**Convocational Neural Networks(CNNs)**

We just learned about convolutions and max pooling.

A convolution is the process of applying a filter (“kernel”) to an image. Max pooling is the process of reducing the size of the image through downsampling.

As you will see in the following Colab notebook, convolutional layers can be added to the neural network model using the Conv2D layer type in Keras. This layer is similar to the Dense layer, and has weights and biases that need to be tuned to the right values. The Conv2D layer also has kernels (filters) whose values need to be tuned as well. So, in a Conv2D layer the values inside the filter matrix are the variables that get tuned in order to produce the right output.

Here are some of terms that were introduced in this lesson:

* **CNNs:** Convolutional neural network. That is, a network which has at least one convolutional layer. A typical CNN also includes other types of layers, such as pooling layers and dense layers.
* **Convolution:** The process of applying a kernel (filter) to an image
* **Kernel / filter:** A matrix which is smaller than the input, used to transform the input into chunks
* **Padding:** Adding pixels of some value, usually 0, around the input image
* **Pooling** The process of reducing the size of an image through downsampling.There are several types of pooling layers. For example, average pooling converts many values into a single value by taking the average. However, maxpooling is the most common.
* **Maxpooling**: A pooling process in which many values are converted into a single value by taking the maximum value from among them.
* **Stride:** the number of pixels to slide the kernel (filter) across the image.
* **Downsampling:** The act of reducing the size of an image

**Summary**

SEND FEEDBACK

**Summary**

In this lesson we learned how Convolutional Neural Networks work with color images and saw various techniques that we can use to avoid overfitting . The main key points of this lesson are:

CNNs with RGB Images of Different Sizes:

* **Resizing**: When working with images of different sizes, you must resize all the images to the same size so that they can be fed into a CNN.
* **Color Images**: Computers interpret color images as 3D arrays.
* **RGB Image**: Color image composed of 3 color channels: Red, Green, and Blue.
* **Convolutions**: When working with RGB images we convolve each color channel with its own convolutional filter. Convolutions on each color channel are performed in the same way as with grayscale images, *i.e.* by performing element-wise multiplication of the convolutional filter (kernel) and a section of the input array. The result of each convolution is added up together with a bias value to get the convoluted output.
* **Max Pooling**: When working with RGB images we perform max pooling on each color channel using the same window size and stride. Max pooling on each color channel is performed in the same way as with grayscale images, *i.e.* by selecting the max value in each window.
* **Validation Set**: We use a validation set to check how the model is doing during the training phase. Validation sets can be used to perform Early Stopping to prevent overfitting and can also be used to help us compare different models and choose the best one.

Methods to Prevent Overfitting:

* **Early Stopping**: In this method, we track the loss on the validation set during the training phase and use it to determine when to stop training such that the model is accurate but not overfitting.
* **Image Augmentation**: Artificially boosting the number of images in our training set by applying random image transformations to the existing images in the training set.
* **Dropout**: Removing a random selection of a fixed number of neurons in a neural network during training.

You also created and trained a Convolutional Neural Network to classify images of Dogs and Cats with and without Image Augmentation and Dropout. You were able to see that Image Augmentation and Dropout greatly reduces overfitting and improves accuracy. As an exercise, you were able to apply everything you learned in this lesson to create your own CNN to classify images of flowers.