# Intro

- In this video we will talk about tricks that will make training of new neural networks much faster!

Transfer learning

- Deep networks learn complex features extractor, but we need lots of data to train it from scratch!

- What if we can reuse an existing features extractor for a new task?

Features extractor

ImageNet
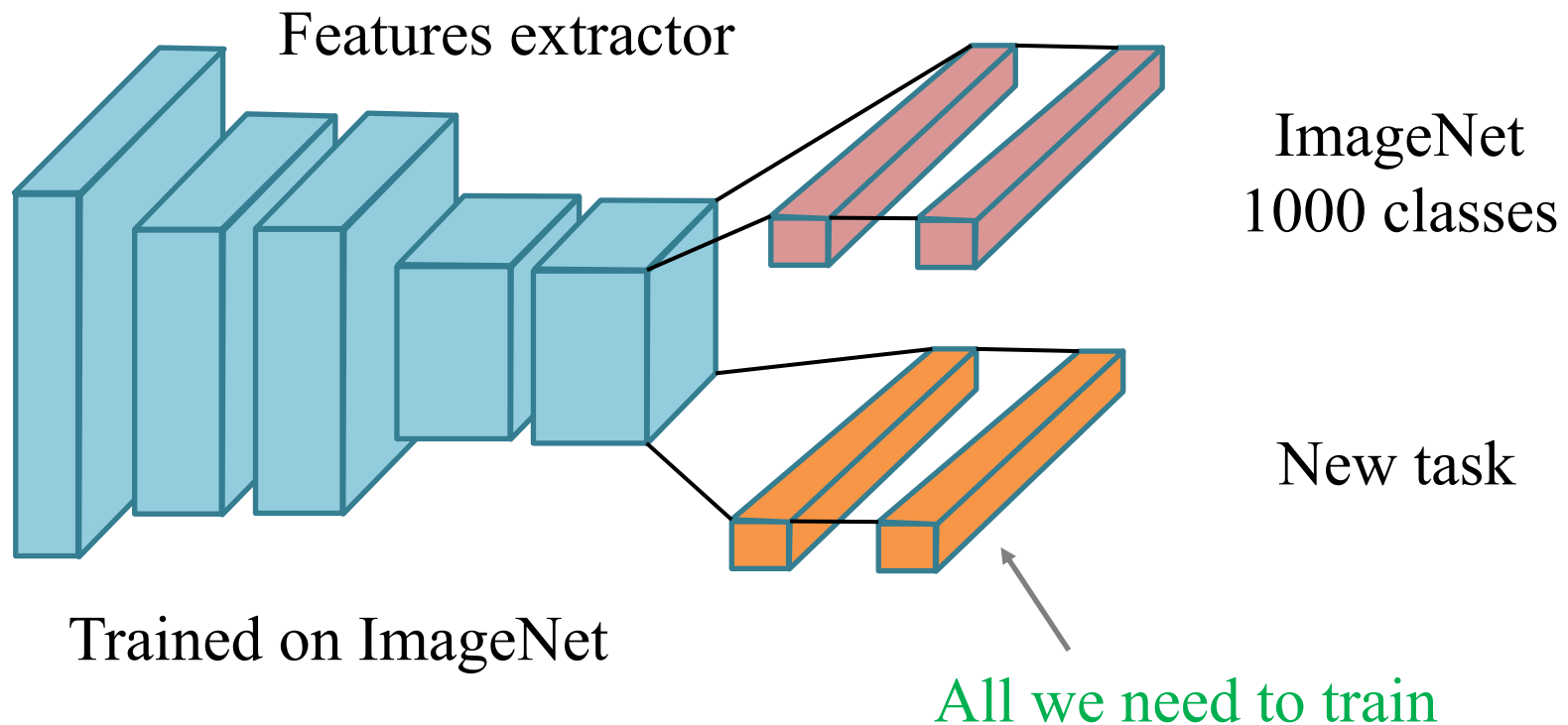1000 classes

Trained on ImageNet

Transfer learning

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Features extractor

ImageNet
1000 classes

New task

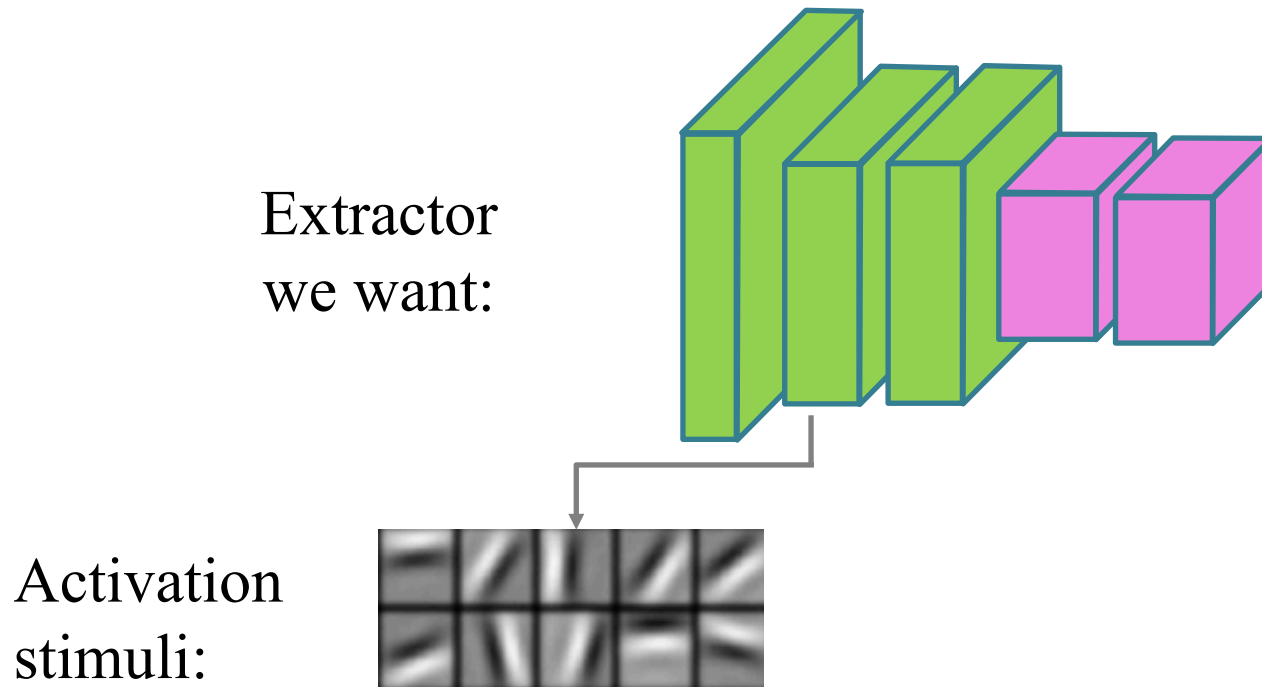Trained on ImageNet

All we need to train
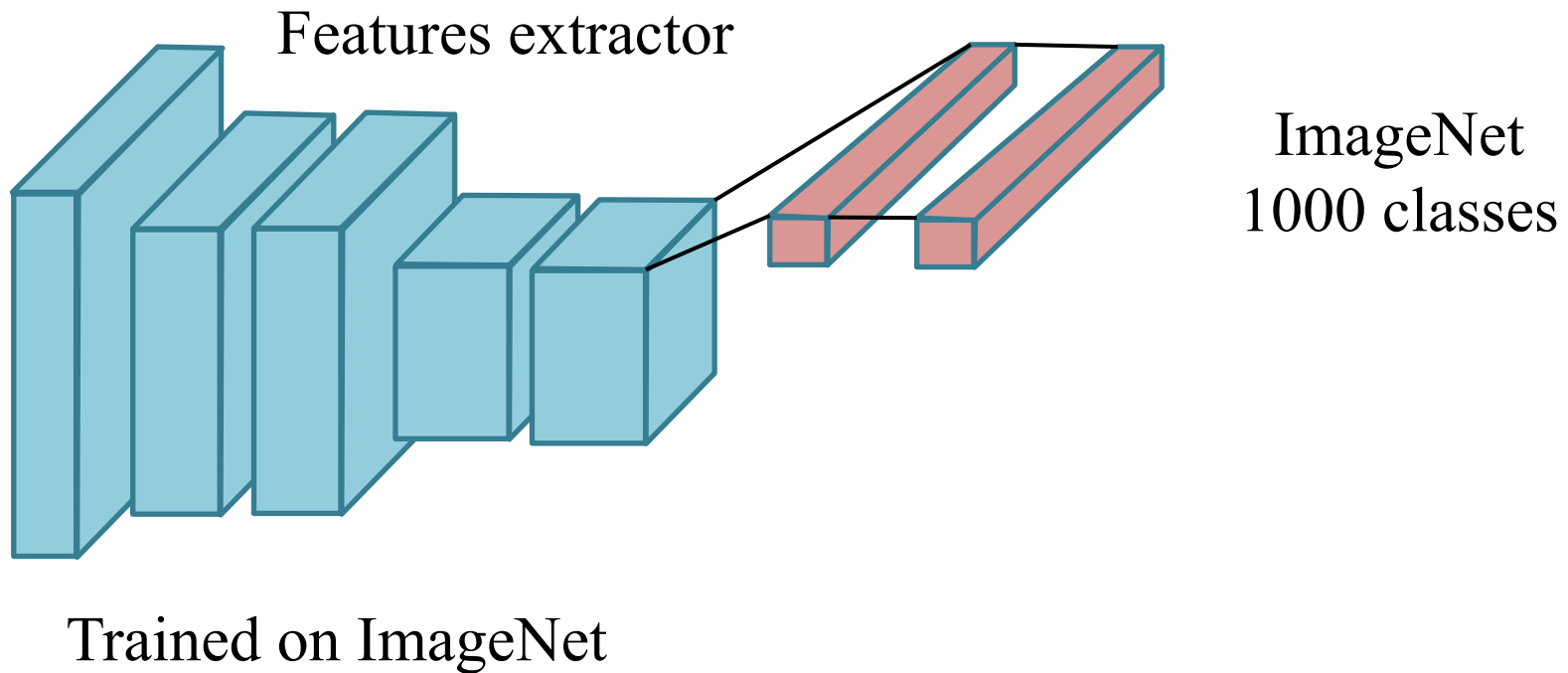
