EN2550 - Fundamentals of Image Processing and Machine Vision

Excercise 01

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Index No.: 190504H

Part 1.

In [ ]:
```
for i in range(1,6):
  print(i, ':', i**2)
```

```
1 : 1
2 : 4
3 : 9
4 : 16
5 : 25
```

Part 2.

In [ ]:
```
import sympy
for i in range(1,6):
  if not sympy.isprime(i):
    print(i, ':', i**2)
```

```
1 : 1
4 : 16
```

Part 3.

In [ ]:
```
squares = [i**2 for i in range(1,6)]
for i,i2 in enumerate(squares):
  print(i+1, ':', i2)
```

```
1 : 1
2 : 4
3 : 9
4 : 16
5 : 25
```

Part 4.

In [ ]:
```
non_prime = [i for i in range(1,6) if not sympy.isprime(i)]
for i,i2 in enumerate(non_prime):
  print(i2, ':', i2**2)
```

```
1 : 1
4 : 16
```

Part 5. a)

In [ ]:
```
import numpy as np
A = np.array([[1,2],[3,4],[5,6]])
B = np.array([[7,8,9,1],[1,2,3,4]])
C = np.matmul(A,B)
print(C)
```

```
[[ 9 12 15  9]
 [25 32 39 19]
 [41 52 63 29]]
```

Part 5. b)

In [ ]:
```
A = np.array([[1,2],[3,4],[5,6]])
B = np.array([[3,2],[5,4],[3,1]])
C = np.multiply(A,B)
print(C)
```

```
[[ 3  4]
 [15 16]
 [15  6]]
```

Part 6.

In [ ]:
```
X = np.random.randint(10, size=(5,7))
print(X)
```

```
[[3 9 2 0 8 1 1]
 [0 3 5 8 1 4 7]
 [5 2 5 9 9 6 9]
 [6 7 5 7 7 2 5]
 [5 6 3 9 9 3 8]]
```

In [ ]:
```
X[2:5,0:2] #slicing
```

Out[ ]:
```
array([[1., 2.],
       [1., 3.],
       [1., 4.]])
```

Part 7.

In [ ]:
```
x = np.array([[1], [2], [3]])
y = np.array([4, 5, 6])

print('ex1 =',x+y)

x = np.array([[1,2,3], [4,5,6], [7,8,9], [10, 11, 12]])
v = 2

print('ex2 =',x*v)

x = np.array([1, 2, 3])
y = np.array([4, 5, 6])

print('ex3 =',x*y)
```

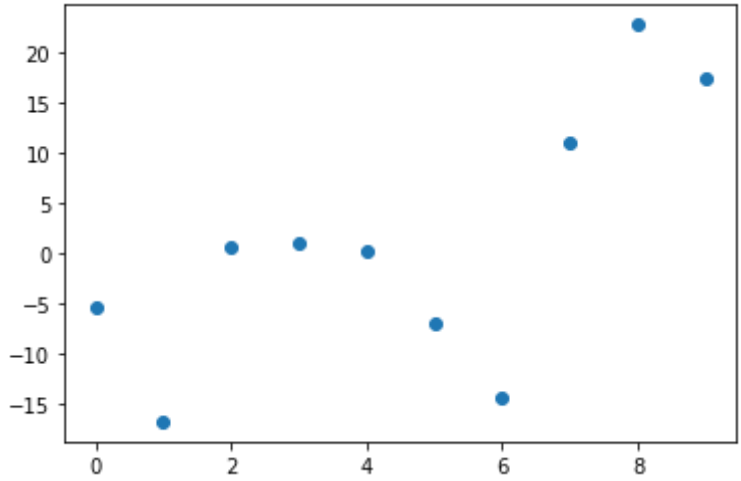
```
ex1 = [[5 6 7]
 [6 7 8]
 [7 8 9]]
ex2 = [[ 2  4  6]
 [ 8 10 12]
 [14 16 18]
 [20 22 24]]
ex3 = [ 4 10 18]
```

Part 8.

In [ ]:
```
import matplotlib.pyplot as plt

m,c = 2,-4
N = 10
x = np.linspace(0,N-1,N).reshape(N, 1)
sigma = 10
```

```
y = m*x + c + np.random.normal(0 , sigma , (N, 1))
plt.scatter(x,y)

X = np.append(np.ones((N,1)), x, axis=1)

Y = np.linalg.inv(X.T @ X)@ X.T @ y
print(Y)
```

```
[[-12.17740669]
 [  2.92184283]]
```



Part 10.

