Transfer Learning with TensorFlow Hub

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Outline

- Basics of deep learning neural networks
- Introduction to transfer learning and Tensorflow Hub
- Case study (using Tensorflow, keras, Tensorflow Hub)

Code:
https://staff.sharcnet.ca/guanw/2022/transferLearning.tar.gz

Basics of Neural Networks

- Made up of a number of layers
- Each layer contains
  - Zero or more trainable variables and
  - Zero or more non-trainable variables
- Trainable variable != Trainable parameter in Tensorflow

In deep learning terminology: weights = variables = parameters?

Training Mode vs Inference Mode

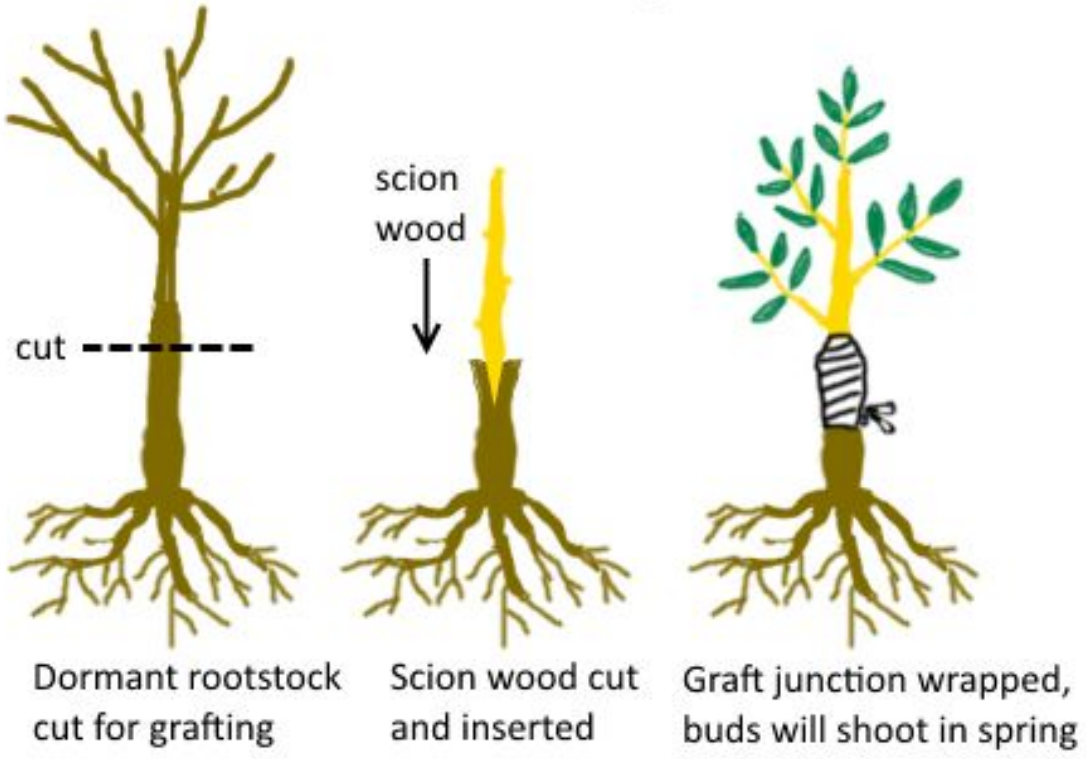
Training mode

- Trainable variables in a neural network are gradually updated in training mode so as to minimize a predefined loss
- Two passes
  - Feed forward
  - Back propagation

