Deep Learning Project 3

Image generation

Dutt Salveen Singh, Patryk Prusak

November 18, 2024

Warsaw University of Technology

Introduction

Problem

Test and compare different architectures of image generators, with the constraint that at least one of the examined models must be capable of generating satisfactory images. The dataset used for training and testing the models should be the 10% sample of the LSUN Bedrooms Dataset that consists of a number of images of bedrooms.

Experiments

Hyperparameters

For the hyper-parameters, we chose to investigate optimizers with different learning rates, number of epochs, scheduler's training steps, and batch sizes.

Procedure

1. Split the dataset into train and test sets, with 10% test size, and scale the images to 64 by 64 pixels.
2. Choose a starting parameter X (such as batch size) and answer the following question: given a set of basic (commonly seen in literature) parameter values (such as a hyperparameter) excluding parameter X, what value for X results in best accuracy?
3. Choose the best-found value for parameter X and replace the parameter's basic initial value, then choose a different parameter X and start from 2.

Metric

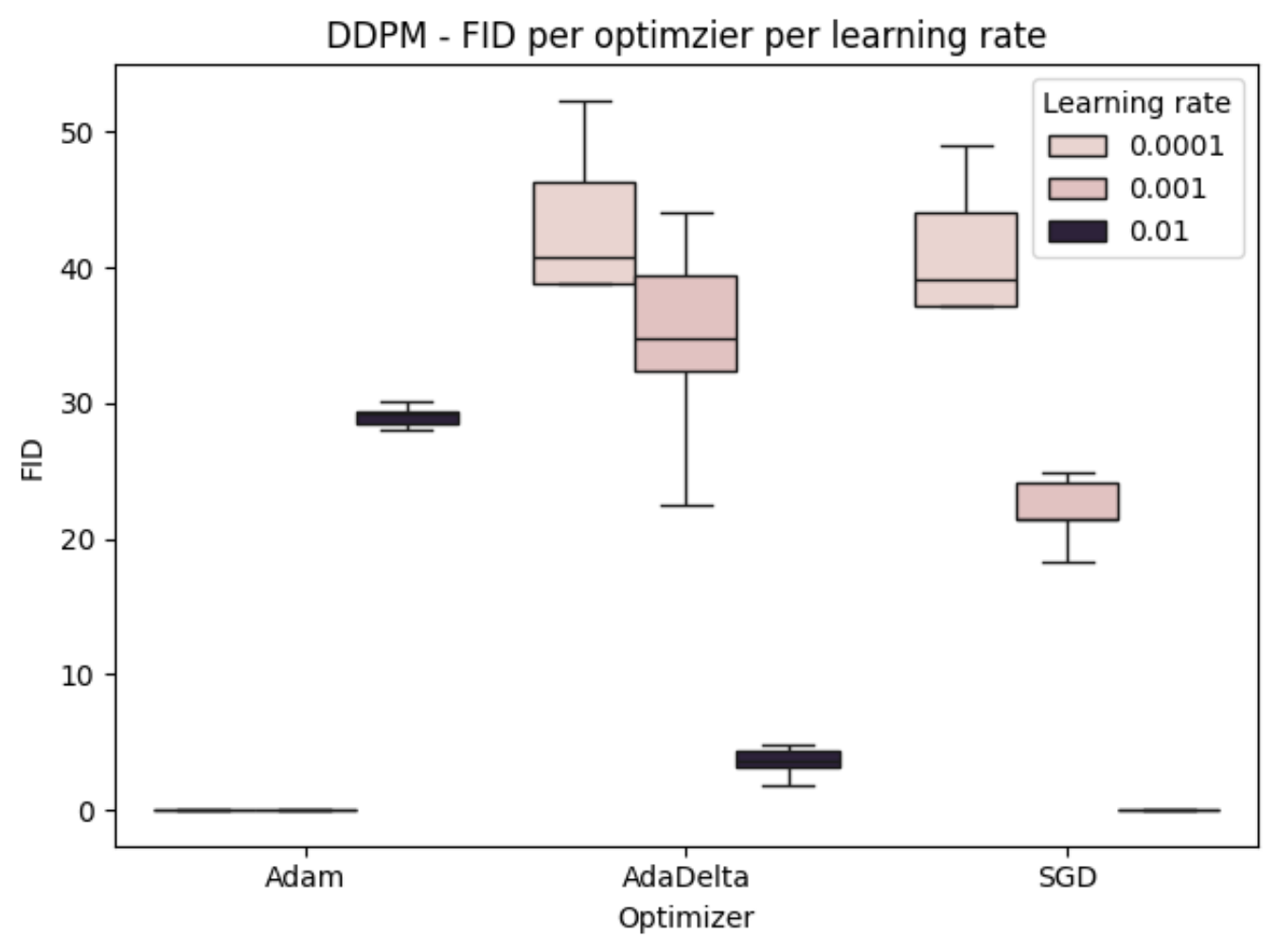
Fréchet inception distance (FID) - metric, commonly used in literature, comparing two sets of images: real and generated by an image generation model.