Transfer learning

- You need less data to train (for training only final MLP)

- It works if a domain of a new task is similar to ImageNet's

- Won't work for human emotions classification, ImageNet doesn't have people faces in the dataset!
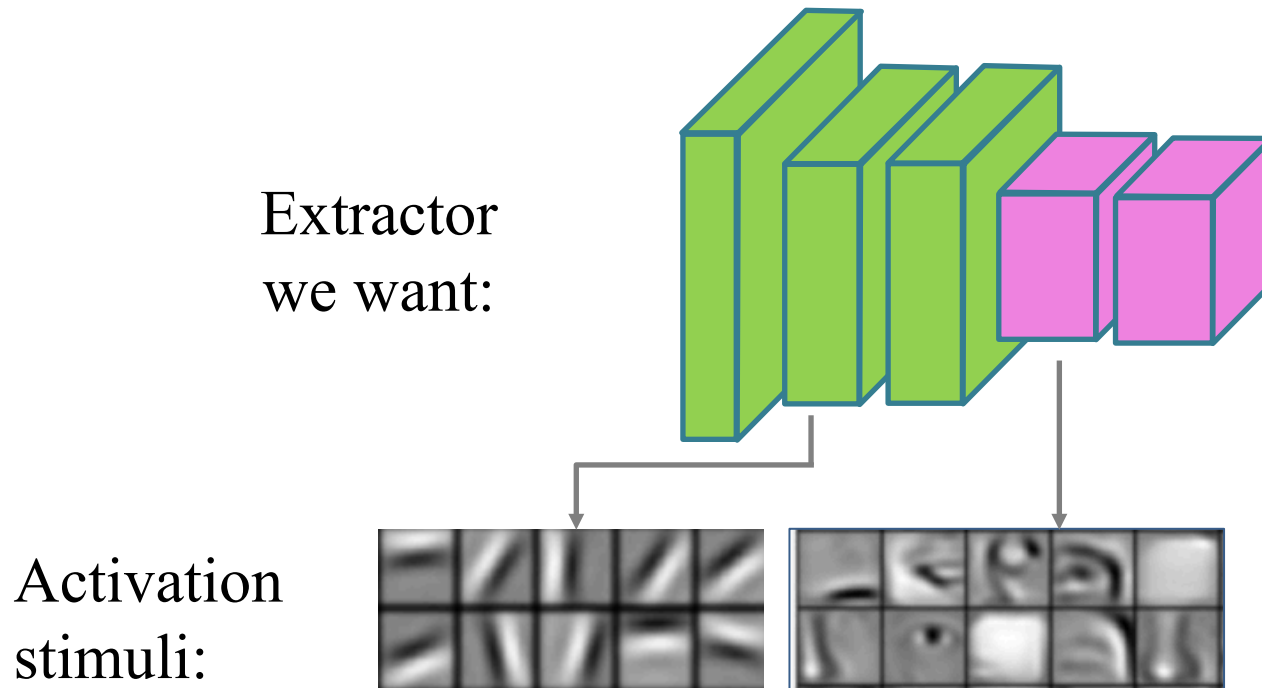
Transfer learning

