Project 5 - Diffusion - Part A

Sampling from the Model

For this part, I ran the model on the three prompts twice, with a different number of inference steps each time (20 and then 50). Outputs are displayed below, for the images as well as the upsampled images. The second set of images has slightly higher resolution than the first. All images are pretty accurate with respect to the prompt. The second oil painting seems more like an oil painting to me than the first, however. Also, I chose a seed of 180.

20 Inference Steps

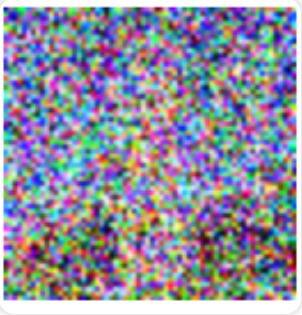
50 Inference Steps

Implementing the Forward Process

Here, I implemented the forward function which takes in an image im and a timestep t as input to generate a noisy image. Here are the outputs of the test image (Campanile) with timesteps of 250, 500, and 750.

Campanile (250 noise level)

Campanile (500 noise level)

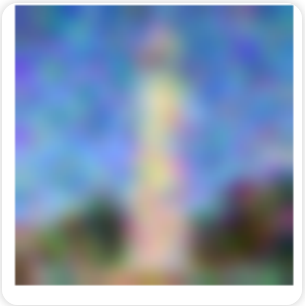


Campanile (750 noise level)

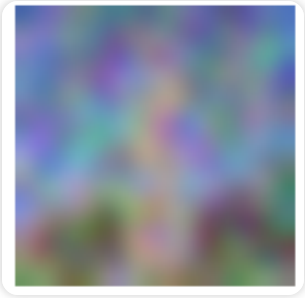
Classical Denoising

Here, I simply used Gaussian blur filtering to try and remove the noise. I have displayed the outputs for filtering the three noised images from the previous section below. I used parameters of 7, 13, and 17 respectively for the blurring.

Filtered campanile (250 noise level)



Filtered campanile (500 noise level)

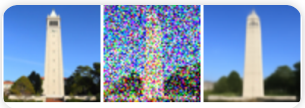


Filtered campanile (750 noise level)

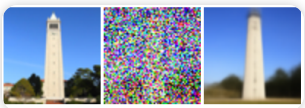
One Step Denoising

Here, I implemented one step denoising and have displayed the outputs of this on the three noised images (250, 500, 750) below. Each set of three is the original image, noised, and denoised version side-by-side.

250 Noise Set



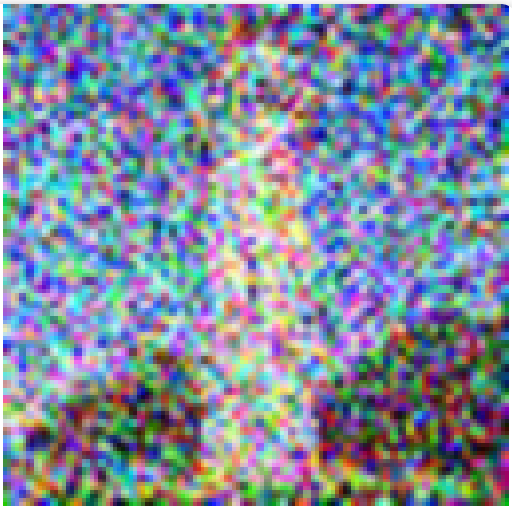
500 Noise Set



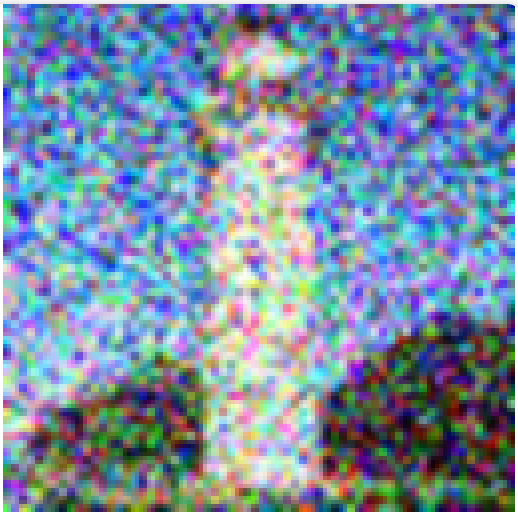
750 Noise Set

Iterative Denoising

I implemented iterative denoising here and have displayed below the results of every fifth loop of denoising, as well as the final results (final denoised image, one-step denoised, and noised image).