Models

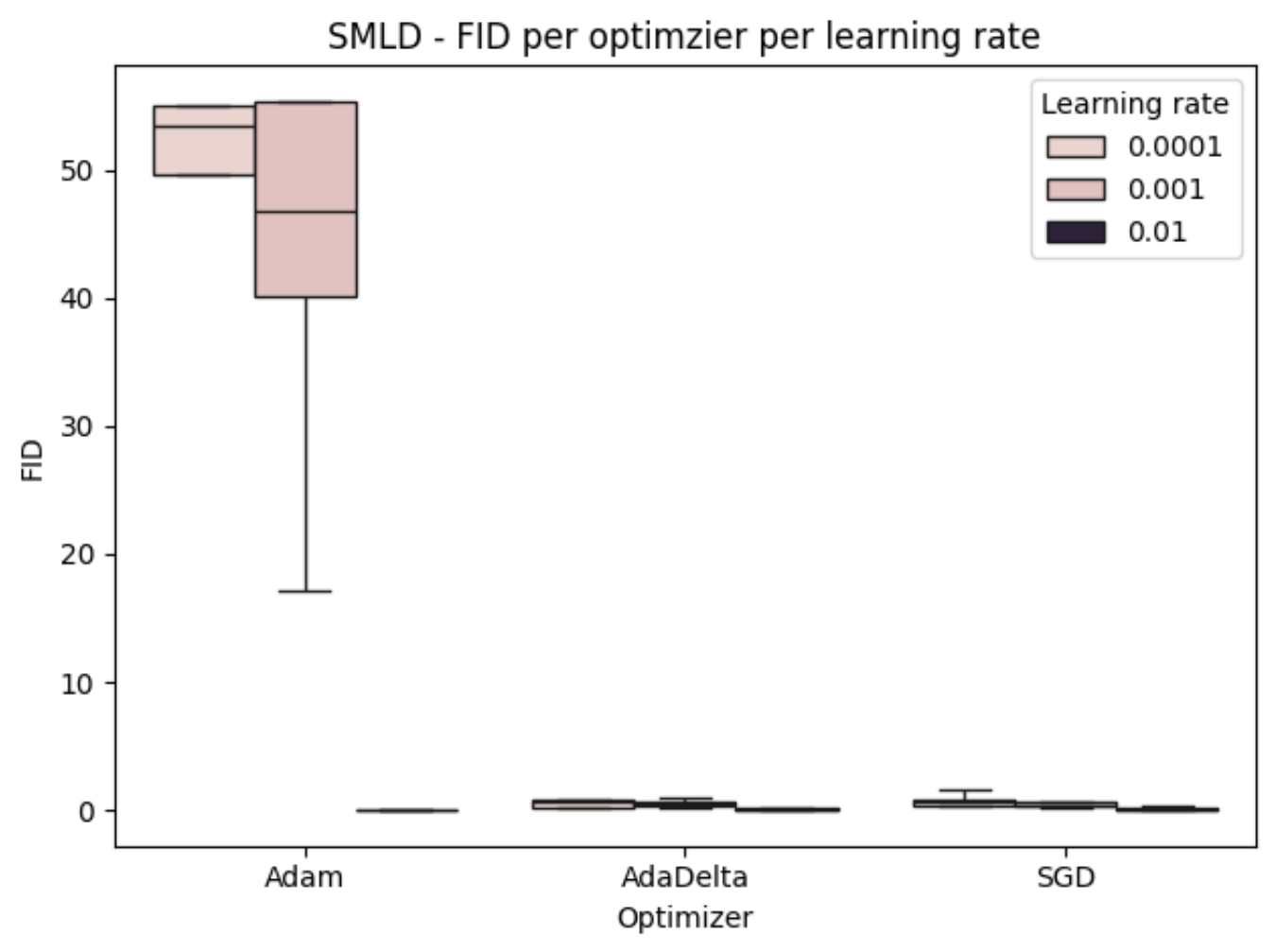
1. Denoising Diffusion Probabilistic Model (DDPM) .
2. Score Matching with Langevin Dynamics (SMLD).
3. Both are based on the U-Net model.