- But what if we need to classify human emotions?

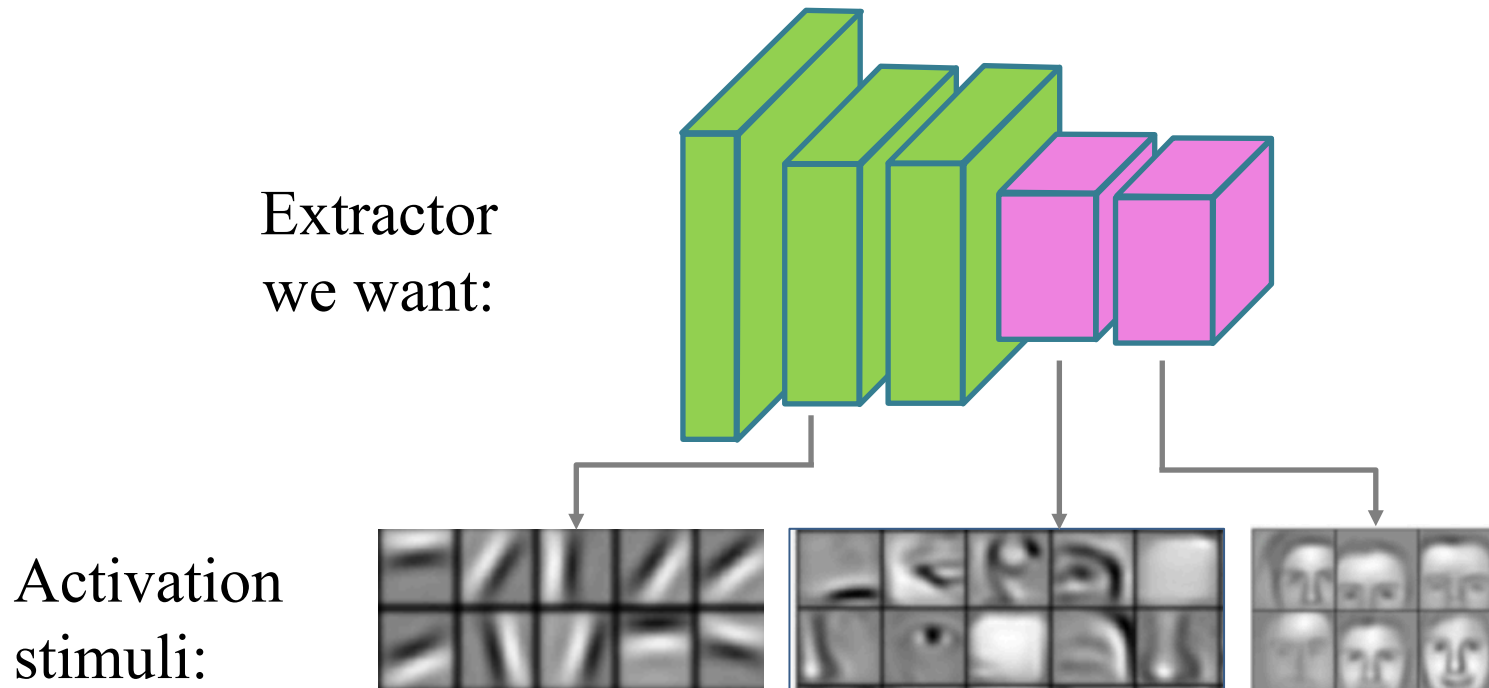- Maybe we can partially reuse ImageNet features extractor?

