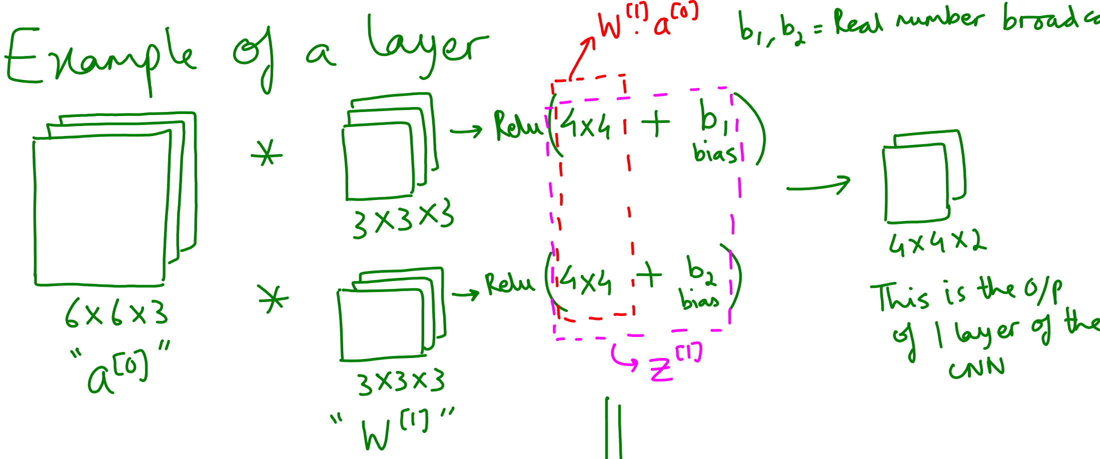
Example of a layer

b_1, b_2 = Real number broadcasted to all members of o/p Image

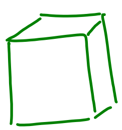


$$a^{[1]} = g\left(z^{[1]}\right)$$

where g is "Relu"

$\Rightarrow$ we went from $6 \times 6 \times 3 \; (a^{[0]})$ to $4 \times 4 \times 2 \; (a^{[1]})$

Q If you have 10 filters that are $3 \times 3 \times 3$ in 1 layer of a NN, how many params does that layer have?



$3 \times 3 \times 3$

$+ 1$ bias

ie, 28×10 Filters $= 280$ params

$\Rightarrow$ # params Remain small irrespective of the Image size

Summary of Notation

1 * In layer "l" of CNN

$f^{[l]}$ = filter size in layer l

$p^{[l]}$ = padding size, can be 0 (valid padding)

$s^{[l]}$ = stride for this layer

2 * Input coming into this layer "l"

$n_H^{[l-1]} \times n_W^{[l-1]} \times n_C^{[l-1]}$

$n_H^{[l-1]}$ → height of Image in prev layer

$n_W^{[l-1]}$ → width of Image in prev. layer

$n_C^{[l-1]}$ → # channels

3 * Output

$n_H^{[l]} \times n_W^{[l]} \times n_C^{[l]}$ → # channels

$n_H^{[l]}$ → height of convoluted Image

$n_W^{[l]}$ → width of convoluted Image

4 Height of Image in output layer

$$n_H^{[l]} = \left\lfloor \frac{n_H^{[l-1]} + 2p^{[l]} - f^{[l]}}{s^{[l]}} + 1 \right\rfloor$$

5 Width of Image in output layer

$$n_W^{[l]} = \left\lfloor \frac{n_W^{[l-1]} + 2p^{[l]} - f^{[l]}}{s^{[l]}} + 1 \right\rfloor$$

10 * Weights of the layer "l"

$$\underbrace{f^{[l]} \times f^{[l]} \times n_C^{[l-1]}}_{\text{filter dim}} \times \underbrace{n_C^{[l]}}_{\text{\# filters}}$$

6 * $n_C^{[l]}$ = number of filters in layer l (= # channels that are outputted in layer l)

7 * Filter dimension

$$f^{[l]} \times f^{[l]} \times \underbrace{n_C^{[l-1]}}$$

↓ This must match # channels of input

8 * Activation dimension

$a^{[l]} = g(z^{[l]})$

$z^{[l]}$ = output at l^{th} layer

↳ ie, $n_H^{[l]} \times n_W^{[l]} \times n_C^{[l]}$

⇓

$\dim(a^{[l]})$

$= n_H^{[l]} \times n_W^{[l]} \times n_C^{[l]}$

9 * Vectorized Activation

$A^{[l]} = m \times n_H^{[l]} \times n_W^{[l]} \times n_C^{[l]}$

↑ # examples

11 * Bias

$n_C^{[l]}$ = # filters, can be written as $(1 \times 1 \times 1 \times n_C^{[l]})$