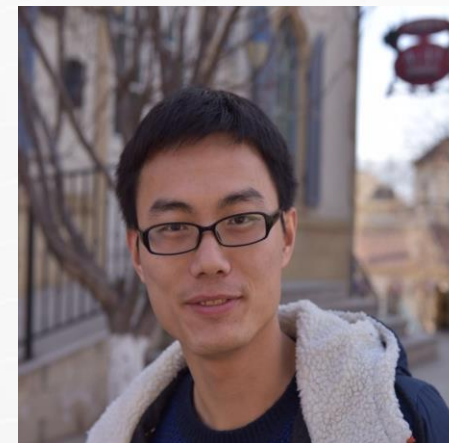
# Team Members



Lele Cheng



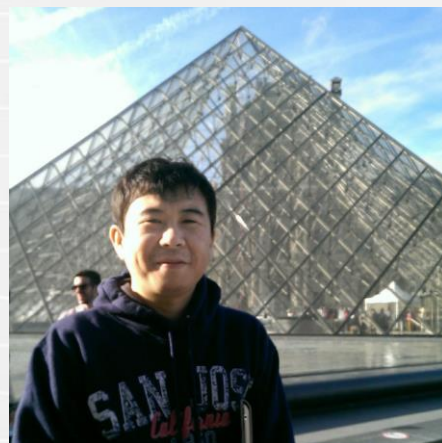
Liming Zhao



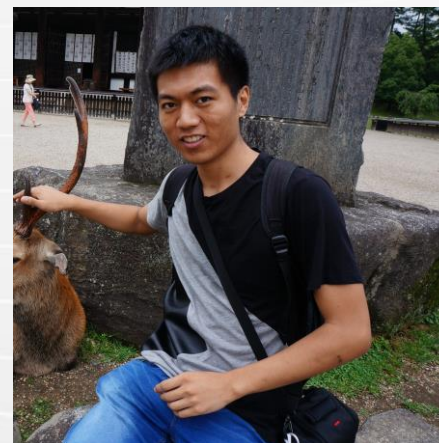
Dangwei Li



Chenwei Xie



Yun Zheng



Yingya Zhang



Pan Pan

Thanks