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LAMPIRAN A

```
#otsu 2
# import required module
import os
import matplotlib as plt
import matplotlib.pyplot as plt
import numpy as np
import cv2
from skimage import data
from skimage.filters import threshold_multiotsu
import csv
matplotlib.rcParams['font.size'] = 9
# Setting the font size for all plots.
def createData(imageName, e_lines, e_circles, otsuResult, show=True):
  # The input image.
  image = cv2.imread(imageName,0)

  # Applying multi-Otsu threshold for the default value, generating
  # three classes.
  # thresholds = threshold_otsu(image)
  ret,th =
cv2.threshold(image,0,255,cv2.THRESH_BINARY+cv2.THRESH_OTSU)
  ret, thresh1 = cv2.threshold(image, 120, 255, cv2.THRESH_BINARY +
                                            cv2.THRESH_OTSU)

  # print(ret)
  # print(th)
  ret0 = [ret]
  # Using the threshold values, we generate the three regions.
  regions = np.digitize(image, bins=ret0)
```

```
fig, ax = plt.subplots(nrows=2, ncols=2, figsize=(28,28))

# Plotting the original image.
ax[0][0].imshow(image, cmap='gray')
ax[0][0].set_title('Original')
ax[0][0].axis('off')

# Plotting the histogram and the two thresholds obtained from
# multi-Otsu.
ax[0][1].hist(image.ravel(), bins=255)
ax[0][1].set_title('Histogram')
for thresh in ret0:
    ax[0][1].axvline(thresh, color='r')

# Plotting the Multi Otsu result.
ax[1][0].imshow(thresh1,cmap='gray')
ax[1][0].set_title('Otsu result')
ax[1][0].axis('off')

ax[1][1].hist(thresh1.ravel(), bins=255)
ax[1][1].set_title('Histogram Otsu')
for thresh1 in ret0:
    ax[1][1].axvline(thresh1, color='r')

plt.subplots_adjust()
if show == False:
   plt.close()
else :
  plt.show()
fig.savefig(otsuResult, dpi=300)
```

```
#deteksi garis
RGB = cv2.imread(imageName)

# Convert the img to grayscale
gray = cv2.cvtColor(RGB, cv2.COLOR_BGR2GRAY)

# Apply edge detection method on the image
edges = cv2.Canny(gray, 50, 150, apertureSize=3)



# This returns an array of r and theta values
lines = cv2.HoughLines(edges, 1, np.pi/18, 200)
# print(lines)
# The below for loop runs till r and theta values
# are in the range of the 2d array
backtorgb = cv2.cvtColor(image,cv2.COLOR_GRAY2RGB)
lines_pos = []
if lines is not None:
  for r_theta in lines:
      arr = np.array(r_theta[0], dtype=np.float64)
      r, theta = arr
      # Stores the value of cos(theta) in a
      a = np.cos(theta)

      # Stores the value of sin(theta) in b
      b = np.sin(theta)

      # x0 stores the value rcos(theta)
      x0 = a*r
```

```
        # y0 stores the value rsin(theta)
        y0 = b*r

        # x1 stores the rounded off value of (rcos(theta)-1000sin(theta))
        x1 = int(x0 + 1000*(-b))

        # y1 stores the rounded off value of (rsin(theta)+1000cos(theta))
        y1 = int(y0 + 1000*(a))

        # x2 stores the rounded off value of (rcos(theta)+1000sin(theta))
        x2 = int(x0 - 1000*(-b))

        # y2 stores the rounded off value of (rsin(theta)-1000cos(theta))
        y2 = int(y0 - 1000*(a))
        distance = np.linalg.norm([x1 - x2, y1 - y2])
        lines_pos_data = [x1,y1,x2,y2,distance]
        lines_pos.append(lines_pos_data)

        # cv2.line draws a line in img from the point(x1,y1) to (x2,y2).
        # (0,0,255) denotes the colour of the line to be
        # drawn. In this case, it is red.

        cv2.line(backtorgb, (x1, y1), (x2, y2), (0, 0, 255), 2)

    # All the changes made in the input image are finally
    # written on a new image houghlines.jpg

    cv2.imwrite("linesDetected.jpg", backtorgb)  #not necessary at the moment
    # Ll=len(lines)
```

```
# mendeteksi lingkaran
# Blur using 3 * 3 kernel.
gray_blurred = cv2.blur(gray, (3, 3))

# Apply Hough transform on the blurred image.
detected_circles = cv2.HoughCircles(gray_blurred,
                  cv2.HOUGH_GRADIENT, 1, 20, param1 = 50,
              param2 = 30, minRadius = 1, maxRadius = 40)

# Draw circles that are detected.
if detected_circles is not None:

    # Convert the circle parameters a, b and r to integers.
    detected_circles = np.uint16(np.around(detected_circles))

  # for pt in detected_circles[0, :]:
    #    a, b, r = pt[0], pt[1], pt[2]

        # Draw the circumference of the circle.
    #   cv2.circle(img, (a, b), r, (0, 255, 0), 2)

        # Draw a small circle (of radius 1) to show the center.
      #  cv2.circle(img, (a, b), 1, (0, 0, 255), 3)
      # cv2.imshow("Detected Circle", img)
        #cv2.waitKey(0)



#Deteksi lingkaran

# Read image.
img = cv2.imread(imageName)
```

```
# Convert to grayscale.
g = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

# Blur using 3 * 3 kernel.
gb = cv2.blur(g, (3, 3))

# Apply Hough transform on the blurred image.
dc = cv2.HoughCircles(gb,
            cv2.HOUGH_GRADIENT, 1, 20, param1 = 50,
        param2 = 30, minRadius = 1, maxRadius = 40)
# print("Ini lingkaran", dc[0])
# print("Garis" , lines)

# export 'lines' variable to csv
# export 'dc' variable to csv

# data lingkaran
data_circles = [['x', 'y', 'r']]
for data in dc[0]:
  data_circles.append(data)



# name of csv file
filename = e_circles

# writing to csv file
with open(filename, 'w', newline=") as csvfile:
    # creating a csv writer object
    csvwriter = csv.writer(csvfile)
```

