Convolutional neural networks

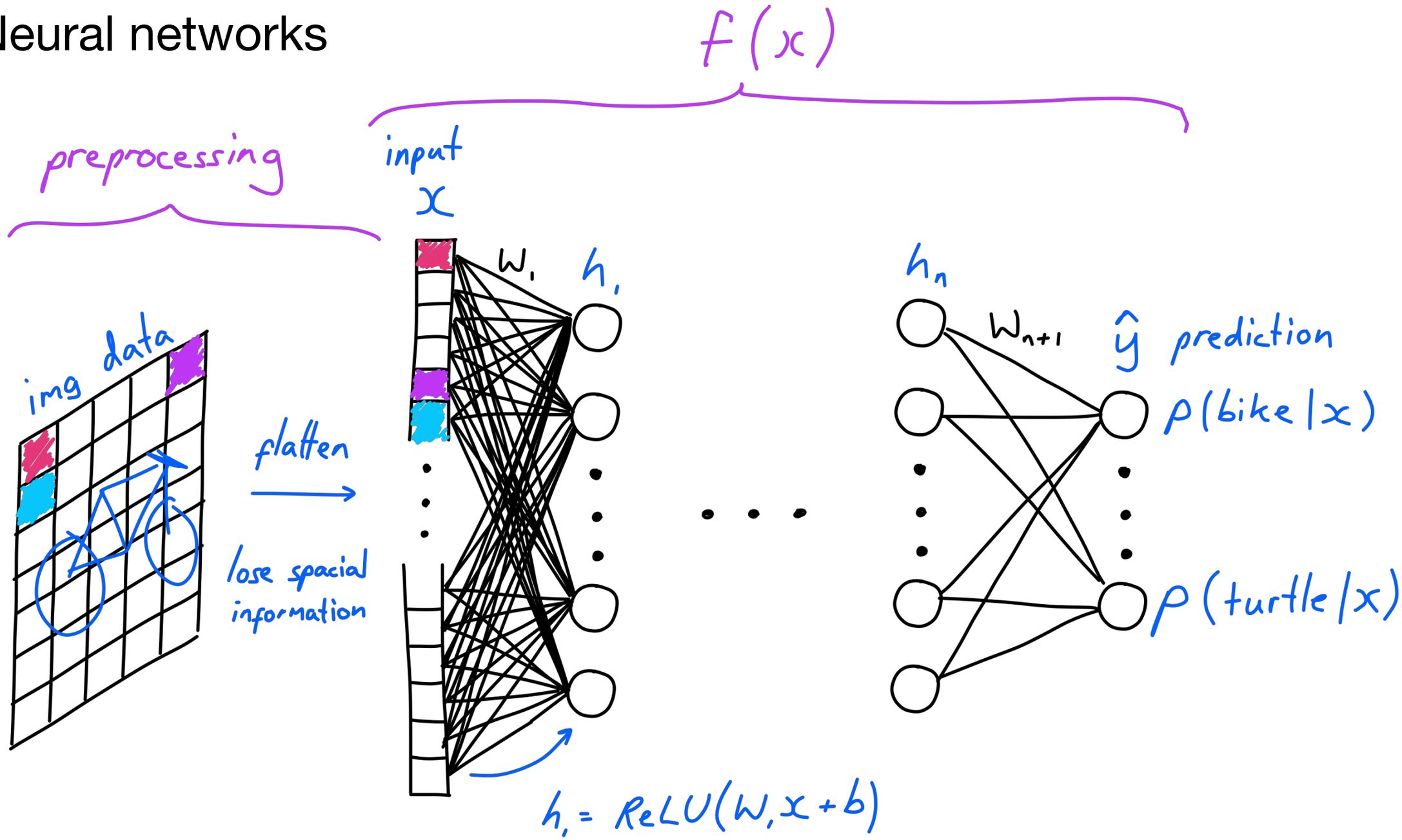
The Academy of AI 2018/19

Session 9

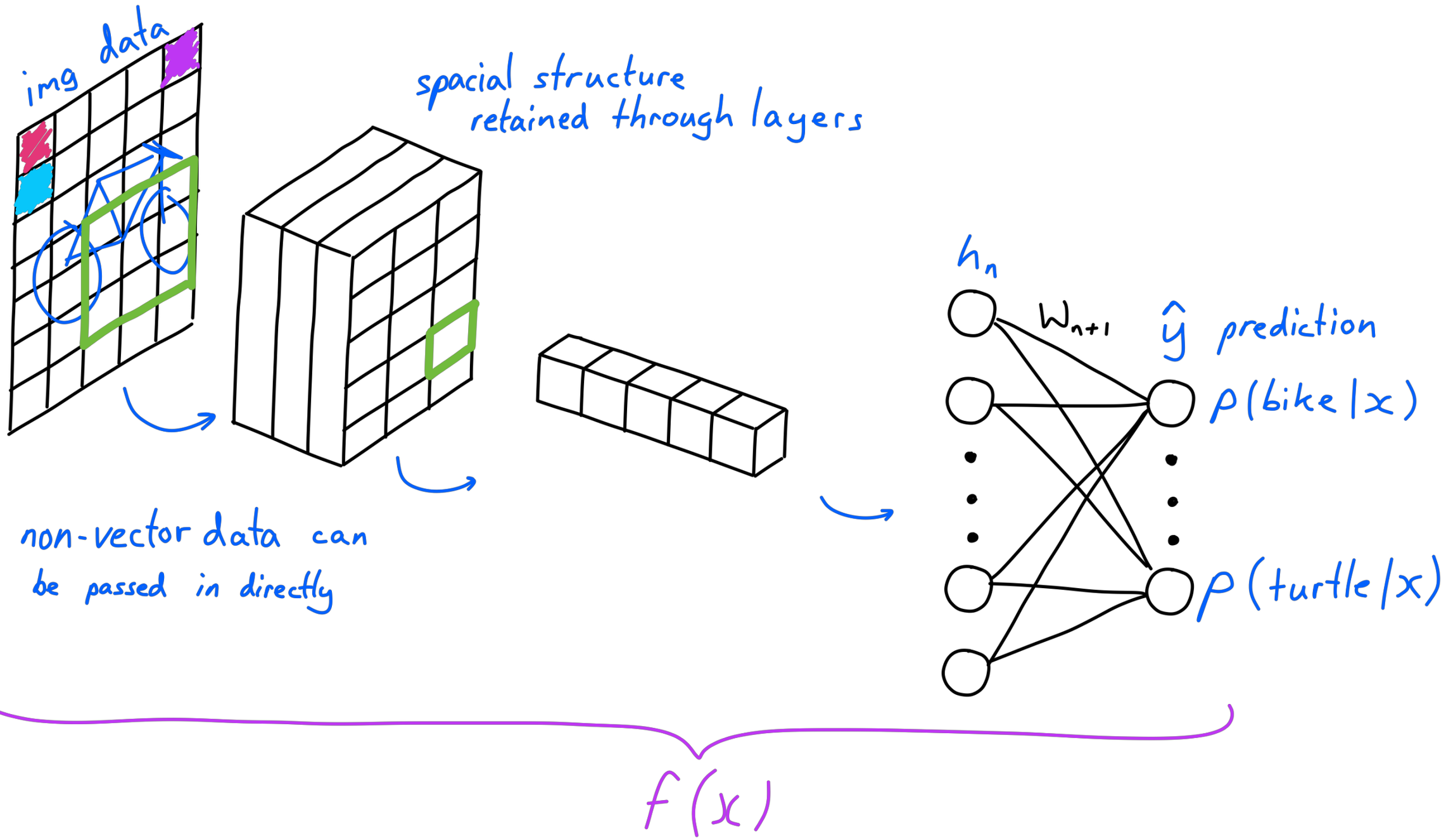
Students for AI

Recap:

- Neural networks

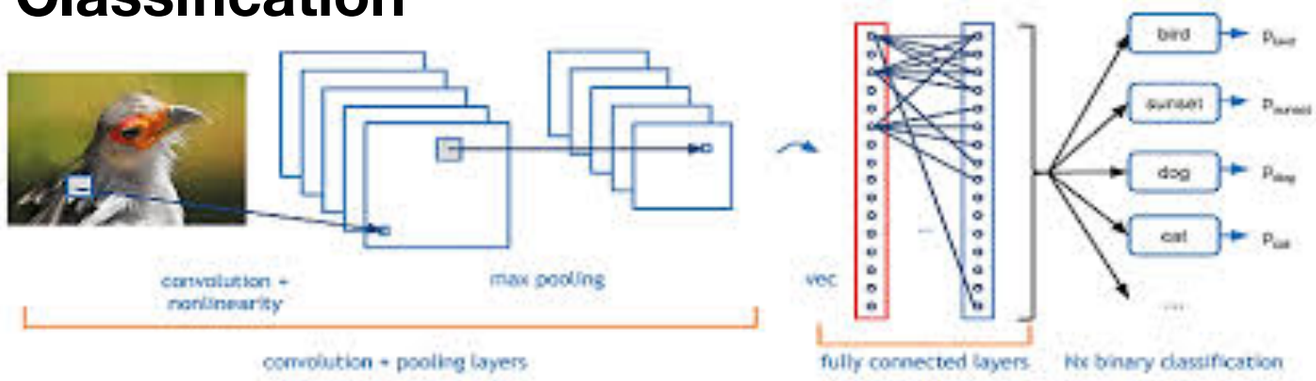


Today: Convolutional Neural Networks

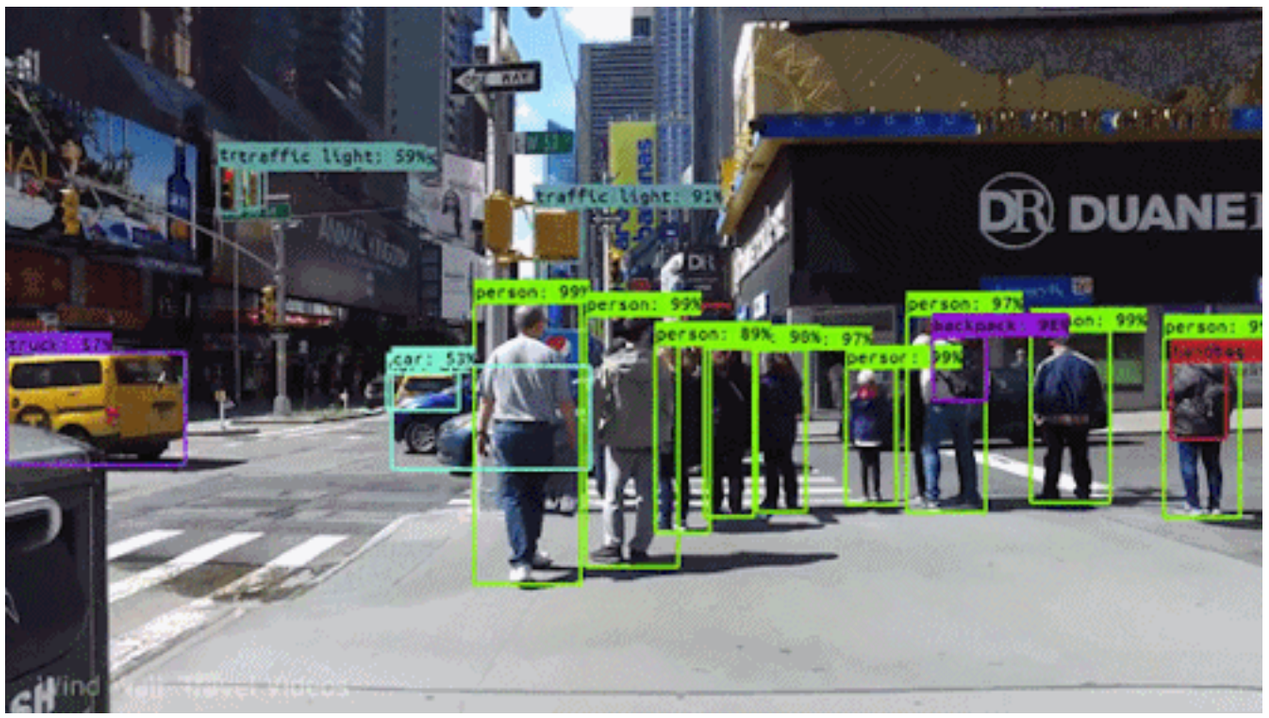


Applications of CNNs

Classification



Detection



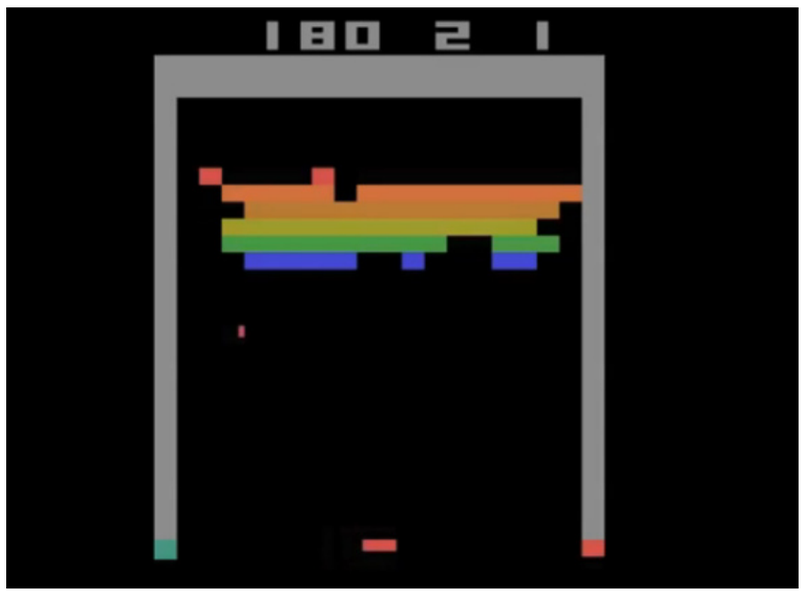
