CS563 - IMAGE ANALYSIS

ASSIGNMENT-1

Group members:

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Given Problem:

Perform a series of image analysis operations like erosion, dilation followed by connected component analysis of given images to obtain the following results:

- Binary image of the given grayscale images
- Clean output of all detected objects from the images
- Features like perimeter, area, second moments, centroid and circularity
- Bounding box for each identified object

Summary of choices made for the solution:

- In order to complete this assignment we had used python programming language
- For basic tasks (like reading and viewing the image...) we used OpenCV library
- We used OpenCV library to perform dilation and eroding on an image
- For each step we created a function to perform that particular step, for example : we created a function convert_to_binary to convert the given image to binary image and resize_image function to rescale the image if the image is too big…etc
- List of function names and its use :

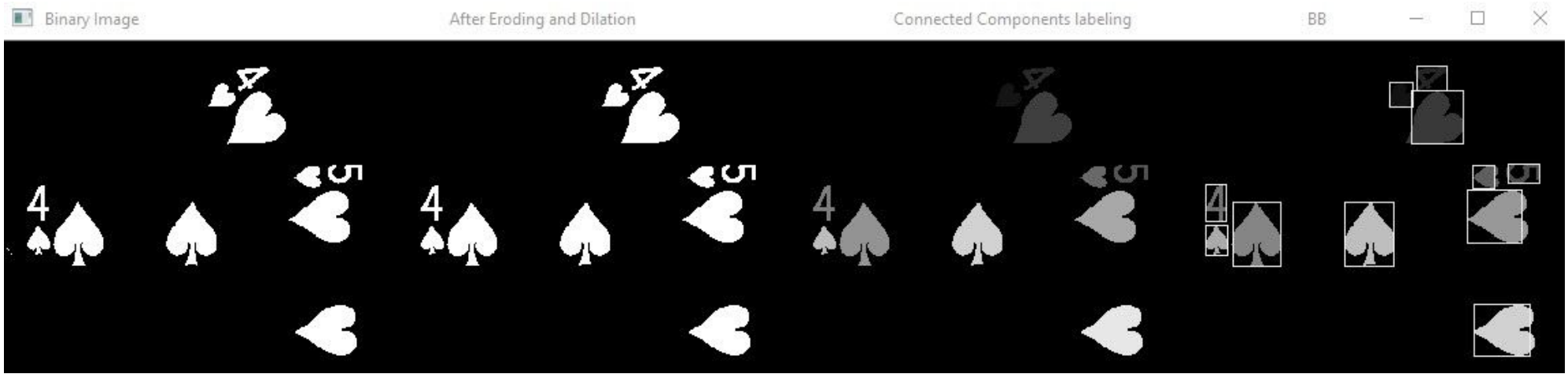
Function name	Input parameters	Function use
stackImages(scale,imgArray)	scale imgArray is the array of image variables which you want to show side by side	All the images created during the process are stacked together by this function and displays them side by side for easy view
welcome_user()	None	To output a welcome message for the user
user_input()	None	To take the name or path of the image to be analysed by the user
get_image_name(image_path)	Image path that is input by the user	Extracts the name from the complete path for further use in the program
set_params(image_name)	Image name	Sets the threshold value and defines a structuring element based on the image used.

scan_image(image_path)	Image path that is input by the user	To read and store the image for further operations
resize_image(image,height,width)	Image as a 2D array of pixel grayscale values from the scan_image function, height of the image and width of the image in pixels	If the image is too large then it reduces the size for faster and easier analysis
convert_to_binary(image,thres_val,name)	Image as a 2D array of pixel grayscale values, threshold value from set_params function and name of the image	Returns an image as a 2D array of binary values (0 for background and 1 for foreground).
closing_operation(image,kernel,name)	Image as a 2D array of binary values, structuring element, and name of the image	Performs erosion followed by dilation on the provided binary image to filter out the noise from the image.
connected_component_analysis(img,height,width,name)	Image as a 2D array of binary values, height and width of the image in pixels and name of the image	This performs connected component analysis of the given image by implementing the row-by-ro algorithm. It uses a series of loops to first negate the binary image, then to perform row-by-row analysis and finally to find equivalencies in the labels
additional_filter(image,height,width)	Image as a 2D array of binary values, height and width of the image in pixels	This removes unwanted components like vertical and horizontal lines, and small dots by enforcing a minimum area for the component and also determining the aspect ratio of the component. Aspect ratio which is too greater than 1 denotes horizontal lines while too less than 1 denotes vertical lines.
area(image,labels)	Image as a 2D array of labels derived from connected component analysis and list of labels	It calculates the area of each labelled component by looping over the image label by label and counts the number of occurrences of each label.
no_of_objects(labels)	List of labels	It gives the number of objects recognized by the program. Prints the length of labels list.
centroid_point(image,labels,areas_for_labels)	Image as a 2D array of labels derived from connected component analysis and list of area values for each object present in the image.	This function calculates the centroid points for each object present in the image.At first the image array is looped by row and sums up the number of labeled pixels present in each row multiplied by the row index number.That summed value is divided by the area of that image to get the row centroid point.Similar steps are used to find column centroid point except this time the image is looped through the column.In this way the function finds both row and column centroid point.
perimeter(image,labels)	Image as a 2d array of labels derived from connected component analysis, and the list of labels	It determines the perimeter of each labelled object by looping over each pixel and checking its N8 neighbouring pixels for the same value. If all neighbouring pixels are the same as the current pixel then that pixel is changed to a zero in a copy of the current image. Finally it counts all the non-zero pixels in that copied image which gives us the perimeter of an object.

