

Project III - Diffusion Project Plan

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1 What we are going to test

1.1 Network architectures

I am planning to test and compare the following network architectures:

- vanilla pixel diffusion: it seems like an easy task to implement with `keras`; however, there are very few internet resources discussing this particular architecture;
- *Denoising Diffusion Probabilistic Model* and *Denoising Diffusion Implicit Models*: I have found well-documented and functioning implementations on the Keras examples site [1, 2];

1.2 Hyper-parameters

My plan for investigating hyper-parameters involves testing various values for the learning rate hyper-parameter, as well as the inclusion of normalization and regularization techniques such as dropout. It appears that unstable gradients, inappropriate learning rates, or insufficient model capacity can lead to training collapse, where the model may converge to a sub-optimal solution or fail to converge altogether, resulting in poor performance during image generation. It would be valuable to identify a set of hyper-parameters that result in training collapse and another set of hyper-parameters that overcome this problem.

1.3 Predictions & evaluation

In addition to calculating and comparing the *Frechet Inception Distance*, results will be assessed qualitatively. Characteristics such as clarity, sharpness, detail, and overall fidelity to the original images will be examined. Attention will be paid to features such as colors, quality, realism, and diversity of the generated images.

References

- [1] Keras DDIM Example. <https://keras.io/examples/generative/ddim/>.
- [2] Keras DDPM Example. <https://keras.io/examples/generative/ddpm/>.