ADRL 2024 - Assignment 2

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1. Implement a vanilla VAE with MSE for conditional likelihood. Report results with different numbers of samples of z during training for the input to the decoder. Plot 10 by 10 grids of both reconstructions and generations. Plot the loss curves for likelihood, KL, and the combined terms. Compute FID with 1000 generated images.
2. Build a CNN-based classifier using the images in the training part of the dataset and report the accuracy on the test set
3. Now, using the VAE trained, perform a posterior inference on all the images and use the thus obtained latent vectors with an MLP for classification. Quantify and document your observations on the advantages/disadvantages of using latent space, in terms of classification accuracy and network size.
4. Implement a beta-VAE with 4 different values of beta and plot 10 by 10 grids of generated and reconstructed data. Document your observation in terms of change in results with varying beta.
5. For one of the VAEs (with the optimal beta), perform posterior inference for a pair of images and plot the generated images in the path of linearly interpolated latents (10 points along the line joining the corresponding latents) for 10 pairs.
6. Implement an adversarial Auto-encoder with MSE loss. Plot the generated images and compute FID.
7. Implement a VQ-VAE with discrete latent space. Perform posterior inference on all the images, post-training. Build a classifier with these latent vectors and calculate the accuracy.
8. Fit a GMM on the vectors from the latent space obtained via posterior inference. Subsequently, sample new latents from the GMM, pass it through the decoder, and plot a grid of 10 by 10 images.

General Instructions:

1. For the first question, both the animal and butterfly datasets are to be used. Second question onwards, use only the Butterfly dataset.

2. You need to resize all images to 128x128 pixels before implementing.

3. Use Google collab with Jupiter notebook for all the computing.

4. You are supposed to submit a single Jupiter notebook with all the solutions made into separate blocks.

5. Use Pytorch for building neural networks. You are supposed to directly use the off-the-shelf functions for the models asked.

6. A report has to be submitted that would list all the experiments, results, and observations. This should be embedded in the Jupiter notebook itself.

7. Use matplotlib for plotting.

8. The final evaluation **does not** depend on the accuracy metrics but is based on the **quality of your experiments and observations thereof**.

9. We will run a plagiarism check on the codes. Any suspicion of copying would lead to a harsh penalty from negative marks in the assignment to a failing grade in the course, depending upon the severity. Therefore, kindly refrain from copying others' codes and/or reports.