Segmentation

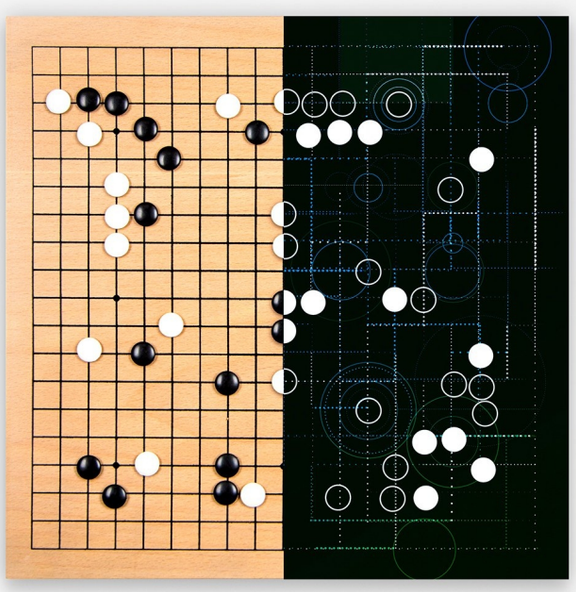
Applications of CNNs

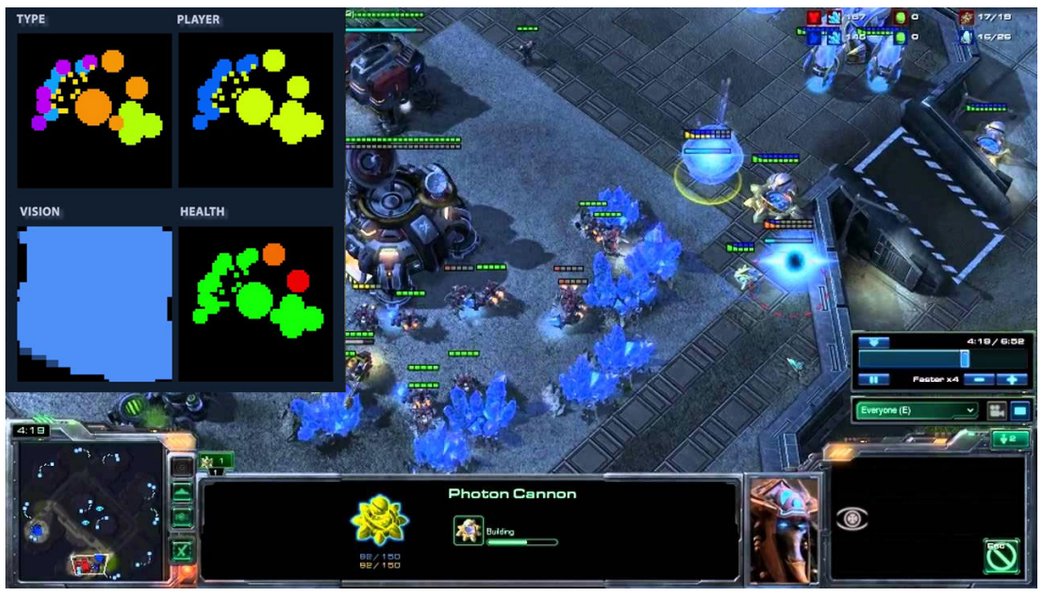
Image captioning

Style transfer

Playing games



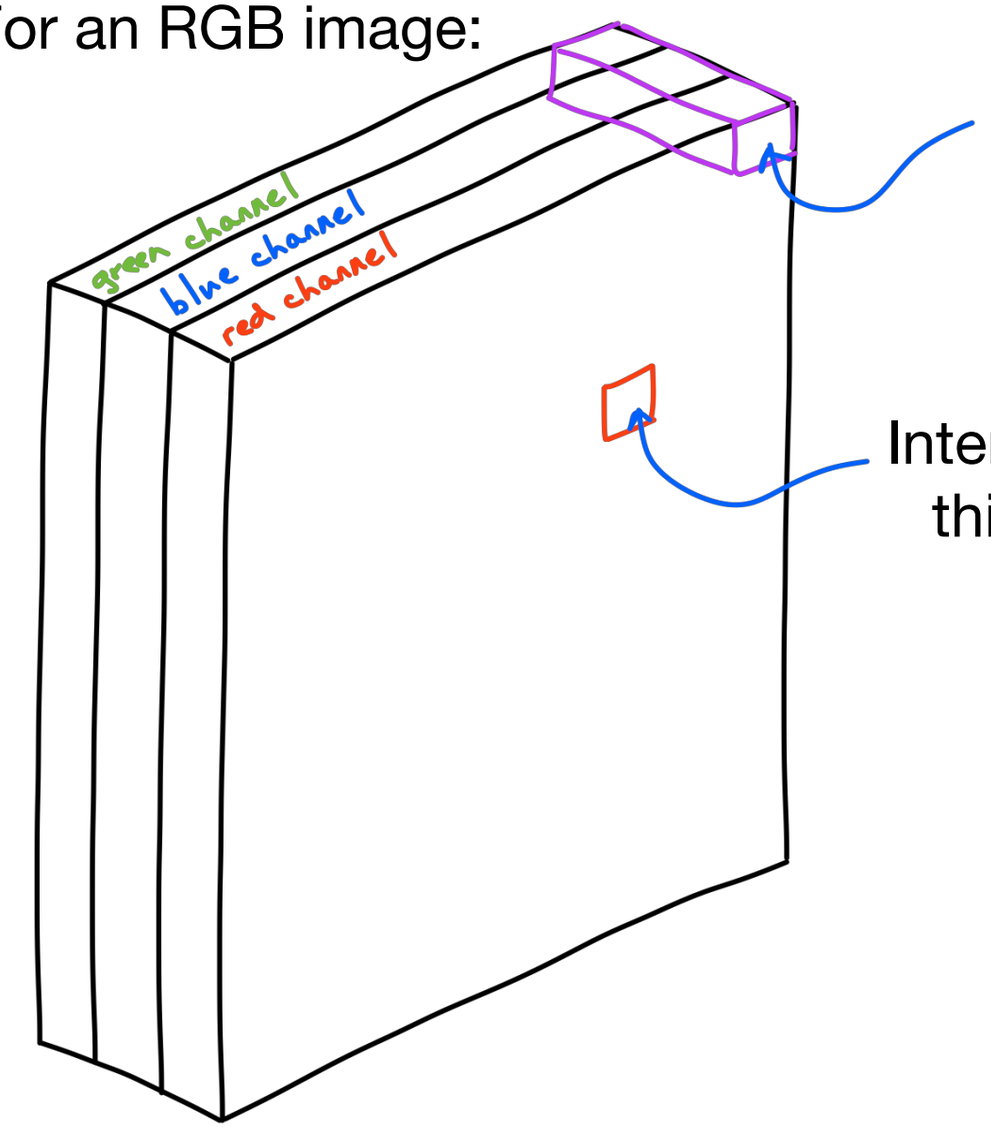




Images as data

