APPLIED PHYSICS 157

Activity 4

FEATURE EXTRACTION FROM IMAGES

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WFY-FX-2

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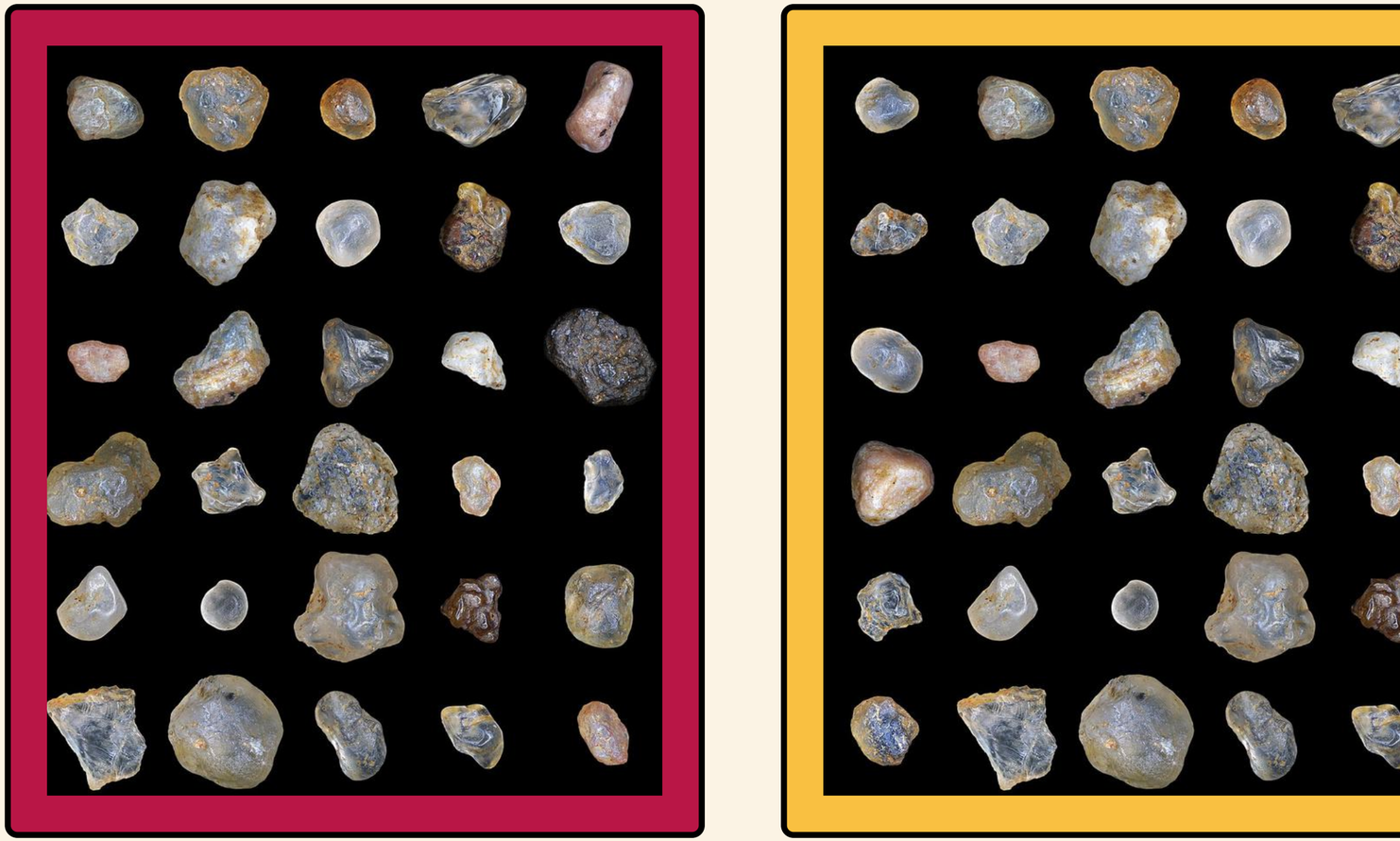
The outputs presented in the succeeding pages are created using ImageJ. The images used are mixture of created and outsourced from the internet.

FEATURE EXTRACTION OF SAND

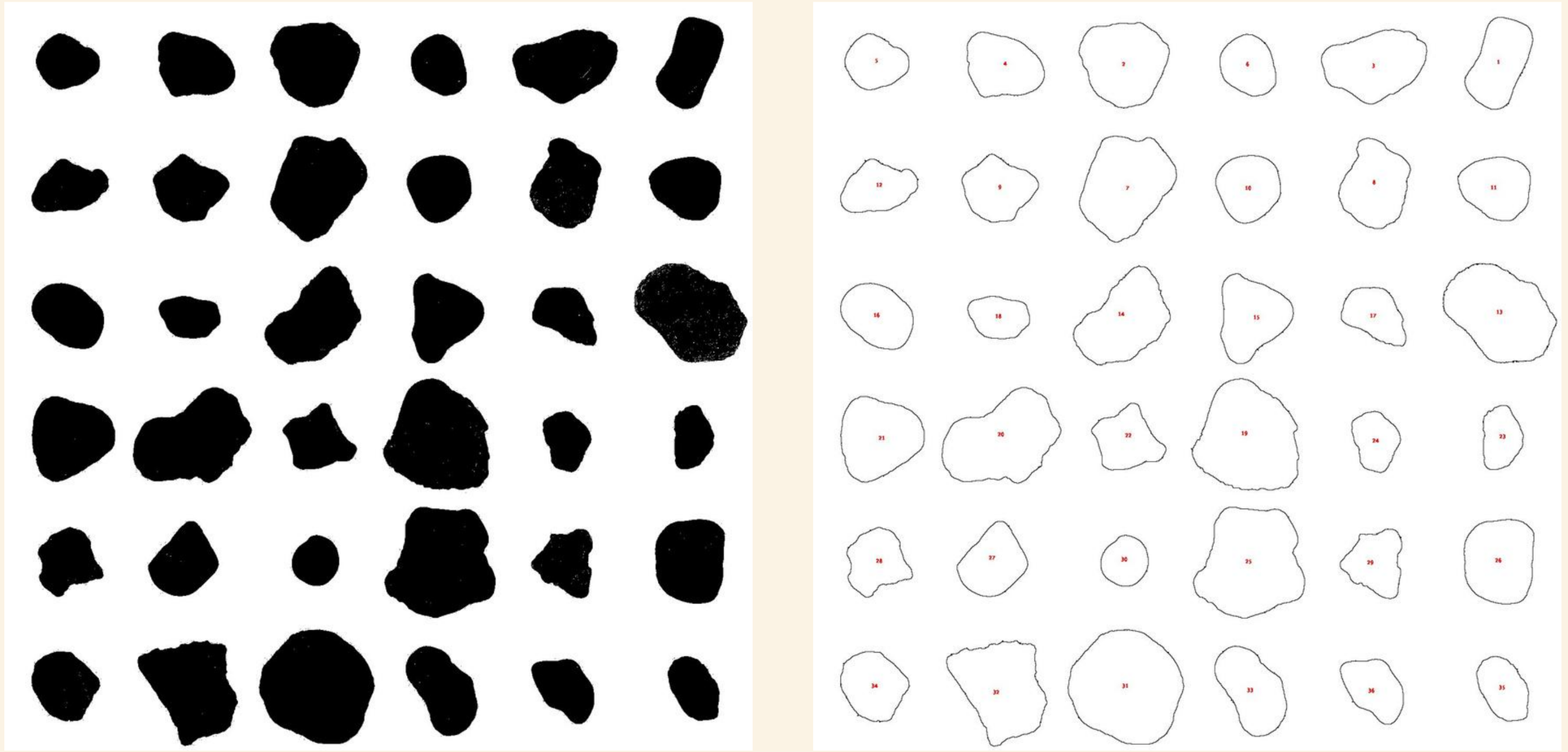
Objectives:

- Extract relevant features from the sand image



Sand image. Adapted from https://images.app.goo.gl/1UEBvwcgLxZTNUNWA

FEATURE EXTRACTION OF SAND



From left to right: binarized image of sand and feature extraction information from the binarized sand image.

FEATURE EXTRACTION OF SAND

	Label	Area	X	Y	Perim.	Major	Minor	Angle
1	pic.jpg	1.158	11.677	1.030	4.618	1.664	0.886	68.700
2	pic.jpg	1.659	5.286	1.023	5.010	1.487	1.420	142.176
3	pic.jpg	1.563	9.559	1.059	5.133	1.780	1.118	11.880
4	pic.jpg	1.119	3.224	1.086	4.174	1.381	1.032	157.082
5	pic.jpg	0.740	1.057	1.027	3.406	1.061	0.888	171.262
6	pic.jpg	0.754	7.404	1.081	3.319	1.074	0.894	121.152
7	pic.jpg	2.027	5.317	3.116	5.766	1.832	1.408	59.385
8	pic.jpg	1.290	9.562	3.113	4.658	1.474	1.115	83.575
9	pic.jpg	0.994	3.143	3.183	4.081	1.205	1.050	177.805
10	pic.jpg	0.968	7.405	3.152	3.772	1.141	1.080	81.480
11	pic.jpg	1.013	11.625	3.147	3.863	1.233	1.046	162.967
12	pic.jpg	0.831	1.095	3.161	3.954	1.295	0.817	12.767
13	pic.jpg	2.200	11.686	5.289	6.346	2.005	1.397	143.898
14	pic.jpg	1.660	5.292	5.409	5.530	1.830	1.155	46.582
15	pic.jpg	1.265	7.455	5.352	4.699	1.379	1.168	77.171
16	pic.jpg	1.014	1.095	5.333	3.856	1.330	0.971	144.779
17	pic.jpg	0.740	9.552	5.320	3.649	1.208	0.780	142.823
18	pic.jpg	0.590	3.159	5.355	2.999	1.052	0.715	171.129
19	pic.jpg	2.532	7.397	7.433	6.507	1.914	1.685	116.074
20	pic.jpg	2.204	3.214	7.447	6.179	2.103	1.334	25.886
21	pic.jpg	1.523	1.112	7.406	4.830	1.440	1.347	31.331
22	pic.jpg	0.888	5.335	7.450	4.019	1.122	1.007	153.657
23	pic.jpg	0.575	11.702	7.411	3.081	1.088	0.673	86.500
24	pic.jpg	0.607	9.564	7.456	3.090	1.027	0.753	102.194
25	pic.jpg	2.610	7.451	9.541	6.662	1.931	1.721	67.482
26	pic.jpg	1.448	11.682	9.498	4.609	1.493	1.235	88.471
27	pic.jpg	0.991	3.061	9.527	3.922	1.264	0.999	55.150
28	pic.jpg	0.865	1.077	9.514	3.951	1.096	1.006	64.809
29	pic.jpg	0.833	9.570	9.532	3.943	1.096	0.968	92.008
30	pic.jpg	0.530	5.304	9.509	2.747	0.858	0.786	64.916
31	pic.jpg	2.863	5.331	11.652	6.537	1.973	1.848	132.655
32	pic.jpg	1.968	3.200	11.661	6.257	1.807	1.387	121.120
33	pic.jpg	1.202	7.463	11.701	4.643	1.661	0.922	119.931
34	pic.jpg	0.996	1.021	11.624	3.968	1.211	1.047	122.404
35	pic.jpg	0.698	11.741	11.677	3.373	1.200	0.740	118.900
36	pic.jpg	0.805	9.541	11.672	3.631	1.263	0.811	133.482

sand_summary

Slice	Count	Total Area	Average Size	%Area	Perim.	Major	Minor	Angle
pic.jpg	36	45.726	1.270	28.207	4.466	1.416	1.089	102.044

Extracted feature from the binarized sand image. The feature contains information on the area, perimeter, X and Y values, major, minor, and angle of the sands.

Following the instructions from the activity handout, I was able to create the table from the left. While ImageJ offers multiple features, I decided to use only a few.

The sand image was binarized and its features, including area, perimeter, centroid, and fit ellipse, were the only things I extracted. The scale used for the third to last image from the left was set to 2 millimeters.

