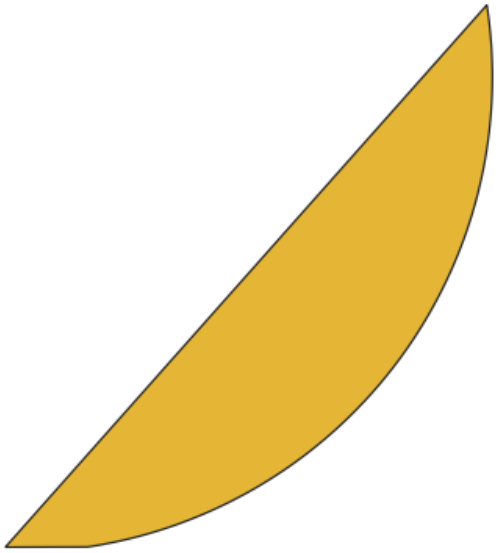
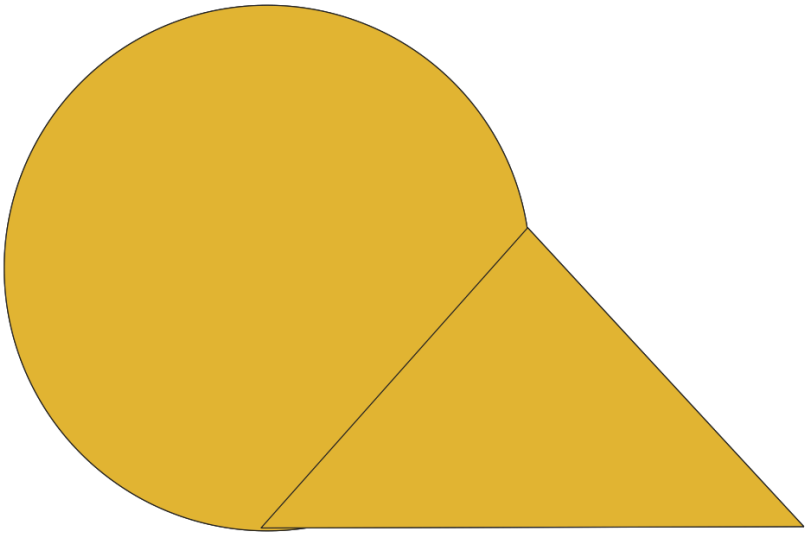
Solutions: Assignment for Senior Software Engineer - Geospatial

Question 4:

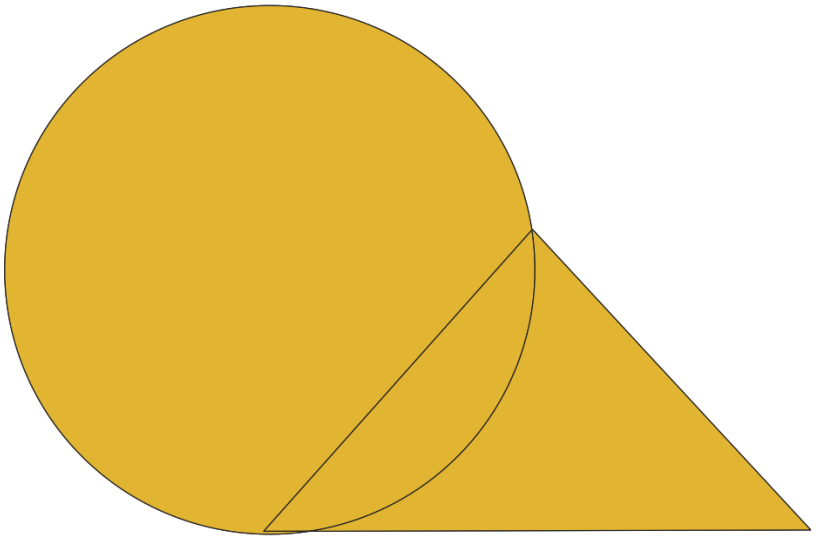
Intersect: Creates a new layer containing only the overlapping areas from the input layers. The output layer's attributes table includes attributes from both input layers for these overlapping areas.



