ml-scratch-pooling

December 19, 2023

1 More Filters!

[1]:
```
import numpy as np
import matplotlib.pyplot as plt
from scipy.ndimage import gaussian_filter
```

[2]:
```
img = plt.imread("ImageSq.jpeg")
Nx, Ny, Nz = np.shape(img)
print(f"Height: {Nx}, Width: {Ny}, RGB: {Nz}")
plt.imshow(img)
plt.show()
```

```
Height: 6069, Width: 4855, RGB: 3
```

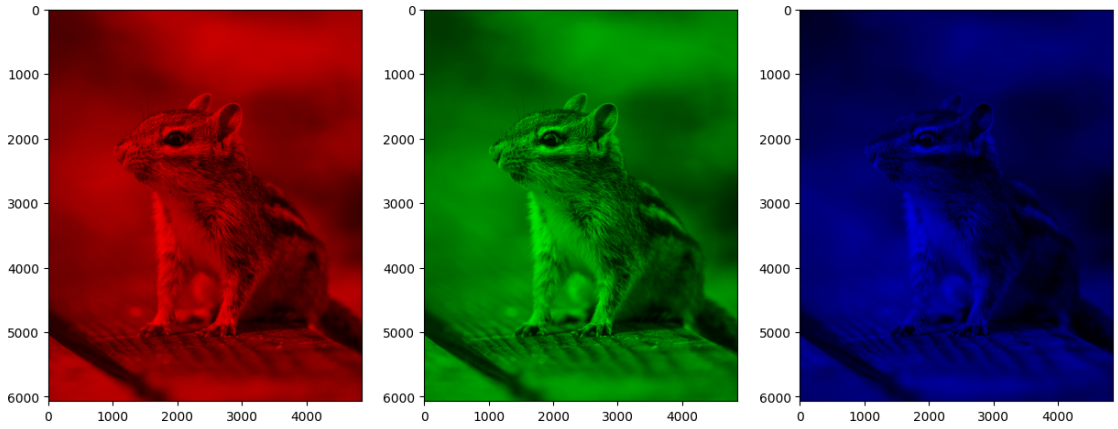
[3]:
```
print(img)
```

```
[[[ 86  62  38]
  [ 86  62  38]
  [ 86  62  38]
  …
  [164 132 109]
  [164 132 109]
  [164 132 109]]

 [[ 86  62  38]
  [ 86  62  38]
  [ 86  62  38]
  …
  [164 132 109]
  [164 132 109]
  [164 132 109]]

 [[ 86  62  38]
  [ 86  62  38]
  [ 86  62  38]
  …
  [164 132 109]
  [164 132 109]
  [164 132 109]]

 …

 [[156 129 100]
  [156 129 100]
  [156 129 100]
  …
  [146 118  94]
  [146 118  94]
  [146 118  94]]

 [[156 129 100]
  [156 129 100]
  [156 129 100]
  …
  [146 118  94]
  [146 118  94]
  [146 118  94]]

 [[156 129 100]
  [156 129 100]
```

```
 [156 129 100]
 …
 [146 118  94]
 [146 118  94]
 [146 118  94]]]
```