Results

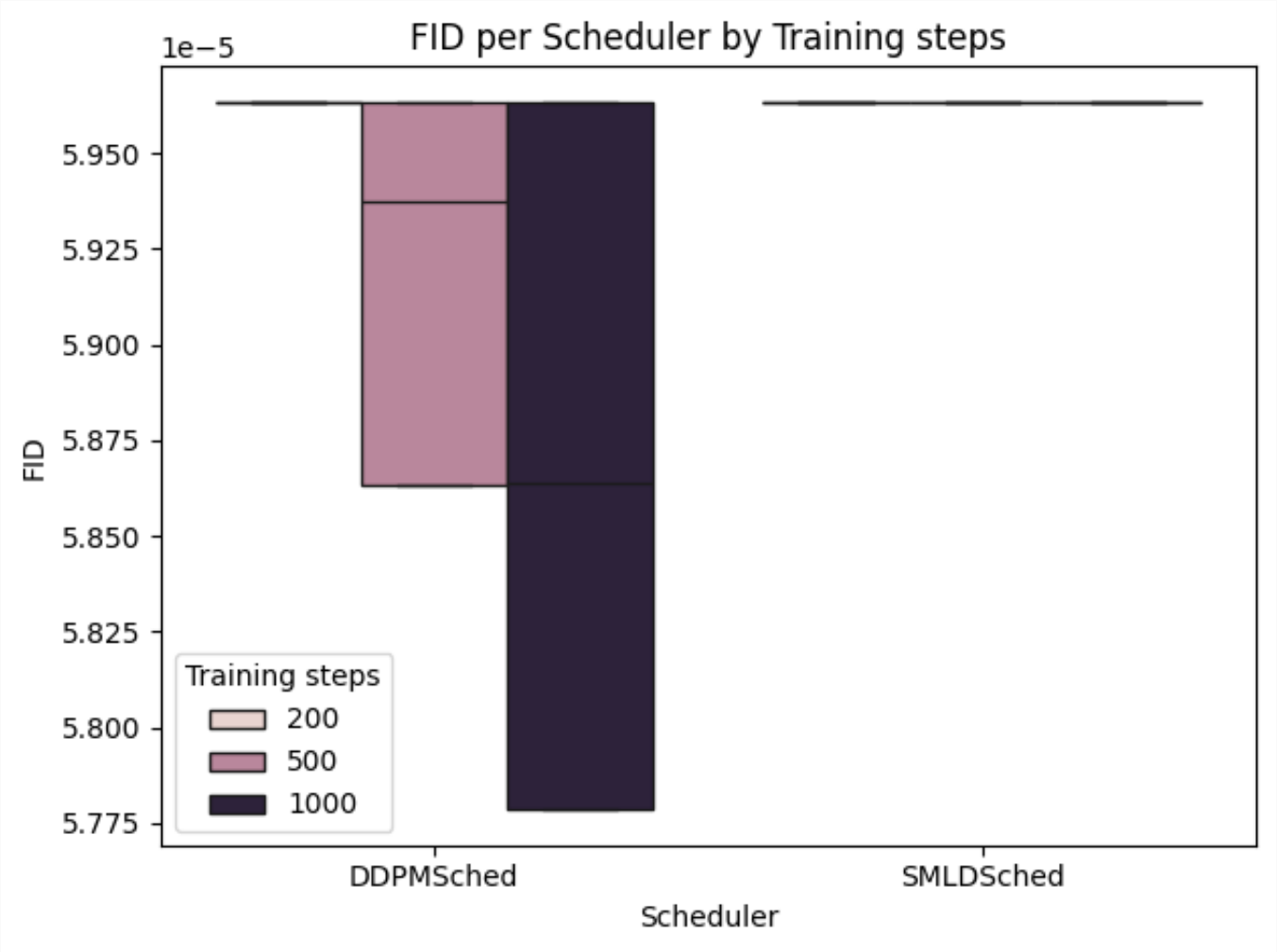
Results


DDPM - FID per optimzier per learning rate
Learning rate
0.0001
0.001
0.01
FID
50
40
30
20
10
0
Adam
AdaDelta
SGD
Optimizer

