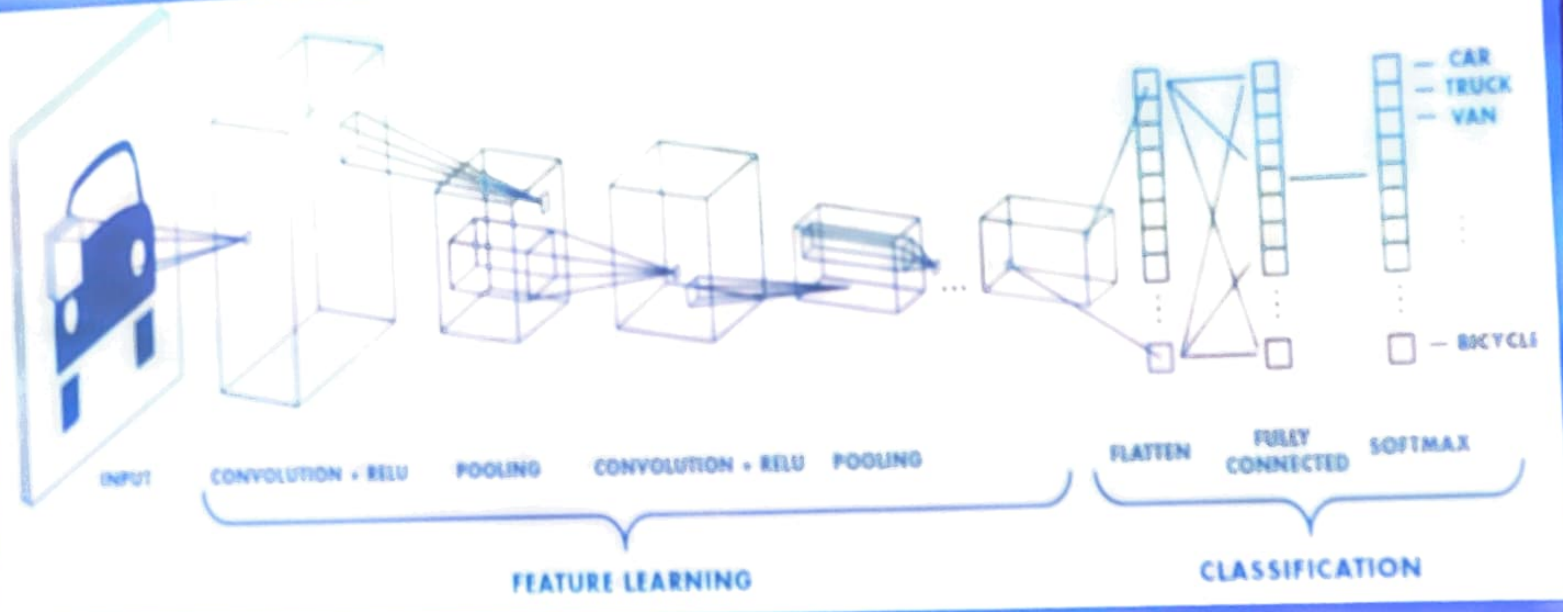
