Transfer Learning

What makes ImageNet good for transfer learning?

ImageNet Large Scale Visual Recognition Challenge

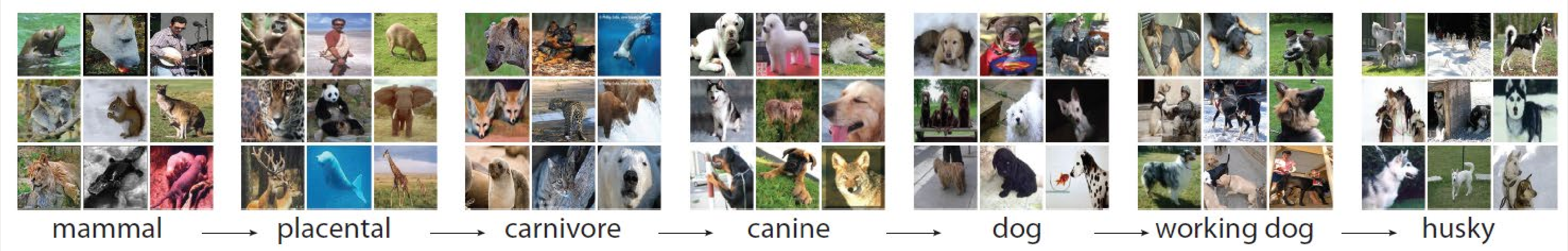
IMAGENET **Large Scale Visual Recognition Challenge 2017 (ILSVRC2017)**

1000 synsets for Object classification/localization

kit fox, Vulpes macrotis
English setter
Australian terrier
grey whale, gray whale, devilfish, Eschrichtius gibbosus, Eschrichtius robustus
lesser panda, red panda, panda, bear cat, cat bear, Ailurus fulgens
Egyptian cat
ibex, Capra ibex
Persian cat
cougar, puma, catamount, mountain lion, painter, panther, Felis concolor
gazelle
porcupine, hedgehog
sea lion
badger
Great Dane
Scottish deerhound, deerhound
killer whale, killer, orca, grampus, sea wolf, Orcinus orca
mink
African elephant, Loxodonta africana

1.2 million images

Synsets



Target Datasets

- PASCAL VOC - 27,450 detection objects; 11,530 images; 20 different classes

Table 1 The VOC classes

Vehicles	Household	Animals	Other
Aeroplane	Bottle	Bird	Person
Bicycle	Chair	Cat	
Boat	Dining table	Cow	
Bus	Potted plant	Dog	
Car	Sofa	Horse	
Motorbike	TV/Monitor	Sheep	
Train			

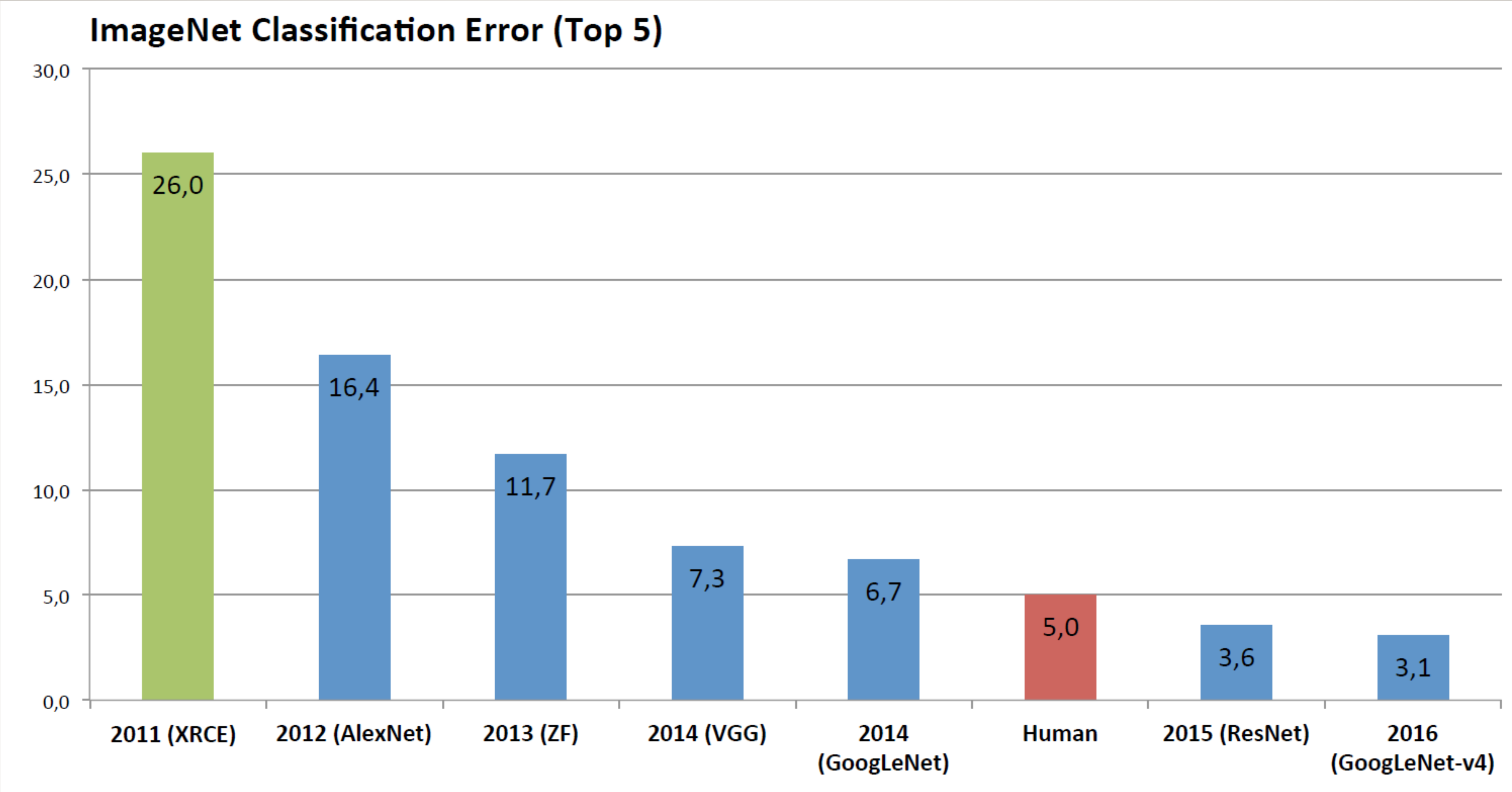
- SUN database: 397 scene categories; 108K images

PASCAL vs ImageNet Large Scale Visual Recognition Competition

Various architectures for transfer learning (trained on ImageNet)

- VGG16
- InceptionV3
- ResNet
- MobileNet
- Xception
- InceptionResNetV2

Performance of various architectures on ImageNet



What makes ImageNet good for transfer learning?