circularity(perimeters,areas_for_labels)	List of perimeter values for each object in the image and list of area values for each object present in the image.	This function calculates the circularity value for each object present in the image. It uses the perimeter and area values for each object and uses |perimeter|^2/area formulae to calculate the circularity value.
second_moments(image,labels,areas_for_labels)	Labeled Image as a 2D array, list of labels used for labeling the image and list of area values for each objects present in the image	This function calculates the second-order row moment, second-order mixed moment and second-order column moment for each object in the image.
evaluate_bounding_box(labels, image,name)	List of area values for each objects present in the image,Labeled Image as a 2D array and name you want to give for the saved file	Draws the bounding box around all the objects present in the image. It loops through the image label by label. It counts the number of rows that label is present in to determine height and then finds the maximum number of columns which contains the label to determine width. This basically gives a range of top, bottom, left and right on which we can loop through and change the pixel value to the grayscale value of our desired border color.

Results:

Output for image1.pgm:



The above is the stacked image of four different images (binary image, After applying eroding and dilation on image, connected component labeling image and bounding box image)

Below are the text output for image1.pgm

Run: Nitish and Moid - Final Image analysis assignment 1

```
C:\Users\91637\.conda\envs\opencv\python.exe "C:/Users/91637/Desktop/opencv final/resources/Nitish and Moid - Final Image analysis assignment 1.py"
* * * * * * * * * * * * * * * * * * * * * * * *
*                                               *
*          Welcome to image analyzer            *
*          This application will take           *
*          an image as input and perform        *
*          following operations:                *
*                                               *
*                                               *
* 1) Conversion to binary                       *
* 2) Erosion                                    *
* 3) Dilation                                   *
* 4) Connected component analysis               *
* 5) Perimeter calculation for components       *
* 6) Area calculation for components            *
* 7) Circularity calculation for components     *
* 8) Second moments calculation for components  *
* 8) Bounding box evaluation for components     *
*                                               *
* * * * * * * * * * * * * * * * * * * * * * * *


Please enter the name of the image to be analyzed.
If image is not available in the current directory then input the complete path:
image1.pgm

Scanning image...

Converting to binary...

Successfully converted to binary!!
Saved to current directory as Binary image image1.pbm

Performing closing operation (erosion + dilation) on image...

Closing operation successful!!
Saved to current directory as Closing operation on image1.pbm

Performing connected component analysis...

Additional filtering to remove unwanted objects...
```

4: Run | TODO | 6: Problems | 5: Debug | Terminal | Python Console

Run: Nitish and Moid - Final Image analysis assignment 1

```
Additional filtering to remove unwanted objects...

Connected components analysis successful!!
Saved to current directory as Connected component analysis on image1.pgm

================================================================================

The number of objects present in the image: 11

================================================================================

The area for the object 1 is 222
The area for the object 2 is 188
The area for the object 3 is 1066
The area for the object 4 is 162
The area for the object 5 is 209
The area for the object 6 is 164
The area for the object 7 is 961
The area for the object 8 is 1049
The area for the object 9 is 202
The area for the object 10 is 964
The area for the object 11 is 1054

================================================================================

The centroid point for the object 1 is (41.513513513513516,163.17117117117118)
The centroid point for the object 2 is (22.66216216216216,156.24774774774775)
The centroid point for the object 3 is (283.1711711711712,901.1126126126126)
The centroid point for the object 4 is (71.73423423423424,185.12612612612614)
The centroid point for the object 5 is (94.66666666666667,214.14414414414415)
The centroid point for the object 6 is (88.63063063063063,21.59009009009009)
The centroid point for the object 7 is (620.7432432432432,244.86036036036037)
The centroid point for the object 8 is (610.5675675675676,1125.3918918918919)
The centroid point for the object 9 is (134.42342342342343,26.00900900900901)
The centroid point for the object 10 is (620.9099099099099,607.0450450450451)
The centroid point for the object 11 is (1008.3063063063063,1152.3468468468468)

================================================================================

The perimeter of the object 1 is 71
The perimeter of the object 2 is 124
```