Extractor
we want:

Activation
stimuli:

Transfer learning

- But what if we need to classify human emotions?

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http://web.eecs.umich.edu/~honglak/icml09-ConvolutionalDeepBeliefNetworks.pdf

Transfer learning

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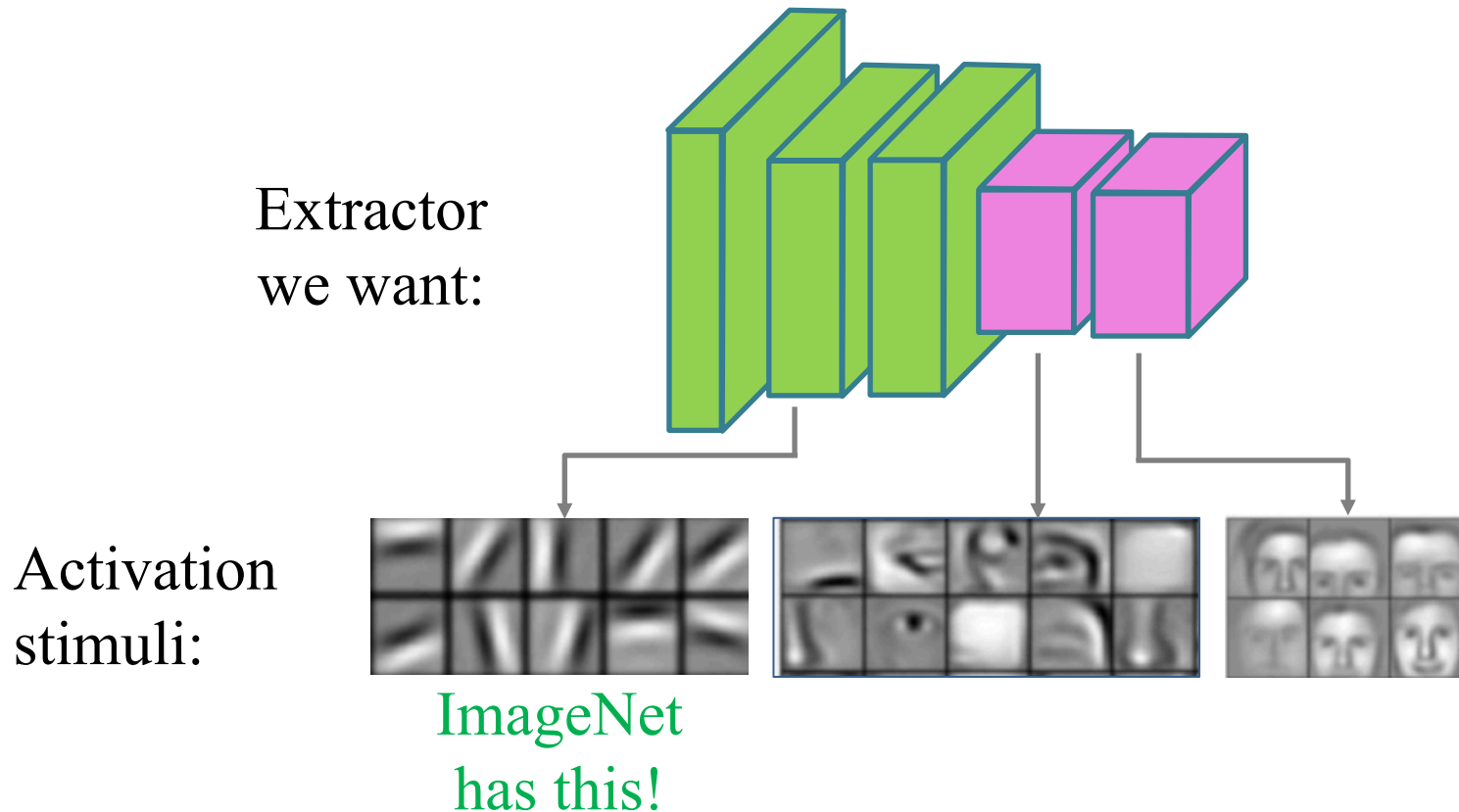Honglak Lee, http://web.eecs.umich.edu/~honglak/icml09-ConvolutionalDeepBeliefNetworks.pdf