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Experimental Approach

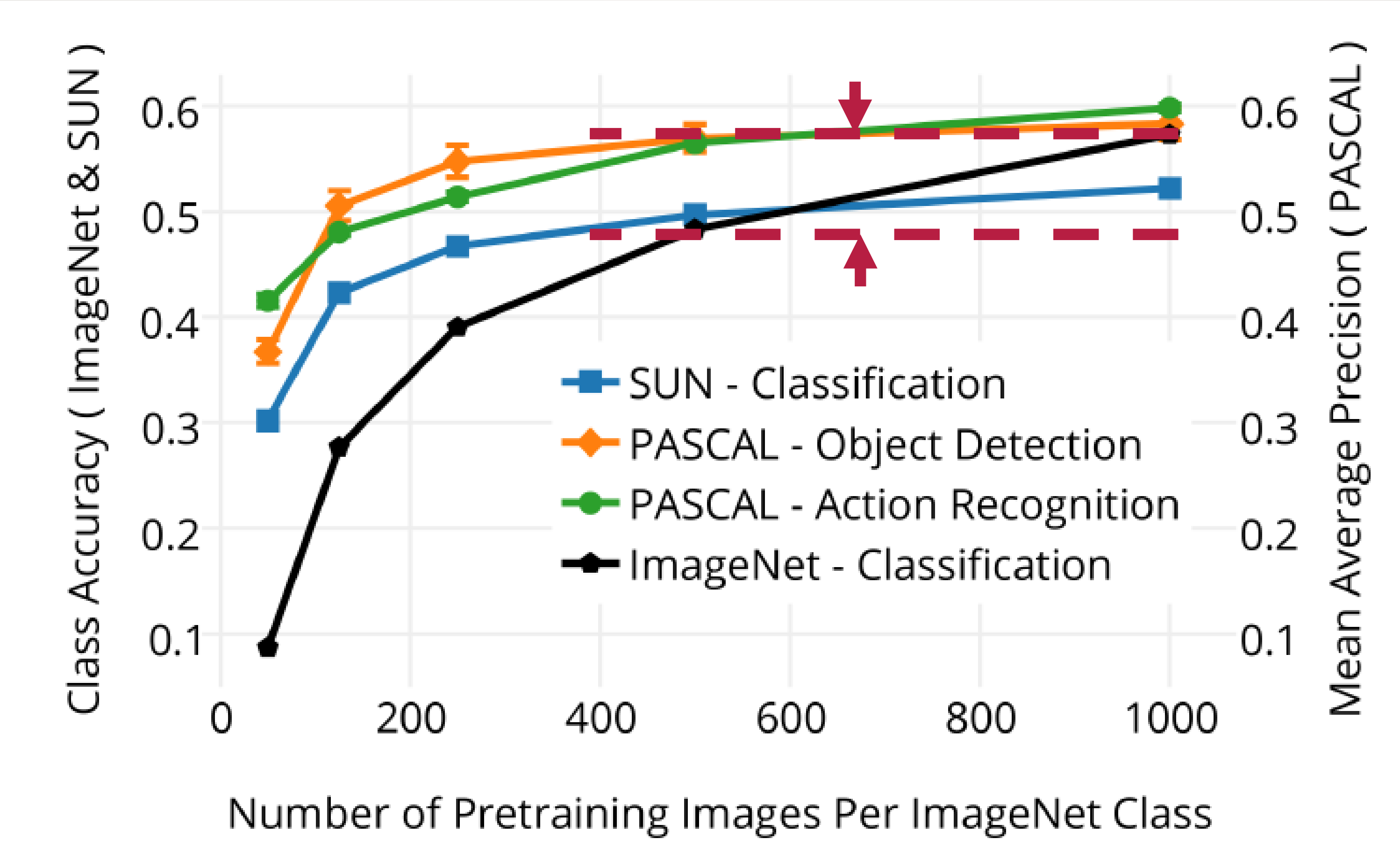
- Pre-training – on ImageNet
- Finetuning – on Target datasets

How does the amount of pre-training data affect transfer performance?

- 5 Models
- 50, 125, 250, 500 and 1000 images

per each of the 1000 ImageNet classes

How does the amount of pre-training data affect transfer performance?