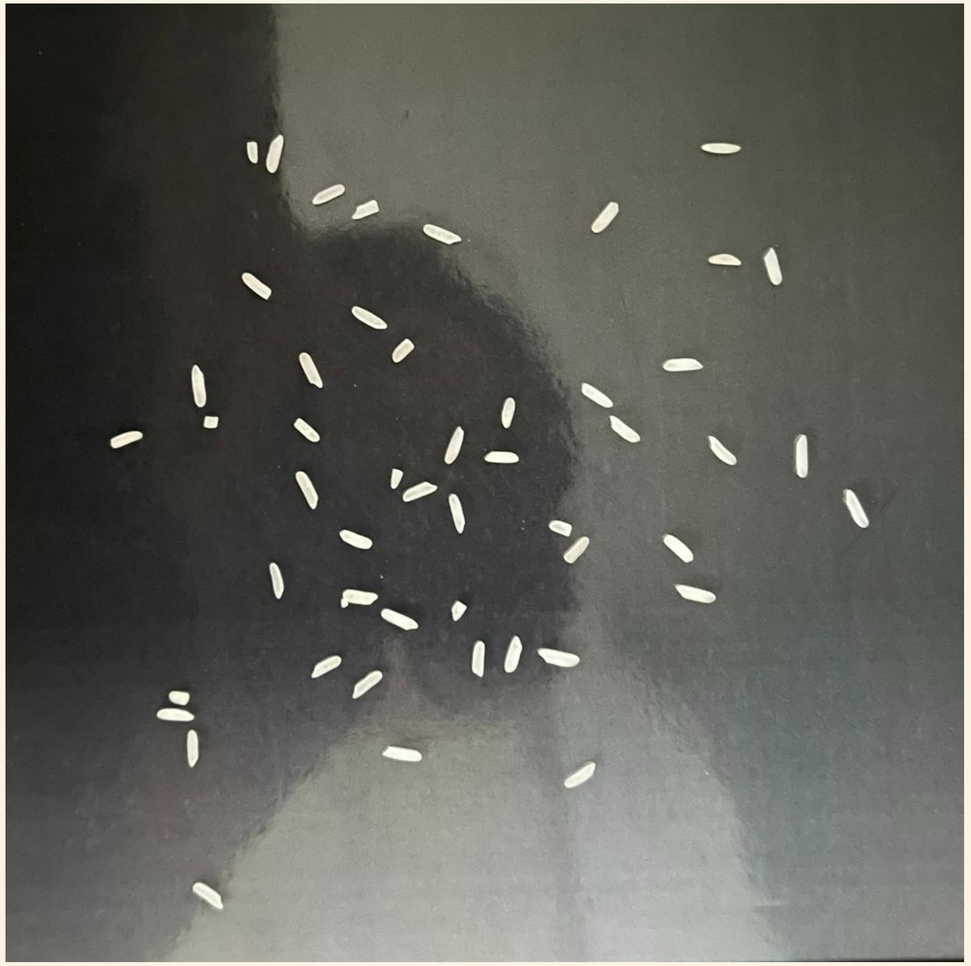
The summary table indicates that the average sand grain size is 1.270 mm, and the total number of sand grains in the image is 36.

FEATURE EXTRACTION OF OTHER OBJECTS

Objectives:

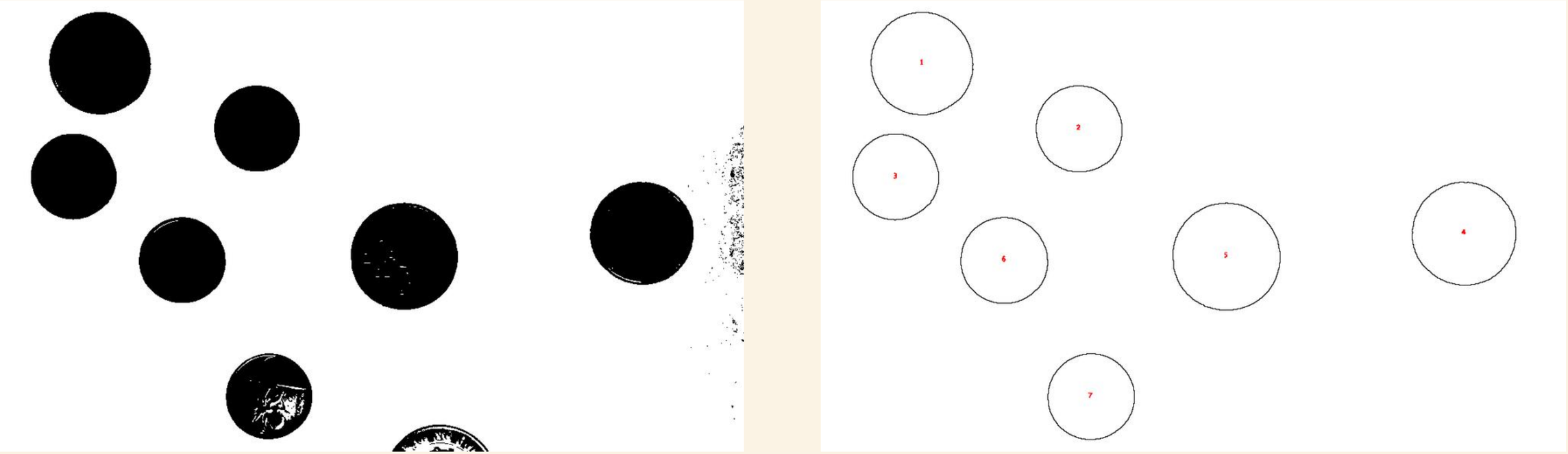
- Extract relevant features from other images

FEATURE EXTRACTION OF OTHER OBJECTS



Images of coins and grains of rice used to extract information using ImageJ.

FEATURE EXTRACTION OF OTHER OBJECTS



From left to right: binarized image of coins and feature extraction information from the binarized coins image.

In this case, I utilized the same technique as the sand feature extraction, which resulted in the same features extracted. Moreover, I excluded the edges of the image during the calculation process. Upon inspecting the left image, it is apparent that certain areas within the selected regions were excluded, causing the extracted features to be affected. This minor error was caused by the inconsistent lighting in the surroundings during the image capture process.

FEATURE EXTRACTION OF OTHER OBJECTS

	Label	Area	X	Y	Perim.	Major	Minor	Angle
1	coinz-1.png	424.600	22.967	14.317	77.213	23.377	23.126	120.064
2	coinz-1.png	301.798	58.773	29.211	64.640	19.741	19.465	129.116
3	coinz-1.png	299.516	16.956	40.097	64.548	19.558	19.499	171.514
4	coinz-1.png	432.759	146.509	52.985	78.011	23.669	23.280	165.687
5	coinz-1.png	466.931	92.326	58.281	80.754	24.460	24.305	158.497
6	coinz-1.png	302.914	41.718	59.161	64.901	19.811	19.468	166.550
7	coinz-1.png	272.238	61.199	89.918	64.678	18.996	18.247	40.443