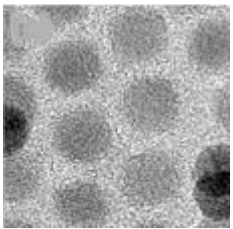
```
      # writing the data rows
      csvwriter.writerows(data_circles)

  # data garis
  data_lines = [['a', 'b','x1','y1','x2','y2','d']]
  if lines is not None:
    for i in range(len(lines)):
      dummy = [lines[i][0][0], lines[i][0][1]] + lines_pos[i]
      data_lines.append(dummy)
    # name of csv file
    filename = e_lines
    # writing to csv file
    with open(filename, 'w', newline='') as csvfile:
        # creating a csv writer object
        csvwriter = csv.writer(csvfile)
        # writing the data rows
        csvwriter.writerows(data_lines)
  return [ret, th, data_circles, data_lines]

def extractData(data, kategori):
  # Extract black and white value
  black = 0
  for subdata in data[1]:
    black += np.count_nonzero(subdata == 0)
  white = 0
  for subdata in data[1]:
    white += np.count_nonzero(subdata == 255)
  # Batas otsu
  batas_otsu = data[0]
  # print(black, white, batas_otsu)
  # Extract circles information
  jumlah_lingkaran =  len(data[2])-1
  # Sum all radius to get average
  sum_radius = round(sum([x[2] for x in data[2] if x[2] != 'r']), 2)
  average_radius = round(sum_radius/jumlah_lingkaran,2)
  # print(jumlah_lingkaran, sum_radius, average_radius)
  # Extract lines information
  jumlah_lines = len(data[3])-1
  # Sum all radius to get average
  sum_lines = round(sum([x[6] for x in data[3] if x[6] != 'd']), 2)
  try:
    average_lines = round(sum_lines/jumlah_lines,2)
  except:
    average_lines = 0
  # print(jumlah_lines, sum_lines, average_lines)
  return [black, white, batas_otsu, jumlah_lingkaran, average_radius,
jumlah_lines, average_lines, kategori]

#SVM
# assign directory
directory = 'cdots'
result_dir = "result_" + directory
# To export result, just upload your image to files folder and click run.
# iterate over files in
# that directory
hasil = []
for filename in os.listdir(directory):
    f = os.path.join(directory, filename)
    # checking if it is a file
    if os.path.isfile(f):
        f_temp = os.path.join(result_dir, os.path.splitext(filename)[0])
        # Set last parameter to True to show result, False to only save it. The value is
False by Default.
        data = createData(f, "{}-lines.csv".format(f_temp), "{}-
circles.csv".format(f_temp), "{}-otsu-result.jpg".format(f_temp), False)
        hasil_temp = extractData(data, directory)
        hasil.append(hasil_temp)
        print("{} done!".format(filename))

data_hasil = [['black',
'white','batas_otsu','n_lingkaran','average_radius','n_lines','average_line_length',
'kategori']]
for sub_data in hasil:
  data_hasil.append(sub_data)
with open('datasvm-cdots.csv', 'w', newline=") as csvfile:
    csvwriter = csv.writer(csvfile)
    csvwriter.writerows(data_hasil)

# Importing required libraries
from seaborn import load_dataset, pairplot
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.svm import SVC
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
df = pd.read_csv('data.csv')
# df = df.drop(columns=['average_line_length'])
# Print the first 5 rows of the DataFrame
print(df.head())
#print(df.head())
# Dropping missing records
pairplot(df, hue='kategori')
```

```
plt.show()

X = df[['black', 'n_lingkaran']]
y = df.iloc[:, -1]

X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=100)

# Building and training our model
clf = SVC(kernel='linear')
clf.fit(X_train, y_train)

import numpy as np
from seaborn import scatterplot
w = clf.coef_[0]
b = clf.intercept_[0]
x_visual = np.linspace(55,70) #Disesuaikan
y_visual = -(w[0] / w[1]) * x_visual - b / w[1]

scatterplot(data = X_train, x='black', y='n_lingkaran', hue=y_train) #Disesuaikan
plt.plot(x_visual, y_visual)
plt.show()
```

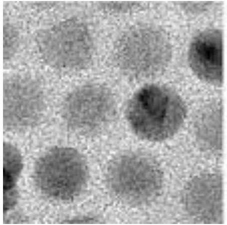
LAMPIRAN B

Kumpulan gambar TEM C-dots dan Non C-dots.

