# Numerical

November 12, 2018

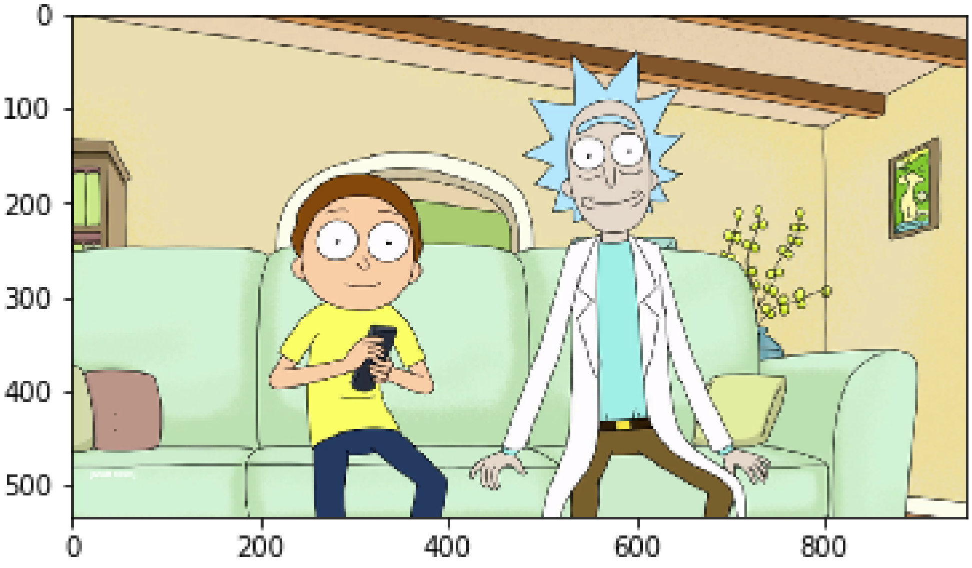
## 1 Edge detection with sobel filter

```
In [1]: import numpy as np
        import matplotlib.pyplot as plt
        from math import sqrt
        from PIL import Image
        import requests
        from io import BytesIO
```

```
In [2]: #Importing image from url
        response = requests.get("https://i.amz.mshcdn.com/ze5SEAuSgYdquI6DVj4TBqZczWQ=/950x534/f
        rickimg = Image.open(BytesIO(response.content))
        rick = np.asarray(rickimg)
        rick.setflags(write=1)
        print("Shape of image: "+ str(rick.shape))

        plt.imshow(rick)
```

```
Shape of image: (534, 950, 3)
```

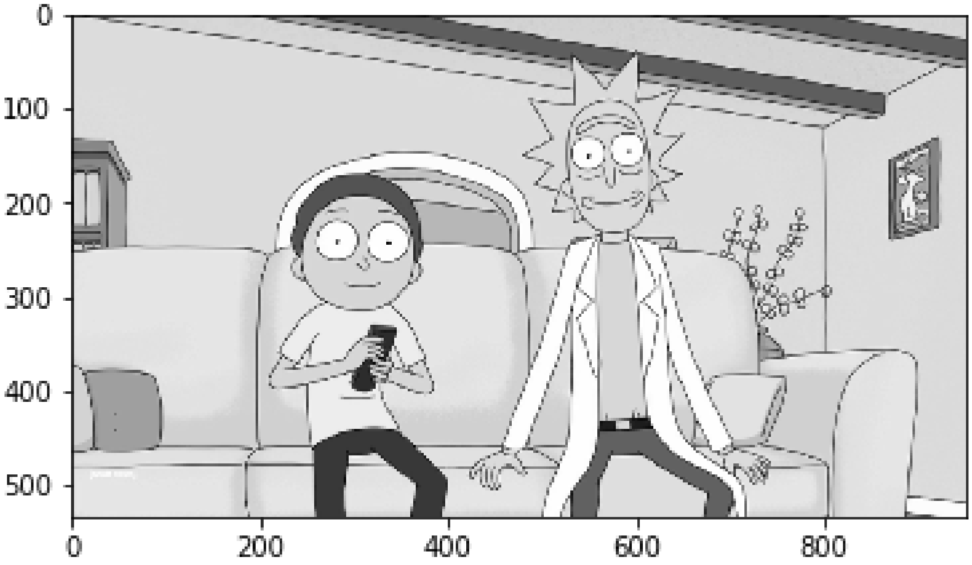
```
Out[2]: <matplotlib.image.AxesImage at 0x7fcb66855f28>
```



```
In [3]: #Converting image to grayscale
        #Each pixel get the greyscale value of 0.299*Red + 0.587*Green + 0.114*Blue.
        grayRick = np.dot(rick[...,:3], [0.299, 0.587, 0.114])

        print("Shape of image: "+ str(grayRick.shape))
        plt.imshow(grayRick, cmap = 'gray')
```

```
Shape of image: (534, 950)
```