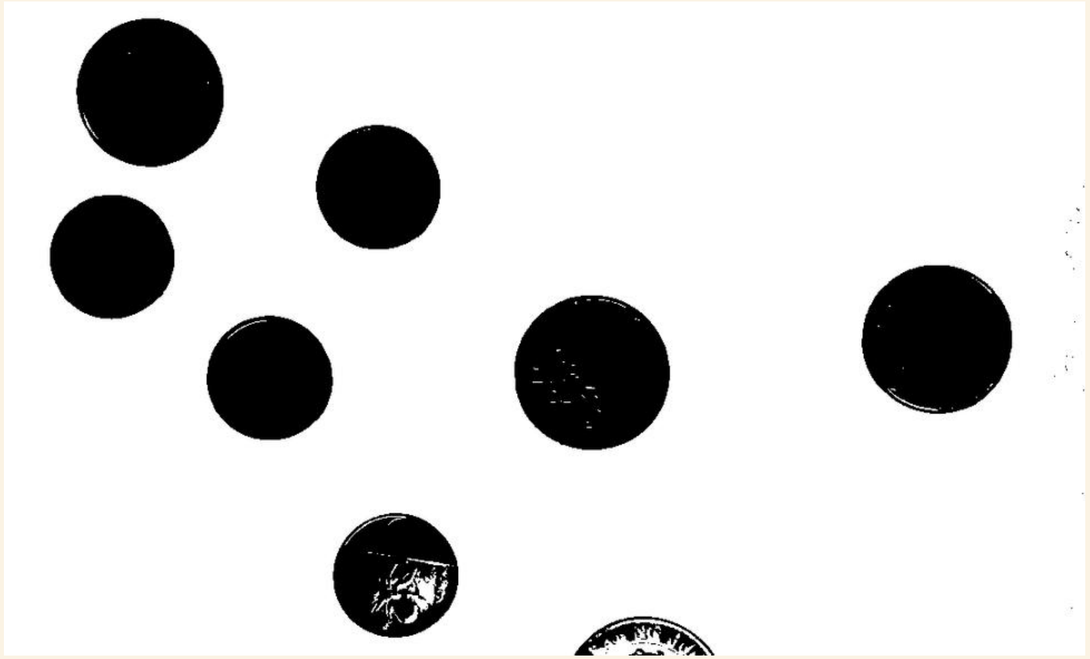
Slice	Count	Total Area	Average Size	%Area	Perim.	Major	Minor	Angle
coinz-1.png	7	2500.756	357.251	14.348	70.678	21.373	21.056	135.982

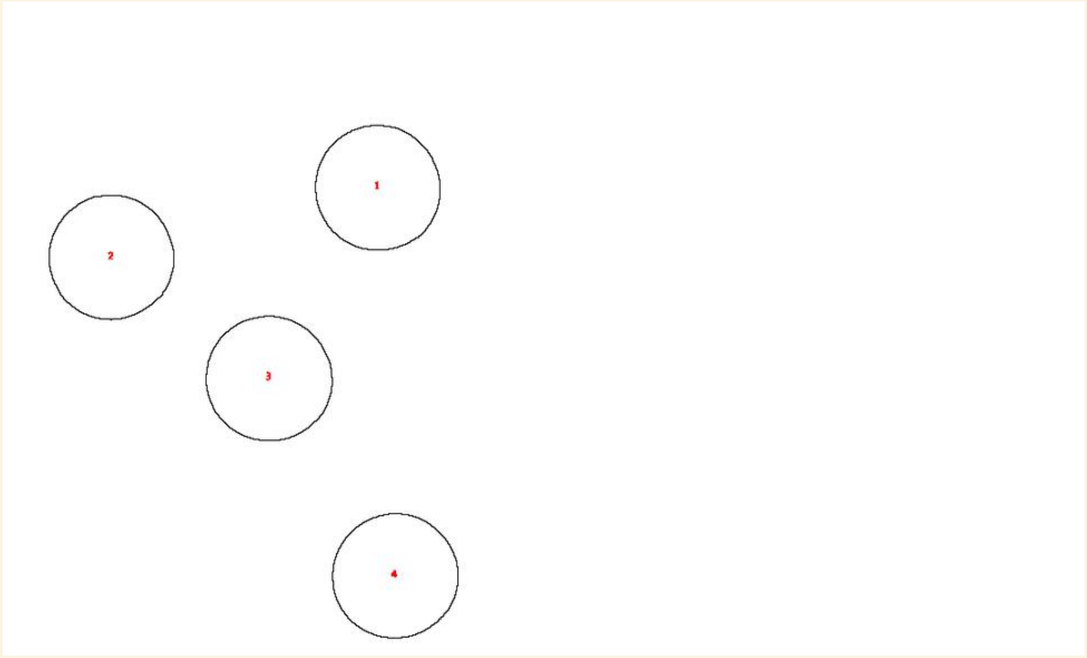
Extracted features from the binarized coins image.

The extracted features from the image are displayed in the table, with a scale of 20 mm for the 25-cent coin. The extracted features were restricted to those with an area greater than 250 and circularity between 0 and 1. I then chose to evaluate the area, perimeter, centroid, and fit ellipse features.

The summary includes the total number of coins, as well as the total area and average size of the coins.

FEATURE EXTRACTION OF OTHER OBJECTS





From left to right: binarized image of coins and feature extraction information which only contains features revolving around the 25-cents coins.

In this instance, my goal was to differentiate the 25-cent coins in the provided image. I utilized the same procedure for feature extraction as in previous techniques, but focused solely on areas within the 250-350 range to ensure that the 25-cents coins were shown since I scaled them to have a diameter of 20 mm.

FEATURE EXTRACTION OF OTHER OBJECTS

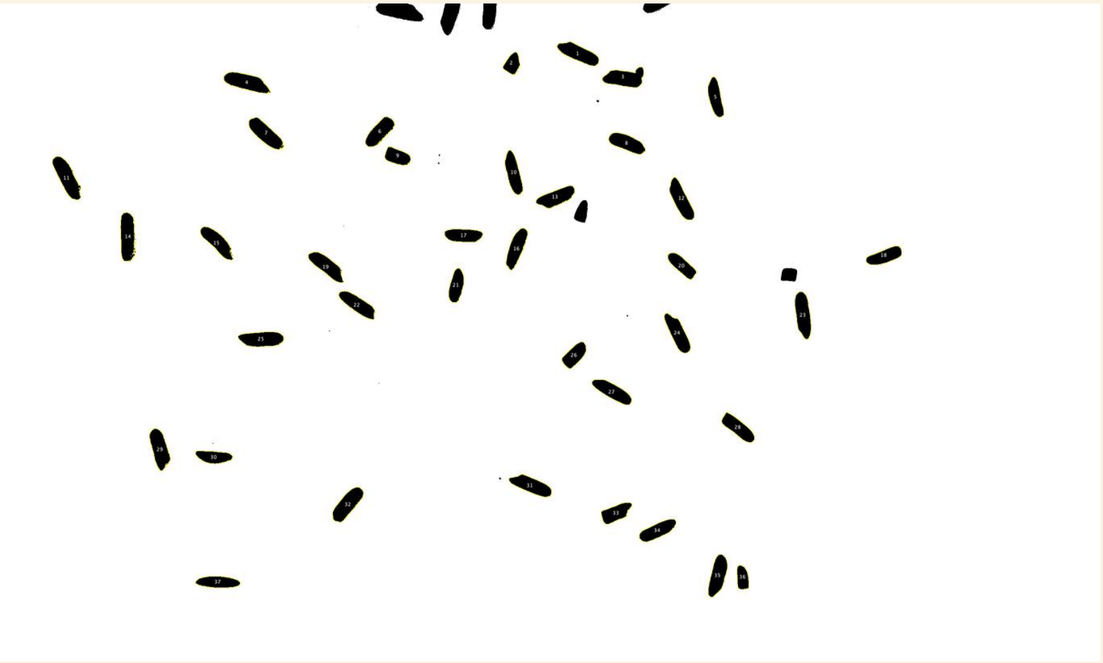
	Label	Area	X	Y	Perim.	Major	Minor	Angle
1	coinz-1.png	313.471	59.961	29.798	65.938	20.117	19.840	130.723
2	coinz-1.png	311.201	17.298	40.904	65.844	19.938	19.874	171.182
3	coinz-1.png	314.426	42.558	60.360	66.204	20.184	19.834	168.012
4	coinz-1.png	277.423	62.380	91.686	65.883	19.233	18.366	41.689