Loop 4



Loop 9

Loop 14

Loop 19

Final Image

One-Step Image

Noised Image

Diffusion Model Sampling

Here, I generated 5 high-quality images from scratch by using i_start = 0 and passing in random noise.





5 Generations

Classifier Free Guidance

Here, I implemented a function for iterative denoising but with CFG. I have attached 5 images of high-quality photos here.





5 Generations

Image to Image Translation

I created edits of the test image using different noise levels, using the iterative denoise cfg function for denoising. I also did this for two of my generated images.






Campanile



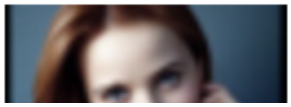


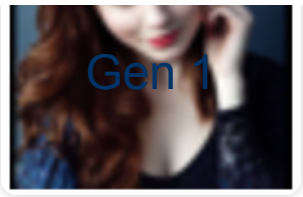






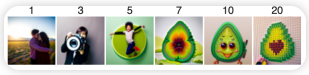




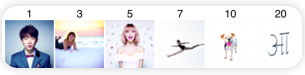



Editing hand-drawn and web images

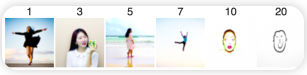
Here I again did image-to-image translation, but with hand drawn and web images as shown below.



Web Avocado



Hand Drawn Om



Hand Drawn Smile

Inpainting

Here I used a mask to create new content in part of the image. I did this for three images and used two different masks. The last two have my own custom mask which changes the center.

Campanile

Avocado

Cloud

Visual Anagrams

Here I generated three images that look like one image normally and another when viewed upside-down.

Fire / Old Man

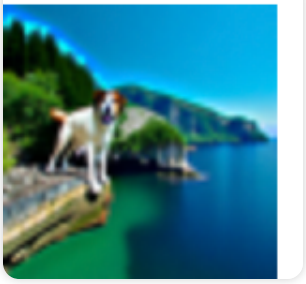
Barista / Dog

Coast / Pencil

Hybrid Images

Here I generated three images that look like one image up-close and another when viewed from far away.

Skull (Far) / Waterfall (Close)



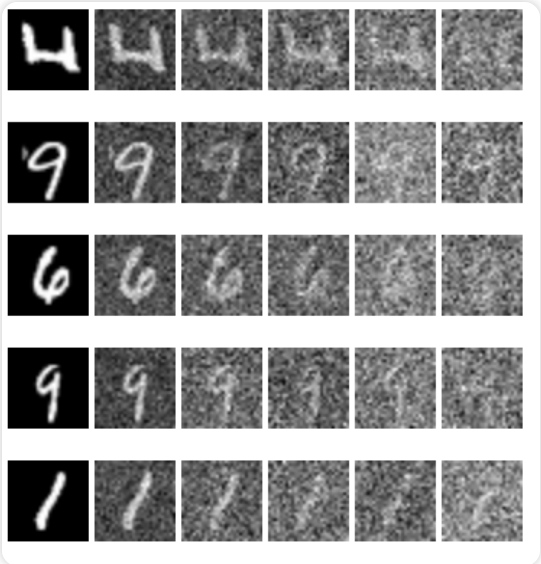
Coast (Far) / Dog (Close)

Man (Far) / Snowy Mountain (Close)

