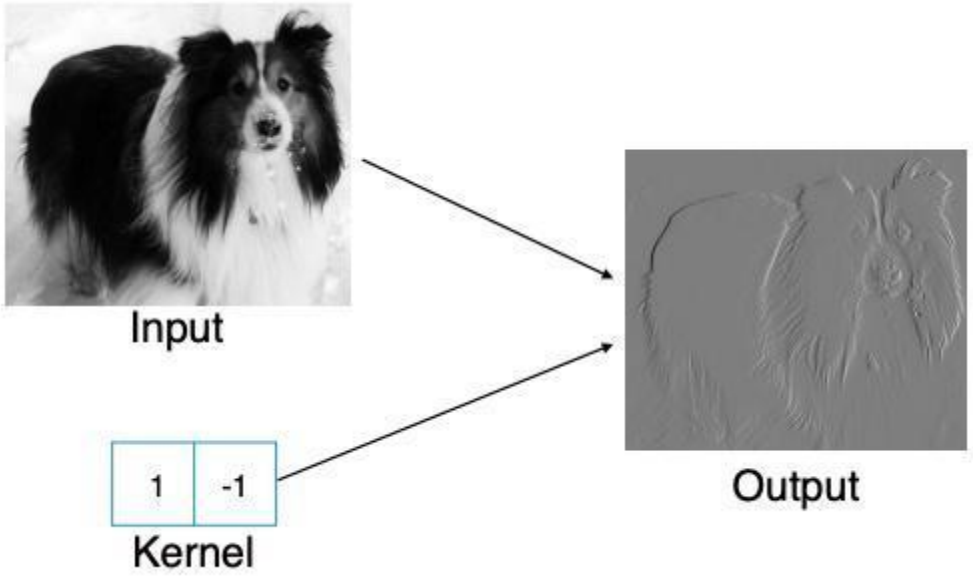
Module 4

Stride in CNN

How are CNNs built?

In order to understand Stride, we should know little about how CNNs are built.



Source: https://course.ece.cmu.edu/

Think of a CNN as a collection of small, overlapping magnifying glasses called **filters**.

These filters scan over different parts of a picture to find interesting things, like edges, shapes, or colours. These filters **slide** or **convolve** over the entire image bit by bit.

What is Stride in CNN?

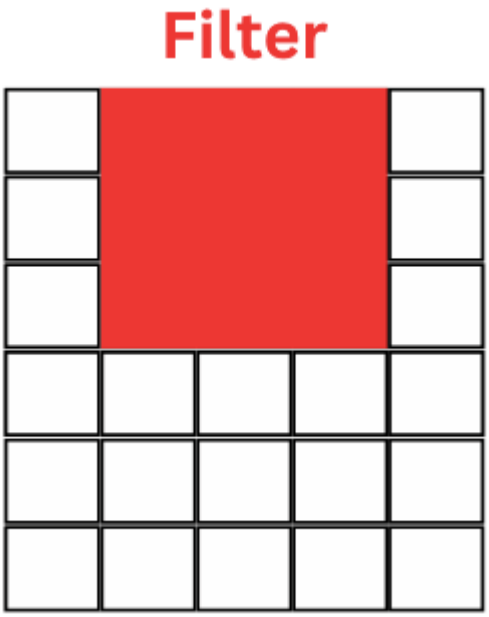
In simple terms, stride is like telling our filters how big of steps they should take while sliding over the picture in one direction.

It's similar to how we decide to take big leaps or small steps when playing jump games. These steps can be small or big.

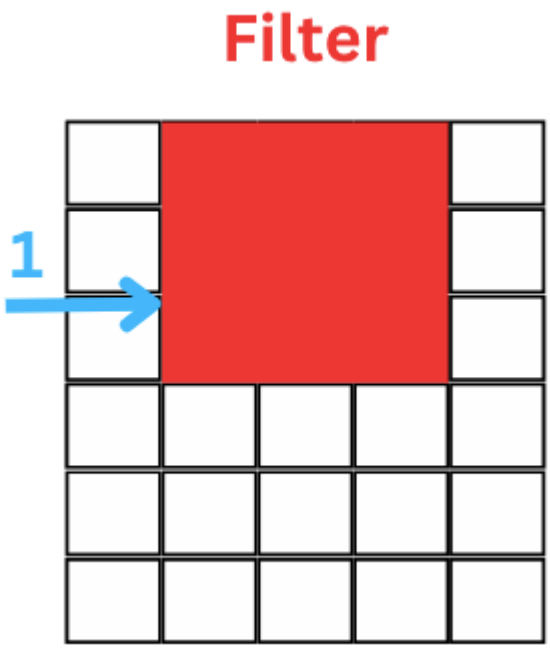
In the world of CNNs, **Stride** determines how many squares or pixels our filters skip when they move across the image, from left to right and from top to bottom.