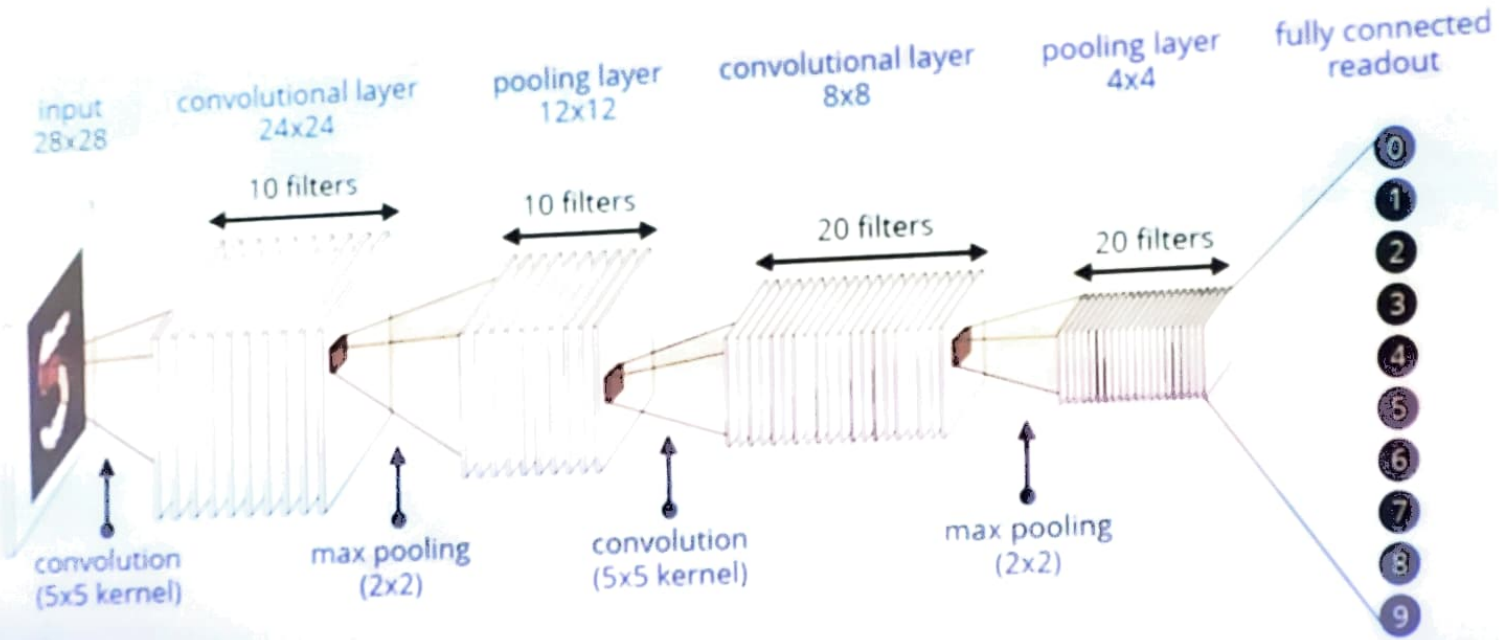

