# Homework Assignment 9

Due Date: 6pm on Tuesday April 25th

## 1. Reading summary (6 points)

> Ho, Jonathan, Ajay Jain, and Pieter Abbeel. "Denoising diffusion probabilistic models." *Advances in Neural Information Processing Systems* 33 (2020): 6840-6851.

Please summarize the reading material in your own words. This exercise will help you comprehend the main objectives in the reading besides the technical details. Your summary should consist of three parts:

1. One-sentence summary
2. One-paragraph summary
3. Half-page summary

## 2. Questions (4 points)

Please select **Three** questions to answer from the following list, and write down **one** question that you have about reading material. Your question can be about a specific concept that is difficult to understand, a line of confusion, or something you would like to learn more about.

**Chapter 1**

- What advanteges and limitations do diffusion models have as a generative model?

**Chapter 2**

- How are diffusion models different from other types of latent variable model, according to the paper?
- What are the purpose of the variance schedule $\beta_1, \ldots, \beta_T$
- In the forward process, how does diffusion model sample $x_t$ in closed form at an arbitrary timestep $t$?
- Explain the meaning of $L_T$, $L_{t-1}$, $L_0$ in Equation 5.

**Chapter 3 & 4**

- What parameterization method is used to represent mean $\mu_\theta$ in the reverse process?
- Explain the training and sampling process of DDPM
- What simplified training process does this paper propose?

**Open question:**

- How can we condition the sampling process of DDPM on other variables (e.g. class label)?
- Discuss the difference between DDPM and other generative models (e.g.flow-based model and VAE)