Homework 3

Principles of Artificial Intelligence (5083)
23rd November, 2023

Question 1.

Jerry, a future biologist, intends to gift his daughter a genetically modified flower that is truly unique. However, lacking inspiration, he decides to employ AI to assist him in crafting a one-of-a-kind flower. Unhappy with the initial design, Jerry begins searching for extinct flowers. Eventually, he stumbles upon a database of sunflowers that had become extinct by then, hoping to create a genuinely unique sunflower for his daughter using this newfound resource. Help Jerry!

Part 1: GAN (40 pts)

Using the dataset to generate (32, 32, 3) flower pictures

- (20 pts) With **latent_dim = 10**, **epochs = 100** show the training history (loss of generator and discriminator) and the generated figure every 10 epoch. The input should always be $\texttt{tf.random.normal}(\texttt{shape} = (1, \texttt{latent\_dim}), \texttt{seed} = 1)$
- (10 pts) Change the **latent_dim = 256**, and repeat the above process.
- (10 pts) Try to generated higher resolution pictures (128, 128, 3), and show 4 figures at the end. The hyperparameters are up to you.

Part 2: VAE (40 pts)

Same dataset as GAN, but generate a specific class of flower (you can choose whatever class you want from the dataset).

- (20 pts) With **latent_dim = 3**, **epochs = 100** show the training history (loss of KL and reconstruction) and the generated figure every 10 epochs. The input should always be the same as Part 1. Plot the figure like Figure 1 with the code in file, and plot the specific class of flower (one figure is enough) like Figure 2.
- (10 pts) Now let the **latent_dim = 256**, and repeat the above process.
- (10 pts) Explain the reparameterization operation at the bottleneck and how it can replace the original sampling and do the backpropgation? Derive the gradient $\frac{\partial \mu}{\partial L}, \frac{\partial \sigma}{\partial L} =?$

Part 3: Combination (20 pts)

- (20 pts) Each method above has its pros and cons. Please google methods that combine both models' advantages. Choose one and briefly explain how it works.

Hints:

- TAs are your friends. Please **DO NOT** hesitate to contact the TAs if you have questions.

Grading: Please submit your program and a short report (less than **5 pages**). In your report, please provide the required figures as mentioned, followed by some discussions. Also in your code file, you need the **COMMENT** for each function and described it, do not just simply copy and paste from Google. Your grades will be decided based on both the codes and report.

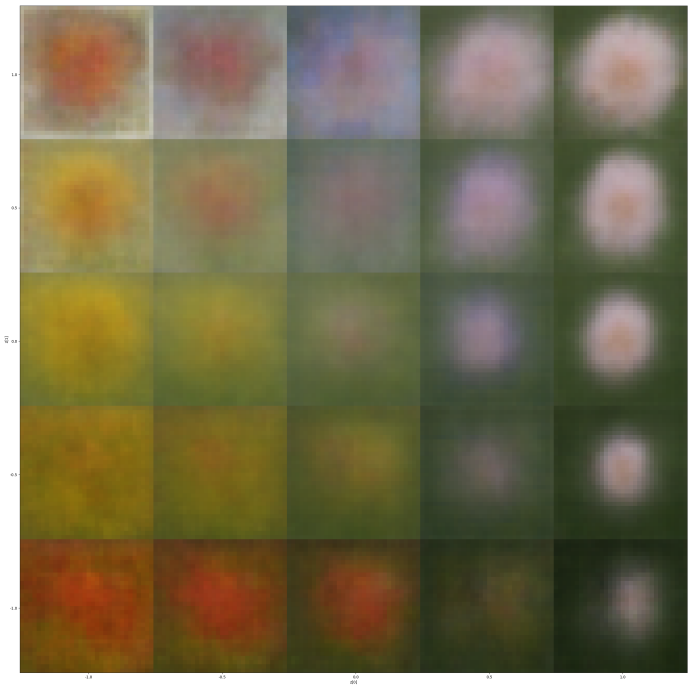

Figure 1:

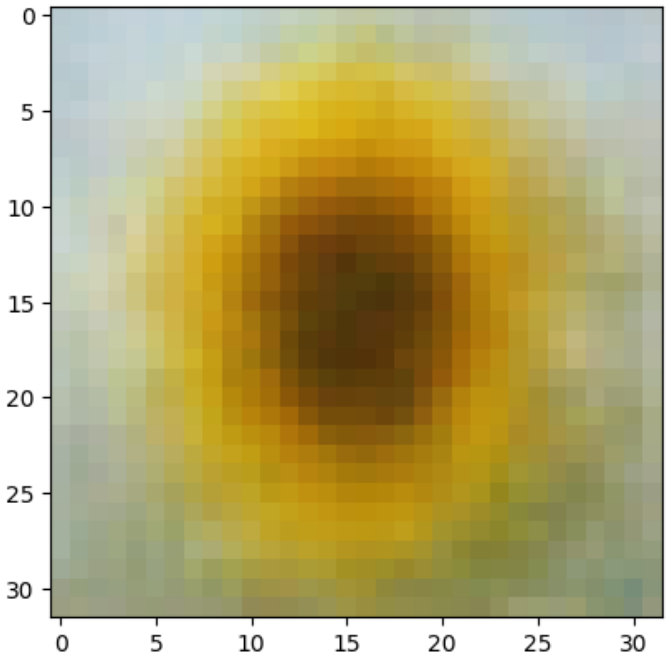

Figure 2: