Transfer Learning for Hand Written Digit Classification

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http://rurfid.ru.ac.bd/ru_profile/public/teacher/

Outlines

- What is Transfer Learning?
- How to use Transfer Learning?
- Example of Transfer Learning with Deep Learning
- MNIST Digit Classification using Transfer Learning
  - Demo on TL for MNIST Digit Classification
- Task to be completed Today.

Ref: https://machinelearningmastery.com/transfer-learning-for-deep-learning/

What is Transfer Learning?

- Transfer learning is a machine learning technique where a model trained on one task is re-purposed on a second related task.
- The basic premise of transfer learning is simple: **take a model trained on a large dataset and transfer its knowledge to a smaller dataset**.
- It is the most common approach used in Computer Vision and Natural Language Processing where models are used as the starting point for other problems so as to save time.

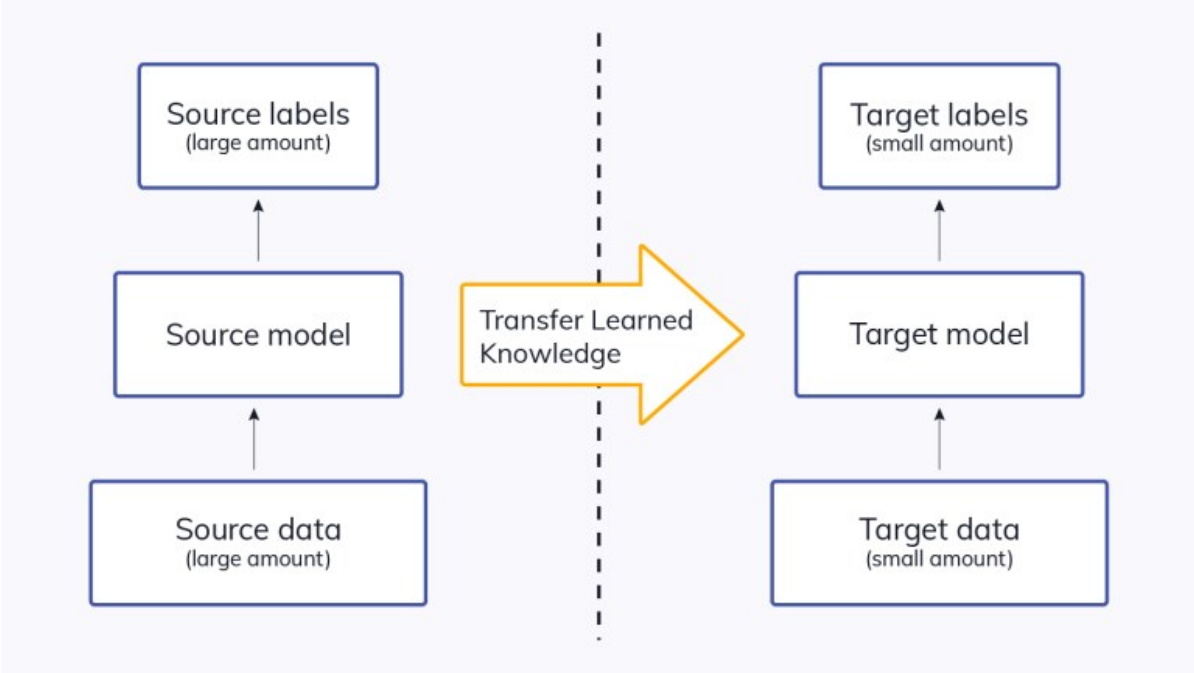
How to use Transfer Learning? (1/2)

- Two common approaches are as follows:
  a) Develop Model Approach
  b) Pre-trained Model Approach

- We will focus on Pre-trained Model Approach:
  - **Select Source Model**. A pre-trained source model is chosen from available models.
  - **Reuse Model**. The model pre-trained model can then be used as the starting point for a model on the second task of interest.
  - **Tune Model**. Optionally, the model may need to be adapted or refined on the input-output pair data available for the task of interest.

