CS726 Programming Assignment – 2 Report

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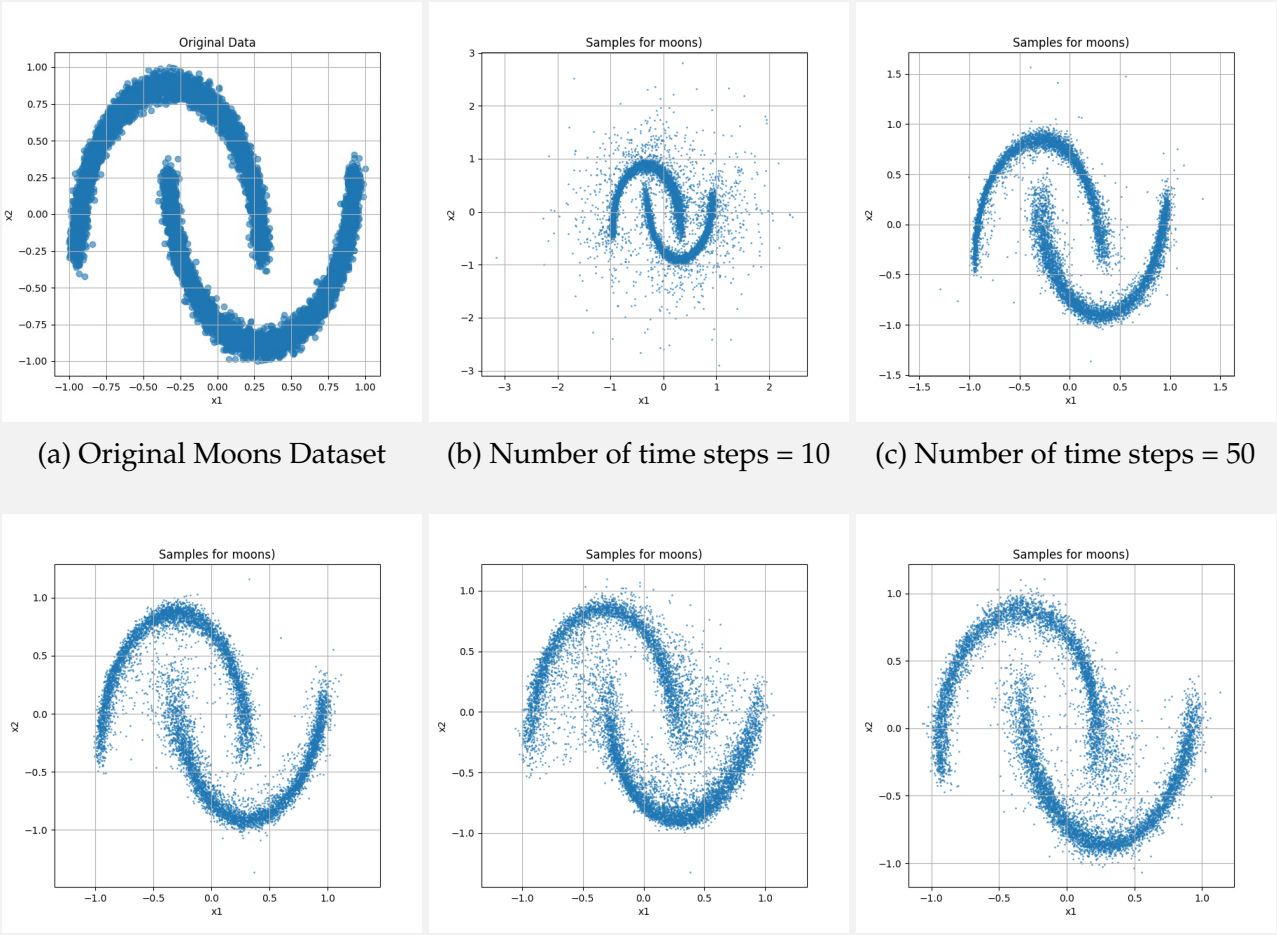
Denoising Diffusion Probabilistic Models

Here are the results of unconditional DDPMs on various datasets (with respect to the number of time steps). We had fixed all other parameters (the best settings observed):