CAR
TRUCK
VAN
BICYCLE
INPUT
CONVOLUTION + RELU
POOLING
CONVOLUTION + RELU
POOLING
FLATTEN
FULLY CONNECTED
SOFTMAX
FEATURE LEARNING
CLASSIFICATION

Fully Connected Layer



- The dataset consists of 43 different classes
- Images are 32 x 32 pixels

How AI Can Improve Medical Care for Those Who Can't Afford It | Dr. Kim Ramasamy | TEDxNapierBridge - YouTube

Kinetica DSC v4 on Vimeo

An Interactive Node-Link Visualization of Convolutional Neural Networks (adamharley.com)

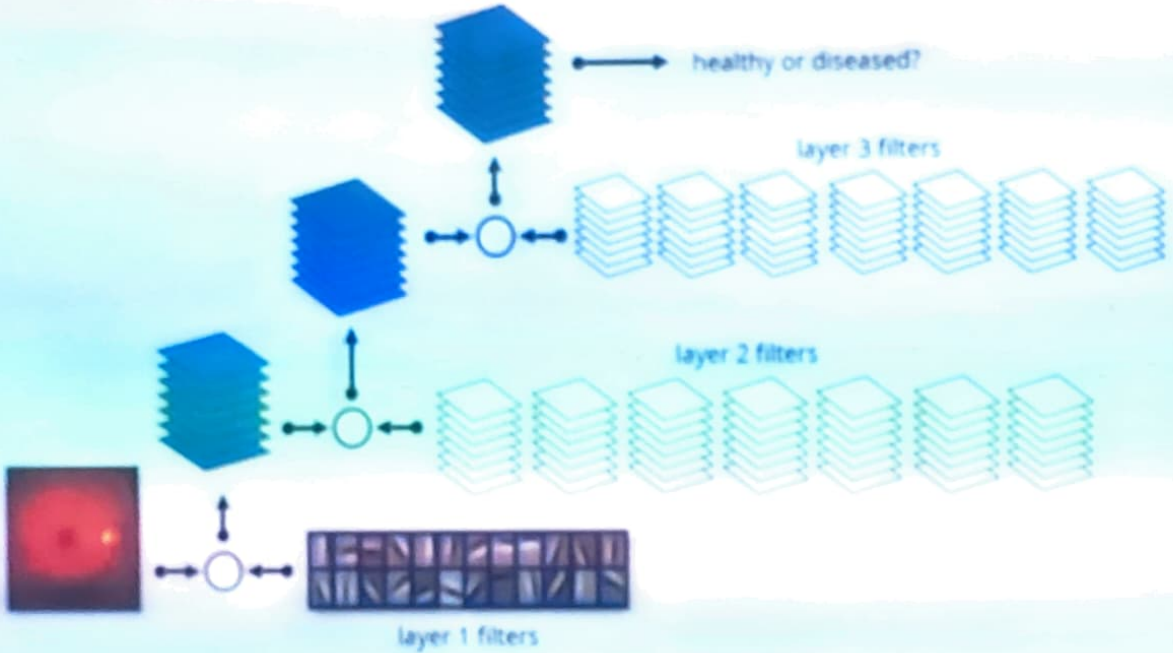
Google works with Aravind Eye Hospital to deploy AI to detect eye disease | VentureBeat

lecun-01a.pdf

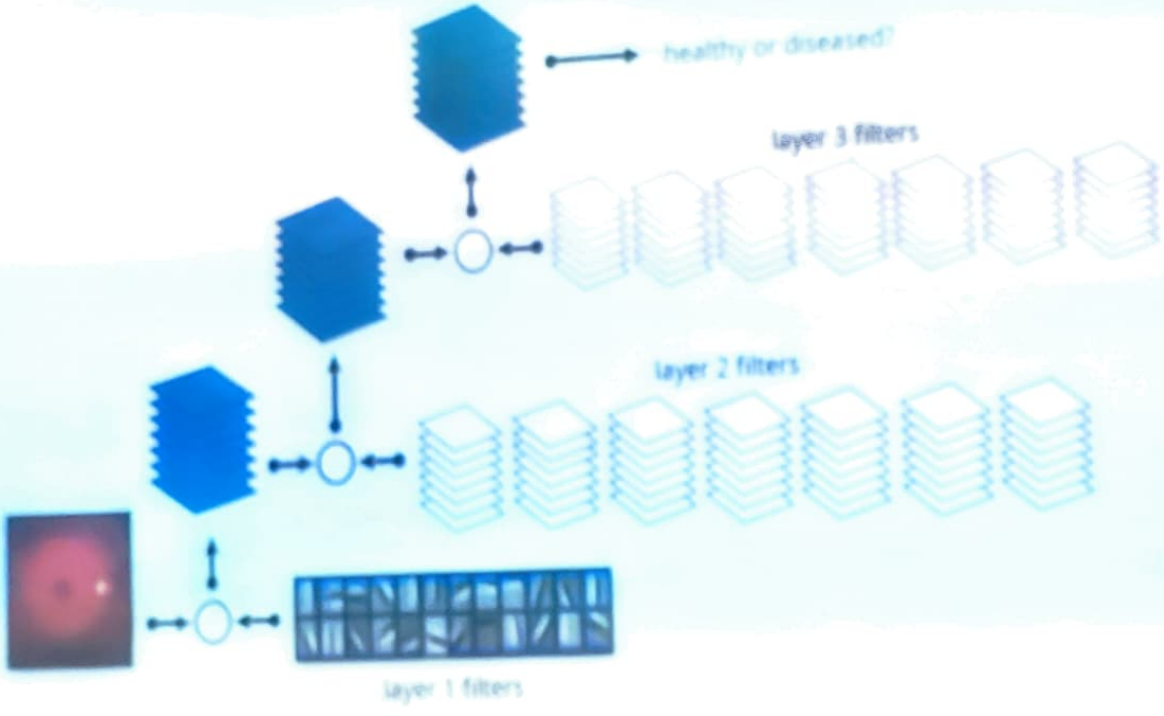
Image Kernels explained visually (setosa.io)