How to use Transfer Learning? (2/2)

- The pre-trained models are usually trained on massive datasets-- a standard benchmark.
- Transfer learning is particularly very useful when you have a small training dataset.
- TL uses the weights from the pre-trained models to **initialize the weights** of the new model.

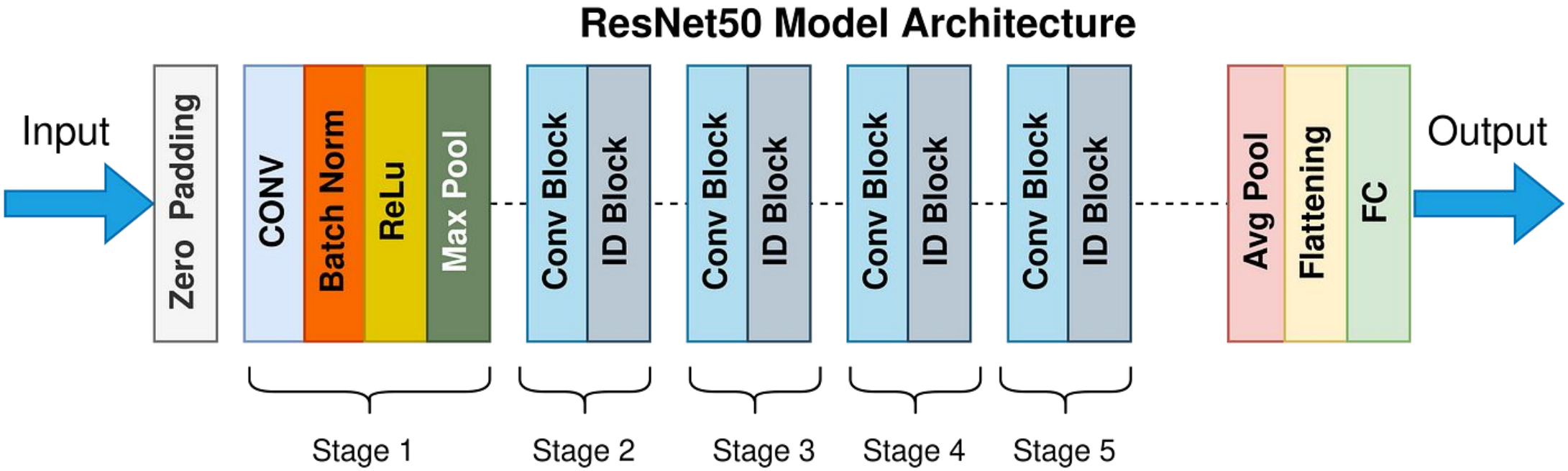


Example of Transfer Learning with Deep Learning (1/3)

Transfer Learning with Image Data

- It is common to perform transfer learning with predictive modeling problems that use image data as input.
- ImageNet: 1000-class photograph classification competition– trained with 1 million of images.
- These models can be downloaded and incorporated directly into new models that expect image data as input.
- Three examples of models of this type include:
  - Oxford VGG Model
  - Google Inception Model
  - Microsoft ResNet Model

