Assignment question: Image Processing - Software Engineering Challenge

Write a python program that executes specific operations on the given hyperspectral image
(🗎 sample_image.tif). Below should be the objectives of your code.

1. Code should have least processing time
2. Well documented and structured code
3. Reproducible work environment for the code on other machines
4. Correctness in the execution of the transformations on the image
5. Code should be designed considering modularity, functional operations and object oriented programming principles

Below are the transformations that are to be executed:
a. Perform band-wise operation (for first 65 bands) by multiplying each pixel value of each band by a gain of 0.9 and then subtract by offset of 5 units. E.g. If the pixel value is "DN", then the updated pixel value would be "DN x gain - offset". The transformation function should be designed to take gain and offset as input arguments.
b. Perform thresholding on band index 50. If the pixel values are greater than 100, set it to 255. If the pixel values are less than or equal to 100 set them to 0. This should lead to a single-band binary mask. Save the mask as a "mask.tif" file, keeping its geometric properties same as a single band input layer. Convert the mask.tif file to a ".geojson" vector file and save the file as "mask.geojson".
c. Perform the operation explained in "b" for the first 20 bands of the hyperion image, and improve the run-time performance by utilizing parallel processing strategy.
d. The 0 value pixels in the image are outside the scene content. They should not be modified during any of the operations.

Requirements:
● Showcase your software engineering skill set by implementing 2 levels of coding - average and a better implementation on run time, memory consumption and code engineering.
● Benchmark or record resource consumption (time and memory) at each of the implementation step

Data Link: 🗎 sample_image.tif

Basic explanation of the data:
        The shared data is a processed hyperspectral image over canada farms, collected by Hyperion satellite. The data has a total of 196 bands, wavelengths ranging from 400 nm to 2500

nm. The pixel values are in 8-bit unsigned int data type format. The properties of the satellite data can be found at https://www.usgs.gov/centers/eros/science/usgs-eros-archive-earth-observing-one-eo-1-hyperion .