Report For EX1.py

For Q1 , the code repersent the calculation of the Normalized Difference Vegetation Index (NDVI) for a substantial dataset consisting of red and Near-Infrared (NIR) band data. Employing Equation 1, it computes NDVI values for each element within a 4377 by 2312 array. The process involves handling the data import and conversion, achieved through a conversion function (**convert_remove**) that transforms strings into floating-point numbers while removing specific elements. Subsequently, the program utilizes a dedicated function (**calculate_ndvi**) to compute NDVI values using the provided red and NIR data arrays, rounding the computed NDVI values to three decimal places. The code displays a 5 by 5 array subset, showcasing the first 5 columns of the first 5 rows, providing a glimpse into the initial NDVI computations within the dataset. Overall, this program effectively computes NDVI values, enabling insight into vegetation health from extensive band reflectance data. Future developments could focus on optimizing processing speed and enhancing error handling for broader applicability and reliability.

Q2 focuses on categorizing NDVI values into different vegetation categories (non-vegetated, low vegetation, medium vegetation, high vegetation, and very high vegetation). The program determines the number of array elements falling into each category, aiding in the assessment and quantification of vegetation levels across the dataset. It iterates through the computed NDVI results, incrementing counters based on predefined thresholds. The code outputs the count of array elements in each category, providing a clear summary of the vegetation distribution within the dataset. Further enhancements could involve creating a more generalized function for categorization, promoting scalability for varying threshold definitions and easier adaptability to different datasets.

Moving to Q3, a function NDVIp() is defined to transform NDVI values into a percentage representation. This function accepts either a single value or a list of values, performing the NDVI percentage transformation accordingly. This transformation is beneficial for presenting NDVI values in a more intuitive and easily understandable format. It also includes a validation check to ensure the input is either a list or a numeric value and provides an appropriate error message if otherwise. The code demonstrates flexibility by handling both single values and lists, facilitating the transformation process for diverse datasets. Further development might involve additional error handling for specific input data types or refining the error message to be more descriptive in cases where the input format doesn’t match the expected types.

Q4 extends the analysis by computing the Root Mean Square Error (RMSE) between predicted NDVIp values (from Q3) and NDVI values (from Q1) for the year 2019. The RMSE calculation quantifies the deviation between predicted and actual values, providing insights into the accuracy of predictive models used in vegetation assessment. he function then calculates the squared differences between corresponding elements of both lists and derives the RMSE using the square root of the averaged squared differences. This process ensures a quantitative assessment of prediction accuracy. The code demonstrates a systematic approach to error assessment between predicted and observed data, aiding in evaluating the model's performance. Further enhancements might involve additional error handling for potential discrepancies in data types or refining the function to accommodate missing or invalid values within the input lists.

Lastly, Q5 The code addresses the fifth question by generating a line plot that showcases the Normalized Difference Vegetation Index Percentage (NDVIp) for multiple years specified in Table 2. It systematically organizes the NDVIp data for different locations as separate lines on the plot, representing the evolution of NDVIp across numerous years for distinct geographic points. Employing the **plt.plot()** function within a loop, the code ensures a methodical presentation of NDVIp values against the corresponding years. This visual display enables straightforward comparison and trend identification for each location over time. Moreover, it ensures the preservation of the visualization as 'ex1_question5.png,' allowing future reference. This approach facilitates a comprehensive understanding of vegetation changes across multiple years for various geographic points, aiding in thorough analysis and pattern recognition.