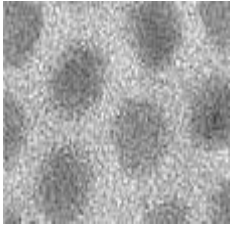
C dots 1



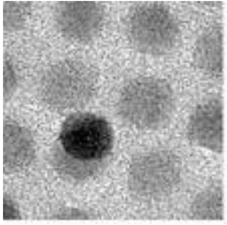
C dots 2



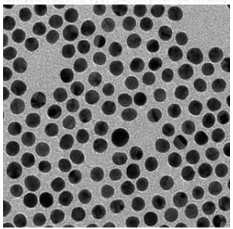
C dots 3



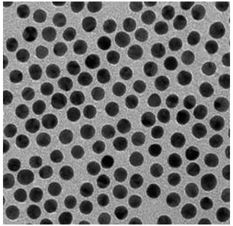
C dots 4



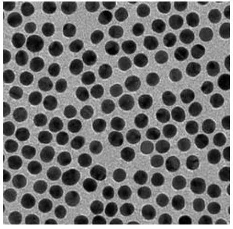
C dots 5



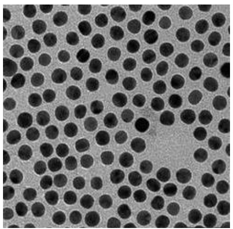
C dots 6



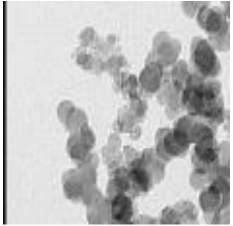
C dots 7



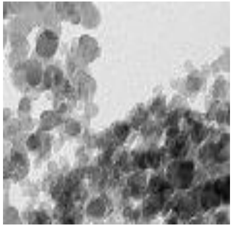
C dots 8



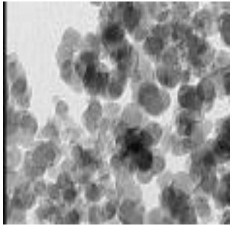
C dots 9



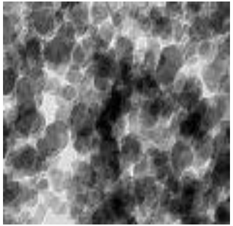
C dots 10



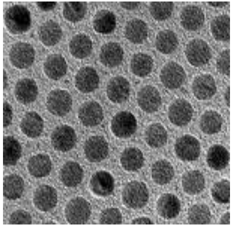
C dots 11



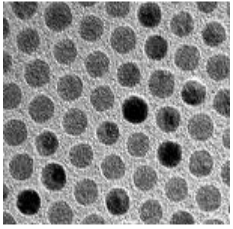
C dots 12



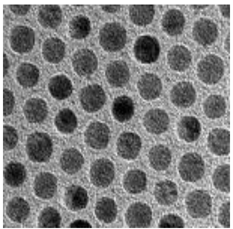
C dots 13



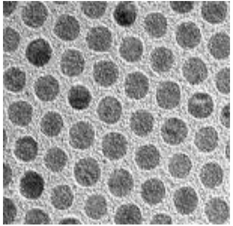
C dots 14



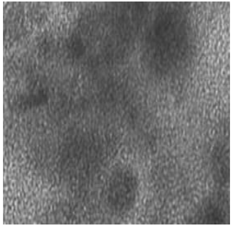
C dots 15



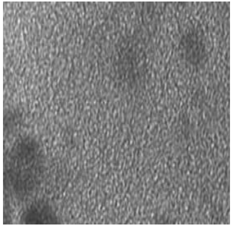
C dots 16



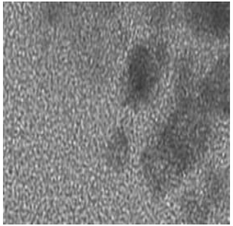
C dots 17



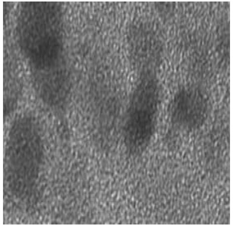
C dots 18



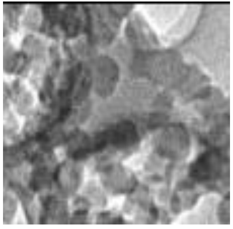
C dots 19



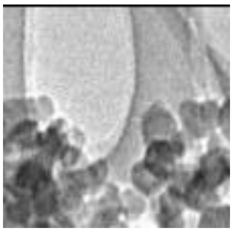
C dots 20



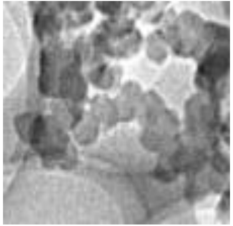
C dots 21



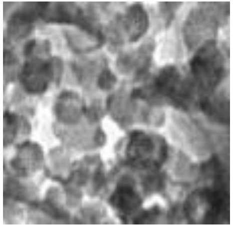
C dots 22



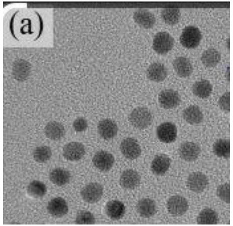
C dots 23



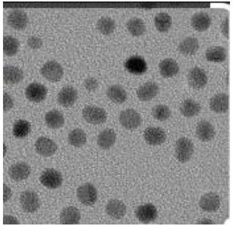
C dots 24



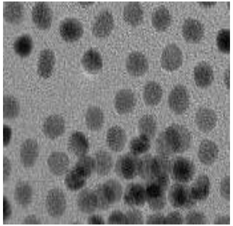
C dots 25



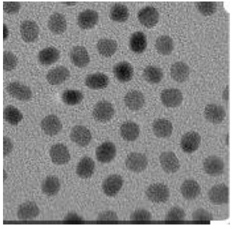
C dots 26

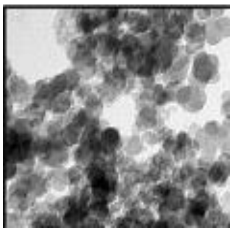
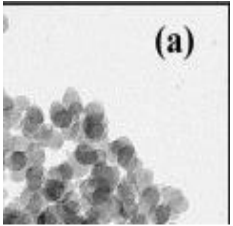
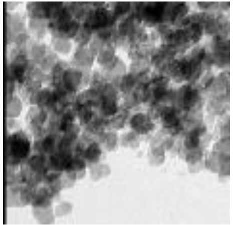
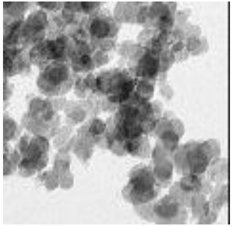
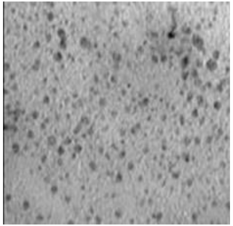
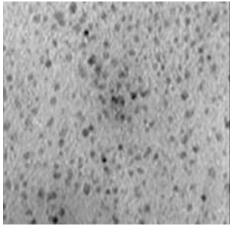
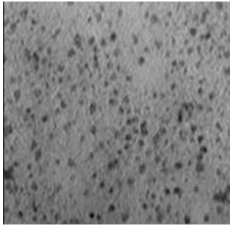