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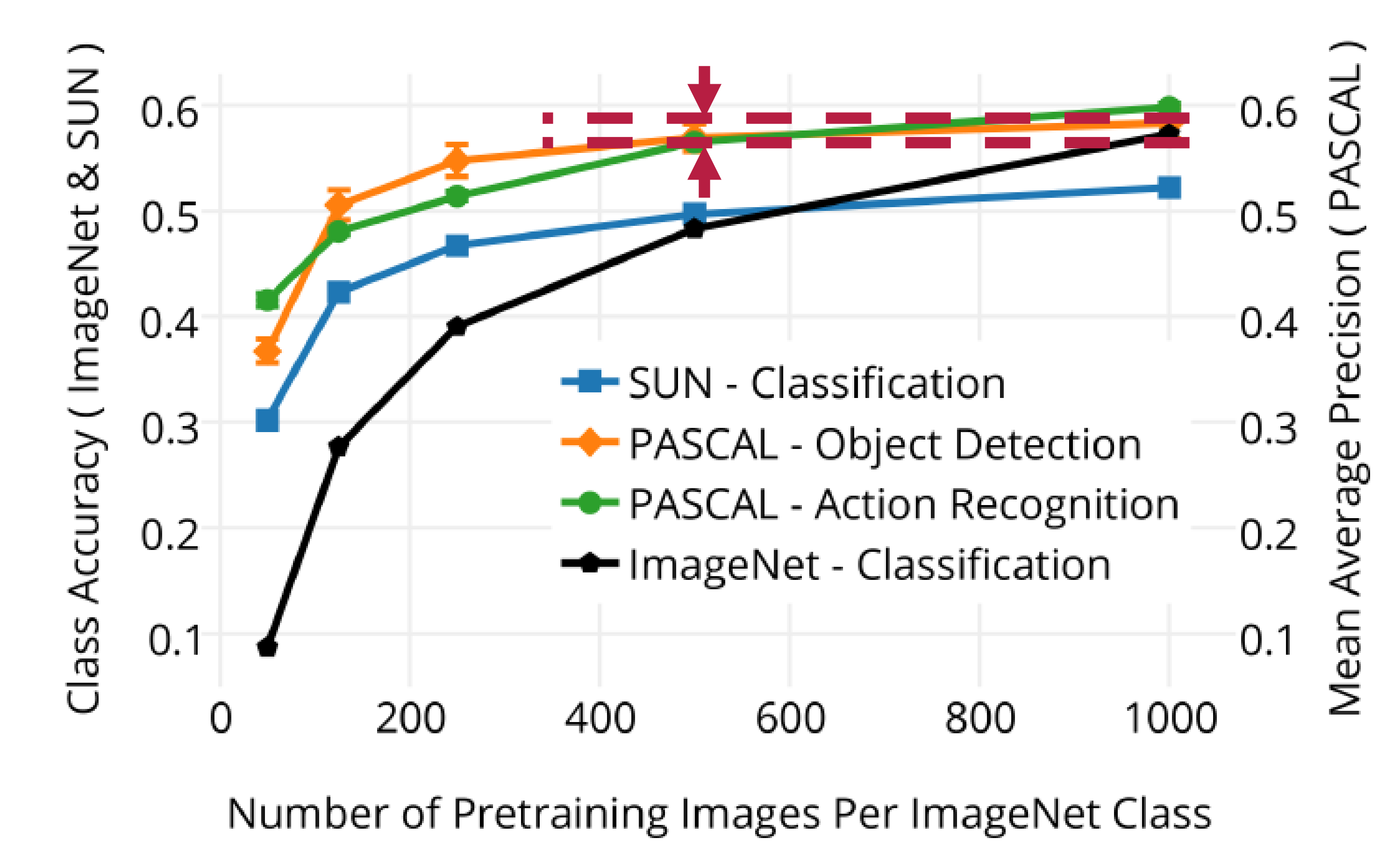
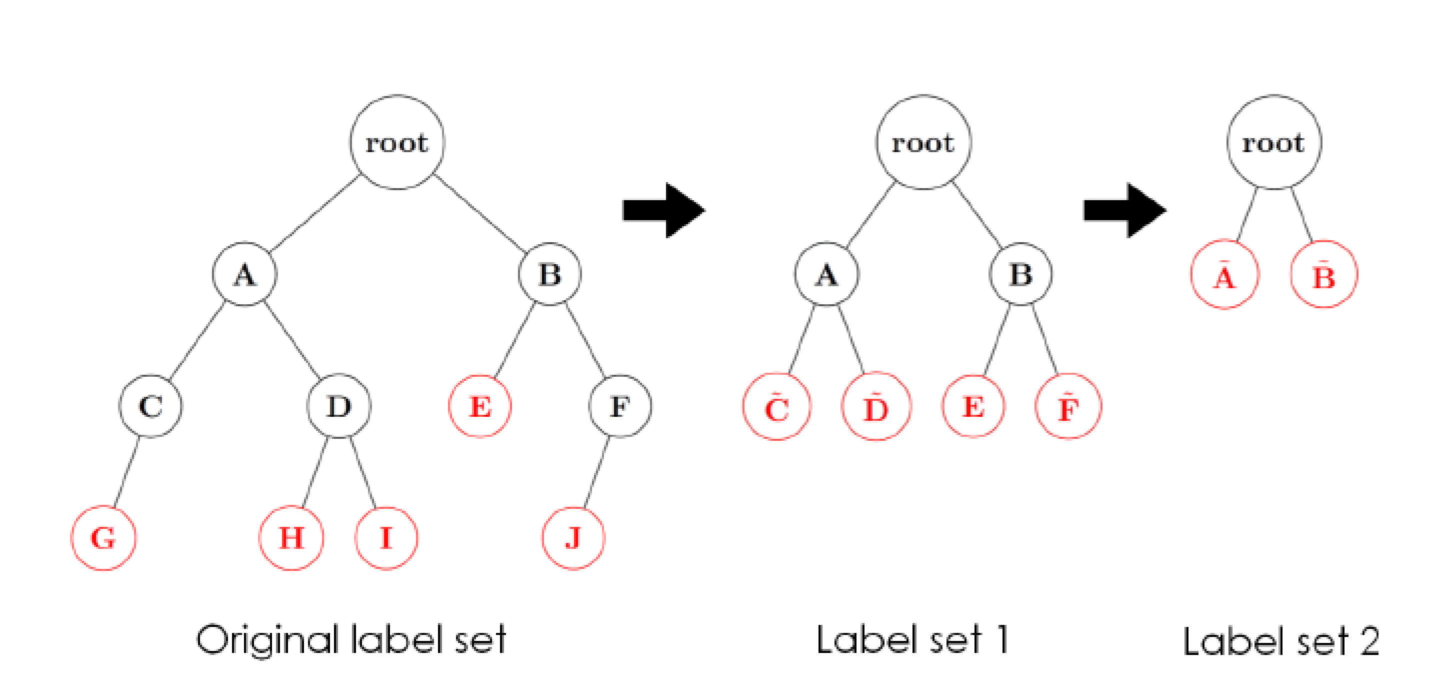


