Convolutional Neural Networks

Anil K Adepu

Dual Degree Student

Guided by

Dr. Umarani J.

Department of CSE

IIITDM Kancheepuram


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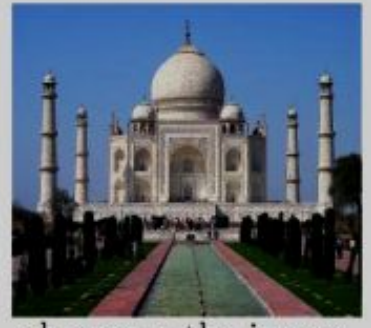
SOME EXAMPLES OF 2D CONVOLUTIONS APPLIED TO IMAGES

$$* \begin{matrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{matrix} =$$

blurs the image

$$* \begin{matrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{matrix} =$$



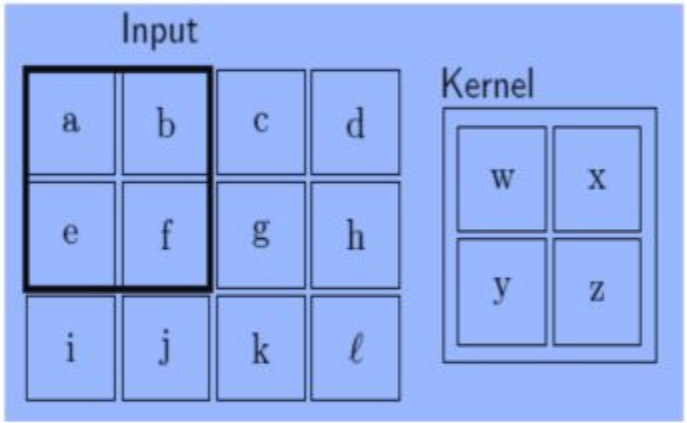
sharpens the image

SOME EXAMPLES OF 2D CONVOLUTIONS APPLIED TO IMAGES

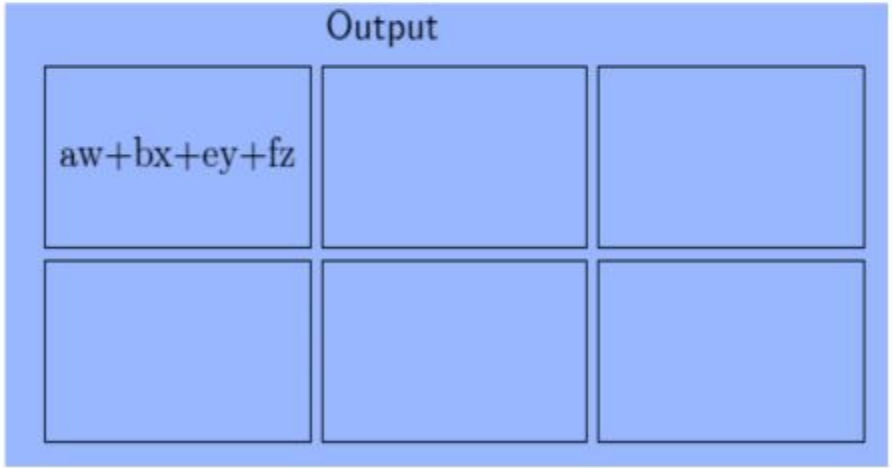
$$* \begin{matrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ 1 & 1 & 1 \end{matrix} =$$