Transfer learning

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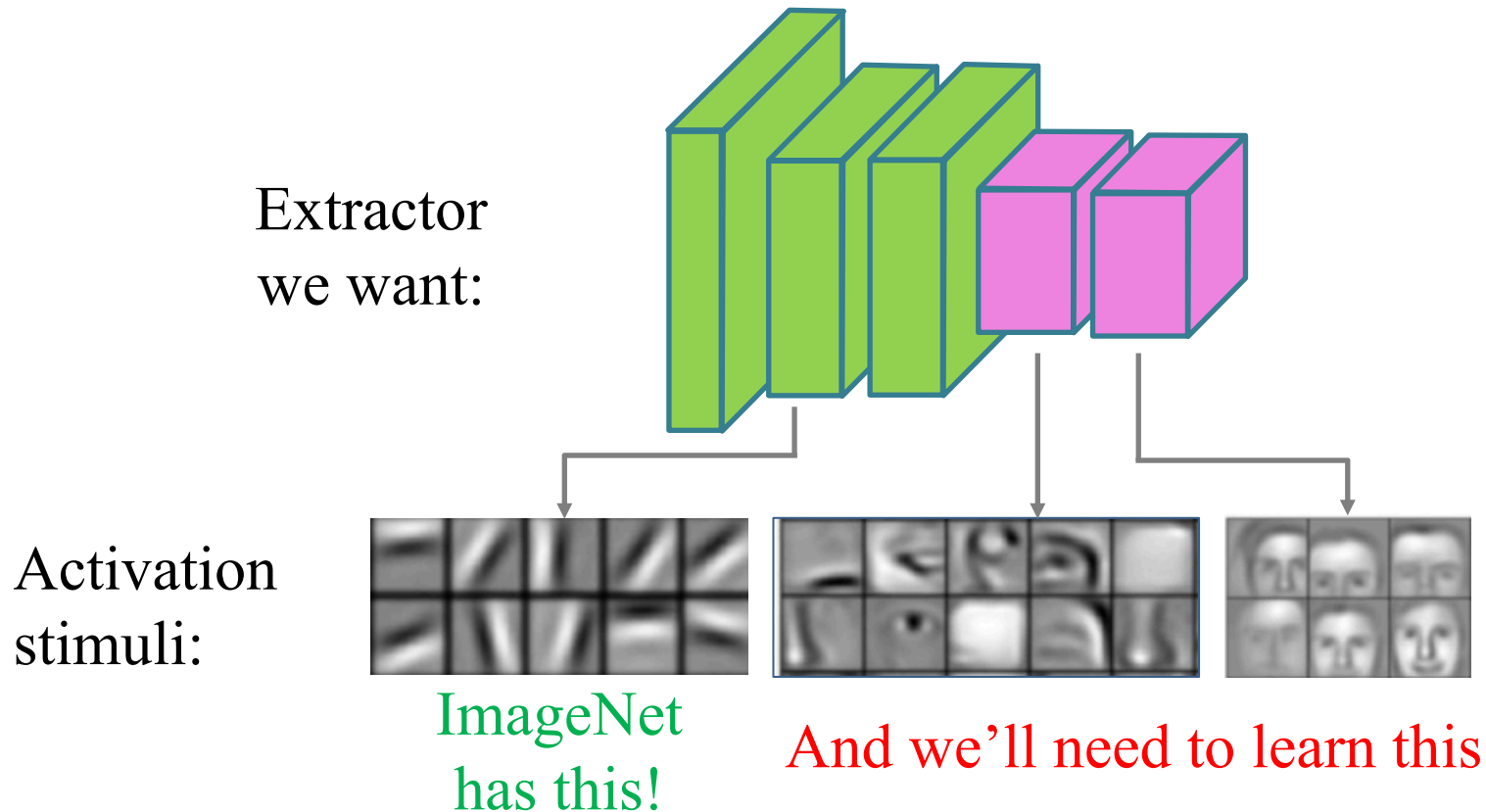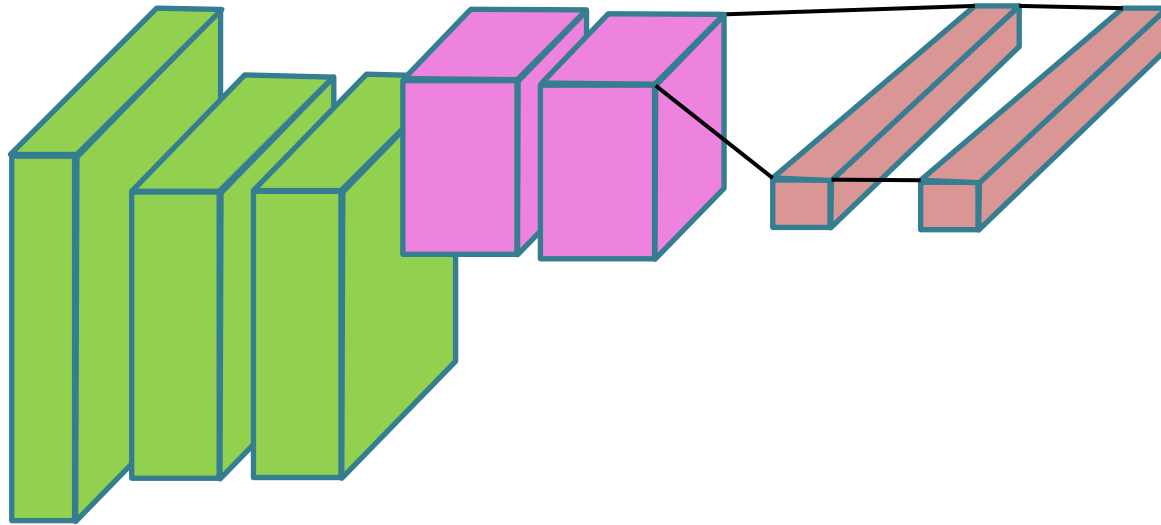# Transfer learning