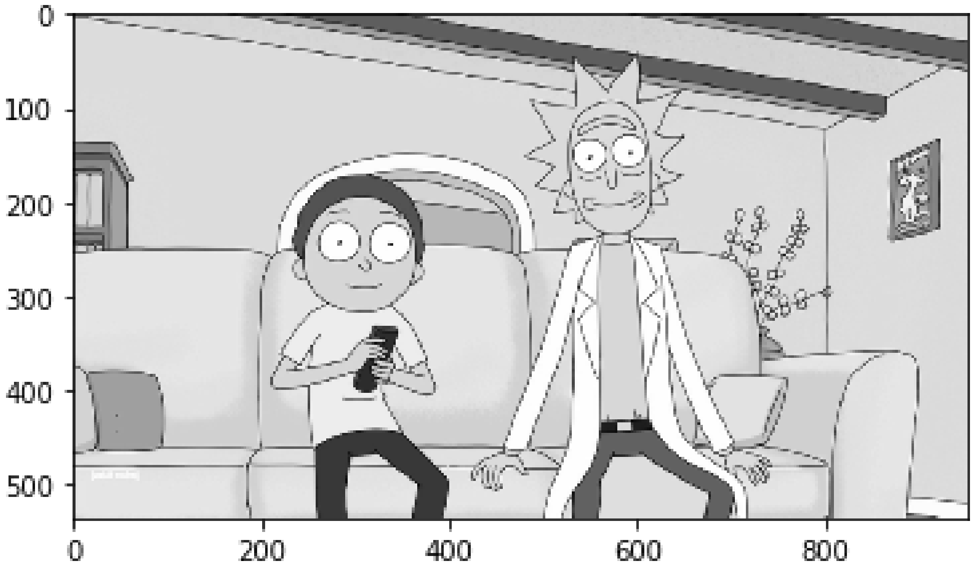
```
Out[3]: <matplotlib.image.AxesImage at 0x7fcb66678e48>
```



```
In [4]: # Adding a padding of zeros around the image, to be able to apply the sobel filter to th
        # edges of the picture.
        # From shape (534, 950) to (536, 952)
        paddedRick = np.pad(grayRick, ((1,1), (1,1)), 'constant')
        print("Shape of image: "+ str(paddedRick.shape))
        plt.imshow(paddedRick, cmap = 'gray')
```

```
Shape of image: (536, 952)
```

```
Out[4]: <matplotlib.image.AxesImage at 0x7fcb649d92e8>
```



```
In [5]: #creating the sobel filters
        sobel_vertical = np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]])
        sobel_horizontal = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]])
```

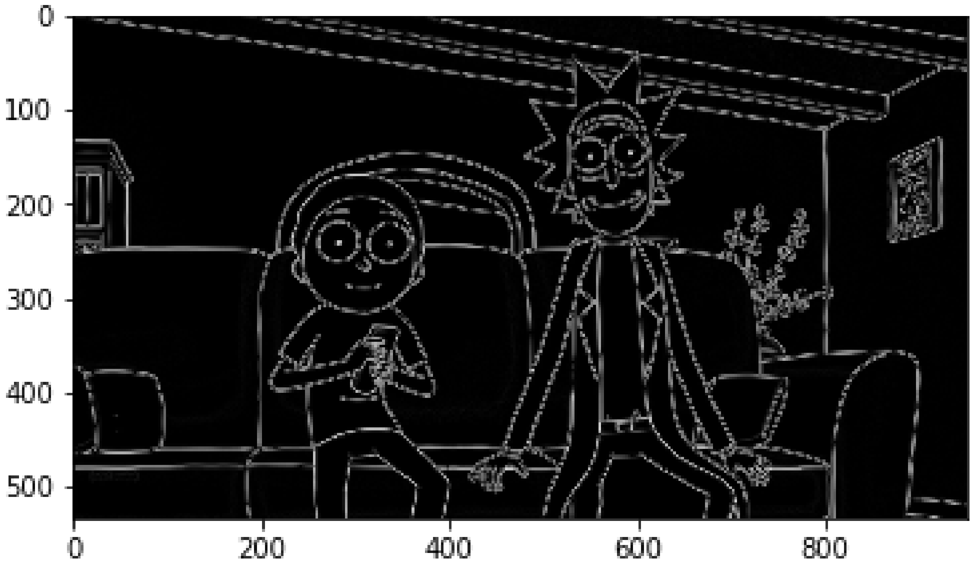
In this stage I convolve the kernels on the padded image. For each pixel inside the padding find the values from the two kernels.