- lbeta=0.0001
- ubeta=0.02
- lr=0.0001 (so that training loss decreases across epochs)
- n_samples=10000
- n_dim=2 (for helix it is 3)
- batch_size=128 (to avoid CUDA memory errors and optimal results)
- epochs=40

Moons



(a) Original Moons Dataset (b) Number of time steps = 10 (c) Number of time steps = 50

(d) Number of time steps = 100 (e) Number of time steps = 150 (f) Number of time steps = 200

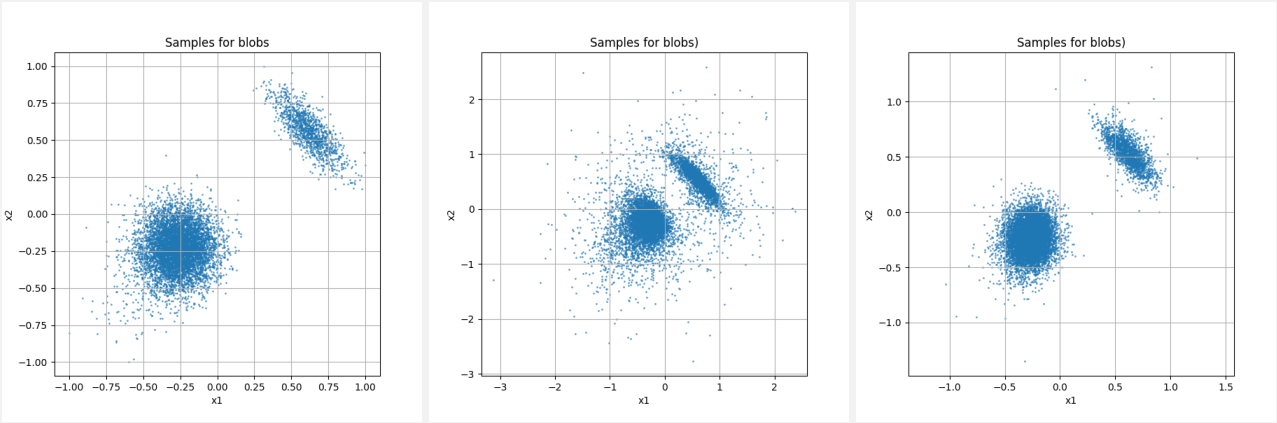
Figure 1: Moons Dataset

Here are the NLL values:

- $T = 10$: 1.048
- $T = 50$: 0.9599
- $T = 100$: 0.9519
- $T = 150$: 0.9218
- $T = 200$: 0.9321

As, we can see from both NLL values and the images, $T = 150$ performed the best.

Blobs



(a) Original Blobs Dataset (b) Number of time steps = 10 (c) Number of time steps = 50

(d) Number of time steps = 100 (e) Number of time steps = 150 (f) Number of time steps = 200