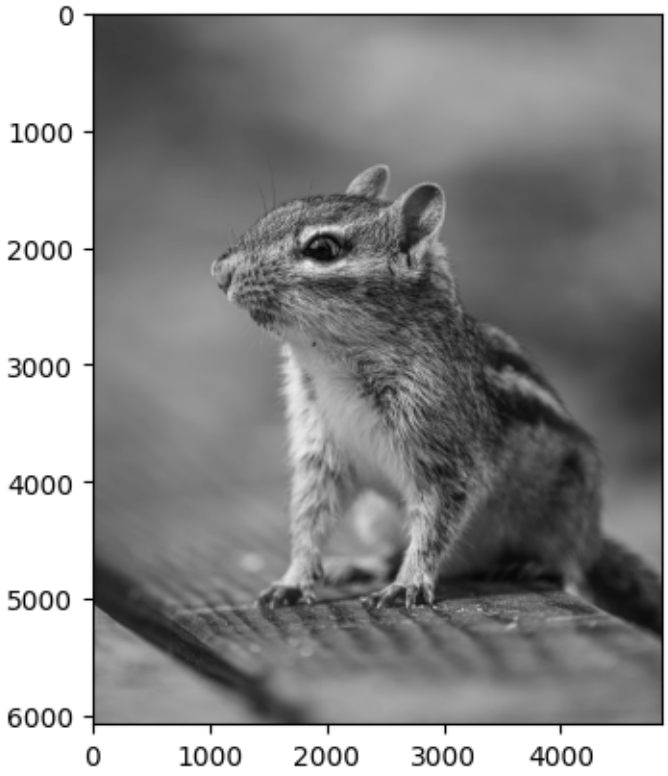
1.1 The RGB Channels

[4]:
```
imgR, imgG, imgB = img.copy(), img.copy(), img.copy()
imgR[:, :, (1, 2)] = 0
imgG[:, :, (0, 2)] = 0
imgB[:, :, (0, 1)] = 0
fig, ax = plt.subplots(nrows = 1, ncols = 3, figsize=(15, 15))
ax[0].imshow(imgR)
ax[1].imshow(imgG)
ax[2].imshow(imgB)
plt.show()
```



1.2 The Grayscale Image

[5]:
```
rgb_weights = [0.2989, 0.5870, 0.1140]
grayscale_image = np.dot(img, rgb_weights)
plt.imshow(grayscale_image, cmap = "gray")
plt.show()
```



[6]:
```
print(np.shape(grayscale_image))
print(grayscale_image)
```

```
(6069, 4855)
[[ 66.4314  66.4314  66.4314 … 138.9296 138.9296 138.9296]
 [ 66.4314  66.4314  66.4314 … 138.9296 138.9296 138.9296]
 [ 66.4314  66.4314  66.4314 … 138.9296 138.9296 138.9296]
 …
 [133.7514 133.7514 133.7514 … 123.6214 123.6214 123.6214]
 [133.7514 133.7514 133.7514 … 123.6214 123.6214 123.6214]
 [133.7514 133.7514 133.7514 … 123.6214 123.6214 123.6214]]
```

1.3 Max Pooling

[104]:
```
def max_pool(image, kernel_size, stride):
    image_height, image_width, channels = image.shape
    kernel_height, kernel_width = kernel_size[0], kernel_size[1]

    output_height = (image_height - kernel_height) // stride + 1
    output_width = (image_width - kernel_width) // stride + 1
    output = np.zeros((output_height, output_width, 3))
```

```
    for c in range(channels):
        for i in range(0, output_height * stride, stride):
            for j in range(0, output_width * stride, stride):
                output[i // stride, j // stride, c] = np.max(image[i : i +␣
↪kernel_height, j : j + kernel_width, c])

    final = output.astype(np.uint8)
    return final
```

[105]:
```
imgnew = max_pool(img, (3, 3), 3)
```

[106]:
```
imgnew
```

[106]:
```
array([[[ 86,  62,  38],
        [ 86,  62,  38],
        [ 86,  62,  38],
        …,
        [164, 132, 109],
        [164, 132, 109],
        [164, 132, 109]],

       [[ 86,  62,  38],
        [ 86,  62,  38],
        [ 86,  62,  38],
        …,
        [164, 132, 109],
        [164, 132, 109],
        [164, 132, 109]],

       [[ 86,  62,  38],
        [ 86,  62,  38],
        [ 86,  62,  38],
        …,
        [164, 132, 109],
        [164, 132, 109],
        [164, 132, 109]],


       …,

       [[160, 130, 102],
        [160, 130, 102],
        [160, 130, 102],
        …,
        [147, 119,  95],
        [147, 119,  95],
        [147, 119,  95]],
```

```
[[159, 129, 101],
 [159, 129, 101],
 [160, 130, 102],
 …,
 [147, 119,  95],
 [147, 119,  95],
 [147, 119,  95]],

[[156, 129, 100],
 [156, 129, 100],
 [156, 129, 100],
 …,
 [148, 120,  96],
 [146, 118,  94],
 [146, 118,  94]]], dtype=uint8)
```