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Extractor
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Activation
stimuli:

ImageNet
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And we'll need to learn this

Honglak Lee, http://web.eecs.umich.edu/~honglak/icml09-ConvolutionalDeepBeliefNetworks.pdf
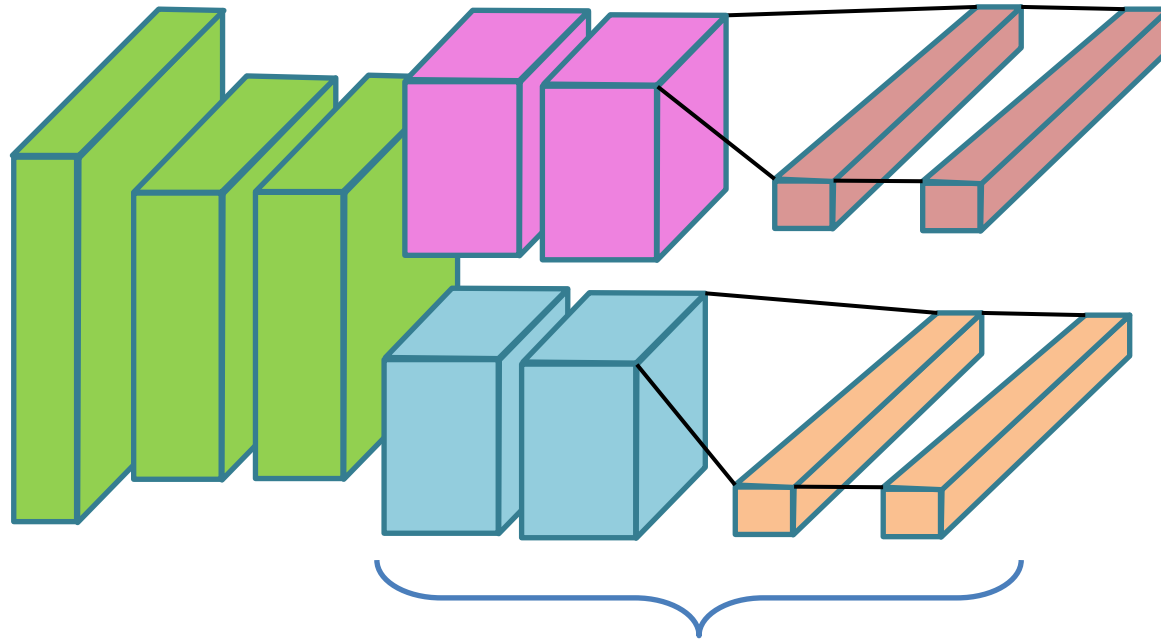
Transfer learning