4: Run | TODO | 6: Problems | 5: Debug | Terminal | Python Console

Run: Nitish and Moid - Final Image analysis assignment 1

```
The perimeter of the object 1 is 71
The perimeter of the object 2 is 124
The perimeter of the object 3 is 171
The perimeter of the object 4 is 118
The perimeter of the object 5 is 72
The perimeter of the object 6 is 114
The perimeter of the object 7 is 213
The perimeter of the object 8 is 179
The perimeter of the object 9 is 82
The perimeter of the object 10 is 213
The perimeter of the object 11 is 180

================================================================================

The c1 circularity for the object 1 is 22.707207207207208
The c1 circularity for the object 2 is 81.7872340425532
The c1 circularity for the object 3 is 27.430581613508444
The c1 circularity for the object 4 is 85.95061728395062
The c1 circularity for the object 5 is 24.803827751196174
The c1 circularity for the object 6 is 79.2439024390244
The c1 circularity for the object 7 is 47.210197710718
The c1 circularity for the object 8 is 30.544327931363203
The c1 circularity for the object 9 is 33.28712871287129
The c1 circularity for the object 10 is 47.06327800829875
The c1 circularity for the object 11 is 30.740037950664135

================================================================================

The second-order row moment for the object 1 is 20.40637935232532
The second-order row moment for the object 2 is 28.2300055950142
The second-order row moment for the object 3 is 50464.68007792796
The second-order row moment for the object 4 is 641.0519460902343
The second-order row moment for the object 5 is 38.39978734715572
The second-order row moment for the object 6 is 930.5883124390047
The second-order row moment for the object 7 is 228201.6676339628
The second-order row moment for the object 8 is 232019.12134970186
The second-order row moment for the object 9 is 165.7563099626249
The second-order row moment for the object 10 is 228748.1943896353
The second-order row moment for the object 11 is 633967.7814314654
====================================================
The second-order mixed moment for the object 1 is 0.05482509536564676
```

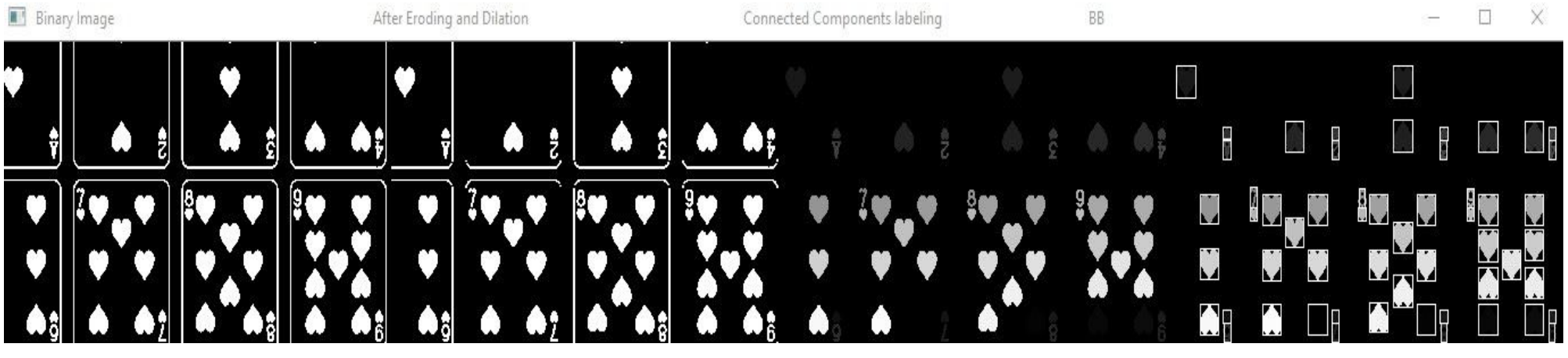
4: Run | TODO | 6: Problems | 5: Debug | Terminal | Python Console