result[i][j]=(sobel[0][0]*image[i-1][j-1]+sobel[0][1]*image[i-1][j]+...+sobel[2, 2]*image[i+1][j+1])

And then combine the absolute magnitude of the results in x- and y-direction: result = sqrt(result- x2+result-y2), and set the pixel value to this value.

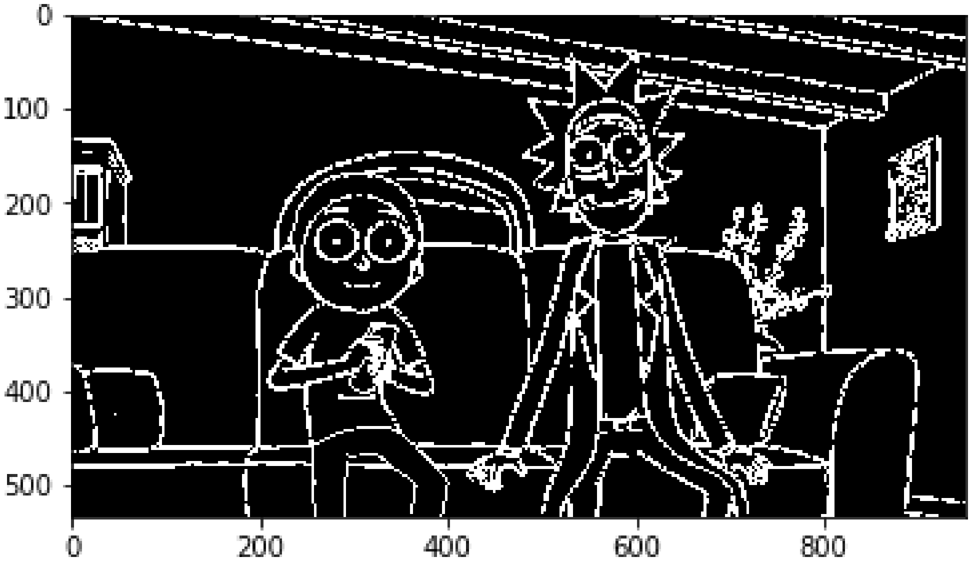
This way one would find the difference in intensity of the pixel evaluated and the neighbour pixels. This will result in an approximation of the gradient of the image intensity. High intensity pixels of the result image represent edges in the original picture.

```
In [6]: #applying sobel kernels
        edgeRick = grayRick.copy()
        for i in range(1, 535):
            for j in range(1, 951):
                Gx = 0
                Gy = 0
                for k in range(3):
                    for l in range(3):
                        Gx += sobel_vertical[k][l]*paddedRick[i-1+k][j-1+l]
                        Gy += sobel_horizontal[k][l]*paddedRick[i-1+k][j-1+l]
                edgeRick[i-1][j-1] = sqrt(Gx**2 + Gy**2)

        plt.imshow(edgeRick, cmap = 'gray')

Out[6]: <matplotlib.image.AxesImage at 0x7fcb649b83c8>
```



```
In [7]: #removing edges below a threshold, and highlighting those above
        finalRick = edgeRick.copy()
        threshold = 150
        for i in range(534):
            for j in range(950):
                if finalRick[i][j] > threshold:
                    finalRick[i][j] = 255
                else:
                    finalRick[i][j] = 0
        plt.imshow(finalRick, cmap = 'gray')
```

```
Out[7]: <matplotlib.image.AxesImage at 0x7fcb6490d2e8>
```


0
100
200
300
400
500
0
200
400
600
800