C dots 27

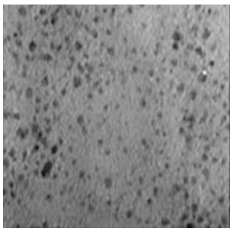


C dots 28

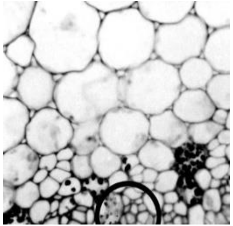


C dots 29	
C dots 30	
C dots 31	
C dots 32	
C dots 33	
C dots 34	
C dots 35	

C dots 36



C dots 37



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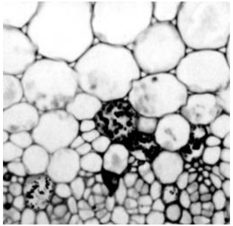
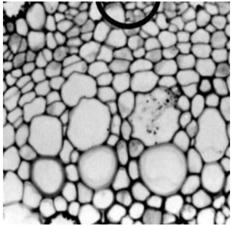


C dots 39



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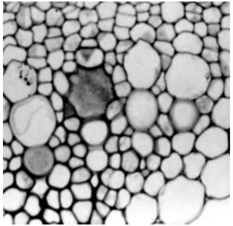

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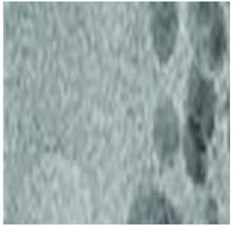
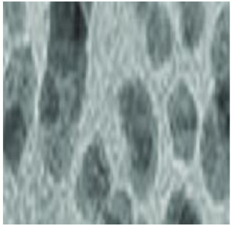


C dots 42



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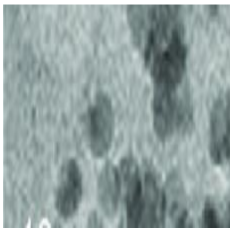

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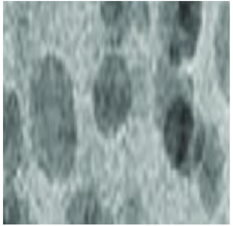

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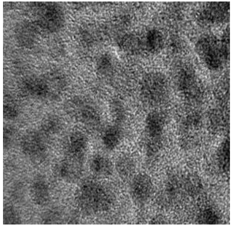

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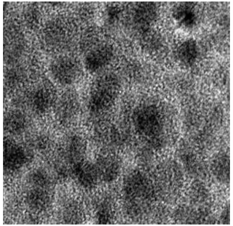
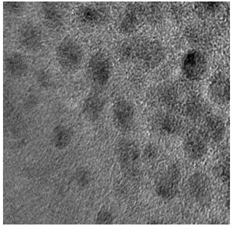
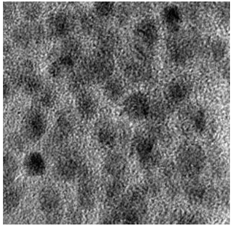


C dots 47



C dots 48



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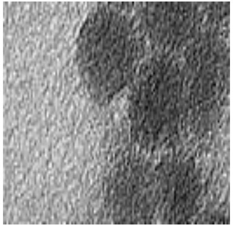
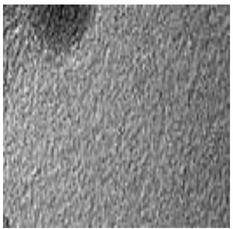
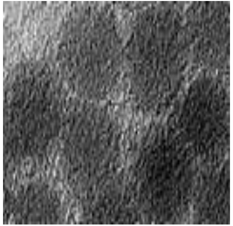


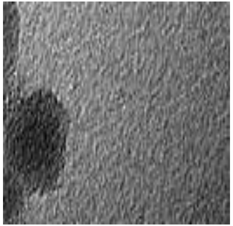
C dots 50



C dots 51



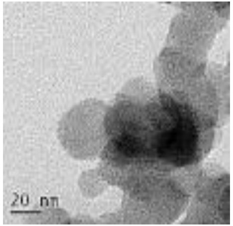
C dots 52



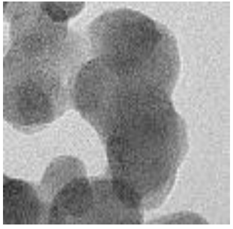
C dots 53

C dots 54

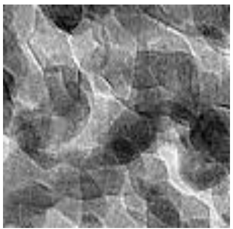
C dots 55



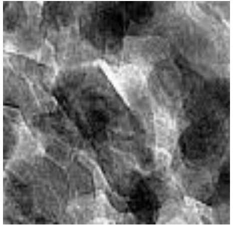
C dots 56



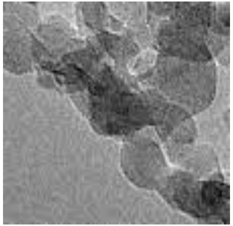
C dots 57



C dots 58



C dots 59



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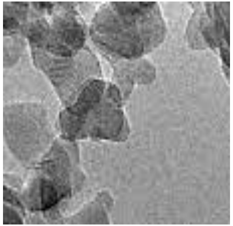

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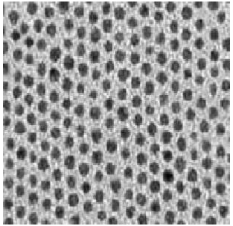
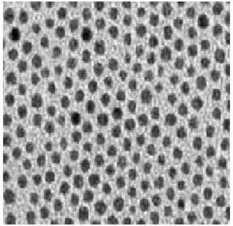
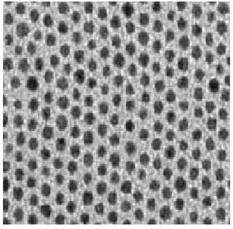


