Masters Course
Neural Networks

Summary
On
Week 1
CNNs Course

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- In neural networks if the size of the input image is large we will have a large number of parameters as well as a very slow learning process.
- Convolutional neural networks solved this problem so we can use image of any size and convolve it with a filter of small size.
- Edges are fundamental features in any image, has it been horizontal or vertical edges. An edge is simply a sharp transition between a set of pixels.
- An example of a 3×3 filter (vertical edge detector) would be:
  1- For the 1st column all ones
  2- For the 2nd column all zeros
  3- For the 3rd column all -1
- Convolution is a specialized kind of linear operation
- **Convolving** around the input image, it is multiplying the values in the filter with the original pixel values of the image (**element wise multiplications**) then summed up.
- They are also known **as shift invariant** or **space invariant artificial neural networks** (**SIANN**),based on their shared-weights architecture and translation invariance characteristics.
- Pooling layers reduce the dimensions of the data by combining the outputs of neuron clusters at one layer into a single neuron in the next layer.
- *Max pooling* uses the maximum value from each of a cluster of neurons at the prior layer.
- *Average pooling* uses the average value from each of a cluster of neurons at the prior layer.
- A distinguishing feature of CNNs is that many neurons can share the same filter.
- This reduces memory footprint because a single bias and a single vector of weights are used across all receptive fields sharing that filter, as opposed to each receptive field having its own bias and vector weighting.
- **Padding** refers to the amount of pixels added to an image when it is being processed by the kernel of a **CNN**.
- If zero padding is set to one, there will be a one pixel border added to the image with a pixel value of zero.
- Padding increases the contribution of the pixels at the border of the original image by bringing them into the middle of the padded image. Thus, information on the borders is preserved as well as the information in the middle of the image.
- **Types of Padding:-**

  1- **Valid Padding :** It implies no padding at all
  2- **Same Padding :** In this case, we add ‘p’ padding layers such that the output image has the same dimensions as the input image.
- **Stride** is the number of pixels shifted over the input matrix.
- When applied on an RGB image for example, Convolution is performed on a volume.
- We use Non linear activation functions after the max pooling layers.
- We use Fully Connected layers after CNNs.
- Output size of an image after convolution is given by: (n + 2p - f)/s + 1
  Where: 1- n is the height or width of input image
  2- p is the padding
  3- f is the size of the filter

4- s is the stride size