In [ ]:

```
import cv2 as cv

im = cv.imread(r'./Images/gal_gaussian.png')

blur = cv.GaussianBlur(im,(5,5),0)

cv.namedWindow('Image',cv.WINDOW_AUTOSIZE)
cv.imshow('Image',im)
cv.waitKey(0)
cv.imshow('Image',blur)
cv.waitKey(0)
cv.destroyAllWindows()
```

Part 11.

In [ ]:

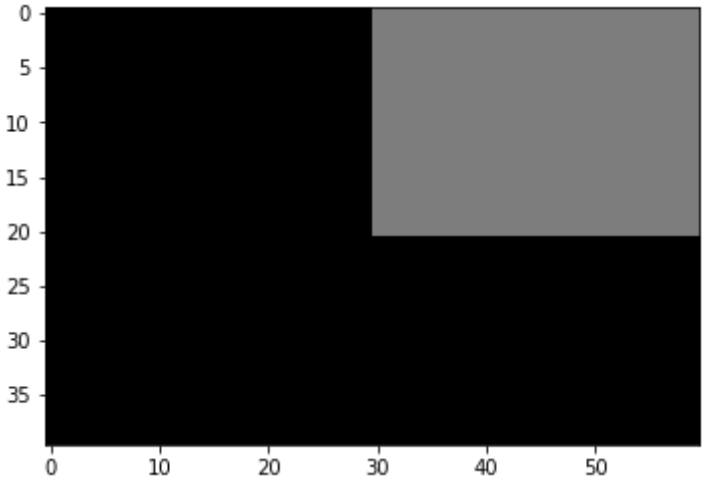
```
import cv2 as cv

im = cv.imread(r'./Images/gal_sandp.png')

median = cv.medianBlur(im,5)

cv.namedWindow('Image',cv.WINDOW_AUTOSIZE)
cv.imshow('Image',im)
cv.waitKey(0)
cv.imshow('Image',median)
cv.waitKey(0)
cv.destroyAllWindows()
```

Part 12.

In [ ]:

```
import numpy as np
import cv2 as cv
```

```
im = np.zeros((40,60),dtype = np.uint8)

im[0:21, 30:61] = 125

fig,ax = plt.subplots()
ax.imshow(im, cmap= 'gray', vmin=0 , vmax=255)
plt.show()
```



Part 13.

In [ ]:

```
import numpy as np
import cv2 as cv

im = np.zeros((40,60,3), dtype = np.uint8)

im[20:41, 0:31] = [132,24,218]

cv.imshow('Image',im)
cv.waitKey()
cv.destroyAllWindows()
```

Part 14.

In [ ]:

```
import cv2 as cv
import numpy as np

im = cv.imread(r'./Images/tom_dark.jpg')

beta = 75

new_im = im + beta

cv.imshow('Original Image', im)
cv.imshow('New Image', new_im)

cv.waitKey()
cv.destroyAllWindows()
```

Part 9. a)

In [ ]:

```
import numpy as np
a = 35
n = -2.5
S = a*10**(2*n)
```

```
S0 = ((-190/(a+20))+10)*10**n
print('S = ',S)
print('S0 = ',S0)
```

```
S =  0.00035000000000000005
S0 =  0.02069854468473848
```

Part 9. b)

In [ ]:

```
import numpy as np

f = lambda x: x**2 - S
f_prime = lambda x: 2*x
newton_raphson = S0 - (f(S0))/(f_prime(S0))
print("S^0.5 = " ,newton_raphson)
```

```
S^0.5 =  0.018803973031013867
```

Part 9. c)

In [ ]:

```
num = [64, 75, 100, 1600]
n = 1
for i in range(4):
    S = num[i]
    a = (S/(10**(2*n)))
    S0 = ((-190/(a+20))+10)*10**n

    f = lambda x: x**2 - S
    f_prime = lambda x: 2*x
    newton_raphson = S0 - (f(S0))/(f_prime(S0))
    print('square root of', S,'is',newton_raphson)
```

```
square root of 64 is 8.000185290224996
square root of 75 is 8.66329604130809
square root of 100 is 10.011904761904761
square root of 1600 is 40.552287581699346
```