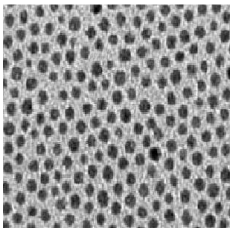
C dots 62



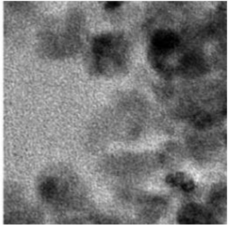
C dots 63



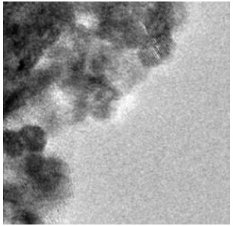
C dots 64



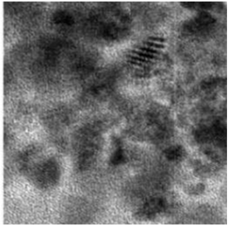
C dots 65



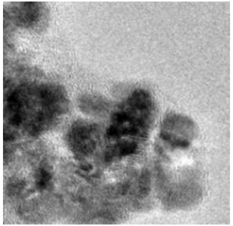
C dots 66



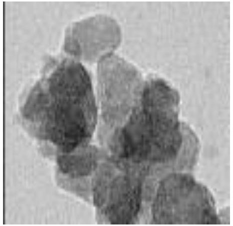
C dots 67



C dots 68

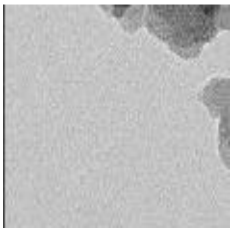


C dots 69

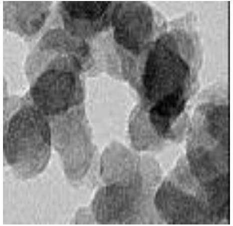


C dots 70

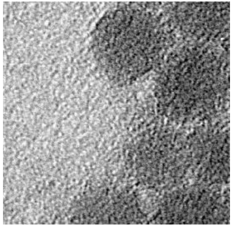
C dots 71



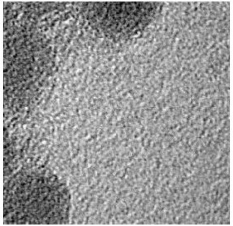
C dots 72



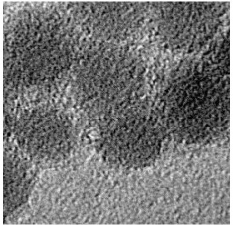
C dots 73



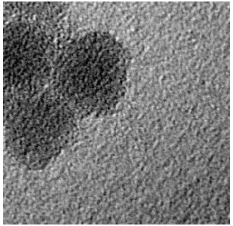
C dots 74



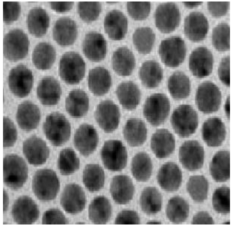
C dots 75



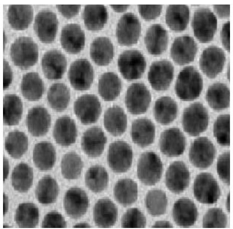
C dots 76



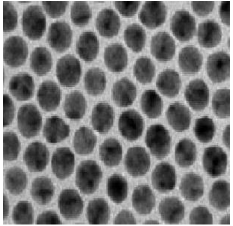
C dots 77



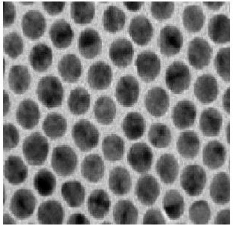
C dots 78



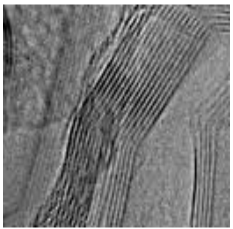
C dots 79



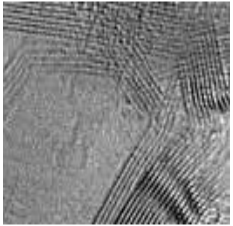
C dots 80



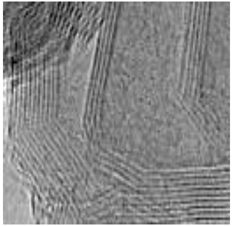
Non C dots 1



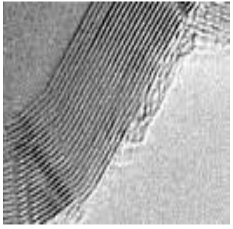
Non C dots 2



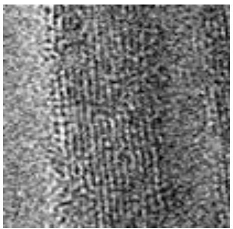
Non C dots 3



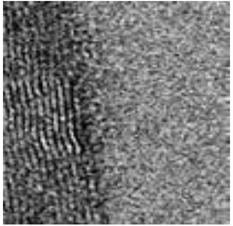
Non C dots 4



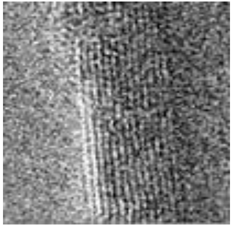
Non C dots 5



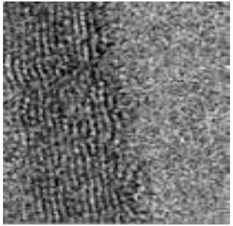
Non C dots 6



Non C dots 7



Non C dots 8

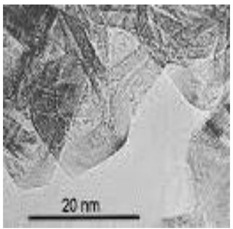


Non C dots 9

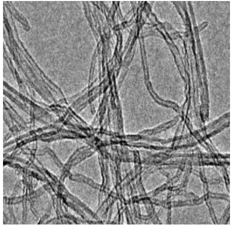
Non C dots 10

Non C dots 11

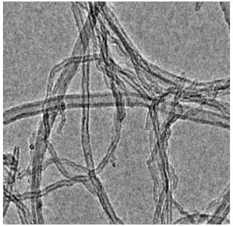
Non C dots 12



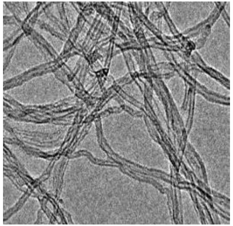
Non C dots 13



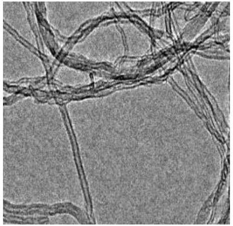
Non C dots 14



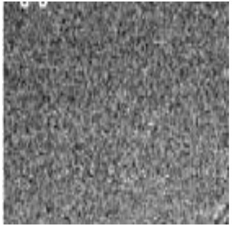
Non C dots 15



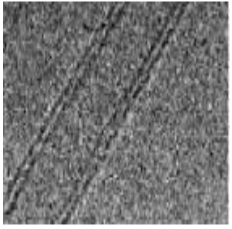
Non C dots 16



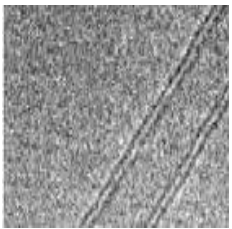
Non C dots 17



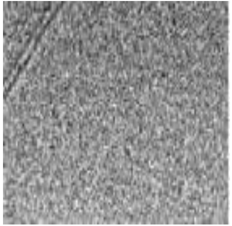