Colour images are tensors of data

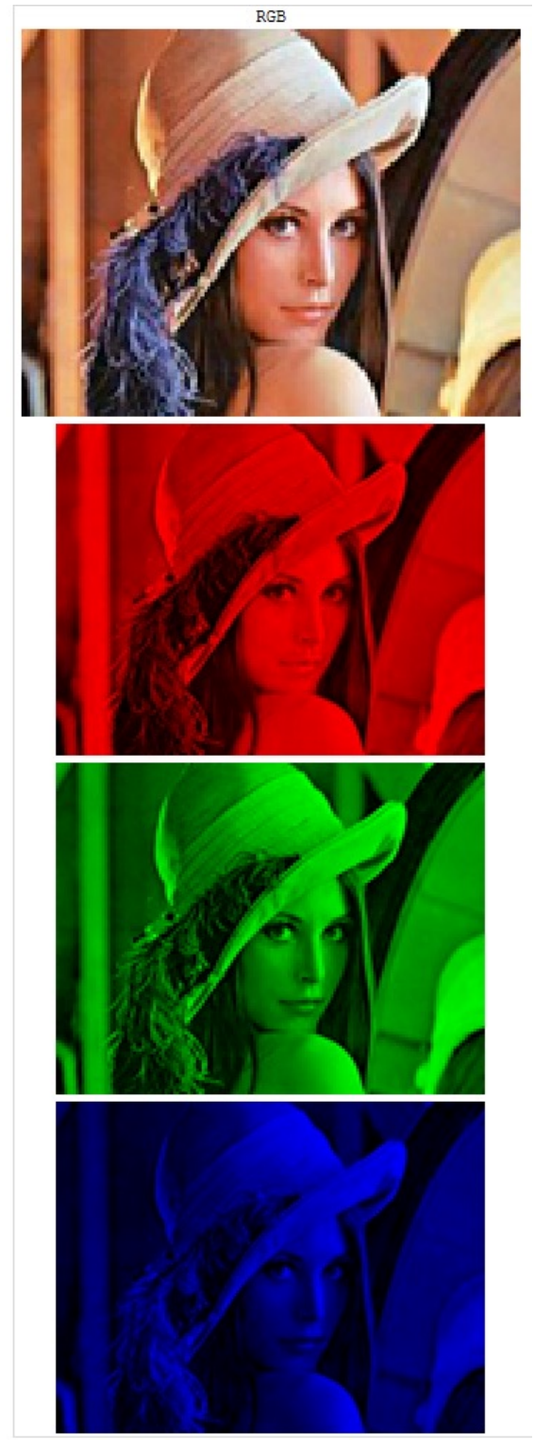
For an RGB image:



What we see is a combination of red, green and blue pixel intensities

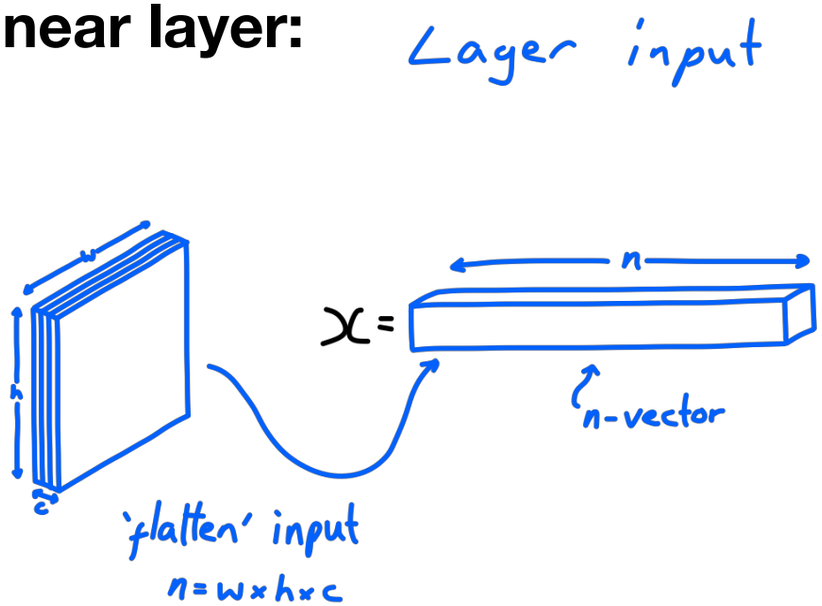
Intensity of red pixel, at this special location