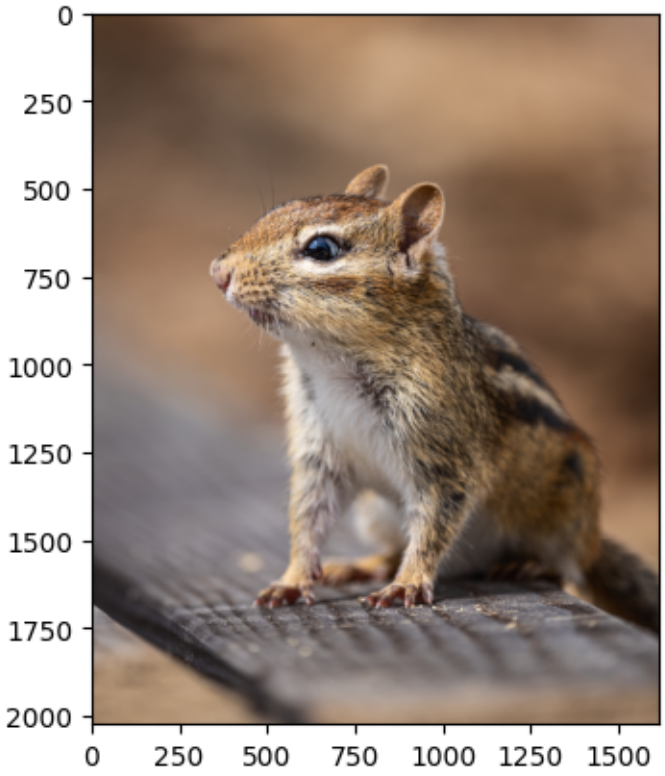
[107]:
```
imgnew.shape
```

[107]:
```
(2023, 1618, 3)
```

1.3.1 Max Pooled using 3×3 filter and stride $= 3$ Final Image: $(2023, 1618)$

[108]:
```
plt.imshow(imgnew)
```

[108]:
```
<matplotlib.image.AxesImage at 0x7e45ffabed70>
```



[109]:
```
plt.imsave("MaxPooled.jpeg", imgnew)
```

[110]:
```
imgnew1 = max_pool(imgnew, (3, 3), 3)
```

[111]:
```
imgnew1.shape
```

[111]:
```
(674, 539, 3)
```

1.3.2 Further Max Pooled using 3×3 filter and stride $= 3$ Final Image: $(674, 539)$

[112]:
```
plt.imshow(imgnew1)
```

[112]:
```
<matplotlib.image.AxesImage at 0x7e461814e050>
```

[113]:
```
plt.imsave("FurtherMaxPooled.jpeg", imgnew1)
```

1.4 Average Pooling

[114]:
```
def avg_pool(image, kernel_size, stride):
    image_height, image_width, channels = image.shape
    kernel_height, kernel_width = kernel_size[0], kernel_size[1]

    output_height = (image_height - kernel_height) // stride + 1
    output_width = (image_width - kernel_width) // stride + 1
    output = np.zeros((output_height, output_width, 3))

    for c in range(channels):
        for i in range(0, output_height * stride, stride):
            for j in range(0, output_width * stride, stride):
                output[i // stride, j // stride, c] = np.mean(image[i : i +␣
↪kernel_height, j : j + kernel_width, c])

    final = output.astype(np.uint8)
    return final
```

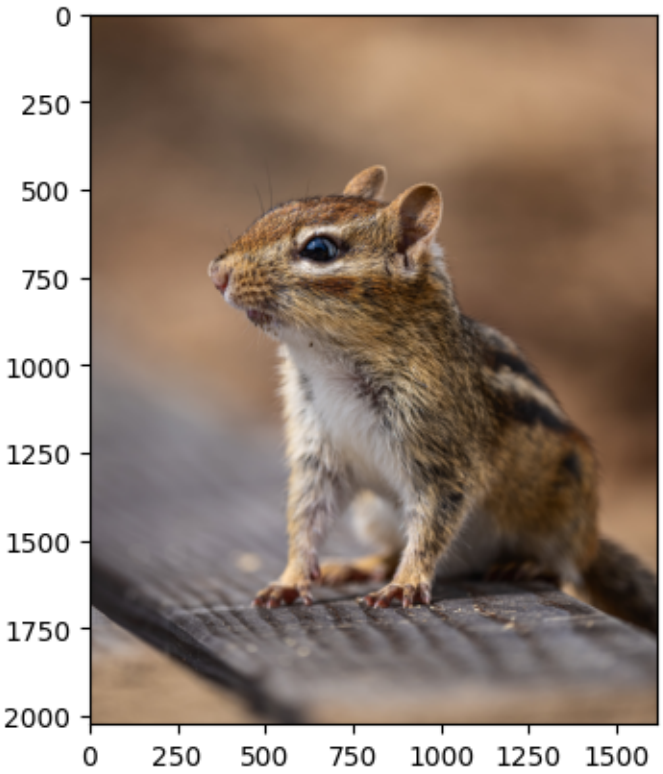
[115]:
```
imgavg = avg_pool(img, (3, 3), 3)
imgavg.shape
```

[115]:
```
(2023, 1618, 3)
```

1.4.1 Average Pooled using 3×3 filter and stride $= 3$ Final Image: $(2023, 1618)$

[116]:
```
plt.imshow(imgavg)
```

[116]:
```
<matplotlib.image.AxesImage at 0x7e45ff6cf160>
```



[117]:
```
plt.imsave("AvgPooled.jpeg", imgavg)
```