Non C dots 18



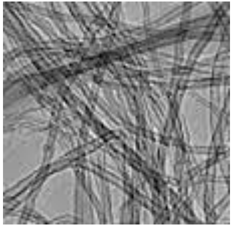
Non C dots 19



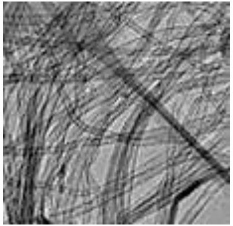
Non C dots 20



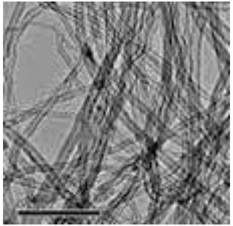
Non C dots 21



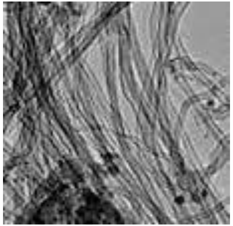
Non C dots 22



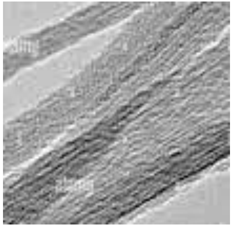
Non C dots 23



Non C dots 24



Non C dots 25



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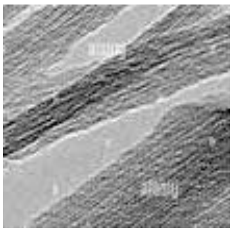

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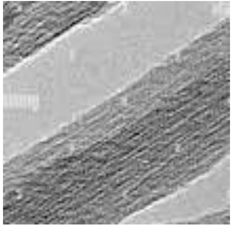

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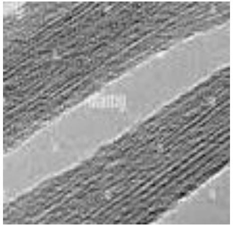

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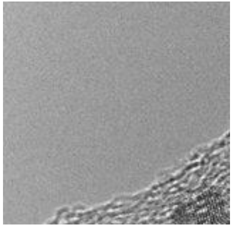

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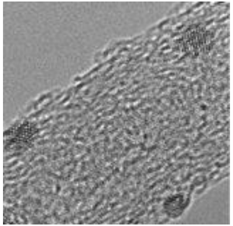

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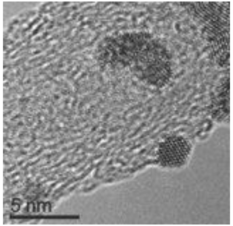

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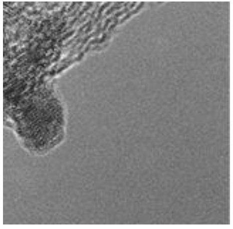

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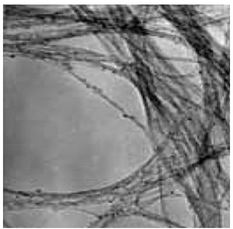

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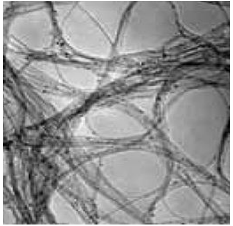

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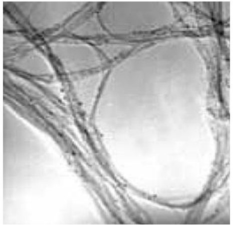

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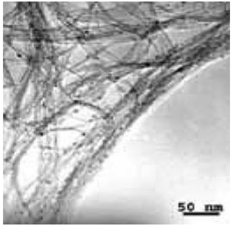

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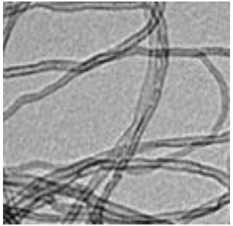

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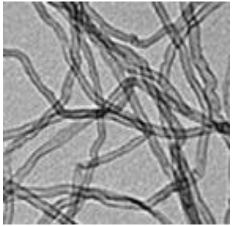

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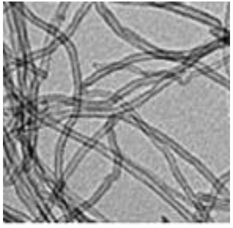

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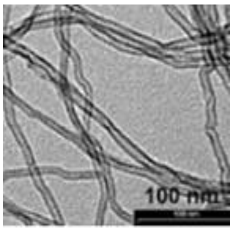

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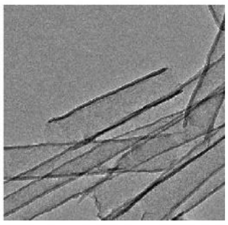

