# Homework X

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Introduction to Signal and Image Processing

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## 1 Quadratic function

**Theorem 1.** *$ax^2 + bx + c = 0$ has 2 real roots if $D > 0$.*

*Proof.* This is my proof that $ax^2 + bx + c = 0$ has 2 real roots if $D > 0$.

$$x_{1,2} = \frac{-b \pm \sqrt{D}}{4ac}$$

□

An example of a quadratic function is shown on fig. 1.

## 2 2D convolution

We experiment with a box-filter and apply the built-in scipy function as in listing 1. An example filtered image is shown in fig. 2.

Listing 1: My 2D convolution approach.

```
from scipy import signal
img = plt.imread('cat.jpg').astype(np.float32)

def boxfilter(n):
    # this function returns a box filter of size nxn
    return (1./(n ** 2))*np.ones((n, n))

bsize = 10
box_filter = boxfilter(bsize)
conv_image_box = signal.convolve2d(img, box_filter)
```

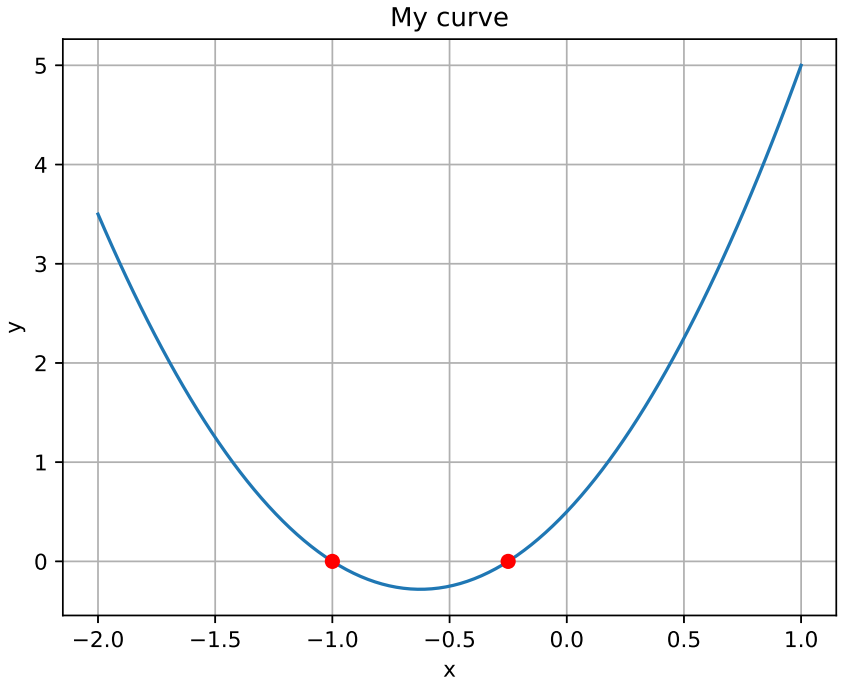


Figure 1: Example of quadratic function $a = 2$, $b = 2.5$, $c = 0.5$. Roots are highlighted in red.

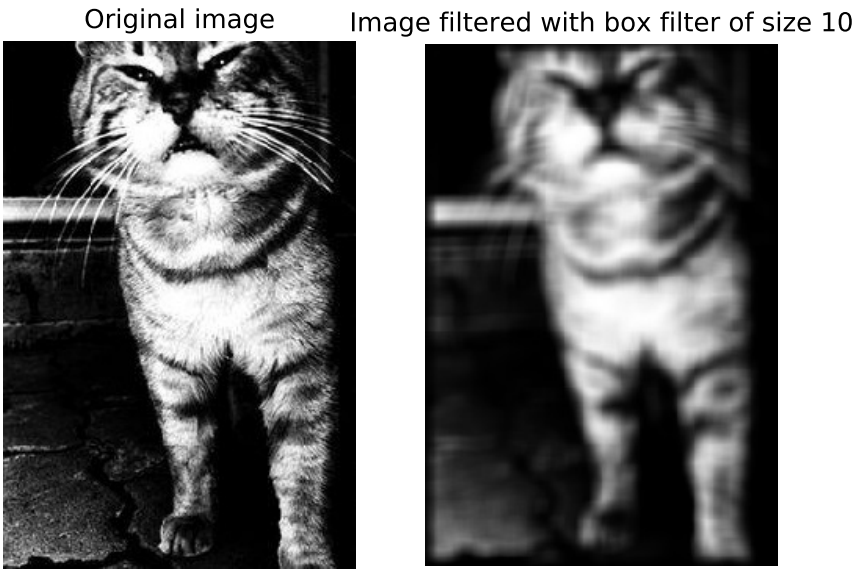


Figure 2: Filtering with a box-filter of size $10 \times 10$.