3 'channels'

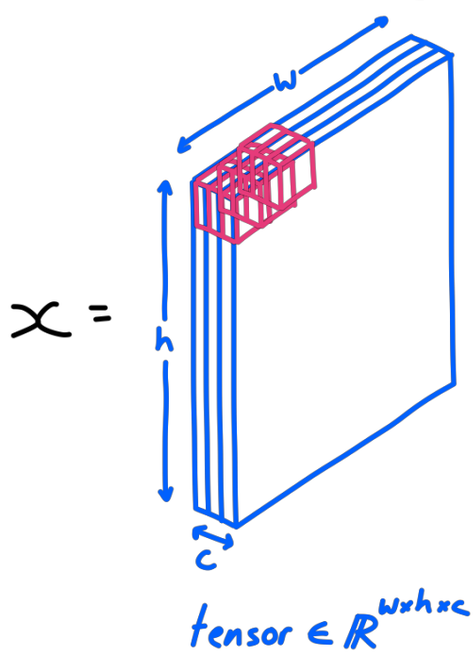


The convolutional layer

Linear layer:



Convolutional layer:



Weights are now 2D filters

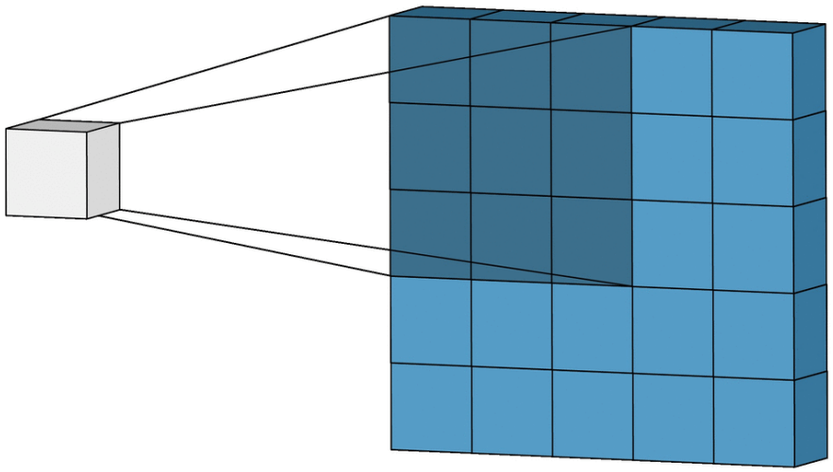
These same filters are applied all over the image