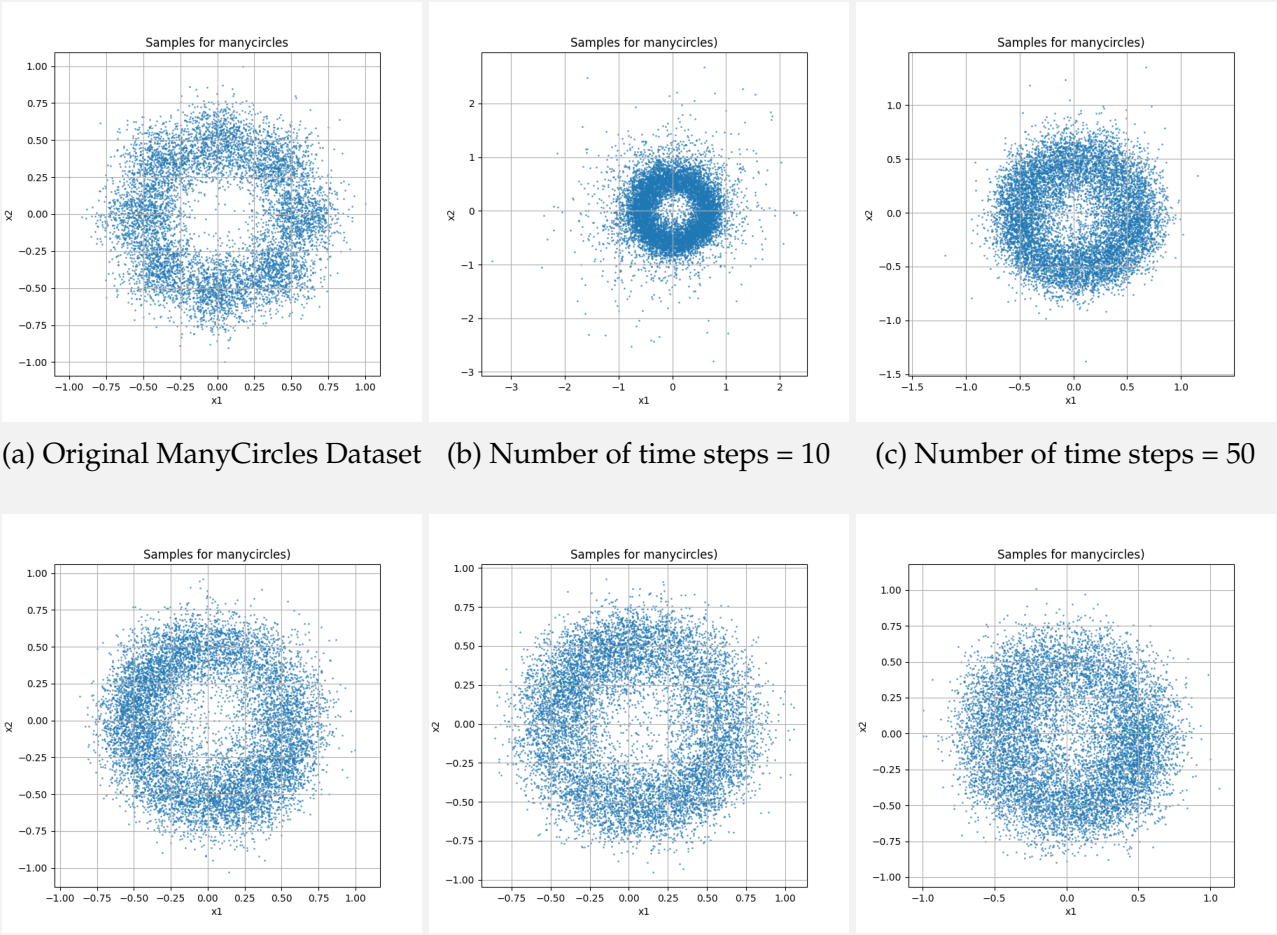
Figure 2: Blobs Dataset

Here are the NLL values:

- $T = 10$: 0.37
- $T = 50$: 0.0152
- $T = 100$: 0.0232
- $T = 150$: -0.0223
- $T = 200$: 0.0045

As, we can see from both NLL values and the images, $T = 150$ performed the best. Moreover, there is a sudden decrease in NLL from 10 to 50, which shows the significant impact of increasing the number of time steps.

Many-Circles



(a) Original ManyCircles Dataset (b) Number of time steps = 10 (c) Number of time steps = 50

(d) Number of time steps = 100 (e) Number of time steps = 150 (f) Number of time steps = 200