Merge: Combines all areas from the input layers into a new layer. The output layer's attributes table includes attributes from both input layers, but identical attributes from different layers are not preserved unless specifically mapped.



Union: Creates a new layer containing all areas from the input layers. The output layer's attributes table includes attributes from both input layers for all areas, with separate fields for identical attributes from different layers. Areas existing in only one input layer will have null values for the attributes of the other layer.



Question 7:

A. Inspect the metadata using any python library and provide the output print out.

Once you run `sentinel_2_processor.py` locally on your PC. The following metadata will be printed out for the input file: **`S2B_MSIL2A_20221127T075159_N0400_R135_T36NXF_20221127T100500.SAFE.zip`**

```
{'AOT_QUANTIFICATION_VALUE': '1000.0',
 'AOT_QUANTIFICATION_VALUE_UNIT': 'none',
```

```
 'AOT_RETRIEVAL_ACCURACY': '0.0',
 'AOT_RETRIEVAL_METHOD': 'SEN2COR_DDV',
 'BOA_QUANTIFICATION_VALUE': '10000',
 'BOA_QUANTIFICATION_VALUE_UNIT': 'none',
 'CLOUDY_PIXEL_OVER_LAND_PERCENTAGE': '67.150432',
 'CLOUD_COVERAGE_ASSESSMENT': '67.681426',
 'CLOUD_SHADOW_PERCENTAGE': '1.00211',
 'DARK_FEATURES_PERCENTAGE': '7.0E-4',
 'DATATAKE_1_DATATAKE_SENSING_START':
'2022-11-27T07:51:59.024Z',
 'DATATAKE_1_DATATAKE_TYPE': 'INS-NOBS',
 'DATATAKE_1_ID': 'GS2B_20221127T075159_029905_N04.00',
 'DATATAKE_1_SENSING_ORBIT_DIRECTION': 'DESCENDING',
 'DATATAKE_1_SENSING_ORBIT_NUMBER': '135',
 'DATATAKE_1_SPACECRAFT_NAME': 'Sentinel-2B',
 'DEGRADED_ANC_DATA_PERCENTAGE': '0.0',
 'DEGRADED_MSI_DATA_PERCENTAGE': '0',
 'FOOTPRINT': 'POLYGON((33.898748981595126 0.904799502316074,
'
              '34.885310549700094 0.904418497286558,
34.88507939165355 '
              '-0.08843451908062, 33.898638724445924
-0.088471771010446, '
              '33.898748981595126 0.904799502316074))',
 'FORMAT_CORRECTNESS': 'PASSED',
 'GENERAL_QUALITY': 'PASSED',
 'GENERATION_TIME': '2022-11-27T10:05:00.000000Z',
 'GEOMETRIC_QUALITY': 'PASSED',
 'GRANULE_MEAN_AOT': '0.106666',
 'GRANULE_MEAN_WV': '2.047634',
 'HIGH_PROBA_CLOUDS_PERCENTAGE': '32.283592',
 'L2A_QUALITY': 'PASSED',
 'MEDIUM_PROBA_CLOUDS_PERCENTAGE': '27.29553',
 'NODATA_PIXEL_PERCENTAGE': '0.0',
 'NOT_VEGETATED_PERCENTAGE': '1.10709',
 'OZONE_SOURCE': 'AUX_ECMWFT',
 'OZONE_VALUE': '273.613039',
 'PREVIEW_GEO_INFO': 'Not applicable',
 'PREVIEW_IMAGE_URL': 'Not applicable',
 'PROCESSING_BASELINE': '04.00',
 'PROCESSING_LEVEL': 'Level-2A',
 'PRODUCT_DOI': 'https://doi.org/10.5270/S2_-znk9xsj',
 'PRODUCT_START_TIME': '2022-11-27T07:51:59.024Z',
 'PRODUCT_STOP_TIME': '2022-11-27T07:51:59.024Z',
 'PRODUCT_TYPE': 'S2MSI2A',
 'PRODUCT_URI':
'S2B_MSIL2A_20221127T075159_N0400_R135_T36NXF_20221127T100500
.SAFE',
```

```
'RADIATIVE_TRANSFER_ACCURACY': '0.0',
'RADIOMETRIC_QUALITY': 'PASSED',
'REFERENCE_BAND': 'B4',
'REFLECTANCE_CONVERSION_U': '1.0259047172003',
'SATURATED_DEFECTIVE_PIXEL_PERCENTAGE': '0.0',
'SENSOR_QUALITY': 'PASSED',
'SNOW_ICE_PERCENTAGE': '0.0',
'SPECIAL_VALUE_NODATA': '0',
'SPECIAL_VALUE_SATURATED': '65535',
'THIN_CIRRUS_PERCENTAGE': '8.102305',
'UNCLASSIFIED_PERCENTAGE': '1.276555',
'VEGETATION_PERCENTAGE': '28.335902',
'WATER_PERCENTAGE': '0.596216',
'WATER_VAPOUR_RETRIEVAL_ACCURACY': '0.0',
'WVP_QUANTIFICATION_VALUE': '1000.0',
'WVP_QUANTIFICATION_VALUE_UNIT': 'cm'}
```