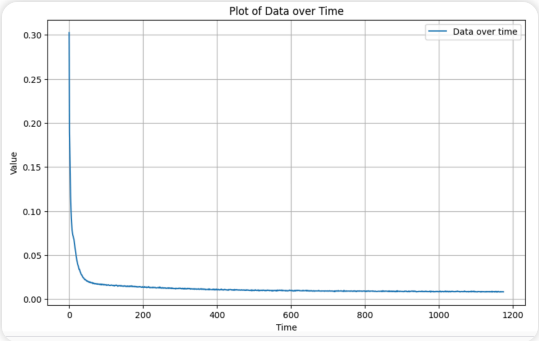
Project 5 - Diffusion - Part B

Part 1 - Training a Single-Step Denoising UNet

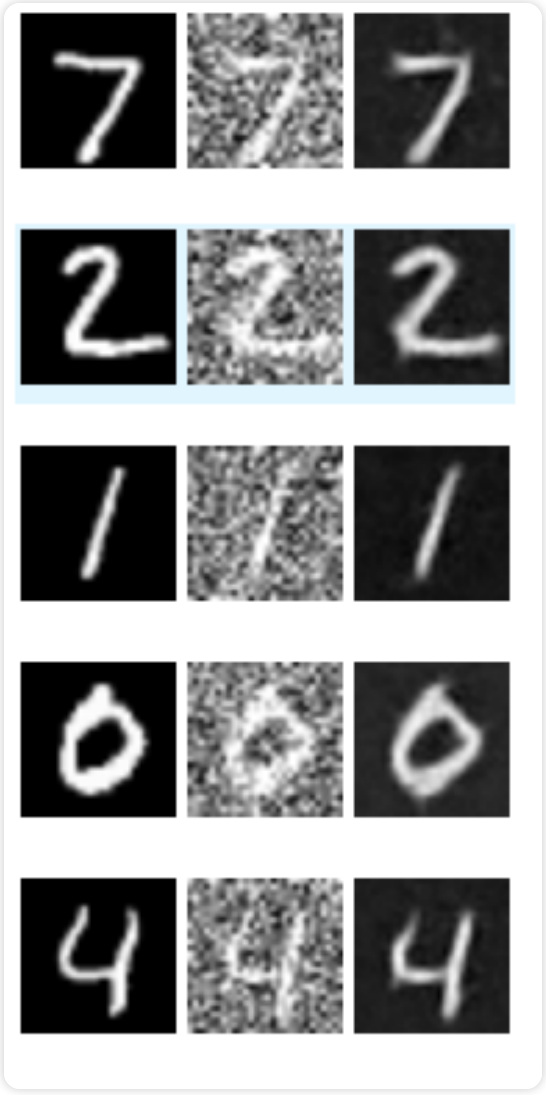
In this part, I trained a single-step denoising UNet. I first implemented the UNet and then used it to train a denoiser. Once that was done, I did some out-of-dist testing to see the results of this denoiser on images of noise levels for which it was not trained.



Digits with noise levels 0, .2, .4, .5, .6, .8, 1

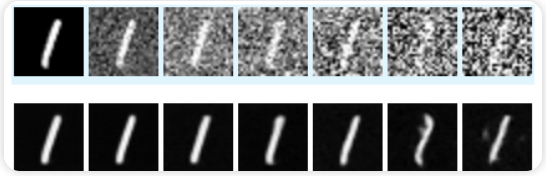


Plot of losses by batch.



Results of original image, noised image, and denoised image after 1 epoch

Results of original image, noised image, and denoised image after 5 epochs.



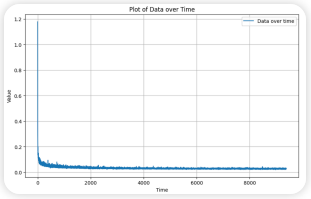
Sample results on test set with varying out-of-distribution noise levels (0, .2, .4, .5, .6, .8, 1).

Part 2 - Training a Diffusion Model

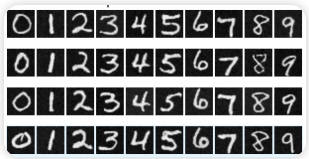
In this part, I trained different diffusion models. I did one that was time-conditioned and one that was class-conditioned as well. Results are below.

Generated Digits after 5 Epochs (Time-Conditioned)

Generated Digits after 20 Epochs (Time-Conditioned)

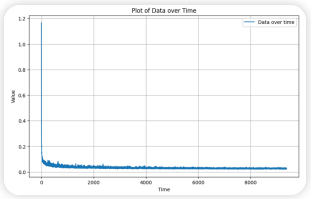


Plot of losses (Time-Conditioned)



Generated Digits after 5 Epochs (Class-Conditioned)

Generated Digits after 20 Epochs (Class-Conditioned)



Plot of losses (Class-Conditioned)

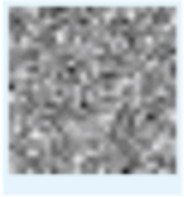
Bells and Whistles - CS 180 Logo

I created a custom prompt embedding and then generated a few possible logos for CS 180 which I have displayed. This was using iterative cfg denoising.

All Logos

Bells and Whistles - Sample GIFs

Here I have added some GIFs of noise that was generated and the images generated by the time-conditional diffusion model.



9

1

4