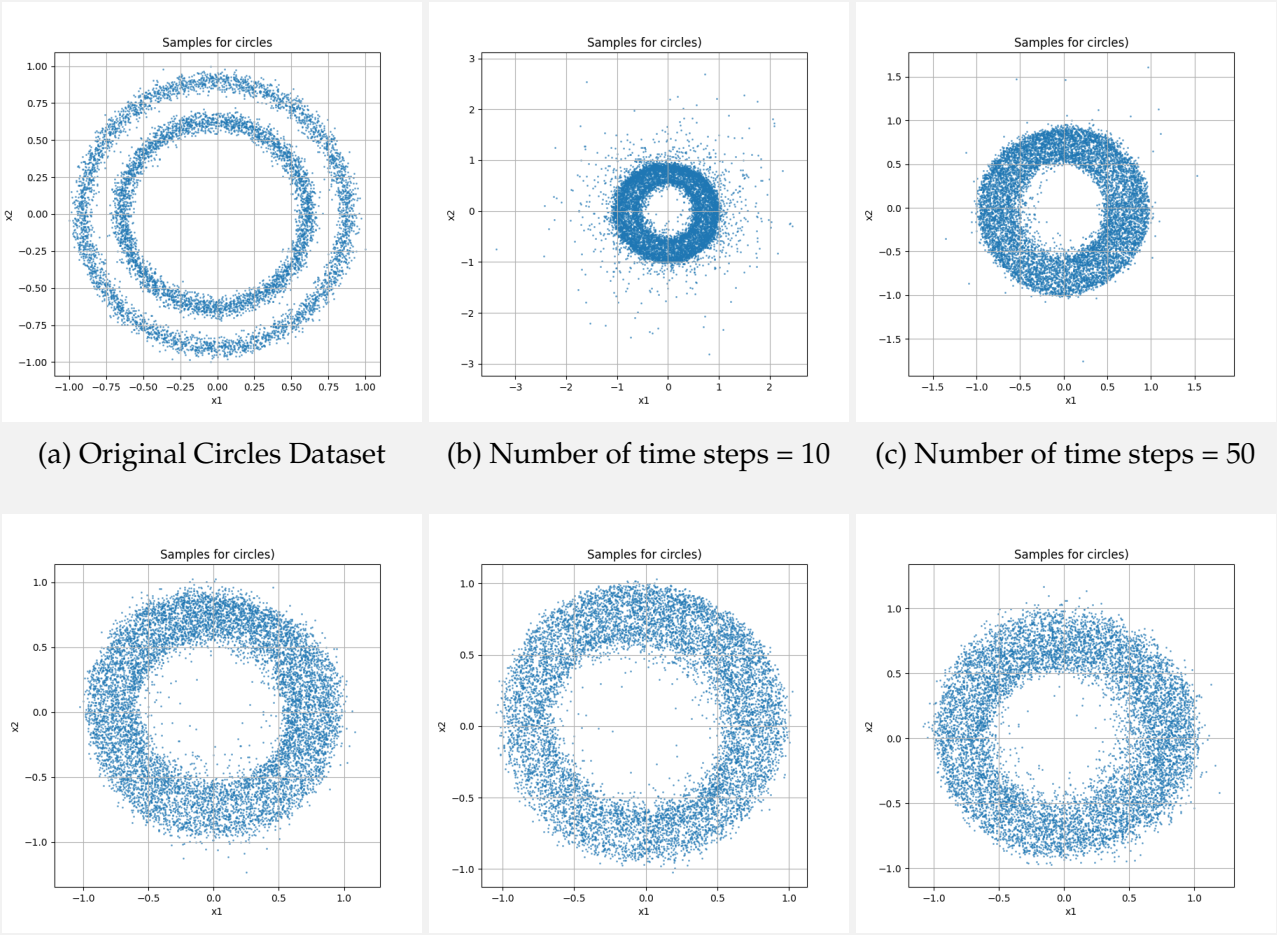
Figure 3: Many Circles Dataset

Here are the NLL values:

- $T = 10$: 0.75
- $T = 50$: 0.548
- $T = 100$: 0.545
- $T = 150$: 0.558
- $T = 200$: 0.522

As, we can see from both NLL values and the images, $T = 200$ performed the best.

Circles



(a) Original Circles Dataset (b) Number of time steps = 10 (c) Number of time steps = 50

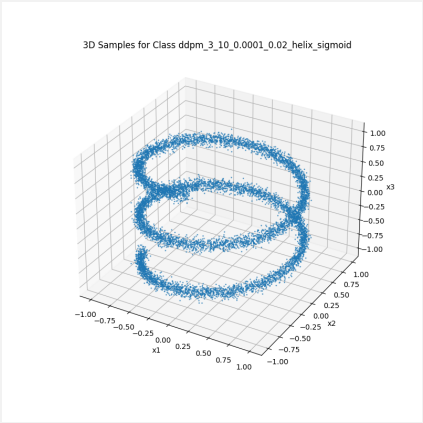
(d) Number of time steps = 100 (e) Number of time steps = 150 (f) Number of time steps = 200