For example, consider the red square as a filter. The computer is going to use this filter to scan the image.

Module 4

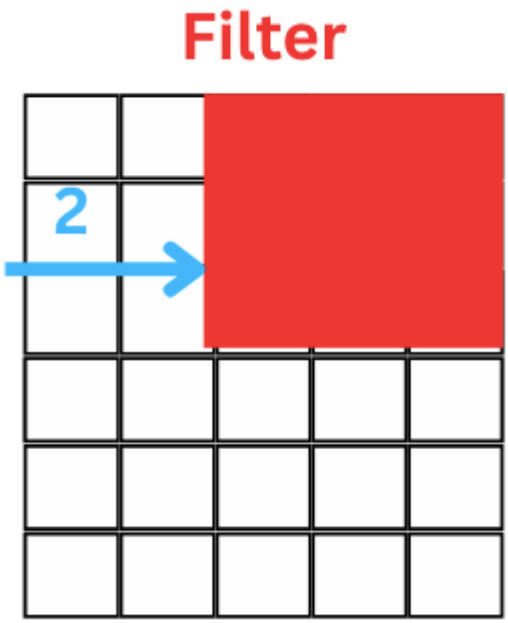


If **stride = 1**, the filter will move one pixel , see the below image:



If **stride = 2**, the filter will move two pixels, see the below image:

Module 4



Why We Need Stride?

Stride is a Convolution Neural Network technique which has two main features. The first is to **reduce the size** of the output feature map. This is because the filter only overlaps with a subset of the input feature map so that the output feature map will be small, and it helps reduce the computational complexity.

The second is the **overlap of the receptive field.** The receptive field is the area of the input feature map that is used to calculate the output of a neuron.

For example, a stride of 2 reduces the overlap of receptive fields by half because the filter will overlap with half of the receptive fields in the previous layer. It helps prevent the CNN from learning redundant features.

How does Stride work?

Assume a convolutional neural network is analysing the content of an image. If the filter size is 4x4 pixels, the contained sixteen pixels will be converted down to 1 pixel in the output layer. As the **stride increases, the resulting output decreases.**

Stride is a parameter that works in conjunction with padding. **Padding** is the feature that puts empty blanks into the frame of the image to minimize the reduction of size in the output layer.

Actually, it is a way of increasing the size of an image to balance the size reduced by the strides. Padding and Stride are the fundamentals for CNN.

Module 4

As we have discussed enough about padding and stride, let's see a comparison between the both.

Difference between Stride And Padding

The table below summarizes the key differences between the both:

Characteristic	Stride	Padding
Definition	The number of pixels that the filter moves over the input image at a time.	The addition of zeros around the edges of the input image.
Effect on output image size	A larger stride results in a smaller output image.	No, but indirectly affects it by increasing the size of the input image.
Default value	1	0
Computational complexity	Lower for larger strides	Higher for larger strides
Ability to preserve detail	Lower for larger strides	Higher for larger strides
Ability to prevent information loss	Lower for valid padding	Higher for same padding

How Does Stride Affect CNNs?

Stride is super important because changing the Stride can help CNNs to do different things, such as:

1. Fine Details vs. Big Picture

If we use a small Stride, the filters take tiny steps. This helps CNNs pay attention to all the tiny details in a picture. It's like looking at a painting up close and noticing every brushstroke.

2. Speed vs. Precision

If we use a big Stride, the filters take bigger steps, which will cover more area quickly. This makes CNN work faster, but it might miss some of the fine details.

It's like looking at the same painting from far away – we see the big picture but not every tiny detail.

Module 4

3. Maintaining a Balance

CNNs often use different Strides at different stages. They start with a small Stride to capture fine details and then switch to a bigger Stride to speed things up while still getting the big picture.