Solving the Paradox of Charge | Sushant Shinde | TEDxBandra

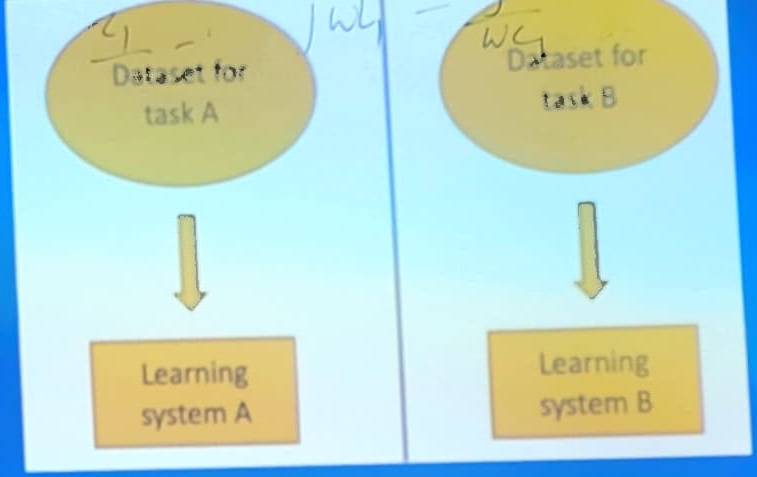
Transfer Learning

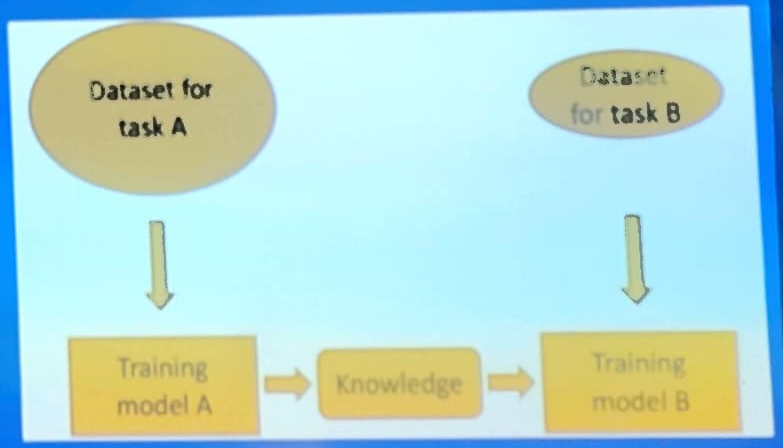


Transfer Learning



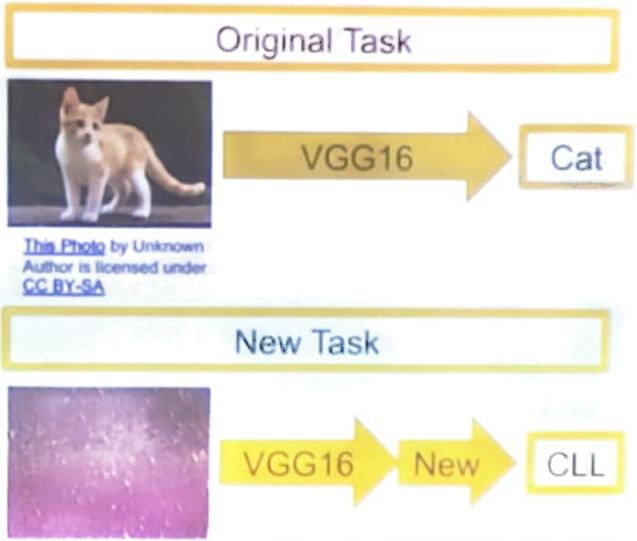
- transfer learning is to reuse the knowledge gained by a network trained for task A on another related task B
- Reusing a trained network as the starting point to train a new network is different from the traditional way of training networks, whereby neural networks are trained on their own for specific tasks on specific datasets.
- To train these successful networks, usually a huge amount of labeled data is required, as well as a vast amount of computational resources and time.
- To get a comprehensive labeled dataset for a new domain, in order to be able to train a network to reach state-of-art-performance, can be difficult or even impossible. As an example, the often-used