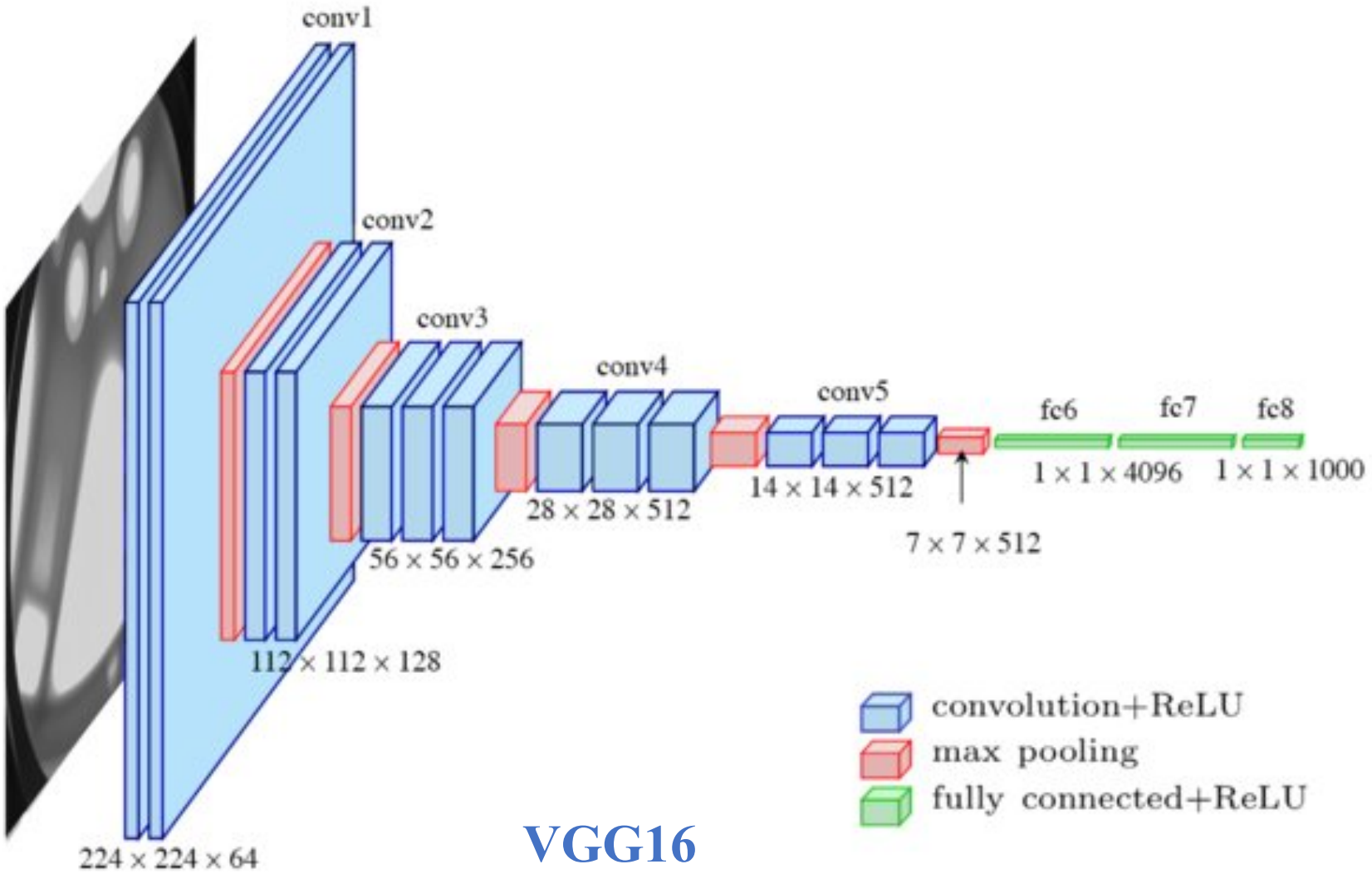
Example of Transfer Learning with Deep Learning (2/3)



ResNet50

https://commons.wikimedia.org/wiki/File:ResNet50.png

Example of Transfer Learning with Deep Learning (3/3)