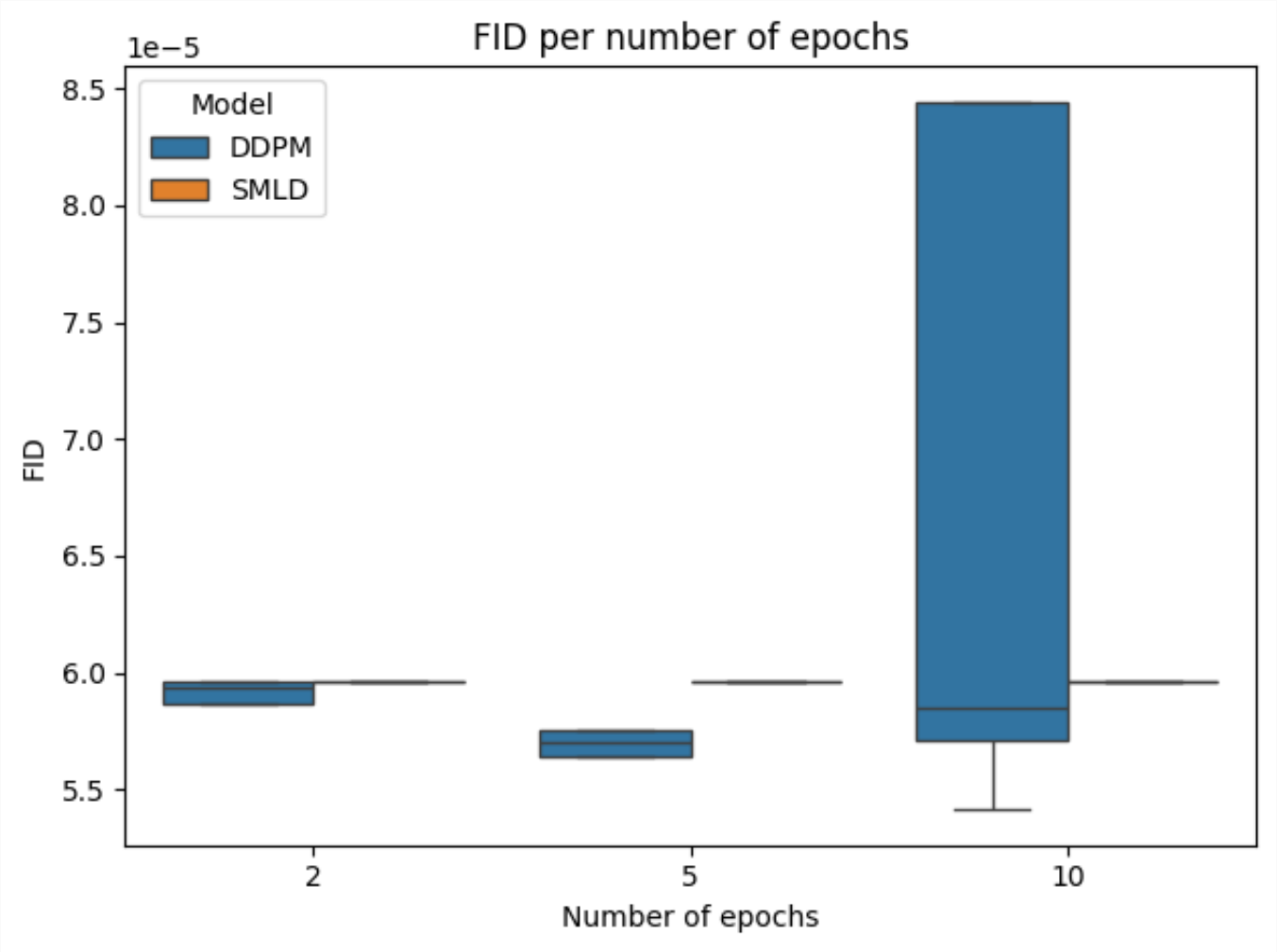
Results


SMLD - FID per optimzier per learning rate
Learning rate
0.0001
0.001
0.01
FID
50
40
30
20
10
0
Adam
AdaDelta
SGD
Optimizer