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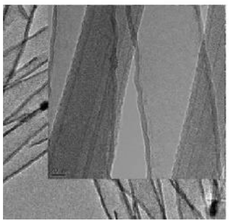

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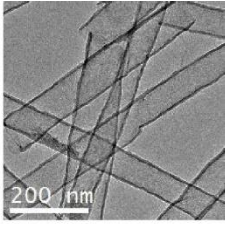

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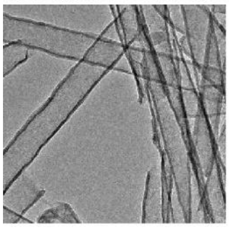

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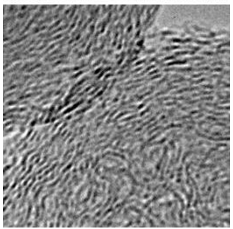

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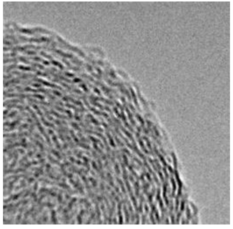

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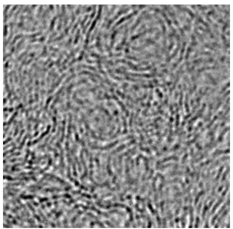

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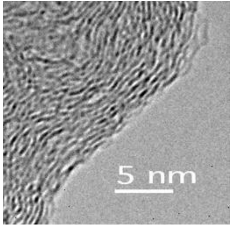

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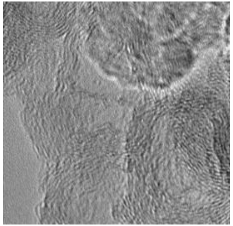

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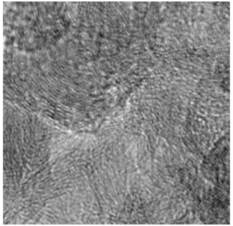

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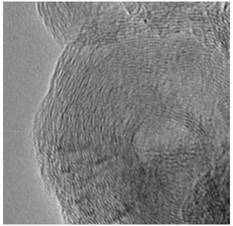

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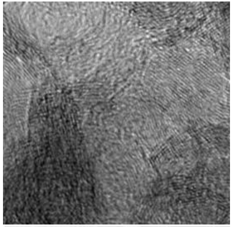

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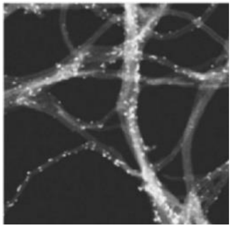

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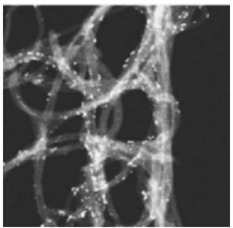

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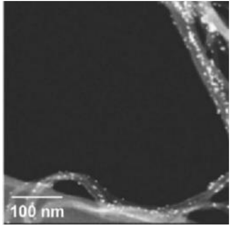

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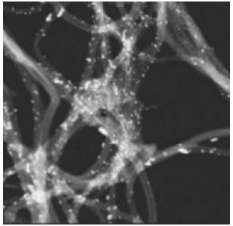

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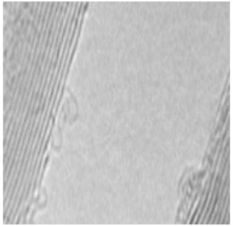

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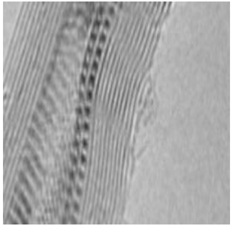

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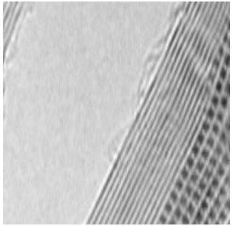

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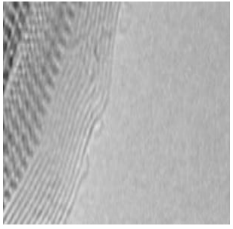

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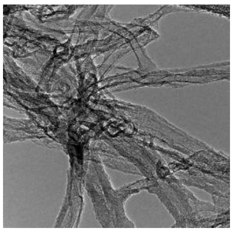

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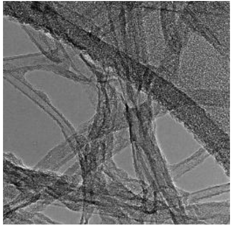

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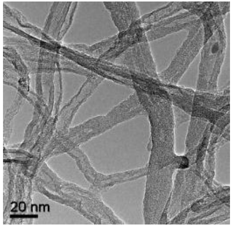

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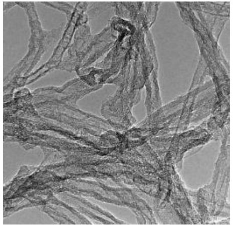

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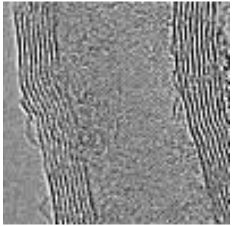

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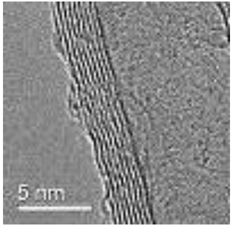

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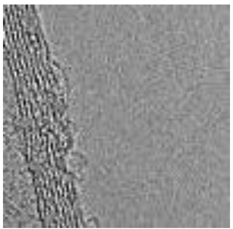

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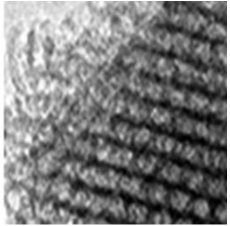

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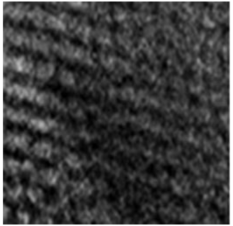