ImageNet features extractor

ImageNet
1000 classes

Transfer learning

ImageNet features extractor

ImageNet
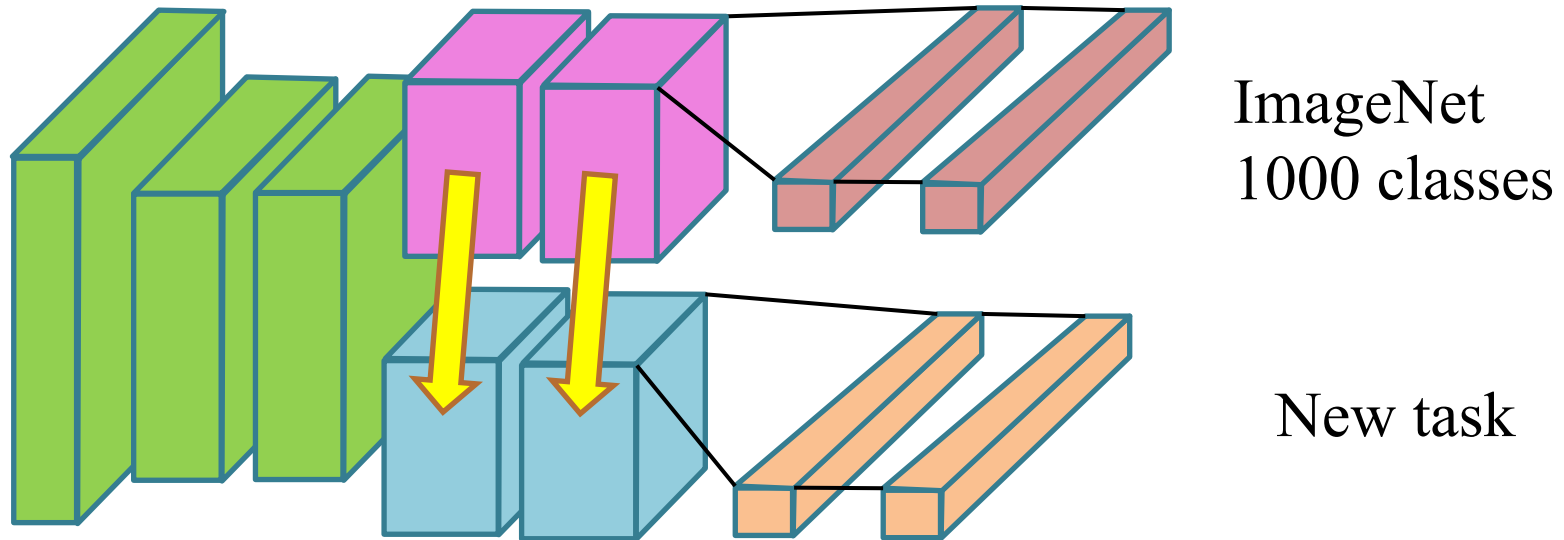1000 classes

New task

All we need to train

Fine-tuning

ImageNet features extractor

ImageNet
1000 classes

New task

- You can initialize deeper layers with values from ImageNet.

- This is called **fine-tuning**, because you don't start with a random initialization.

- Propagate all gradients with smaller learning rate.

Fine-tuning

- Very frequently used thanks to wide spectrum of ImageNet classes

- Keras has the weights of pre-trained VGG, Inception, ResNet architectures

- You can fine-tune a bunch of different architectures and make an ensemble out of them!

Takeaways

	ImageNet domain	Not similar to ImageNet
Small dataset	Train last MLP layers	
Big dataset		

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	ImageNet domain	Not similar to ImageNet
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Big dataset	Fine-tuning of deeper layers	Train from scratch

Takeaways

	ImageNet domain	Not similar to ImageNet
Small dataset	Train last MLP layers	Collect more data
Big dataset	Fine-tuning of deeper layers	Train from scratch

Summary

- In the next video we will take a look at other computer vision problems