ImageNet database, which is used to train state-of-the-art models, has been developed over the course of many years. It would take time to create a similar new dataset for a new image domain.
- Transfer learning allows us to use the knowledge gained during training on a task and domain where sufficient labeled data was available as a starting point, to train new models in domains where not enough labeled data is yet available.





Cancer Cell Classification with Transfer Learning

- Transfer learning can be adapted to a wide range of image classification problems
- Task: Classify histopathology slide images and about the type of lymphoma
  - chronic lymphocytic leukemia (CLL)
  - follicular lymphoma (FL)
  - mantle cell lymphoma (MCL)
- Reuse VGG16 network



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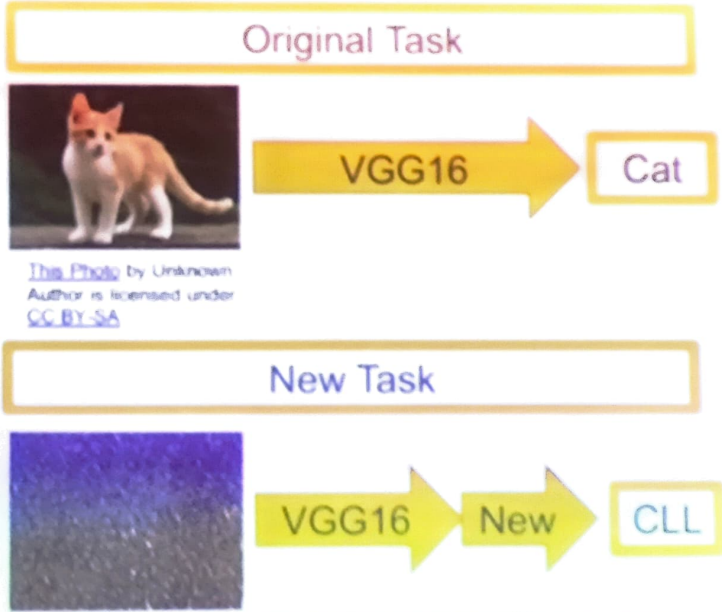
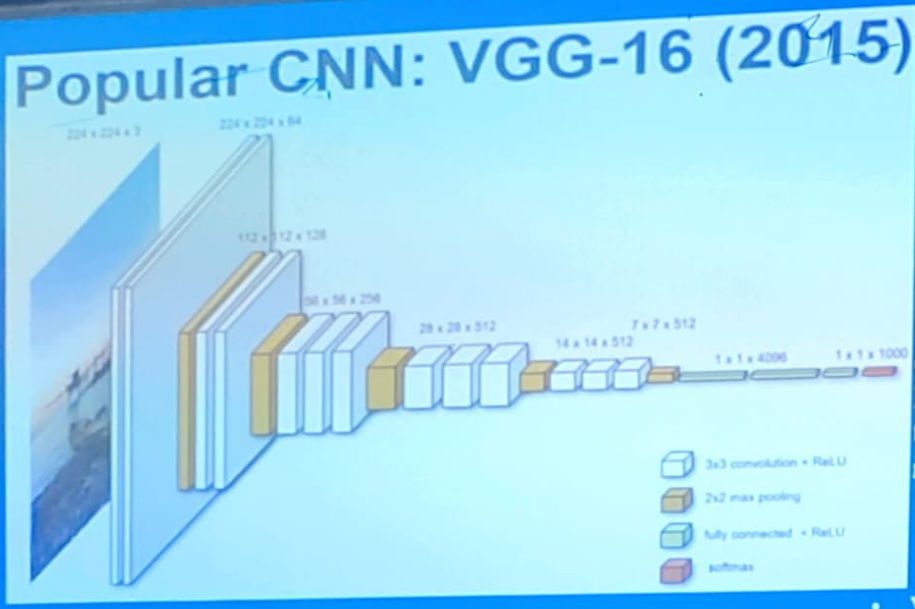