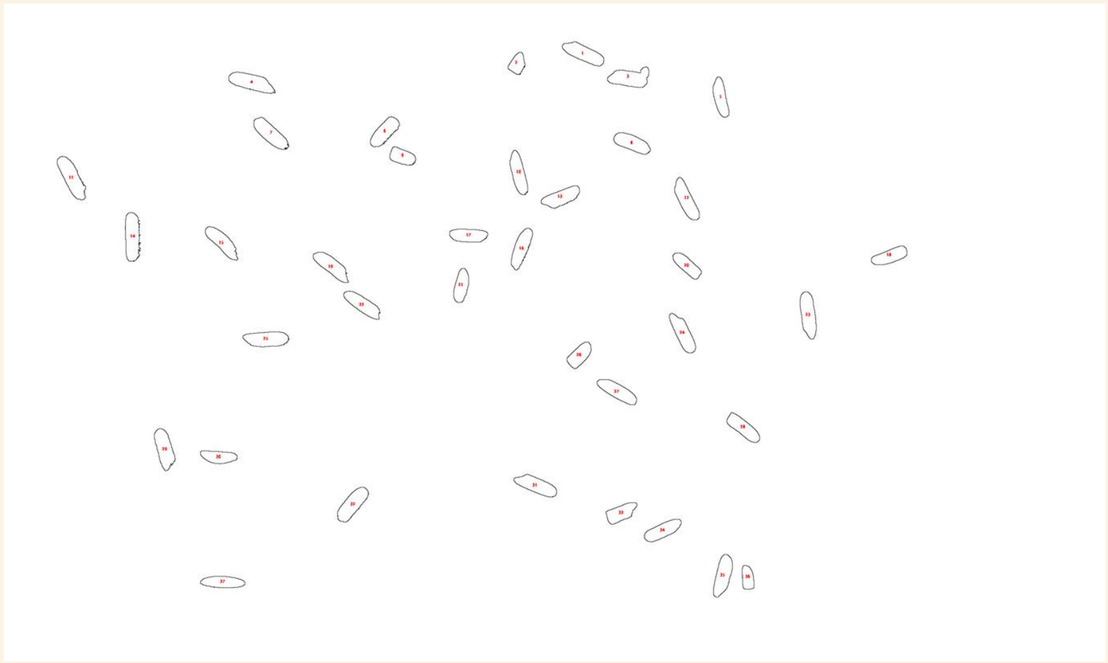
Slice	Count	Total Area	Average Size	%Area	Perim.	Major	Minor	Angle
coinz-1.png	4	1216.521	304.130	6.707	65.967	19.868	19.478	127.902

Extracted features from the binarized 25-cents coins image.

The considerable difference in the coin areas may be explained by the gaps inside the selected regions. This is because some pixels are excluded from the calculation causing a discrepancy in the measured values.

FEATURE EXTRACTION OF OTHER OBJECTS





From left to right: binarized image of grains of rice and feature extraction information which only contains specific feature range.

I applied the same feature extraction techniques for rice grains, but excluded some smaller grains by limiting the area range to 10-30 mm squared. The numbered regions within the chosen area are shown on the right side of the image. On the succeeding page, the extracted features for the right image are presented.

FEATURE EXTRACTION OF OTHER OBJECTS

	Label	Area	StdDev	X	Y	Perim.	Major	Minor	Angle
1	IMG_7312-1.jpeg	22.930	0	121.060	10.411	22.440	9.564	3.053	156.490
2	IMG_7312-1.jpeg	10.595	0	107.216	12.578	13.936	4.478	3.012	70.631
3	IMG_7312-1.jpeg	24.693	0	130.728	15.522	23.388	8.737	3.599	1.687
4	IMG_7312-1.jpeg	25.335	0	51.669	16.419	24.376	10.043	3.212	163.855
5	IMG_7312-1.jpeg	17.380	0	149.661	19.619	20.117	8.671	2.552	101.367
6	IMG_7312-1.jpeg	20.020	0	79.521	26.759	21.013	7.928	3.215	46.919
7	IMG_7312-1.jpeg	23.430	0	55.670	27.148	23.262	9.249	3.225	138.393
8	IMG_7312-1.jpeg	20.184	0	131.142	29.098	20.211	8.311	3.092	158.139
9	IMG_7312-1.jpeg	14.084	0	83.180	31.932	16.133	5.777	3.104	159.991
10	IMG_7312-1.jpeg	20.455	0	107.472	35.420	22.585	9.655	2.697	103.405
11	IMG_7312-1.jpeg	26.769	0	14.189	36.325	25.487	10.436	3.266	117.464
12	IMG_7312-1.jpeg	22.681	0	142.487	40.977	22.798	9.740	2.965	115.308
13	IMG_7312-1.jpeg	20.819	0	116.407	40.407	21.266	8.497	3.119	20.867
14	IMG_7312-1.jpeg	26.120	0	26.833	48.671	28.950	10.811	3.076	90.945
15	IMG_7312-1.jpeg	20.940	0	45.553	49.765	21.940	9.073	2.938	134.425
16	IMG_7312-1.jpeg	20.918	0	108.067	51.021	22.679	9.294	2.866	69.391
17	IMG_7312-1.jpeg	18.000	0	97.014	48.371	19.149	8.219	2.788	177.967
18	IMG_7312-1.jpeg	17.501	0	185.026	52.694	19.074	8.093	2.753	18.725
19	IMG_7312-1.jpeg	21.525	0	68.396	54.757	22.006	9.022	3.038	140.795
20	IMG_7312-1.jpeg	16.046	0	142.647	54.660	17.433	7.462	2.738	138.373
21	IMG_7312-1.jpeg	15.896	0	95.524	58.921	17.522	7.332	2.760	79.301
22	IMG_7312-1.jpeg	20.869	0	74.909	62.817	21.677	9.123	2.912	145.791
23	IMG_7312-1.jpeg	24.129	0	167.949	64.925	23.158	10.208	3.010	97.923
24	IMG_7312-1.jpeg	22.024	0	141.783	68.860	22.460	9.409	2.980	117.996
25	IMG_7312-1.jpeg	23.708	0	54.878	70.012	22.919	9.659	3.125	0.596
26	IMG_7312-1.jpeg	15.988	0	120.209	73.380	16.239	6.411	3.176	47.831
27	IMG_7312-1.jpeg	21.382	0	128.136	80.933	21.685	9.452	2.880	151.005
28	IMG_7312-1.jpeg	19.784	0	154.369	88.532	20.148	8.627	2.920	140.919
29	IMG_7312-1.jpeg	23.137	0	33.535	92.924	22.905	8.934	3.298	103.774
30	IMG_7312-1.jpeg	15.332	0	44.868	94.585	18.276	7.710	2.532	175.312
31	IMG_7312-1.jpeg	22.474	0	111.203	100.575	22.568	9.401	3.044	159.523
32	IMG_7312-1.jpeg	24.008	0	72.786	104.487	21.899	9.063	3.373	50.196
33	IMG_7312-1.jpeg	17.016	0	128.812	106.293	18.320	6.888	3.145	26.477
34	IMG_7312-1.jpeg	19.484	0	137.548	109.955	20.351	8.647	2.869	25.220
35	IMG_7312-1.jpeg	22.431	0	150.143	119.341	21.719	9.264	3.083	75.378
36	IMG_7312-1.jpeg	10.259	0	155.309	119.876	13.373	5.296	2.467	97.817
37	IMG_7312-1.jpeg	17.530	0	45.721	120.735	20.958	9.385	2.378	177.902