PASCAL-DET

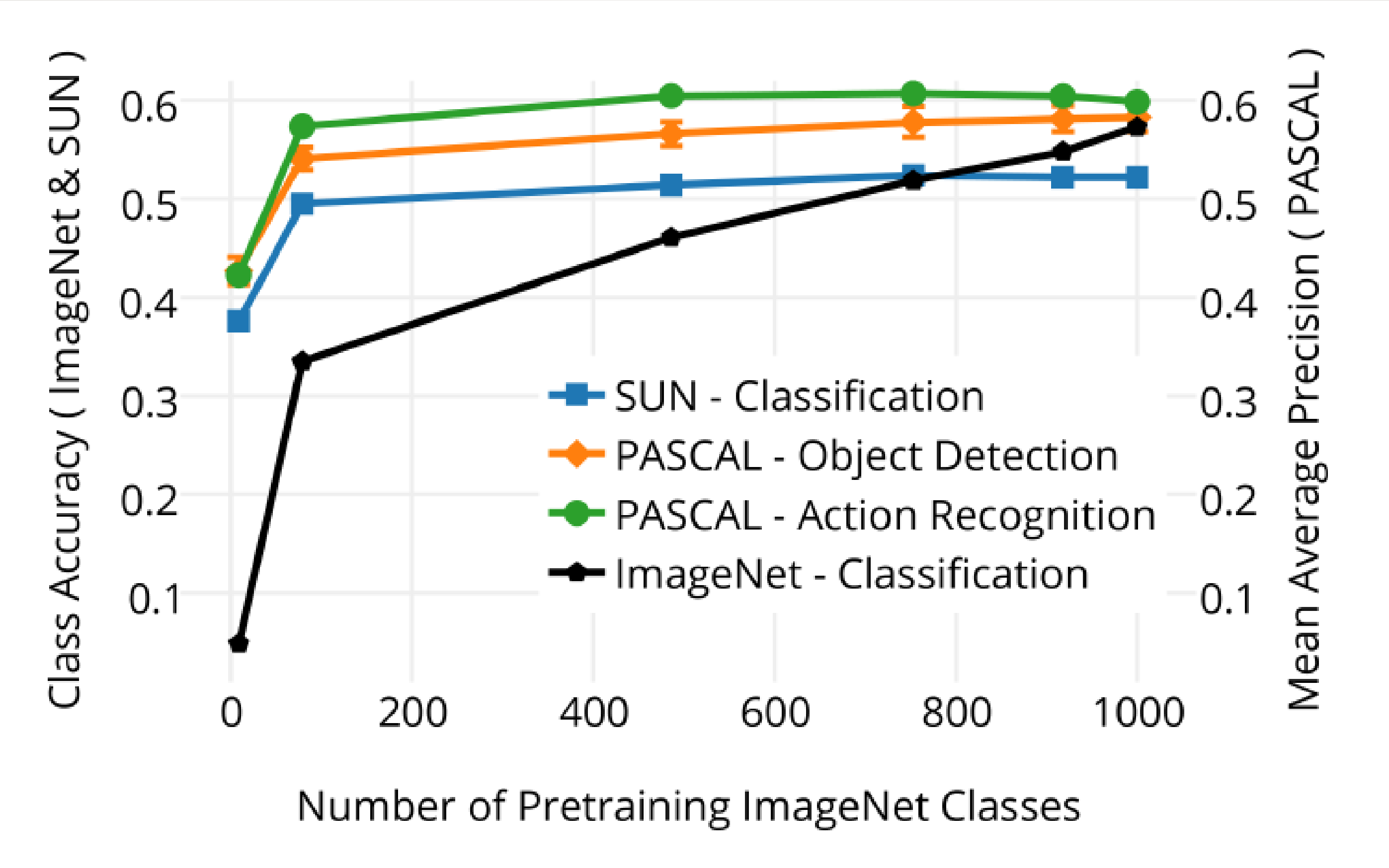
No. of Images	Accuracy
1000	58.3
500	57.0
250	54.6