Figure 4: Circles Dataset

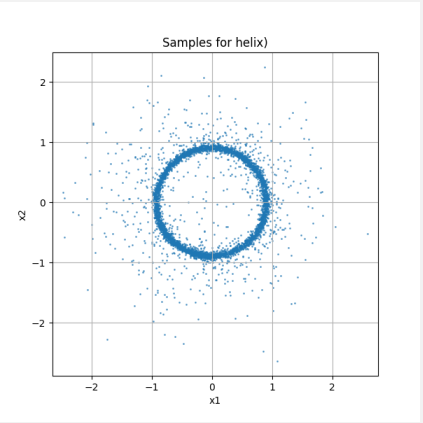
Here are the NLL values:

- $T = 10$: 1.081
- $T = 50$: 0.991
- $T = 100$: 0.9869
- $T = 150$: 1.004
- $T = 200$: 0.992

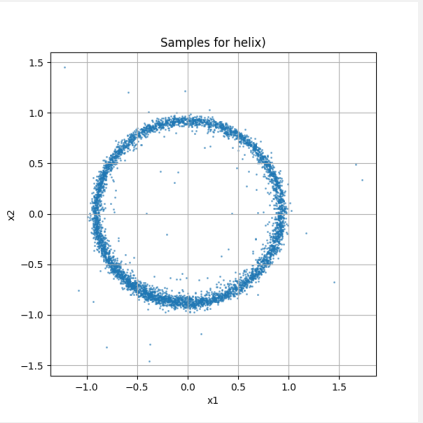
Helix



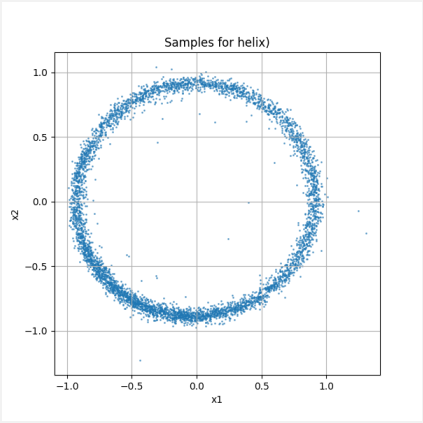
(a) Original Helix Dataset



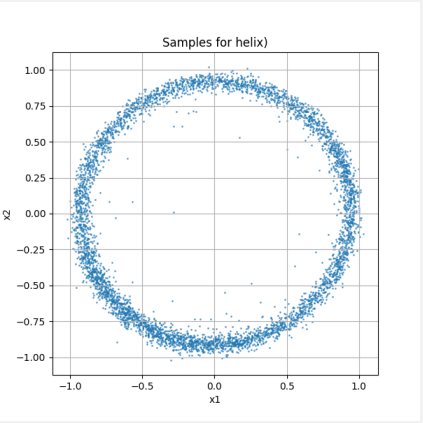
(b) Number of time steps = 10



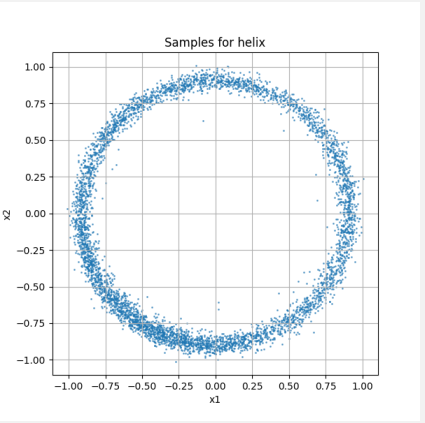
(c) Number of time steps = 50



(d) Number of time steps = 100



(e) Number of time steps = 150



(f) Number of time steps = 200

Figure 5: Helix Dataset

Here are the NLL values:

- $T = 10$: 1.6179
- $T = 50$: 1.514
- $T = 100$: 1.5198
- $T = 150$: 1.528
- $T = 200$: 1.528

As we can see from the images (and the NLL values), 50 performs the best.

Classifier-Free Guidance

Reward Guidance