Slice	Count	Total Area	Average Size	%Area	Perim.	Major	Minor	Angle
IMG_7312-1.jpeg	37	745.873	20.159	2.360	20.930	8.591	2.980	102.651

Extracted features from the binarized grains of rice image.

FEATURE EXTRACTION OF OTHER OBJECTS

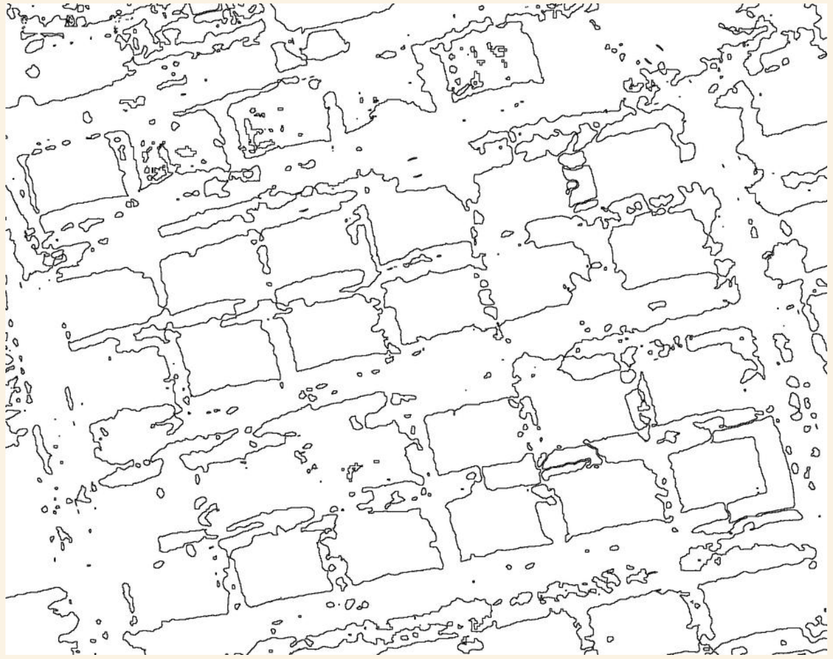


Image used and edge-detected images used to identify necessary information to the roofings. Left image was adapted from https://maps.apple.com/?ll=7.831133,126.070843&q=Dropped%20Pin

In this experiment, I attempted to extract the characteristics of a resettlement area captured through Apple's Maps by taking a screenshot of the image. My goal was to determine the size and quantity of the resettlement areas depicted. Unfortunately, the outcomes were unsatisfactory. The image quality, lack of a consistent background, and limitations of ImageJ may have contributed to the inability to identify the roofing edges, as seen in the right image.

ADDITIONAL ACTIVITIES CREATED

Objectives:

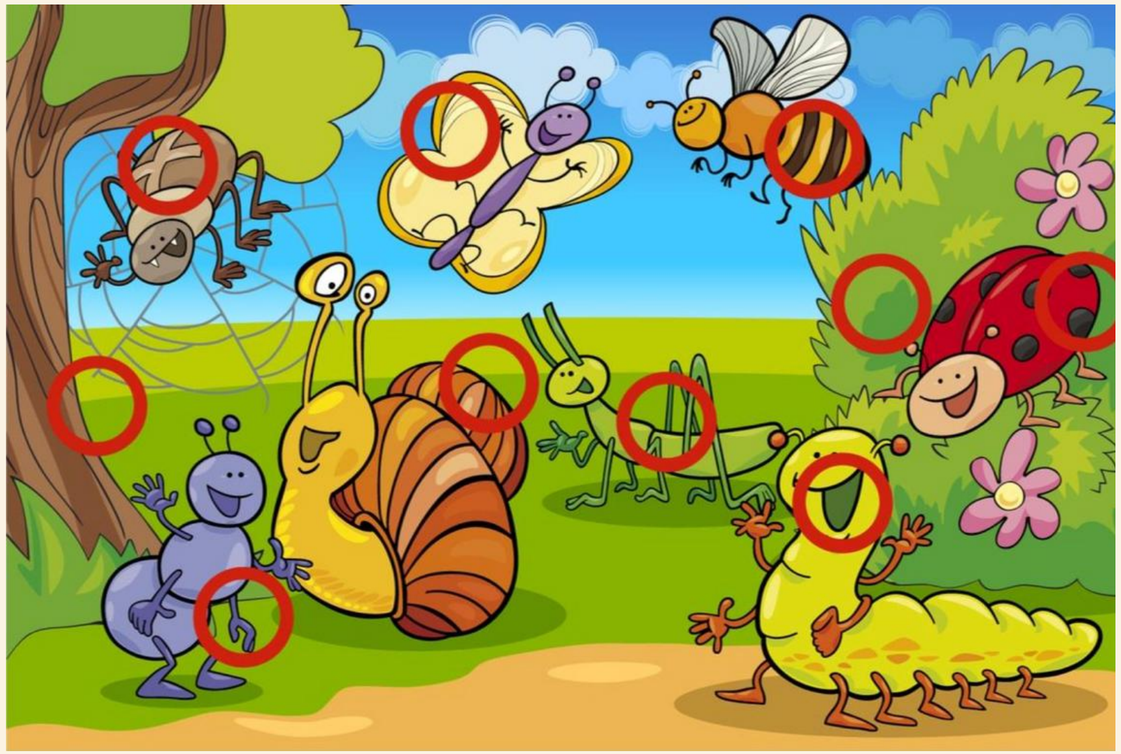
- Further explore the features of ImageJ