Popular CNN: VGG-16 (2015)



- It starts with two convolution layers, each with 64 filters.
- After a max pooling layer, again two convolution layers are used, with 128 filters.
- another max pooling layer is followed by three convolution layers, with 256 filters.
- After one more max pooling layer, there are again three convolution layers, each with 512 filters, followed by another pooling layer and three convolution layers each with 512 filters. After one last pooling layer, three dense layers are used:

We will start from the state-of-the-art VGG16 network as a source network to train a new target network on a dataset of images describing three different subtypes of lymphoma, which are

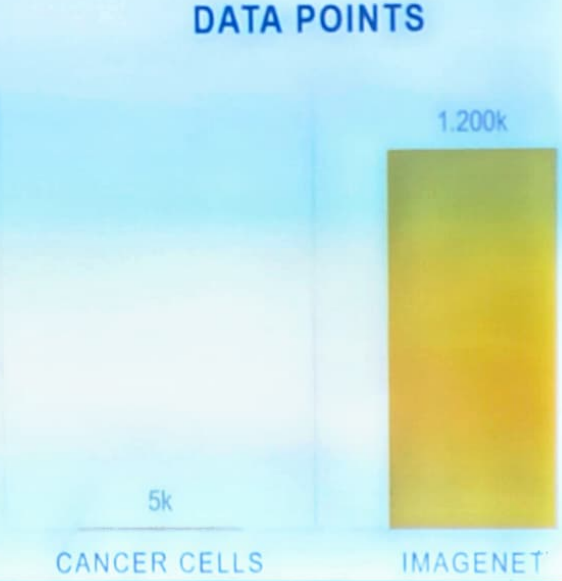
- chronic lymphocytic leukemia (CLL),
- follicular lymphoma (FL),
- and mantle cell lymphoma (MCL).

A typical task for a pathologist in a hospital is to look at histopathology slide images and make a decision about the type of lymphoma.
Even for experienced pathologists this is a difficult task and, in many cases, follow-up tests are required to confirm the diagnosis.

- An assistive technology that can guide pathologists and speed up their job would be of great value.

- VGG16 is one of the winner models on the ImageNet Challenge from 2014.
  - It is a stacked CNN network, using kernels of size 3x3 with an increasing depth—that is with an increasing number of filters.
  - The original network was trained on the ImageNet dataset, containing images 224x224x3, referring to more than 1,000 classes.

- Idea: Reuse existing architecture, pretrained on a similar task
  - E.g., use VGG16 as starting point to solve the cats and dogs classification
- Many ways how the trained network can be used
  - Reuse only network structure
  - Reuse network structure and weights and
    - Retrain only some layer
    - Retrain all layers
    - Add some layers on top
- Why is it helpful?
  - Image classification requires tons of data
    - Often not available
  - VGG16 was trained on more than 1,000,000 images from ImageNet dataset.



Transfer Learning for Image Classification