Run: Nitish and Moid - Final Image analysis assignment 1

```
The second-order row moment for the object 7 is 228201.6676339628
The second-order row moment for the object 8 is 232019.12134970186
The second-order row moment for the object 9 is 165.7563099626249
The second-order row moment for the object 10 is 228748.1943896353
The second-order row moment for the object 11 is 633967.7814314654
====================================================
The second-order mixed moment for the object 1 is 0.05482509536564676
The second-order mixed moment for the object 2 is 62.27776396292784
The second-order mixed moment for the object 3 is 160176.0087035466
The second-order mixed moment for the object 4 is 1664.6085109133148
The second-order mixed moment for the object 5 is 55.94565857723746
The second-order mixed moment for the object 6 is 174.1220739526606
The second-order mixed moment for the object 7 is 90074.0096794843
The second-order mixed moment for the object 8 is 427411.2463088781
The second-order mixed moment for the object 9 is 14.064112547120295
The second-order mixed moment for the object 10 is 223571.7376711692
The second-order mixed moment for the object 11 is 724436.654166911
====================================================
The second-order column moment for the object 1 is 21.39680220761305
The second-order column moment for the object 2 is 749.403625448335
The second-order column moment for the object 3 is 509491.1584652854
The second-order column moment for the object 4 is 4521.334337340338
The second-order column moment for the object 5 is 162.47907315048138
The second-order column moment for the object 6 is 47.487406490208116
The second-order column moment for the object 7 is 35646.20888528514
The second-order column moment for the object 8 is 787753.7955033516
The second-order column moment for the object 9 is 17.078218705727405
The second-order column moment for the object 10 is 218680.67742436766
The second-order column moment for the object 11 is 828031.2092987522

================================================================================


Performing bounding box evaluation...

Bounding box evaluation successful!!
Saved to current directory as Bounding box evaluation on image1.pgm

Image analysis successful!

PRESS ANY KEY TO EXIT...
```

4: Run | TODO | 6: Problems | 5: Debug | Terminal | Python Console

Output for image3.pgm:



The above is the stacked image of four different images (binary image, After applying eroding and dilation on image, connected component labeling image and bounding box image)

Below are the text output for image3.pgm

```
Run: Nitish and Moid - Final Image analysis assignment 1
C:\Users\91637\.conda\envs\opencv\python.exe "C:/Users/91637/Desktop/opencv final/resources/Nitish and Moid - Final Image analysis assignment 1.py"
* * * * * * * * * * * * * * * * * * * * * * * * *
*                                               *
*          Welcome to image analyzer            *
*          This application will take           *
*          an image as input and perform        *
*          following operations:                *
*                                               *
*                                               *
* 1) Conversion to binary                       *
* 2) Erosion                                    *
* 3) Dilation                                   *
* 4) Connected component analysis               *
* 5) Perimeter calculation for components       *
* 6) Area calculation for components            *
* 7) Circularity calculation for components     *
* 8) Second moments calculation for components  *
* 8) Bounding box evaluation for components     *
*                                               *
* * * * * * * * * * * * * * * * * * * * * * * * *


Please enter the name of the image to be analyzed.
If image is not available in the current directory then input the complete path:
image3.pgm

Scanning image...

Converting to binary...

Successfully converted to binary!!
Saved to current directory as Binary image image3.pbm

Performing closing operation (erosion + dilation) on image...

Closing operation successful!!
Saved to current directory as Closing operation on image3.pbm

Performing connected component analysis...

Additional filtering to remove unwanted objects...

4: Run  TODO  6: Problems  5: Debug  Terminal  Python Console
```

```
Run: Nitish and Moid - Final Image analysis assignment 1
Additional filtering to remove unwanted objects...

Connected components analysis successful!!
Saved to current directory as Connected component analysis on image3.pgm

================================================================================

The number of objects present in the image: 55

================================================================================

The area for the object 1 is 249
The area for the object 2 is 247
The area for the object 3 is 251
The area for the object 4 is 246
The area for the object 5 is 247
The area for the object 6 is 245
The area for the object 7 is 40
The area for the object 8 is 45
The area for the object 9 is 43
The area for the object 10 is 46
The area for the object 11 is 51
The area for the object 12 is 52
The area for the object 13 is 47
The area for the object 14 is 46
The area for the object 15 is 37
The area for the object 16 is 56
The area for the object 17 is 243
The area for the object 18 is 242
The area for the object 19 is 245
The area for the object 20 is 241
The area for the object 21 is 243
The area for the object 22 is 242
The area for the object 23 is 243
The area for the object 24 is 54
The area for the object 25 is 43
The area for the object 26 is 47
The area for the object 27 is 43
The area for the object 28 is 242
The area for the object 29 is 249
The area for the object 30 is 246
4: Run  TODO  6: Problems  5: Debug  Terminal  Python Console
```