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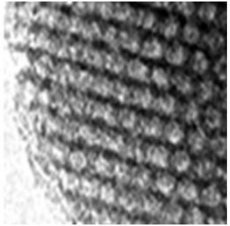

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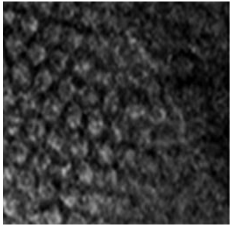

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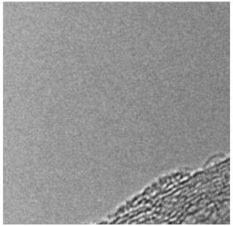

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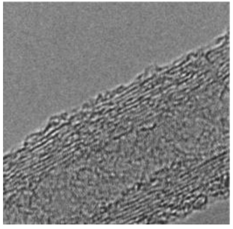

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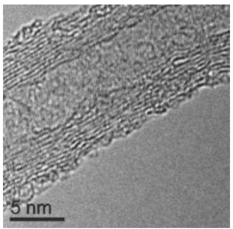

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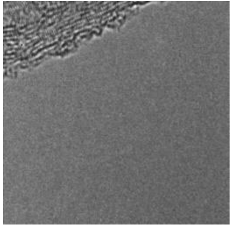

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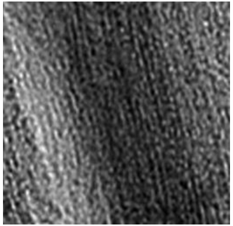

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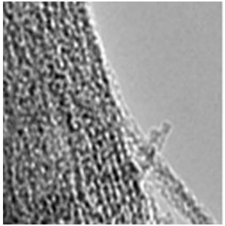

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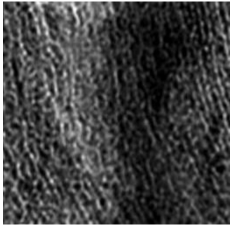

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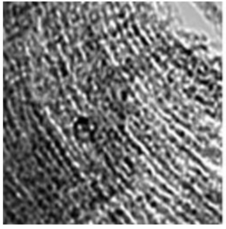
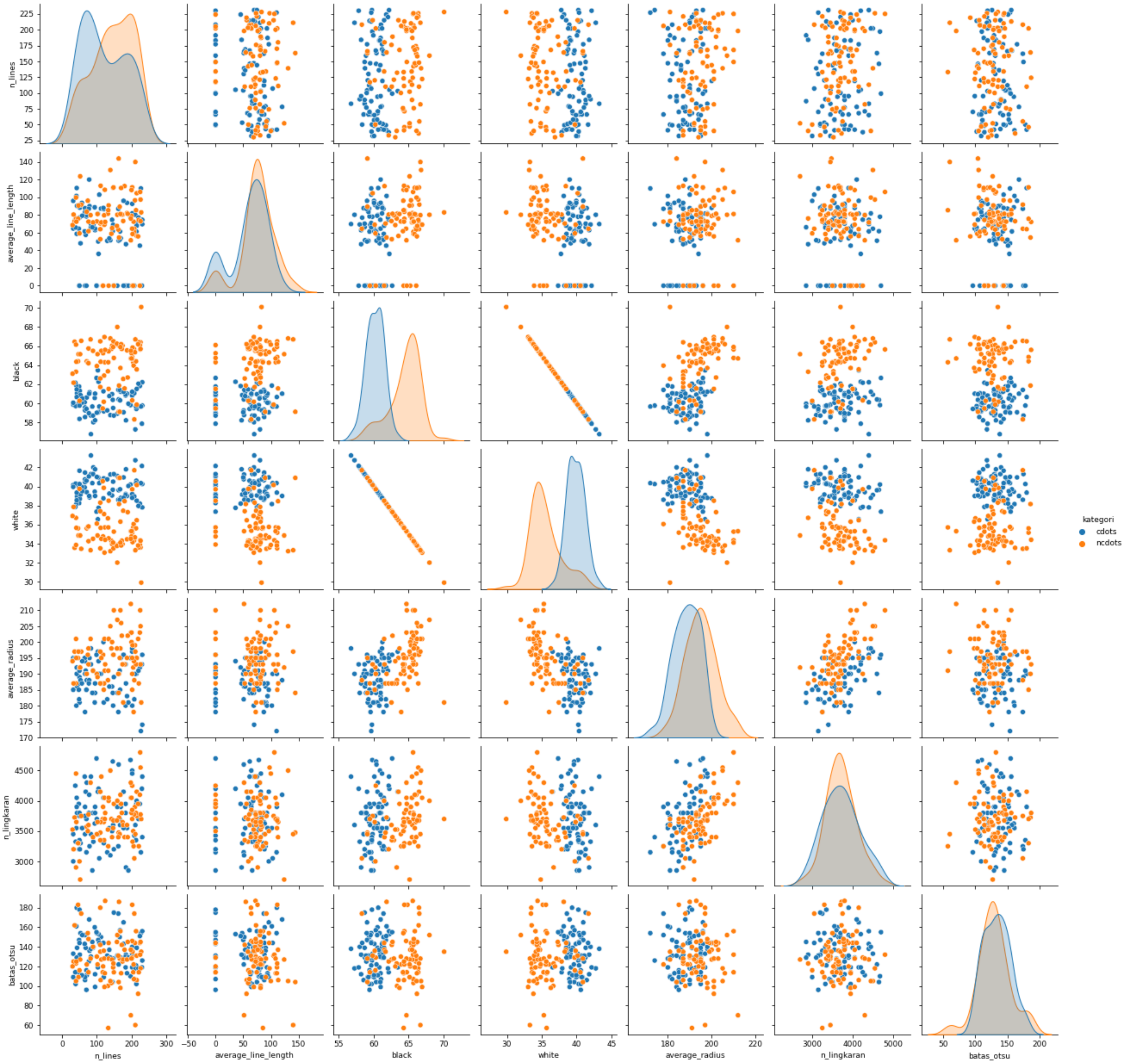


Lampiran C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