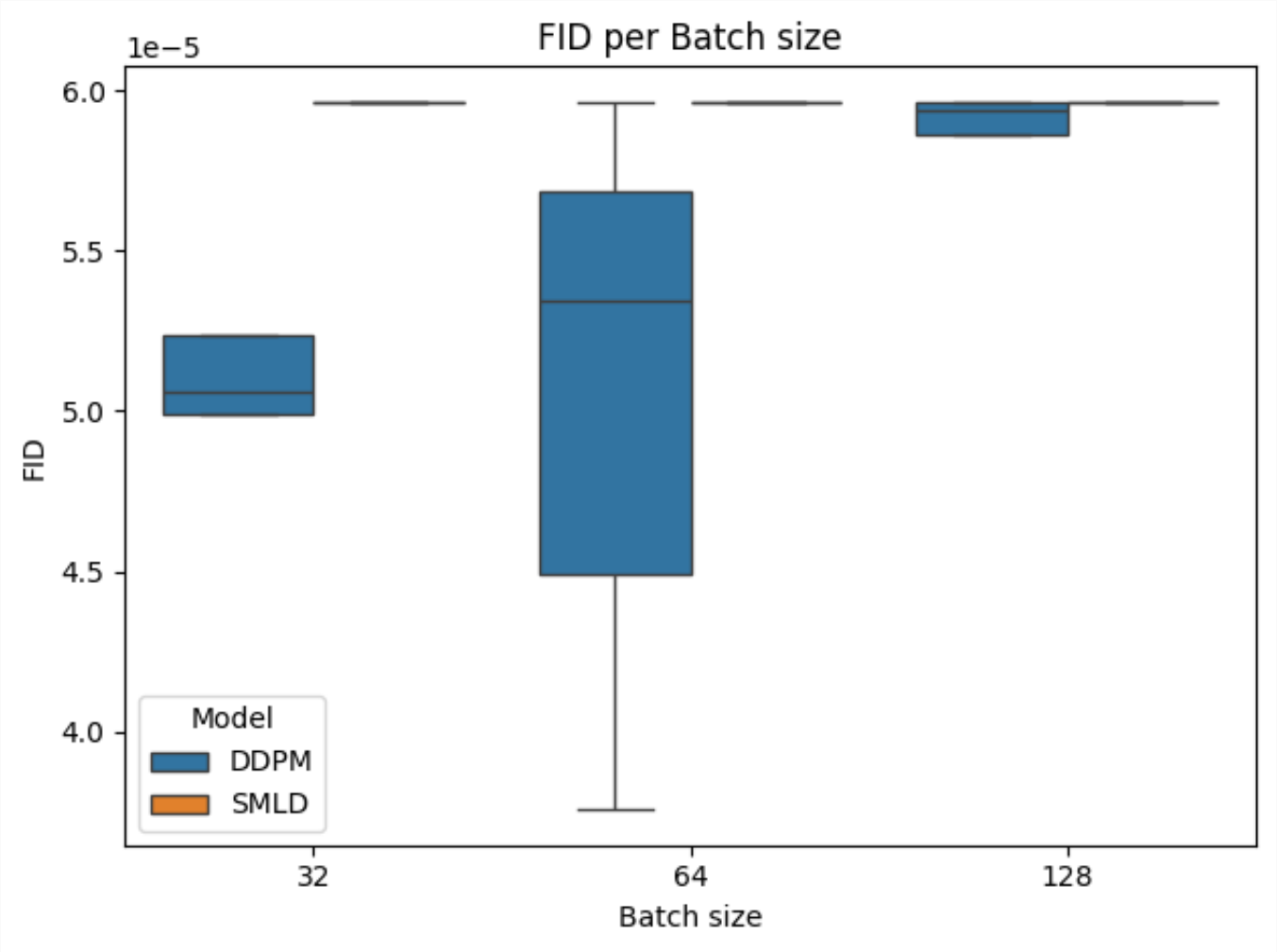
Results


FID per Scheduler by Training steps
1e−5
5.950
5.925
5.900
5.875
5.850
5.825
5.800
5.775
FID
Training steps
200
500
1000
DDPMSched
SMLDSched
Scheduler

Results


FID per number of epochs