Run: Nitish and Moid - Final Image analysis assignment 1

```
The area for the object 22 is 242
The area for the object 23 is 243
The area for the object 24 is 54
The area for the object 25 is 43
The area for the object 26 is 47
The area for the object 27 is 43
The area for the object 28 is 242
The area for the object 29 is 249
The area for the object 30 is 246
The area for the object 31 is 242
The area for the object 32 is 242
The area for the object 33 is 243
The area for the object 34 is 245
The area for the object 35 is 241
The area for the object 36 is 243
The area for the object 37 is 243
The area for the object 38 is 247
The area for the object 39 is 244
The area for the object 40 is 247
The area for the object 41 is 242
The area for the object 42 is 243
The area for the object 43 is 244
The area for the object 44 is 247
The area for the object 45 is 242
The area for the object 46 is 247
The area for the object 47 is 243
The area for the object 48 is 44
The area for the object 49 is 45
The area for the object 50 is 46
The area for the object 51 is 45
The area for the object 52 is 35
The area for the object 53 is 51
The area for the object 54 is 57
The area for the object 55 is 55

================================================================================

The centroid point for the object 1 is (26.289156626506024,13.052208835341366)
The centroid point for the object 2 is (26.188755020080322,202.26104417670683)
The centroid point for the object 3 is (67.0,205.4738955823293)
The centroid point for the object 4 is (65.79116465863454,107.16064257028113)
The centroid point for the object 5 is (66.11646586345381,276.82329317269074)
```

4: Run | TODO | 6: Problems | 5: Debug | Terminal | Python Console

Run: Nitish and Moid - Final Image analysis assignment 1

```
The centroid point for the object 3 is (67.0,205.4738955823293)
The centroid point for the object 4 is (65.79116465863454,107.16064257028113)
The centroid point for the object 5 is (66.11646586345381,276.82329317269074)
The centroid point for the object 6 is (65.4859437751004,314.425702811245)
The centroid point for the object 7 is (10.879518072289157,9.012048192771084)
The centroid point for the object 8 is (12.17269076305221,27.224899598393574)
The centroid point for the object 9 is (11.65863453815261,42.53815261044177)
The centroid point for the object 10 is (12.417670682730924,63.0722891566265)
The centroid point for the object 11 is (15.646586345381525,11.10441767068273)
The centroid point for the object 12 is (16.244979919678716,51.06425702811245)
The centroid point for the object 13 is (14.642570281124499,64.33734939759036)
The centroid point for the object 14 is (14.373493975903614,27.759036144578314)
The centroid point for the object 15 is (16.369477911646587,11.983935742971887)
The centroid point for the object 16 is (24.73895582329317,38.855421686746986)
The centroid point for the object 17 is (110.7429718875502,32.58232931726908)
The centroid point for the object 18 is (110.45381526104417,85.77911646586345)
The centroid point for the object 19 is (111.77510040160642,126.70682730923694)
The centroid point for the object 20 is (109.81927710843374,176.47791164658634)
The centroid point for the object 21 is (110.80722891566265,218.859437751004)
The centroid point for the object 22 is (110.429718875502,271.2530120481928)
The centroid point for the object 23 is (110.87550200803213,311.9156626506024)
The centroid point for the object 24 is (23.883534136546185,58.25301204819277)
The centroid point for the object 25 is (21.052208835341364,13.654618473895582)
The centroid point for the object 26 is (22.907630522088354,32.82329317269076)
The centroid point for the object 27 is (21.056224899598394,46.626506024096386)
The centroid point for the object 28 is (125.81124497991968,105.41767068273093)
The centroid point for the object 29 is (132.72289156626505,203.8714859437751)
The centroid point for the object 30 is (136.62248995983936,275.7951807228916)
The centroid point for the object 31 is (134.40963855421685,310.5261044176707)
The centroid point for the object 32 is (146.59839357429718,32.441767068273094)
The centroid point for the object 33 is (147.8393574297189,86.15261044176707)
The centroid point for the object 34 is (149.08835341365463,126.66265060240964)
The centroid point for the object 35 is (146.54618473895582,176.46184738955824)
The centroid point for the object 36 is (147.89156626506025,218.859437751004)
The centroid point for the object 37 is (147.77510040160644,292.1566265060241)
The centroid point for the object 38 is (165.51807228915663,276.8072289156627)
The centroid point for the object 39 is (163.4859437751004,313.09236947791163)
The centroid point for the object 40 is (170.89156626506025,202.24899598393574)
The centroid point for the object 41 is (184.94779116465864,177.22088353413653)
The centroid point for the object 42 is (187.04819277108433,32.610441767068274)
The centroid point for the object 43 is (187.75100401606426,86.51004016064257)
The centroid point for the object 44 is (190.18875502008032,127.64257028112449)
```

4: Run | TODO | 6: Problems | 5: Debug | Terminal | Python Console

Run: Nitish and Moid - Final Image analysis assignment 1

```
The centroid point for the object 42 is (187.04819277108433,32.610441767068274)
The centroid point for the object 43 is (187.75100401606426,86.51004016064257)
The centroid point for the object 44 is (190.18875502008032,127.64257028112449)
The centroid point for the object 45 is (186.2289156626506,217.96385542168676)
The centroid point for the object 46 is (190.13253012048193,276.83534136546183)
The centroid point for the object 47 is (187.0722891566265,311.8152610441767)
The centroid point for the object 48 is (34.028112449799195,9.775100401606426)
The centroid point for the object 49 is (34.76305220883534,27.224899598393574)
The centroid point for the object 50 is (35.54216867469879,45.40562248995984)
The centroid point for the object 51 is (34.76706827309237,61.72289156626506)
The centroid point for the object 52 is (28.923694779116467,21.437751004016064)
The centroid point for the object 53 is (41.53413654618474,69.72690763052209)
The centroid point for the object 54 is (46.269076305220885,55.95582329317269)
The centroid point for the object 55 is (44.678714859437754,11.927710843373495)

================================================================================

The perimeter of the object 1 is 80
The perimeter of the object 2 is 80
The perimeter of the object 3 is 80
The perimeter of the object 4 is 76
The perimeter of the object 5 is 78
The perimeter of the object 6 is 76
The perimeter of the object 7 is 26
The perimeter of the object 8 is 28
The perimeter of the object 9 is 28
The perimeter of the object 10 is 28
The perimeter of the object 11 is 42
The perimeter of the object 12 is 50
The perimeter of the object 13 is 44
The perimeter of the object 14 is 46
The perimeter of the object 15 is 37
The perimeter of the object 16 is 56
The perimeter of the object 17 is 72
The perimeter of the object 18 is 74
The perimeter of the object 19 is 76
The perimeter of the object 20 is 72
The perimeter of the object 21 is 74
The perimeter of the object 22 is 76
The perimeter of the object 23 is 74
The perimeter of the object 24 is 54
The perimeter of the object 25 is 28
```

4: Run | TODO | 6: Problems | 5: Debug | Terminal | Python Console

Run: Nitish and Moid - Final Image analysis assignment 1

```
The perimeter of the object 23 is 74
The perimeter of the object 24 is 54
The perimeter of the object 25 is 28
The perimeter of the object 26 is 28
The perimeter of the object 27 is 28
The perimeter of the object 28 is 74
The perimeter of the object 29 is 76
The perimeter of the object 30 is 80
The perimeter of the object 31 is 74
The perimeter of the object 32 is 76
The perimeter of the object 33 is 74
The perimeter of the object 34 is 76
The perimeter of the object 35 is 72
The perimeter of the object 36 is 74
The perimeter of the object 37 is 72
The perimeter of the object 38 is 78
The perimeter of the object 39 is 76
The perimeter of the object 40 is 80
The perimeter of the object 41 is 72
The perimeter of the object 42 is 76
The perimeter of the object 43 is 76
The perimeter of the object 44 is 78
The perimeter of the object 45 is 76
The perimeter of the object 46 is 78
The perimeter of the object 47 is 76
The perimeter of the object 48 is 30
The perimeter of the object 49 is 28
The perimeter of the object 50 is 30
The perimeter of the object 51 is 28
The perimeter of the object 52 is 35
The perimeter of the object 53 is 51
The perimeter of the object 54 is 57
The perimeter of the object 55 is 55

================================================================================

The c1 circularity for the object 1 is 25.70281124497992
The c1 circularity for the object 2 is 25.910931174089068
The c1 circularity for the object 3 is 25.49800796812749
The c1 circularity for the object 4 is 23.479674796747968
The c1 circularity for the object 5 is 24.63157894736842
The c1 circularity for the object 6 is 23.57551020408163
```

4: Run | TODO | 6: Problems | 5: Debug | Terminal | Python Console

Run: Nitish and Moid - Final Image analysis assignment 1

```
The c1 circularity for the object 4 is 23.479674796747968
The c1 circularity for the object 5 is 24.63157894736842
The c1 circularity for the object 6 is 23.57551020408163
The c1 circularity for the object 7 is 16.9
The c1 circularity for the object 8 is 17.42222222222222
The c1 circularity for the object 9 is 18.232558139534884
The c1 circularity for the object 10 is 17.043478260869566
The c1 circularity for the object 11 is 34.588235294117645
The c1 circularity for the object 12 is 48.07692307692308
The c1 circularity for the object 13 is 41.191489361702125
The c1 circularity for the object 14 is 46.0
The c1 circularity for the object 15 is 37.0
The c1 circularity for the object 16 is 56.0
The c1 circularity for the object 17 is 21.333333333333332
The c1 circularity for the object 18 is 22.628099173553718
The c1 circularity for the object 19 is 23.57551020408163
The c1 circularity for the object 20 is 21.510373443983404
The c1 circularity for the object 21 is 22.53497942386831
The c1 circularity for the object 22 is 23.867768595041323
The c1 circularity for the object 23 is 22.53497942386831
The c1 circularity for the object 24 is 54.0
The c1 circularity for the object 25 is 18.232558139534884
The c1 circularity for the object 26 is 16.680851063829788
The c1 circularity for the object 27 is 18.232558139534884
The c1 circularity for the object 28 is 22.628099173553718
The c1 circularity for the object 29 is 23.196787148594378
The c1 circularity for the object 30 is 26.016260162601625
The c1 circularity for the object 31 is 22.628099173553718
The c1 circularity for the object 32 is 23.867768595041323
The c1 circularity for the object 33 is 22.53497942386831
The c1 circularity for the object 34 is 23.57551020408163
The c1 circularity for the object 35 is 21.510373443983404
The c1 circularity for the object 36 is 22.53497942386831
The c1 circularity for the object 37 is 21.333333333333332
The c1 circularity for the object 38 is 24.63157894736842
The c1 circularity for the object 39 is 23.672131147540984
The c1 circularity for the object 40 is 25.910931174089068
The c1 circularity for the object 41 is 21.421487603305785
The c1 circularity for the object 42 is 23.76954732510288
The c1 circularity for the object 43 is 23.672131147540984
The c1 circularity for the object 44 is 24.63157894736842
The c1 circularity for the object 45 is 23.867768595041323
```