Inference mode

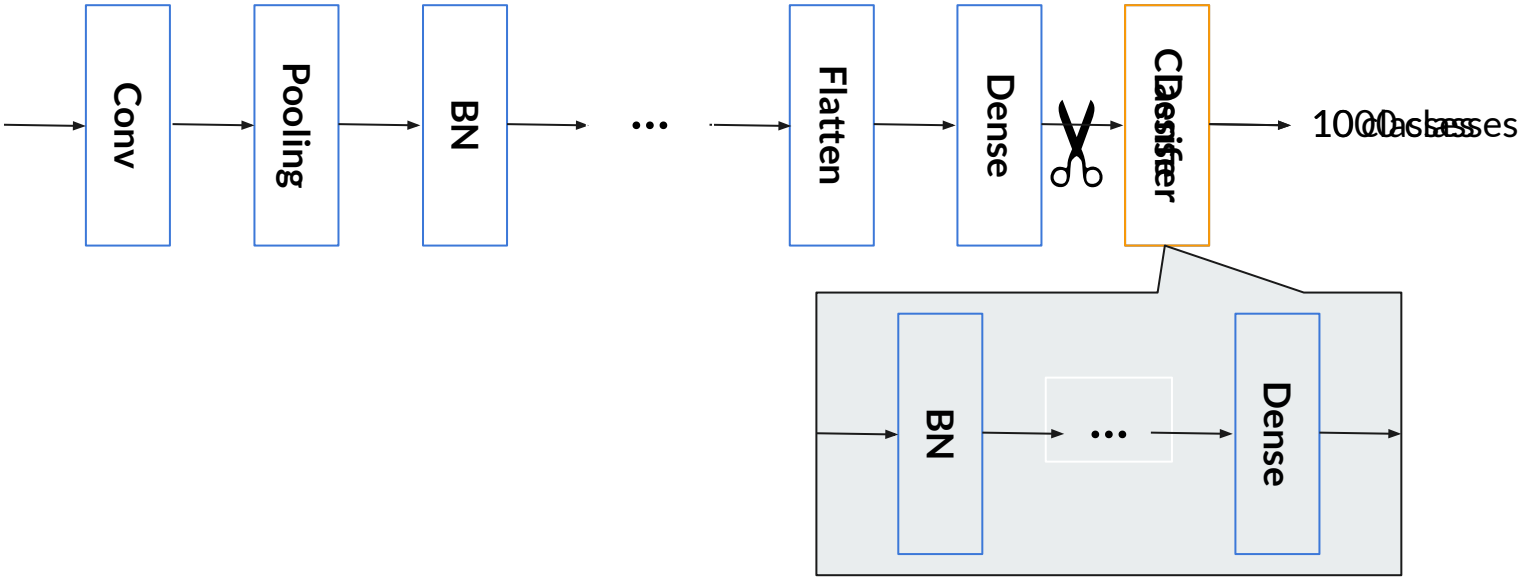
- No variables are changed in inference mode
- One pass
  - Feed forward

Basic Cleft or V-graft



What is Transfer Learning

Definition: Using a pre-trained model to solve a new similar problem



How to Apply Transfer Learning

- Model selection
  - Similar problems: image-based or text-based or voice-based
  - Pre-trained on large training data
- Usage:
  - As feature extractor or
  - Base model to be fine tuned together with added layers

Why Transfer Learning

- Some pre-trained models are proven to be successful and valuable
  - Large scale architectures
  - Trained on large datasets (like ImageNet)
  - Being refined many times
  - Training such a large network needs GPU resources
- Transfer learning
  - Transfer the success (or knowledge) from previous training
  - Training is easier and faster
  - Less trial-n-error in adjusting architecture

The Sources of Pre-trained Models

- Pre-trained models of your own or other's

  tf.keras.models.load_model(filepath, …)

- Keras pre-trained models

  keras.applications.MobileNetV2(weights='imagenet', include_top=False, …)

- **Tensorflow Hub** (previously Model Zoo) pre-trained models

  hub.KerasLayer(url, trainable=False, …)

Tensorflow Hub

- Search for the model you need in the Hub (https://tfhub.dev/)
- Understand the model
- Use the model

How to Do Transfer Learning

- Choose appropriate pre-trained model
  - Type of the application (image-based, text-based, …)
  - Scale of the pre-trained model
- Compatibility at both the input and output ends of the base model
  - Shape
  - Data type
- Train with the base model frozen before fine tuning

Case Study

Task: Transfer pre-trained model MobileNet V2 on classification of images of dogs and cats.

- Load the pre-trained model via Keras interface
- Load the pre-trained model via Tensorflow Hub interface