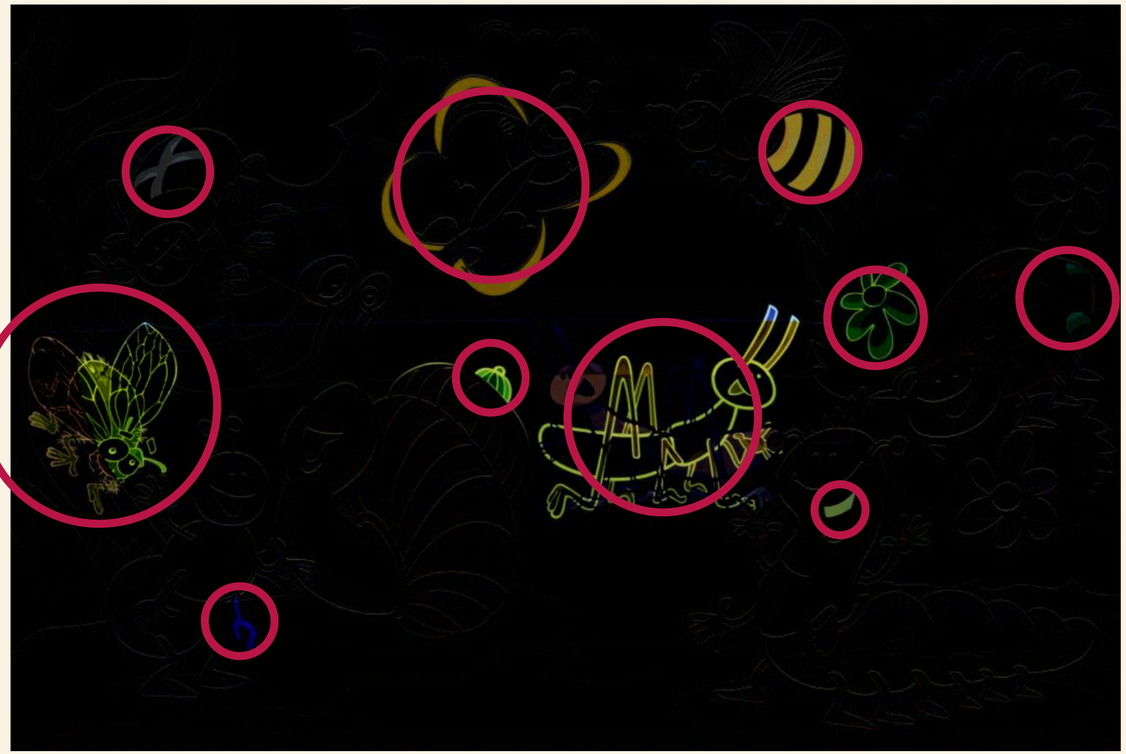
SPOT THE DIFFERENCE BETWEEN TWO PICTURES

Spot the difference between the two pictures. Adapted from https://www.edubloxtutor.com/find-10-differences-two-pictures/

In this case, I utilized ImageJ software to identify differences between the two images displayed above. I used ImageJ's calculator to subtract the right image from the left image, enabling the identification of features that are present in the second image but not in the first image.

SPOT THE DIFFERENCE BETWEEN TWO PICTURES





Left: Answer key to the previous images. Right: Using imageJ to spot the difference between the two pictures.

The image on the left serves as the answer key for the preceding images. By examining the image on the right, we can observe that the highlighted portions indicate the differences between the two images. Upon comparison, both images pinpointed an equal number of differences. This affirms that ImageJ is a viable tool for detecting differences between two pictures.