1e−5
8.5
8.0
7.5
7.0
6.5
6.0
5.5
FID
Model
DDPM
SMLD
2
5
10
Number of epochs

Results

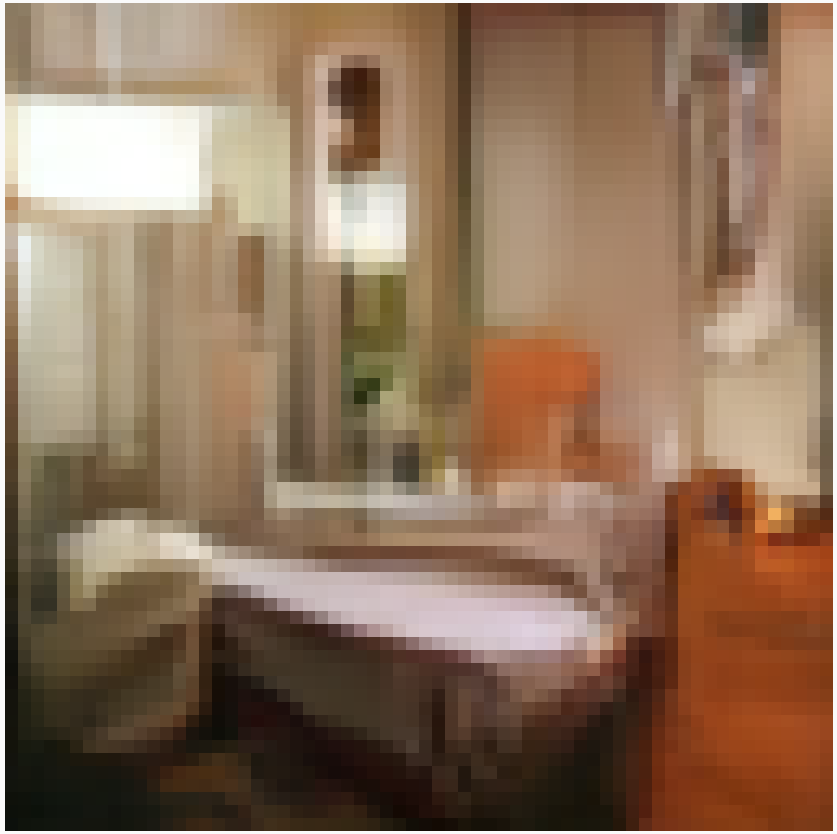

FID per Batch size
1e−5
6.0
5.5
5.0
4.5
4.0
FID
Model
DDPM
SMLD
32
64
128
Batch size