detects the edges

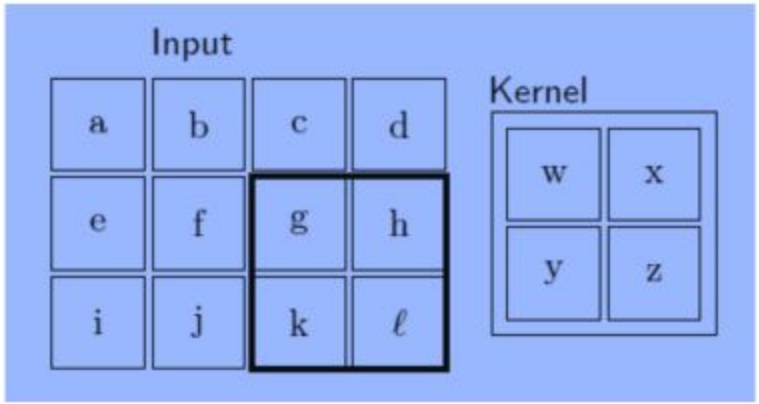
THE CONVOLUTION OPERATION



- Let us apply this idea to a toy example and see the results



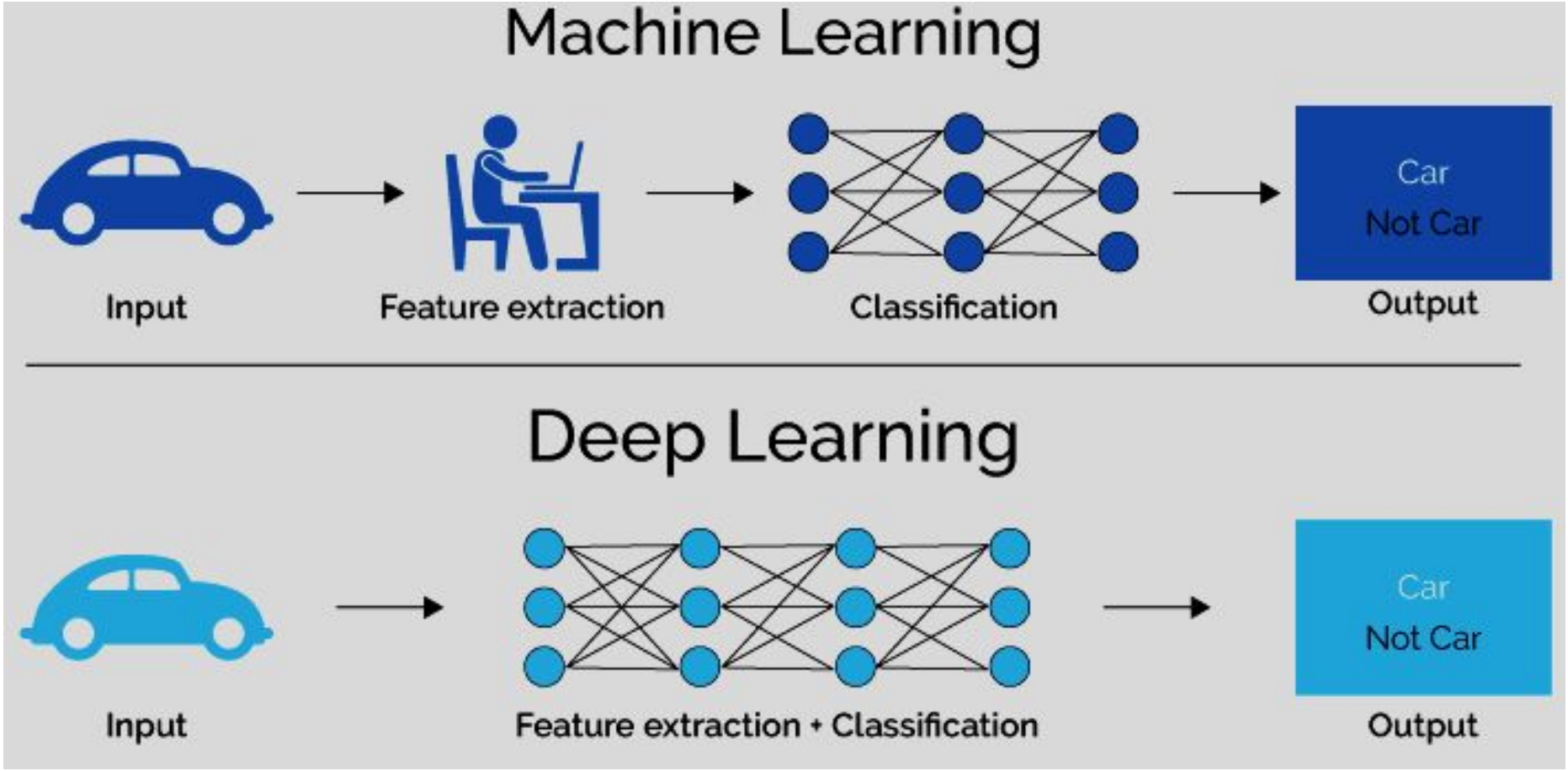
THE CONVOLUTION OPERATION



- Let us apply this idea to a toy example and see the results

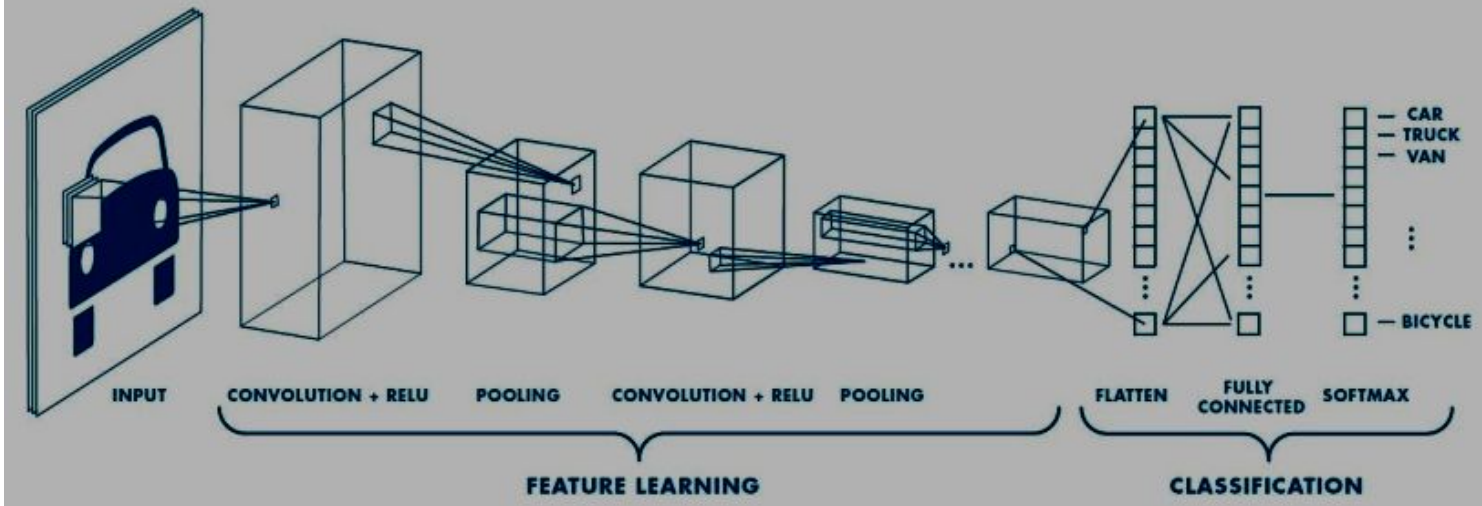
Output

aw+bx+ey+fz	bw+cx+fy+gz	cw+dx+gy+hz
ew+fx+iy+jz	fw+gx+jy+kz	gw+hx+ky+ℓz

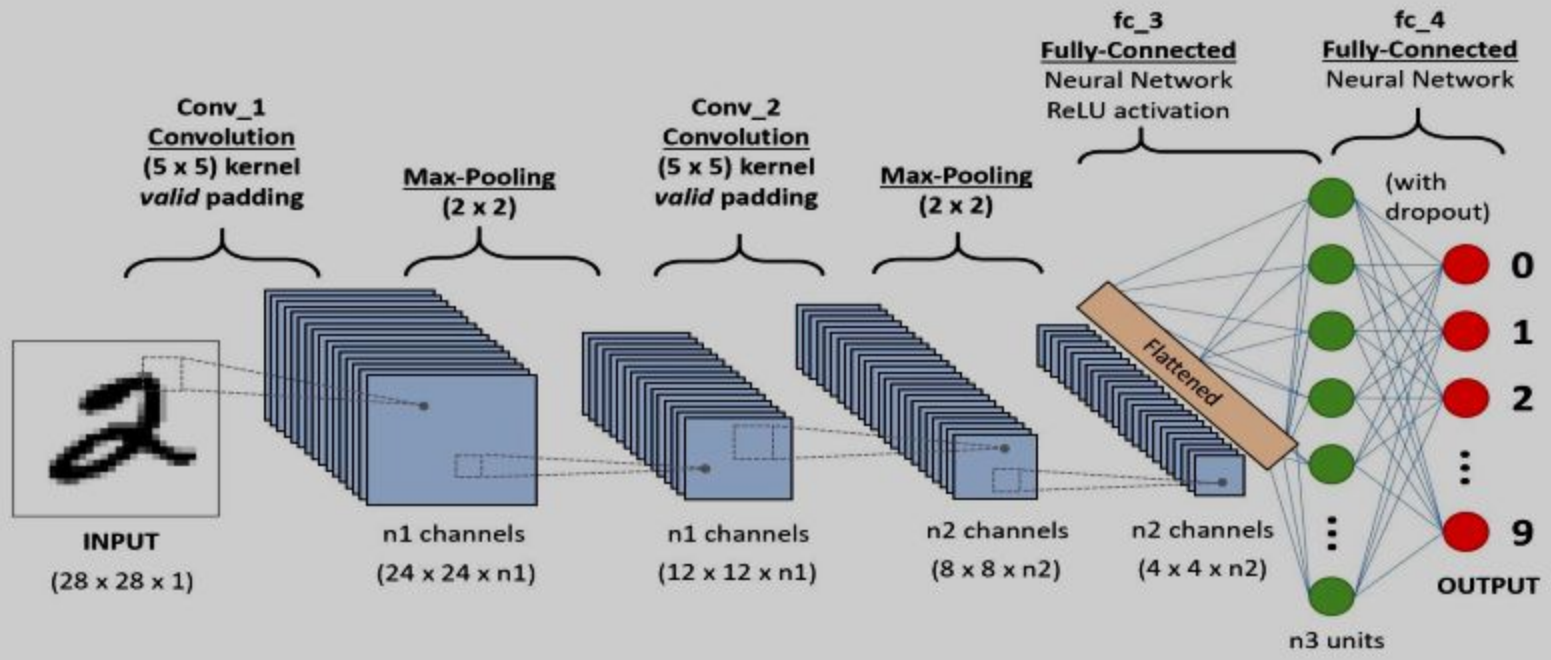

Machine Learning
Input
Feature extraction
Classification
Car
Not Car
Output
Deep Learning
Input
Feature extraction + Classification
Car
Not Car
Output

How CNNs Work?

- These operations are repeated over tens or hundreds of layers, with each layer learning to identify different features



- So far, we have focused only on the convolution operation.
  Let us see what a full convolutional neural network looks like



It has alternate convolution and pooling layers
What does a pooling layer do?
Let us see