B. Only keep the extent of the image covered by the region and add a metadata tag called “region” that should have the value “test roi”.

A snippet of subset file - **test_roi.tif** showing added metadata:

```
……..
  RADIOMETRIC_QUALITY=PASSED
  REFERENCE_BAND=B4
  REFLECTANCE_CONVERSION_U=1.0259047172003
  region=test roi
  SATURATED_DEFECTIVE_PIXEL_PERCENTAGE=0.0
  SENSOR_QUALITY=PASSED
……..
```

C. Calculate the Min, Max, Mean, Median and Standard Deviation of the spectral index mentioned in Question 1 and any OTHER two indices - what can you infer from the spectral index outputs and the statistics?

NDVI, NDWI and EVI zonal statistics for Min, Max, Mean, Median and Standard Deviation.

```
onal_statistics_db=> SELECT * FROM test_roi_tbl;
```

image_date	min	max	mean	median	std_dev
2024-03-15	-0.05908976495265961	0.6738551259040833	0.4945444133424539	0.5072463750839233	0.06412473830772163
2024-03-15	-0.6188784837722778	0.06144971027970314	-0.42755065074164744	-0.4367622137069702	0.06276932215864407
2024-03-15	-17620	15060	4.053278536039713	4.182857513427734	172.1729614260082

```
(3 rows)
```

D. Using PostgreSQL, create a database called zonal_statistics_db then in python, create a table called test_roi_tbl and columns should be image_date, min, max, mean, median, std_dev . Update the values of the Question 4 c. above to the table and print out the values to make sure they were saved correctly.

The **zonal_statistics_db** and the the **test_roi_tbl** created and zonal statistics results for the NDVI, NDWI and EVI indices successfully inserted:

```
zonal_statistics_db=> SELECT * FROM test_roi_tbl;
```

image_date	min	max	mean	median	std_dev
2024-03-15	-0.05908976495265961	0.6738551259040833	0.4945444133424539	0.5072463750839233	0.06412473830772163
2024-03-15	-0.6188784837722778	0.06144971027970314	-0.42755065074164744	-0.4367622137069702	0.06276932215864407
2024-03-15	-17620	15060	4.053278536039713	4.182857513427734	172.1729614260082

```
(3 rows)
```

On success, inserted values are printed:

```
Values {'min': -0.05908976495265961, 'max':
0.6738551259040833, 'mean': 0.4945444133424539, 'std':
0.06412473830772163, 'median': 0.5072463750839233} inserted
successfully.

Values {'min': -0.6188784837722778, 'max':
0.06144971027970314, 'mean': -0.42755065074164744, 'std':
0.06276932215864407, 'median': -0.4367622137069702} inserted
successfully.

Values {'min': -17620.0, 'max': 15060.0, 'mean':
4.053278536039713, 'std': 172.1729614260082, 'median':
4.182857513427734} inserted successfully.
```