4: Run TODO 6: Problems 5: Debug Terminal Python Console

Run: Nitish and Moid - Final Image analysis assignment 1

```
The c1 circularity for the object 43 is 23.672131147540984
The c1 circularity for the object 44 is 24.63157894736842
The c1 circularity for the object 45 is 23.867768595041323
The c1 circularity for the object 46 is 24.63157894736842
The c1 circularity for the object 47 is 23.76954732510288
The c1 circularity for the object 48 is 20.454545454545453
The c1 circularity for the object 49 is 17.42222222222222
The c1 circularity for the object 50 is 19.565217391304348
The c1 circularity for the object 51 is 17.42222222222222
The c1 circularity for the object 52 is 35.0
The c1 circularity for the object 53 is 51.0
The c1 circularity for the object 54 is 57.0
The c1 circularity for the object 55 is 55.0

================================================================================

The second-order row moment for the object 1 is 23.340929985000244
The second-order row moment for the object 2 is 22.88895268569193
The second-order row moment for the object 3 is 24.816733067729082
The second-order row moment for the object 4 is 22.423783290670766
The second-order row moment for the object 5 is 22.275567776855095
The second-order row moment for the object 6 is 22.607127337314076
The second-order row moment for the object 7 is 2672.8862026418924
The second-order row moment for the object 8 is 2562.8109019746976
The second-order row moment for the object 9 is 2608.357307440276
The second-order row moment for the object 10 is 2534.2211573726368
The second-order row moment for the object 11 is 3224.4330357100494
The second-order row moment for the object 12 is 3327.8519521397275
The second-order row moment for the object 13 is 3434.732558191408
The second-order row moment for the object 14 is 3488.4050818254686
The second-order row moment for the object 15 is 7793.743048172285
The second-order row moment for the object 16 is 6663.640791795988
The second-order row moment for the object 17 is 25.218541676249377
The second-order row moment for the object 18 is 27.860666336893274
The second-order row moment for the object 19 is 23.05553024325811
The second-order row moment for the object 20 is 29.56373110298514
The second-order row moment for the object 21 is 25.98554682809777
The second-order row moment for the object 22 is 27.40026453852185
The second-order row moment for the object 23 is 26.100151112656295
The second-order row moment for the object 24 is 6803.812612341384
The second-order row moment for the object 25 is 9227.689846337813
The second-order row moment for the object 26 is 8849.366132735679
```