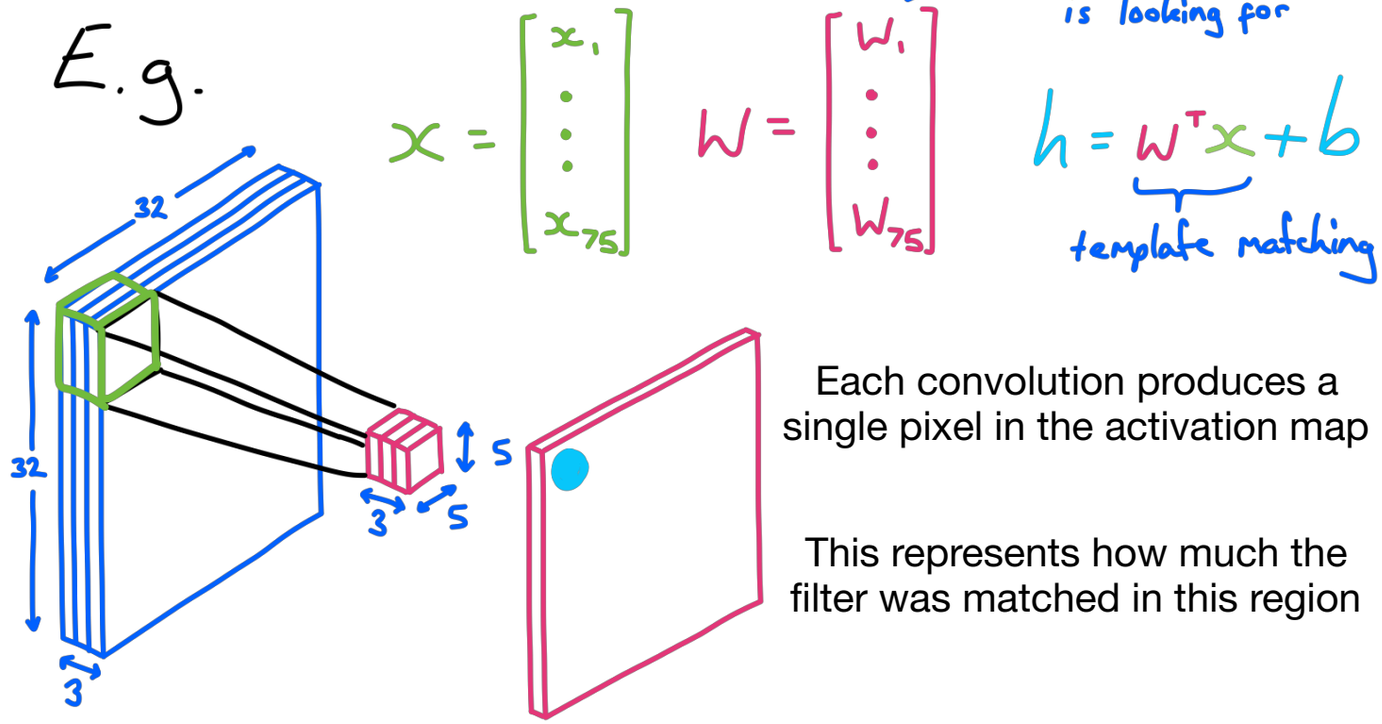
Weights always cover the full depth (all channels) of the input

The output is a stack of 'activation maps'

Convolution concretely

What convolution looks like:





Each convolution produces a single pixel in the activation map

This represents how much the filter was matched in this region

We can make different design choices within convolutional layers:

Stride: the distance we move the filter along by after each convolution

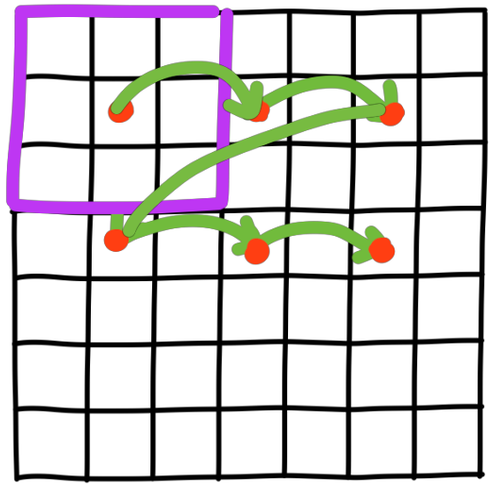
Kernel size: the size of the filter, and hence the size of the pattern we are looking for

Padding: the size and type of extra features that we border the input with

Convolutional layers are powerful because:

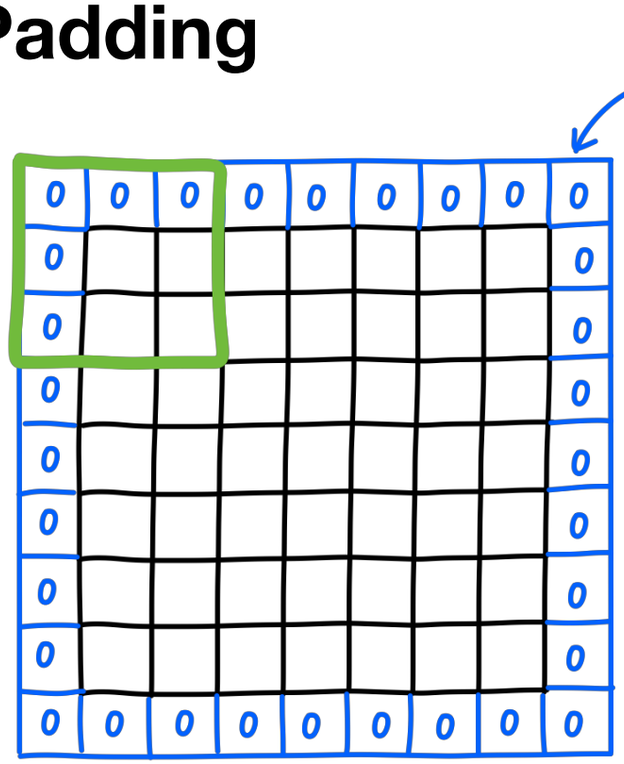
- Each layer requires less parameters
- We can build features from features which interact spacially

Stride



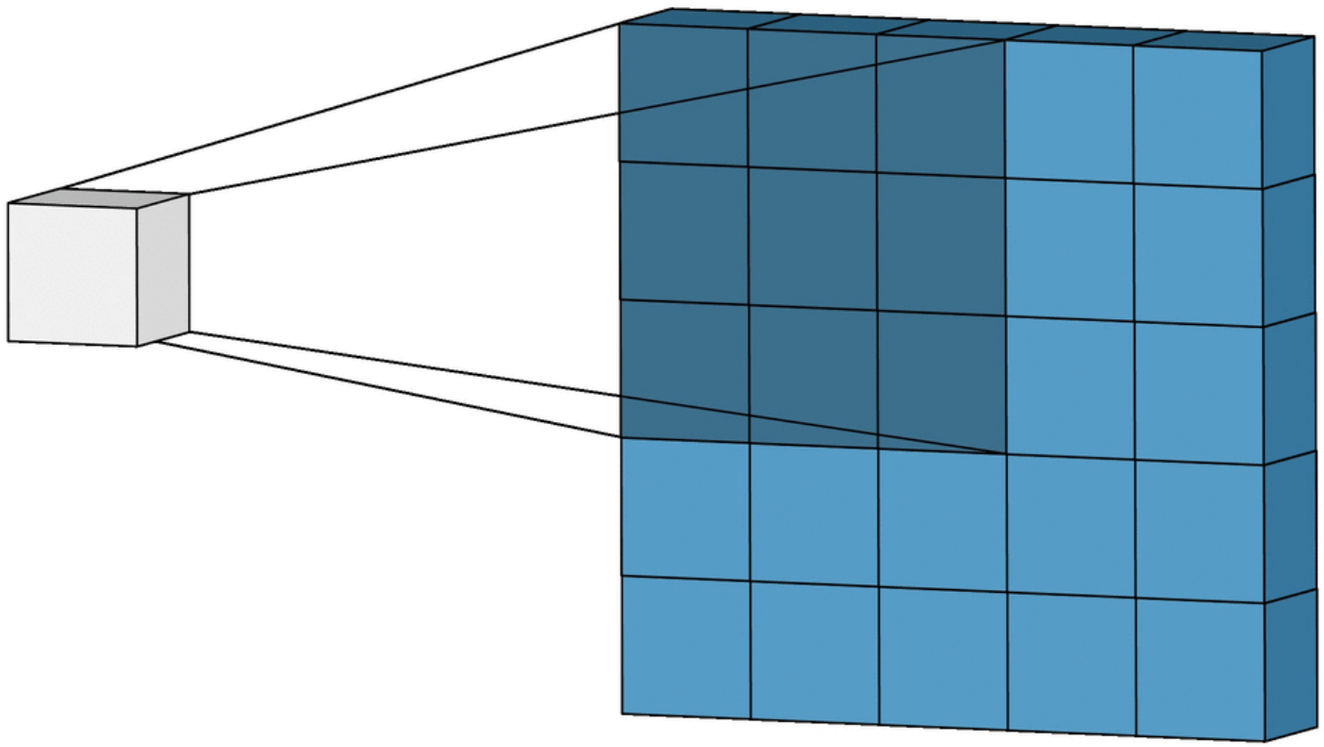
Striding our filter with step sizes greater than 1 can decrease the size of our activation maps, and save computation - making our model faster, and saving memory

