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Tensorflow Investigation

- An end to end open source machine learning platform
- Core open source library to help you develop and train ML model
- Comprehensive, flexible ecosystem of tools, libraries and community resources
- Easy model building
- Robust ML production anywhere
- Powerful expirementation for research
- Examples
  - Helping doctors detect respiratory disease using machine learning (developers)
  - Advancing access to human rights information (Enterprise)
  - Enabling medical staff to prescribe the right antibiotics with Tensor flow (Research)

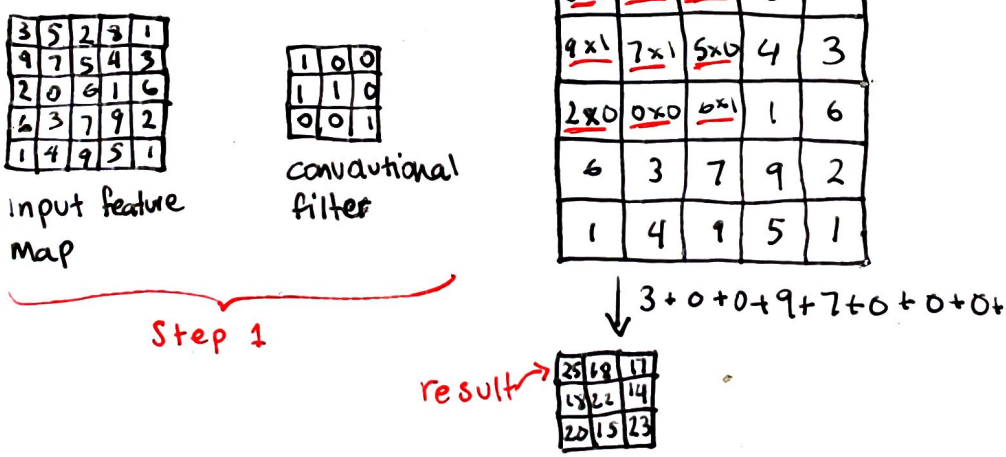
Image Classification - Convolutional Neural Network

- progressively extract higher and higher level representations of the image content
- CNN takes just the image's raw pixel data as input and "learns" how to extract these features
  - is able to infer what object they constitute

Convolution

- Convolution extracts tiles of the input feature map
- Applies filters to them to compute new features
- Producing an ouput feature map
- Convolved feature
  - which may have a different size and depth than the input feature map
- Size of the tiles are extracted (ie. 3×3 or 5×5)
- Depth of ouput feature map

- For each filter-tile pair, the CNN performs element-wise multiplication of the filter matrix and the tile matrix
- Sum all element of resulting matrix to get a single value.



- CNN "learns" the optimal values for the filter matrices that enable it to extract meaningful features from input feature map
  - textures, edges, shapes
- as # of filters applied to input ↑, # of features the CNN can extract ↑
- trade off is that filters compose the majority of resources expended by the CNN
- Training time also increases as more filters added
- Each filter added to the network provides less incremental value than the previous one

ReLU - Rectified Linear Unit

- ReLU is used as an activation function in a variety of neural network
- $F(x) = \max(0, x)$, returns x for all values of $x > 0$, and returns 0 for all values of $x \leq 0$

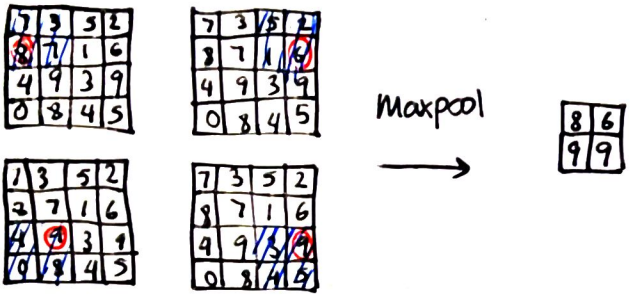
Pooling

- CNN downsamples the convolved feature (to save on processing time)
- Reducing the number of dimensions of the feature map, while still preserving the most critical feature info.

"max pooling"

- Slide over feature map and extract tiles of a specified size
- For each tile, maximum value is output into a new feature map, rest of values are discarded
  - Size: max pooling filter (ie. 2x2)
  - Stride: distance, in pixels, seperating each extracted tile

Example.



Fully Connected Layers

- After CNN are one or more fully connected layers
- When 2 layers are "fully connected", every node in the first layer is connected to every node in the second layer
- To perform classification based on features extracted by convolutions
- Final fully connected layer contains a softmax activation function.
- Outputs a probability value from 0 to 1 for each of the classification labels the model is trying to predict.