4: Run TODO 6: Problems 5: Debug Terminal Python Console

Run: Nitish and Moid - Final Image analysis assignment 1

```
The second-order mixed moment for the object 49 is 17712.722435659638
The second-order mixed moment for the object 50 is 29387.726289127168
The second-order mixed moment for the object 51 is 41644.554328693615
The second-order mixed moment for the object 52 is 20724.573252505143
The second-order mixed moment for the object 53 is 41492.08328328671
The second-order mixed moment for the object 54 is 27772.767018189024
The second-order mixed moment for the object 55 is 5510.350206081718
==================================================
The second-order column moment for the object 1 is 21.511007886969626
The second-order column moment for the object 2 is 19.216884774027747
The second-order column moment for the object 3 is 28.737705233002515
The second-order column moment for the object 4 is 18.983278200469638
The second-order column moment for the object 5 is 19.969147030213165
The second-order column moment for the object 6 is 32.47211707250261
The second-order column moment for the object 7 is 1484.872434315576
The second-order column moment for the object 8 is 13407.07387300204
The second-order column moment for the object 9 is 38336.47173207633
The second-order column moment for the object 10 is 73369.81219272061
The second-order column moment for the object 11 is 1325.374947462897
The second-order column moment for the object 12 is 34912.77281911085
The second-order column moment for the object 13 is 72468.38860594912
The second-order column moment for the object 14 is 13234.374983432946
The second-order column moment for the object 15 is 3526.9341558135275
The second-order column moment for the object 16 is 16329.370945917924
The second-order column moment for the object 17 is 19.232739575486725
The second-order column moment for the object 18 is 19.77060240697265
The second-order column moment for the object 19 is 19.3608785111761
The second-order column moment for the object 20 is 38.17139142649357
The second-order column moment for the object 21 is 34.62819974428935
The second-order column moment for the object 22 is 60.29651534546022
The second-order column moment for the object 23 is 57.88856452136055
The second-order column moment for the object 24 is 41615.17624178103
The second-order column moment for the object 25 is 3299.7270216571906
The second-order column moment for the object 26 is 17893.02550027504
The second-order column moment for the object 27 is 46388.90469808626
The second-order column moment for the object 28 is 21.78397782440458
The second-order column moment for the object 29 is 21.604296704891865
The second-order column moment for the object 30 is 22.99468871666496
The second-order column moment for the object 31 is 75.91243589646167
The second-order column moment for the object 32 is 18.859766991228224
The second-order column moment for the object 33 is 19.134004409725772
The second-order column moment for the object 34 is 19.460645038970743
```

4: Run TODO 6: Problems 5: Debug Terminal Python Console

Run: Nitish and Moid - Final Image analysis assignment 1

```
The second-order column moment for the object 27 is 46388.90469808626
The second-order column moment for the object 28 is 21.78397782440458
The second-order column moment for the object 29 is 21.604296704891865
The second-order column moment for the object 30 is 22.99468871666496
The second-order column moment for the object 31 is 75.91243589646167
The second-order column moment for the object 32 is 18.859766991228224
The second-order column moment for the object 33 is 19.134004409725772
The second-order column moment for the object 34 is 19.460645038970743
The second-order column moment for the object 35 is 38.362530627099275
The second-order column moment for the object 36 is 34.62819974428935
The second-order column moment for the object 37 is 52.67359725978121
The second-order column moment for the object 38 is 19.949945433164217
The second-order column moment for the object 39 is 43.93551875551466
The second-order column moment for the object 40 is 19.216836975399417
The second-order column moment for the object 41 is 32.653422945324486
The second-order column moment for the object 42 is 19.105149439047278
The second-order column moment for the object 43 is 18.840972488280915
The second-order column moment for the object 44 is 19.093221103198875
The second-order column moment for the object 45 is 42.59550139220618
The second-order column moment for the object 46 is 20.135025901044973
The second-order column moment for the object 47 is 58.07349582772595
The second-order column moment for the object 48 is 1426.7816860725131
The second-order column moment for the object 49 is 13407.07387300204
The second-order column moment for the object 50 is 37213.73865218162
The second-order column moment for the object 51 is 74077.62886405058
The second-order column moment for the object 52 is 14703.455538735549
The second-order column moment for the object 53 is 69678.72344943203
The second-order column moment for the object 54 is 33291.1530119633
The second-order column moment for the object 55 is 1287.4277887013552

================================================================================


Performing bounding box evaluation...

Bounding box evaluation successful!!
Saved to current directory as Bounding box evaluation on image3.pgm

Image analysis successful!

PRESS ANY KEY TO EXIT...
```

4: Run TODO 6: Problems 5: Debug Terminal Python Console

Brief explanation of results:

1) At first the welcome message will be displayed and the code prompts you to enter the location of the image
2) After you enter the location of the image, at first the image is converted to binary
3) Following is the sequence on showing the text output

- ➢ Converts image to binary and saves the image as “Binary image image3.pgm” in the current directory.
- ➢ Then it perform eroding and dilation and saves the image as “Closing operation on image3.pgm”
- ➢ It performs Connected Component Analysis on the image and saves the image as “Connected component analysis on image3.pgm”
- ➢ Additional filtering is done to remove unwanted images (like lines , shadows .etc)
- ➢ Displays the number of objects present in the image.
- ➢ Displays the area for each object present in the image .
- ➢ Displays the centroid points for each object present in the image .
- ➢ Displays the perimeter value for each object present in the image .
- ➢ Displays the c1 circularity value for each object present in the image.
- ➢ Displays the The second-order row moment for each object present in the image.
- ➢ Displays the The second-order mixed moment for each object present in the image
- ➢ Displays the The second-order column moment for each object present in the image
- ➢ Performs bounding box on the image and saves the file as “Bounding box evaluation on image3.pgm”
- ➢ At last all the created images are stacked together side by side and will be displayed.