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>
> Pengolahan Citra Digital (Konvolusi)

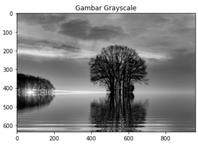
1.Korelasi dan konvolusi dengan perputaran 180 derajat

In [ ]:
```
import numpy as np
import matplotlib.pyplot as plt
import cv2
from scipy import signal
```

In [ ]:
```
from google.colab import files
files.upload()
```

In [ ]:
```
img = cv2.imread('gambar-pemandangan-png-5.png')
img = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
plt.title('Gambar Grayscale')
plt.imshow(img, cmap = 'gray') #Melakukan Plotting gambar
```

Out[ ]:
```
<matplotlib.image.AxesImage at 0x7f7431a33670>
```



In [ ]:
```
#Melakukan inisiasi perputaran matrix
e = 3
def rotasi (mat):
  i = e - 1;
  while (i>=0):
    j = e-1;
    while(j>=0):
      print(mat[i][j], end = " ");
      j = j-1;
    print();
    i = i-1;
  return mat
gauss = (1.0/16)*np.array([[1,2,1],[2,4,2],[1,2,1]])
gauss_rotate = rotasi (gauss.copy())
```

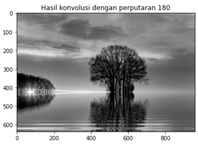
```
0.0625 0.125 0.0625
0.125 0.25 0.125
0.0625 0.125 0.0625
```

In [ ]:
```
#Melakukan korelasi gambar
img = cv2.imread('gambar-pemandangan-png-5.png')
img = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
correlation = signal.correlate2d (img, gauss_rotate)
plt.title ('Hasil korelasi dengan perputaran 180')
plt.imshow(correlation, cmap = 'gray')
```

Out[ ]:
```
<matplotlib.image.AxesImage at 0x7f7431a6d0d0>
```

In [ ]:
```
img = cv2.imread('gambar-pemandangan-png-5.png')
img = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
convolusi = signal.convolve2d (img, gauss_rotate)
plt.title('Hasil konvolusi dengan perputaran 180')
plt.imshow(convolusi, cmap = 'gray')
```

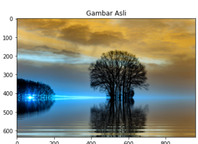
Out[ ]:
```
<matplotlib.image.AxesImage at 0x7f7f43183c760>
```



2. Melakukan perhitungan convolusi secara manual dengan FFT, kemudian bandingkan waktu yang diperlukan.

In [ ]:
```
img = cv2.imread('gambar-pemandangan-png-5.png')
plt.title('Gambar Asli')
plt.imshow (img)
```

Out[ ]:
```
<matplotlib.image.AxesImage at 0x7f74317cc490>
```



In [ ]:
```
#Mencetak matriks gambar
print(img)
```

```
[[[184 141  71]
  [186 141  71]
  [186 142  73]
  ...
  [212 194 148]
  [211 193 148]
  [211 193 149]]

 [[181 141  72]
  [184 142  71]
  [186 142  72]
  ...
  [211 193 147]
  [212 194 146]
  [212 194 149]]

 [[180 140  74]
  [181 141  72]
  [183 141  70]
  ...
  [213 194 148]
  [213 195 149]
  [213 195 151]]

 ...

 [[111 111 111]
  [111 110 110]
  [111 111 113]
  ...
  [141 109  52]
  [143 111  51]
  [143 111  54]]

 [[112 119 113]
  [111 117 113]
  [109 117 113]
  ...
  [144 110  55]
  [147 110  54]
  [144 112  54]]

 [[119 124 113]
  [119 122 113]
  [119 124 115]
  ...
  [144 107  51]
  [144 107  51]
  [144 108  51]]]
```

In [ ]:
```
#Membuat fungsi untuk konvolusi manual
def convolusi (X,Y):
  X_height = X.shape[0]
  X_width = X.shape[1]

  Y_height = Y.shape[0]
  Y_width = Y.shape[1]

  H = (Y_height)//2
  W = (Y_width)//2

  out = np.zeros((X_height, X_width))
  for i in np.arange (H+1, X_height - H):
    for j in np.arange (W+1, X_width - W):
      sum = 0
      for k in np.arange (-H,H+1):
        for l in np.arange (-W,W+1):
          a = X[i + k,  j + l]
          w = Y[H + k,  W + l]
          sum += (w*a)
      out[i,j] = sum
  return out
```

In [ ]:
```
img = cv2.imread('gambar-pemandangan-png-5.png')
img = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
mean = (1.0/9) *np.array([[1,1,1],[1,1,1],[1,1,1]])
img_out = convolusi(img,mean)
print(img_out) #Waktu yang diperlukan adalah 11s
```

```
[[  0.           0.           0.           ...   0.           0.
    0.          ]
 [  0.           0.           0.           ...   0.           0.
    0.          ]
 [  0.           0.         124.88888889 ... 183.77777778 184.33333333
    0.          ]
 ...
 [  0.           0.         111.88888889 ...  96.11111111  96.88888889
    0.          ]
 [  0.           0.         115.44444444 ...  95.66666667  96.22222222
    0.          ]
 [  0.           0.           0.           ...   0.           0.
    0.          ]]
```

In [ ]:
```
plt.imshow(img_out, cmap = 'gray', interpolation = 'bicubic')
plt.title('Hasil Konvolusi secara manual')
plt.xticks([],plt.yticks([]))
plt.show()
```

```
  File "<ipython-input-73-a16be79fb353>", line 1
    plt.imshow(img_out,cmap = 'gray' interpolation = 'bicubic')
                                     ^
SyntaxError: invalid syntax
```

In [ ]:
```

```

In [ ]:
```
from scipy import signal
img = cv2.imread('gambar-pemandangan-png-5.png')
imgg = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
y = signal.fftconvolve(imgg, mean, mode = 'full')
print('The convoluted sequence is ', y)
```

```
The convoluted sequence is  [[ 13.88888889  27.77777778  41.77777778 ...  60.66666667  40.44444444
   20.22222222]
 [ 27.77777778  55.66666667  83.66666667 ... 121.33333333  81.
   40.55555556]
 [ 41.66666667  83.44444444 125.33333333 ... 182.33333333 121.77777778
   61.        ]
 ...
 [ 38.55555556  76.77777778 115.44444444 ...  96.22222222  64.33333333
   32.33333333]
 [ 26.22222222  52.22222222  78.44444444 ...  63.88888889  42.66666667
   21.44444444]
 [ 13.33333333  26.55555556  40.         ...  31.44444444  21.
   10.55555556]]
```

In [ ]:
```
plt.imshow(y, cmap = 'gray', interpolation = 'bicubic')
plt.title('Hasil Konvolusi secara FFT ')
plt.xticks([],plt.yticks([]))
plt.show()
```