Padding



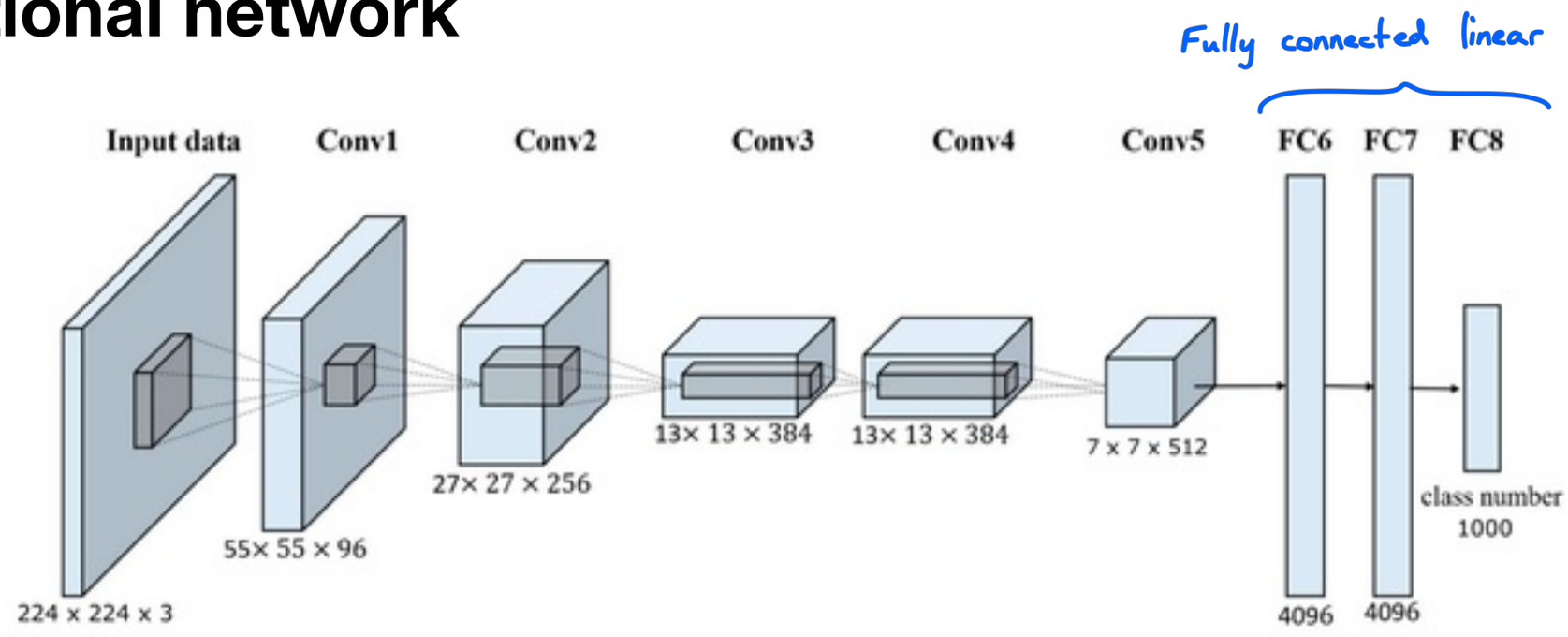
Without padding, the edges of each input to a conv layer are sampled from less

Without padding, activation maps decrease in size through conv layers, this puts a bound on how deep they can be, and hence limits their capacity

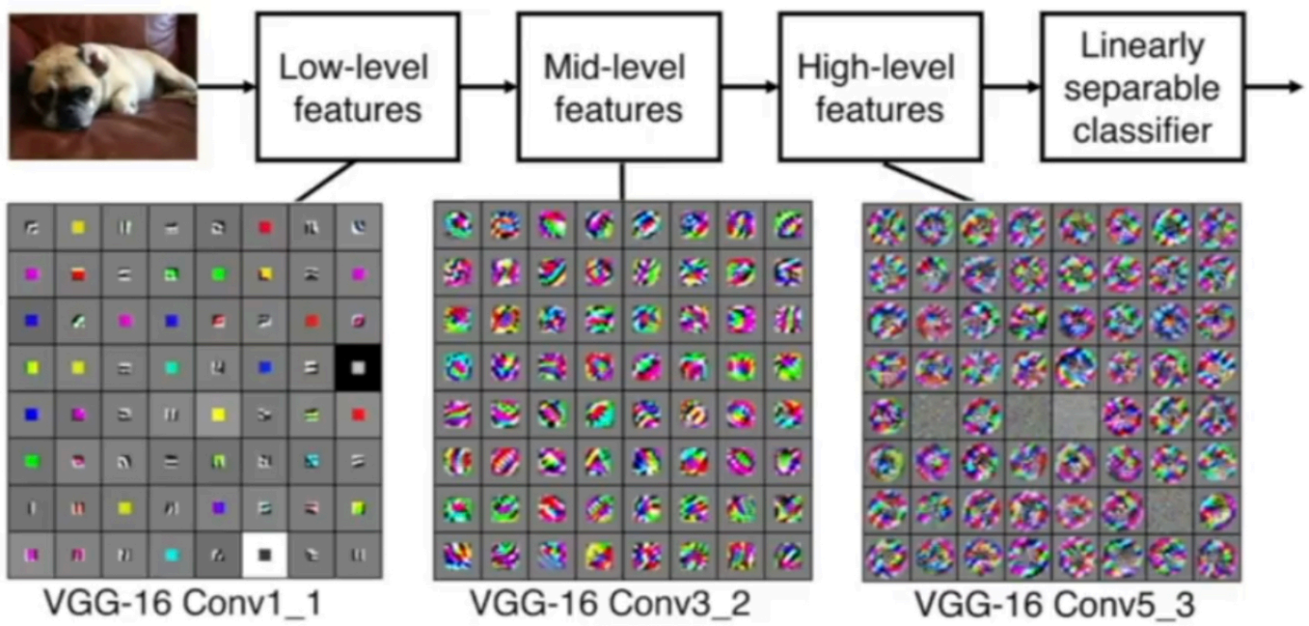


What are the stride, padding and kernel size for this operation?

A convolutional network



Each layer builds on the features from the previous layer, so the network learns hierarchically more complex filters



Break & demo:

https://cs.stanford.edu/people/karpathy/convnetjs/demo/cifar10.html

Final notices:

Deep learning office hours will happen every Sunday
Request a slot on the Google form

Coursework:

Sign up for AF if you want to get real practice, serve real people and make money...