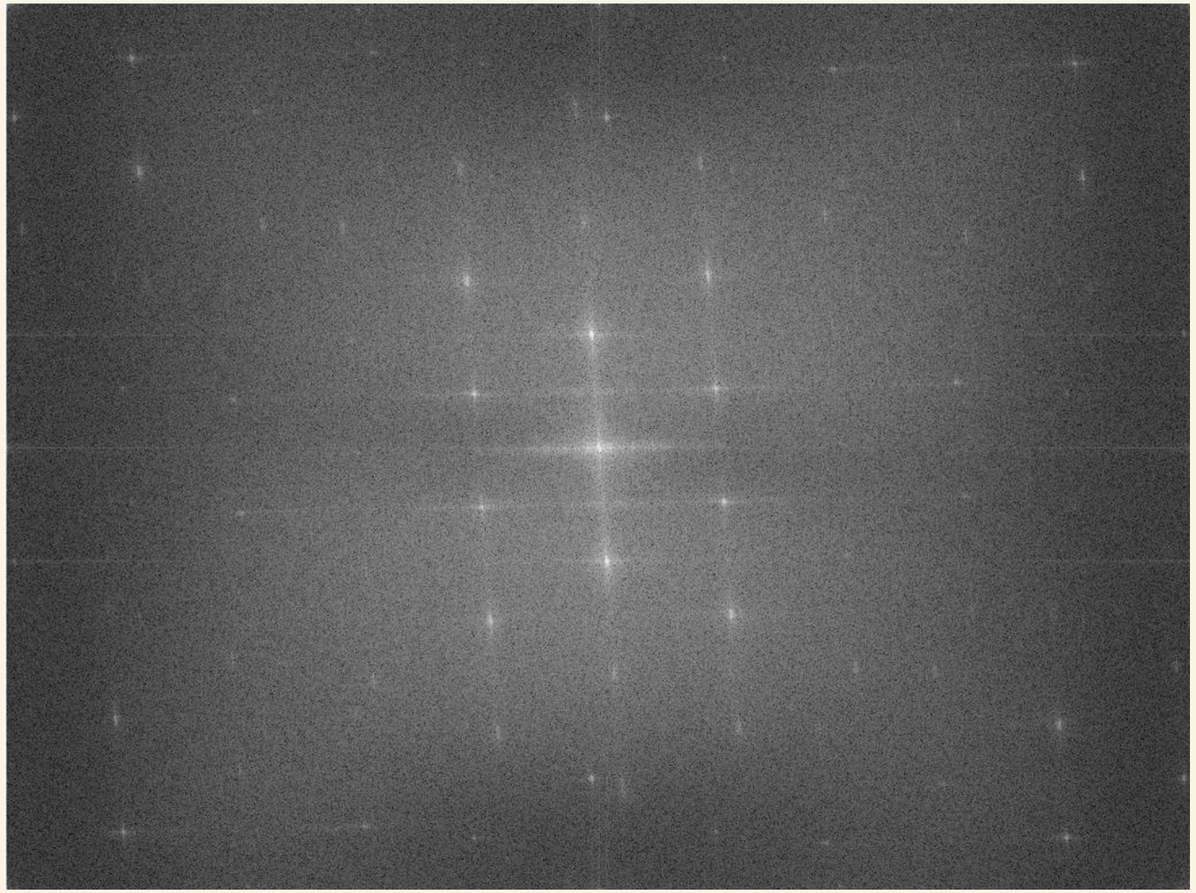
USING FFT IN IMAGEJ

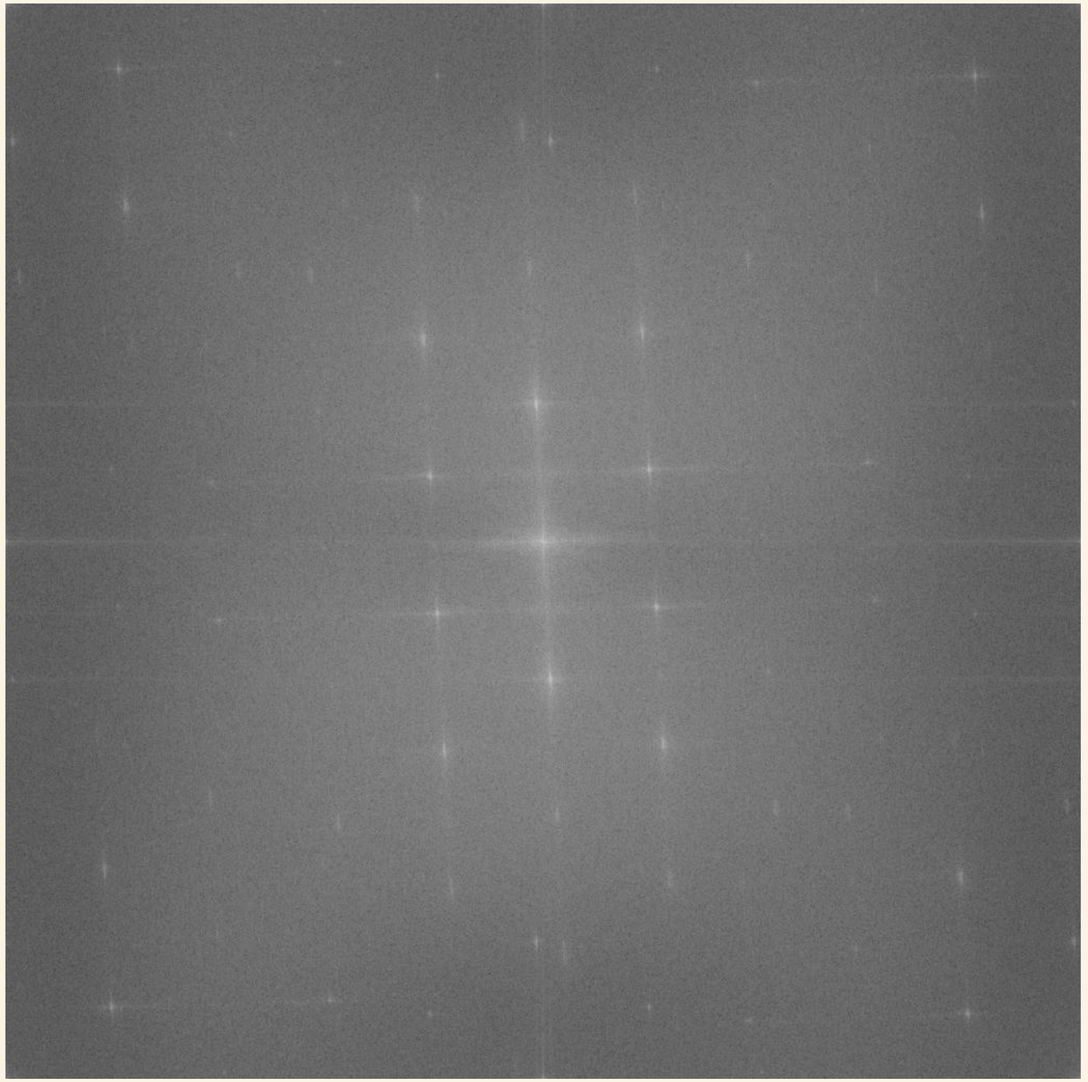
Painting used in Activity 3. Adapted from https://uvle.upd.edu.ph/mod/resource/view.php?id=445794

As part of my further exploration, I utilized ImageJ's FFT feature to generate the FFT of the painting utilized in activity three. Upon reviewing the next page, I compared the FFT results from both MATLAB and ImageJ, and saw that they generated images having similar features.

This observation validates ImageJ's capability as a substitute for identifying an image's FFT without the need to create complex code sequences in MATLAB or other programming languages, making the process faster and more efficient.

USING FFT IN IMAGEJ





Left: MATLAB generated FFT of the painting. Right: ImageJ generated FFT of the painting.

REFLECTION

RATING: 105 / 100

This particular activity was the easiest one I have encountered so far in this subject. However, I faced a few challenges during the process, mainly due to the unavailability of a plain background that was not affected by external factors such as sunlight, shadows, and camera limitations. Nevertheless, I was able to modify the images to minimize the external influences. Additionally, I explored various features of the application, and I was surprised at how some features were readily available, whereas it took me a while to perform the same tasks using MATLAB. These included functions such as Fast Fourier Transform (FFT), image binarization, and threshold adjustment. Although the interface appears simple, the application is genuinely powerful.

I was able to complete the necessary tasks, and I added my personal touch, which I believe deserves some extra points.

References

Photo by Daria. (n.d). UvLe. Retrieved from https://uvle.upd.edu.ph/mod/resource/view.php?id=445794.

Plessis, S. (2020). Find 10 Differences [Digital Image]. Retrieved from https://www.edubloxtutor.com/find-10-differences-two-pictures/.

Wikipedia. (2023). Sand grains of yellow building sand [Digital Image]. Retrieved from https://images.app.goo.gl/1UEBvwcgLxZTNUNWA.