Final FID

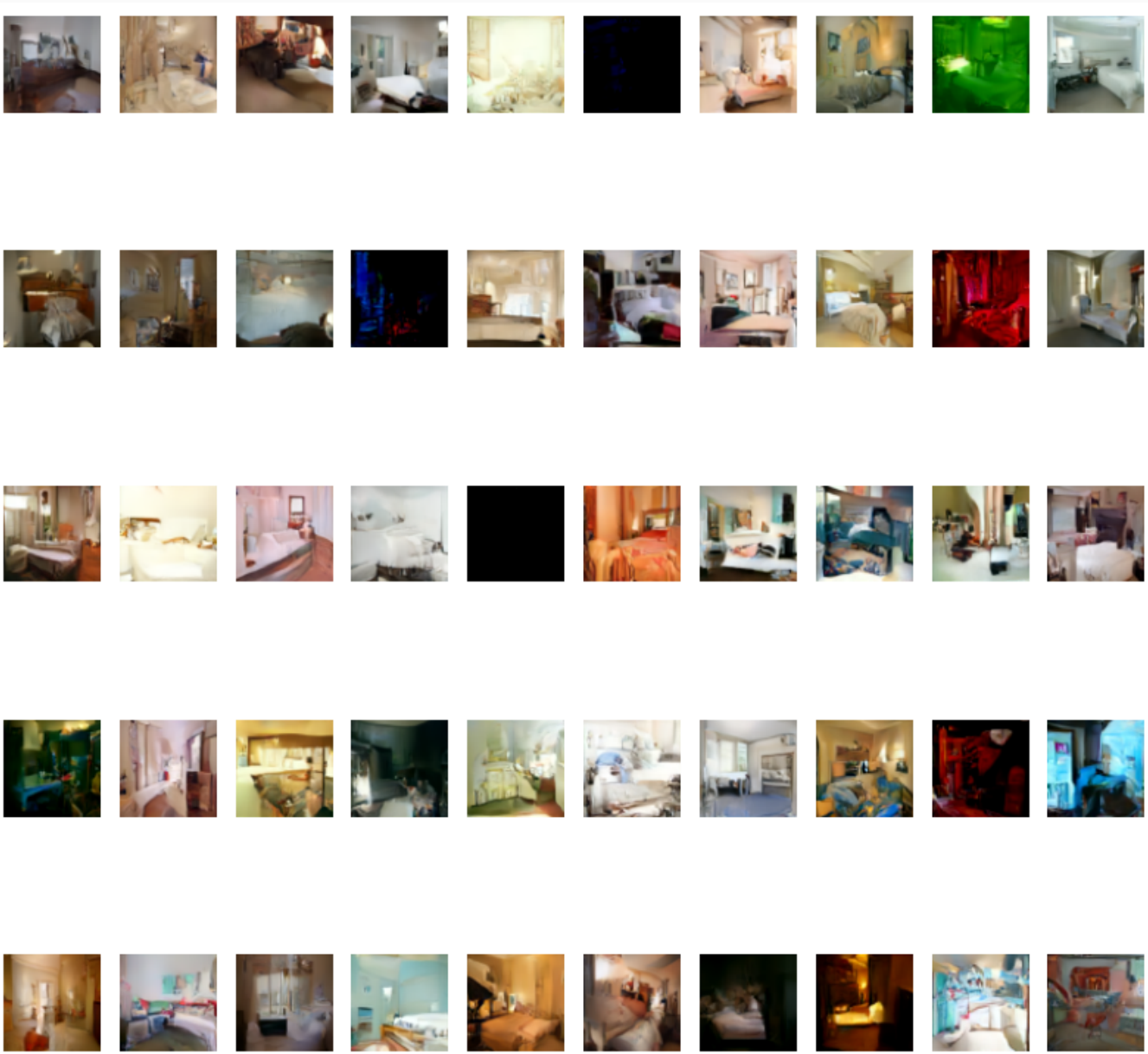
	DDPM	SMLD
FID	3.1919e-05	5.58e-02

Generated Images

DDPM



DDPM



Conclusions

Conclusions

1. Successfully investigated the effects of the following parameters: batch size, learning rate, number of epochs, optimizer type, and training steps.
2. Experiments have been performed to analyze their (hyperparameters) impact on the Fréchet Inception Distance of the chosen models in the task of generating images resembling bedrooms.
3. Satisfactory results with DDPM model.

Thank You