

iterate until you find the right number of layers to reuse. If you have plenty of training data, you may try replacing the top hidden layers instead of dropping them, and even add more hidden layers.

Model Zoos

Where can you find a neural network trained for a task similar to the one you want to tackle? The first place to look is obviously in your own catalog of models. This is one good reason to save all your models and organize them so you can retrieve them later easily. Another option is to search in a *model zoo*. Many people train Machine Learning models for various tasks and kindly release their pretrained models to the public.

TensorFlow has its own model zoo available at <https://github.com/tensorflow/models>. In particular, it contains most of the state-of-the-art image classification nets such as VGG, Inception, and ResNet (see [Chapter 13](#), and check out the *models/slim* directory), including the code, the pretrained models, and tools to download popular image datasets.

Another popular model zoo is Caffe's [Model Zoo](#). It also contains many computer vision models (e.g., LeNet, AlexNet, ZFNet, GoogLeNet, VGGNet, inception) trained on various datasets (e.g., ImageNet, Places Database, CIFAR10, etc.). Saumitro Dasgupta wrote a converter, which is available at <https://github.com/ethereon/caffe-tensorflow>.

Unsupervised Pretraining

Suppose you want to tackle a complex task for which you don't have much labeled training data, but unfortunately you cannot find a model trained on a similar task. Don't lose all hope! First, you should of course try to gather more labeled training data, but if this is too hard or too expensive, you may still be able to perform *unsupervised pretraining* (see [Figure 11-5](#)). That is, if you have plenty of unlabeled training data, you can try to train the layers one by one, starting with the lowest layer and then going up, using an unsupervised feature detector algorithm such as *Restricted Boltzmann Machines* (RBMs; see [Appendix E](#)) or autoencoders (see [Chapter 15](#)). Each layer is trained on the output of the previously trained layers (all layers except the one being trained are frozen). Once all layers have been trained this way, you can fine-tune the network using supervised learning (i.e., with backpropagation).

This is a rather long and tedious process, but it often works well; in fact, it is this technique that Geoffrey Hinton and his team used in 2006 and which led to the revival of neural networks and the success of Deep Learning. Until 2010, unsupervised pretraining (typically using RBMs) was the norm for deep nets, and it was only after the vanishing gradients problem was alleviated that it became much more common to train DNNs purely using backpropagation. However, unsupervised pretraining (today typically using autoencoders rather than RBMs) is still a good option when