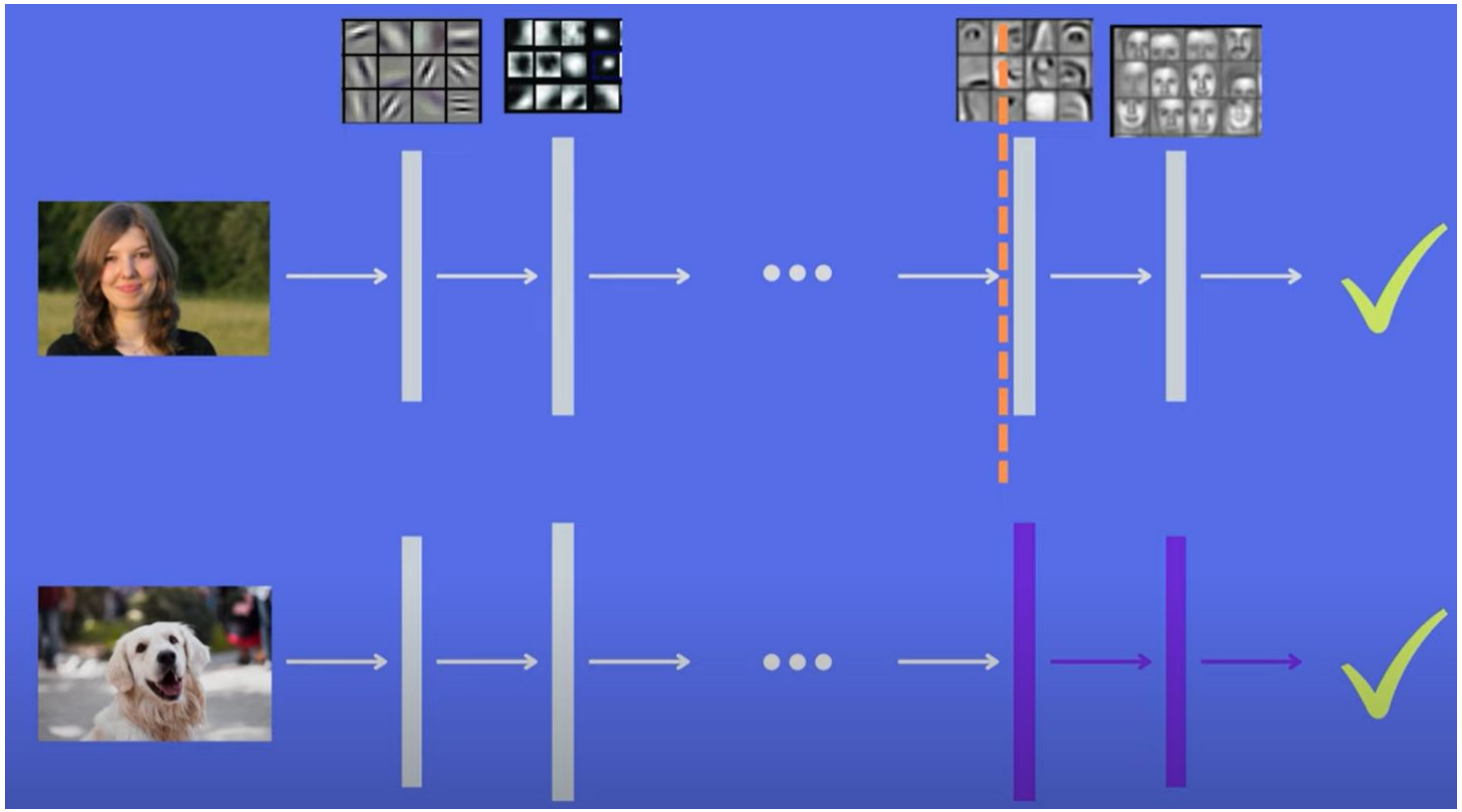
VGG16

https://www.researchgate.net/publication/322512435_Automatic_localization_of_casting_defects_with_convolutional_neural_networks

MNIST Digit Classification with CNN (1/2)

Graphical View of TL Concepts for Image Classification:

- Top Model classify human face. It can be reused for animal classification.
- Just freeze FC layers and set new FC layer with output layer.
- Leave other trained parameters unchanged except new FC and output layer
- Train the updated network with new data and use it for prediction.



MNIST Digit Classification with CNN (2/2)

Demo: Transfer Learning for MNIST Digit Classification with ResNet50

https://colab.research.google.com/drive/1DMGgaButbzASGW1Ka0RkmTKWbXRUIVVT?usp=share_link

Task to be Completed Today

Design a Customize TL for Handwritten Digit Classification using VGG16 with the following specifications:

1. Generate a TL model with:
   i. Freeze FC and output layers of VGG16
   ii. Set new FC and output layer for MNIST classification
   iii. Initialize weight with 'ImageNet'

3. In new FC, use Dense layer of size 512 followed by output Dense Layer of size 10 with SoftMax Activation Function

4. Use the MNIST database for training and testing.

5. Use Data Augmentation for train and test set of MNIST before training.

5. Carefully read the problem specifications and implement the TL accordingly.