The effect of number of pretraining classes on transfer performance



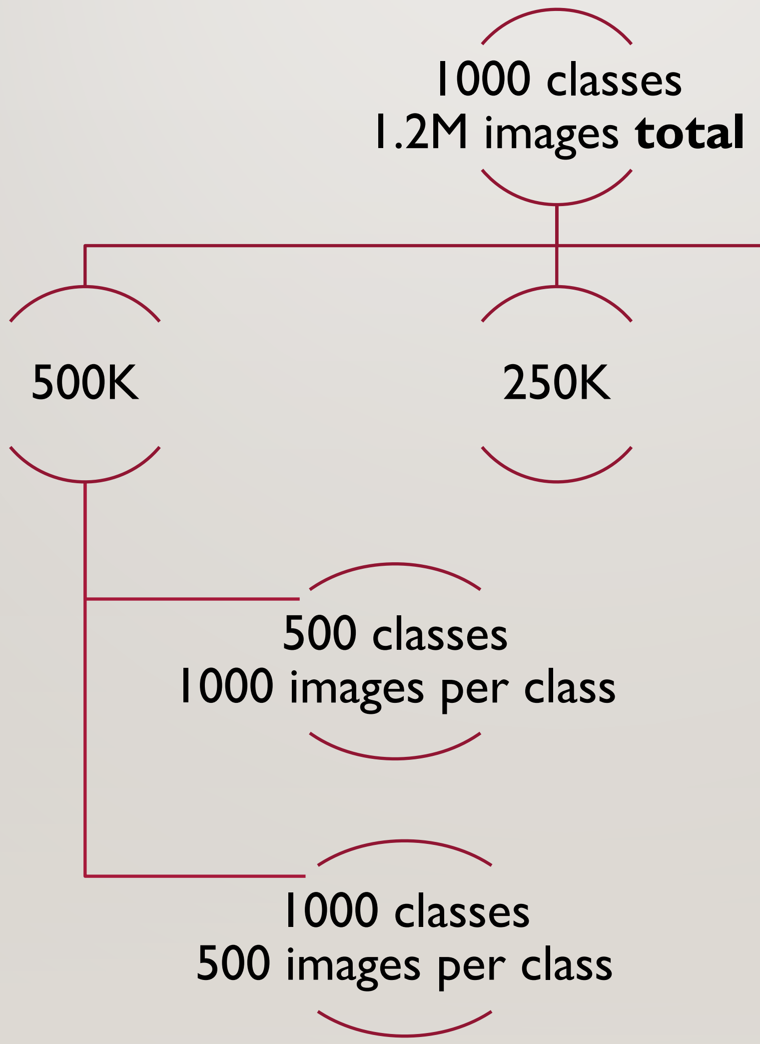
5 sets of labels constituting 918, 753, 486, 79, and 9 classes

The effect of number of pretraining classes on transfer performance



Making the ImageNet classes finer will not help improve transfer performance

More Classes or More Examples Per Class?



More Classes or More Examples Per Class?

Dataset	PASCAL			SUN		
Data size	500K	250K	125K	500K	250K	125K
More examples/class	57.1	54.8	50.6	50.6	45.7	42.2
More classes	57.0	52.5	49.8	49.7	46.7	42.3

How important is to pretrain on classes that are also present in a target task?

- PASCAL – 20 classes
- ImageNet minus PASCAL 20 – 771 classes

Pre-trained Dataset	PASCAL
ImageNet	58.3 ± 0.3
Pascal removed ImageNet	57.8 ± 0.1

Conclusion

- CNN training may not be as data-hungry as thought
- Tested only on AlexNet
- PASCAL and SUN may be too similar to ImageNet to test the generalization of learned features