ASSIGNMENT-1

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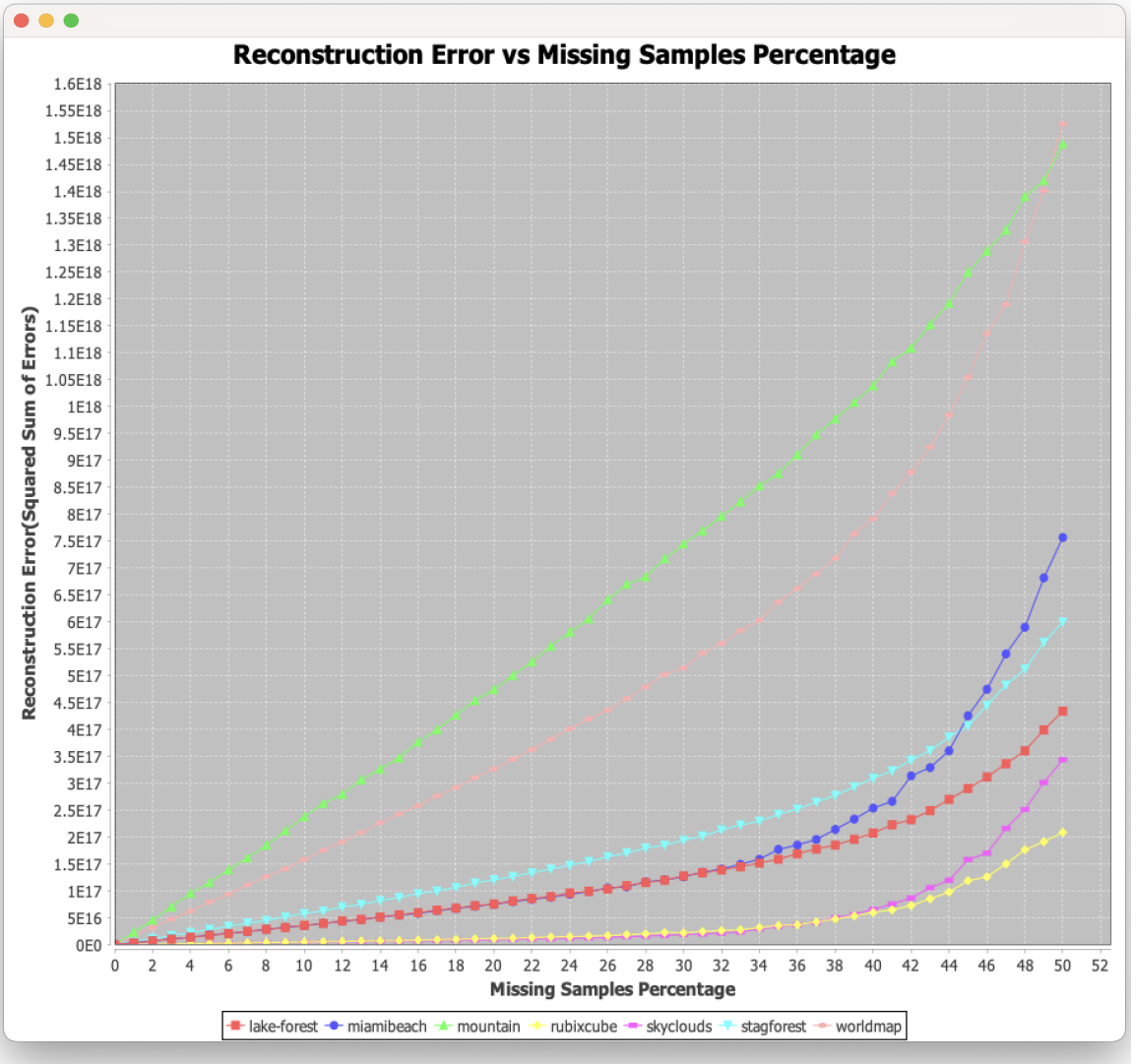
PART 3:

Q1. For each of the given images, plot a graph for the reconstruction error.

Ans:



Q2. Which image has higher errors, which image has lower error? Why are all the plots different?

Ans: Images that have a more intricate and textured pattern, more color variance and less uniformity have higher reconstruction errors. In our case mountain.rgb has the higher errors. This is because when we remove a sample from such images, we are potentially removing a unique piece of information that can't be easily inferred from its neighbours. For example in the picture of "mountain" there are many colours and very less uniformity amongst the pixels, so when one pixel is removed, it is difficult to calculate its correct value using the neighbouring pixels.

In contrast, images that have large uniform areas will have lower reconstruction errors. In our case rubixcube.rgb has the lower errors. "rubixcube" has more than half of its pixels as black which gives rise to a lot of uniformity in the picture. And If we remove a sample from a uniform region, the neighbourhood samples are likely very similar to the removed sample, so reconstruction will be more accurate.

The plots are different for each image due to the variability in content. An image of a clear blue sky like "sky clouds" is fundamentally different in complexity from an image of a detailed world map or mountain. This content/colour variability & extent of uniformity affects the reconstruction error. The pictures having less uniform areas will have more reconstruction errors.

Q3. From your quantitative analysis, can you qualitatively describe which image will have higher error and which image will have lower error.

Ans: Based on the quantitative analysis:

- Images that are likely to have higher reconstruction error:
    - Images with high variability and details (e.g., detailed textures, intricate patterns, and sharp edges).
    - Images where colours change rapidly over a short distance.
    - Scenes with a lot of small objects or intricate structures.
    - Like in the "mountain" picture, we have so many stars in the sky, mountains and forests all having different colours and mountains have very well defined shapes and there is a shooting star in the midst of the sky, and also has a lot of stars in the sky. Such characteristics cannot be easily inferred from the neighbours.
- Images that are likely to have lower reconstruction error:
    - Images with large areas of the same or very similar colours (e.g., clear sky, empty walls).
    - Scenes without much detail or fine structures.
    - Images where the scene is largely out of focus or blurred.
    - For e.g skyclouds picture is a picture of plain blue sky. Has very less Colour variance, no intricate patterns and in general we can see a lot of uniformity in

the picture. RubixCube is also an example of this case. As it has more than half of its pixels as black. It has a lot of uniformity.

EXTRA CREDIT:

The Random Forest is used in this algorithm to predict the reconstruction error of images based on extracted features such as entropy, edge density, and colour variance, by training on a set of sample images and their computed features.

My model is able to predict the reconstruction error values with a Total Mean Absolute Percentage Error in prediction of approximately 31.78%.