Assignment 2

24789 - Intermediate to Deep Learning (Spring 2023)

Out Date: 2023/3/21 (Tue)
Due Date: 2023/3/29 (Wed) @ 11:59 pm EST

All exercises should be submitted to Gradescope.

You can refer to Python3 tutorial, Numpy documentation and PyTorch documentation while working on this assignment. Please follow the programming template provided in the assignment. Please use Pizza for any questions on the assignment. You should submit the assignment as:

Submission file structure

andrewID-HW2
p1
andrewID_p1.py
andrewID_p1_report.pdf

- Submit the zip file in Homework 2 Programming section of Gradescope
- Submit the PDF of Python notebook in Homework 2 section of Gradescope

Please make sure you run all the cells and your submission clearly shows all the outputs with visible cell numbers. Any deviations from the submission structure would attract penalty to the assignment score.

Coding Exercise (50 points)

PROBLEM

Image Generation using GAN (50 points)

In this question, you will apply Generative Adversarial Networks (GAN) to generate images of faces. Specifically, you will use Pytorch to build GAN models and evaluate the loss. The dataset used in this exercise is the CelebA dataset and is included in in the .zip folder. Sample code is also provided for you to help develop the model. Follow the instructions in the sample code and answer the questions below.

a) Data Preprocessing and visualization - 10 points: Firstly, you need to load the dataset and plot it to make sure you are using the dataset correctly. The data is stored in a file called HW2DeepLearning24789.zip. The zip file needs to be unzipped first. We recommend using Colab in this question for faster training. Colab provides a free GPU for you to train a GAN model. You can either mount this zip file on Google Drive and extract data or you can mount the zip file on Google Colab. Although mounting on Google Colab is a temporary solution as you may have to mount it every time you work on the homework, we recommend mounting it on Google Colab itself for faster training time. You can load the data using the built-in Pytorch tool Dataset and visualize the image using the code provided in the template. Each RGB image will be resized to (3,128, 128) pixels to save on training time. Start with loading 49,736 images to generate images. You should have similar images to the picture in Figure 1

Fig. 1: Training example from Dataset

Please design your own image augmentation method and visualize one image. Print the face for this image.

b) Training the GAN model with Binary Cross Entropy Loss - 40 points: With the data loaded above, follow the instructions provided in the sample code to build your own GAN model. A sample GAN skeleton is built in the python script for reference. You should refer to the python file for more detail.

You should build your own model and create a celebrity face that looks similar to or better then the one in Fig2 to get a full mark. The estimated training time for a GAN model is 15min for 15 epochs using a Colab GPU. You need to do the following:

- Show an image of a generated face from your GAN that is of equal or higher quality to the one below.
- Plot your loss versus iterations for the generator and discriminator
- 5 point bonus if you can match the GAN output in Fig. 4

PROBLEM

Image Generation using GAN Output Quality (20 points)

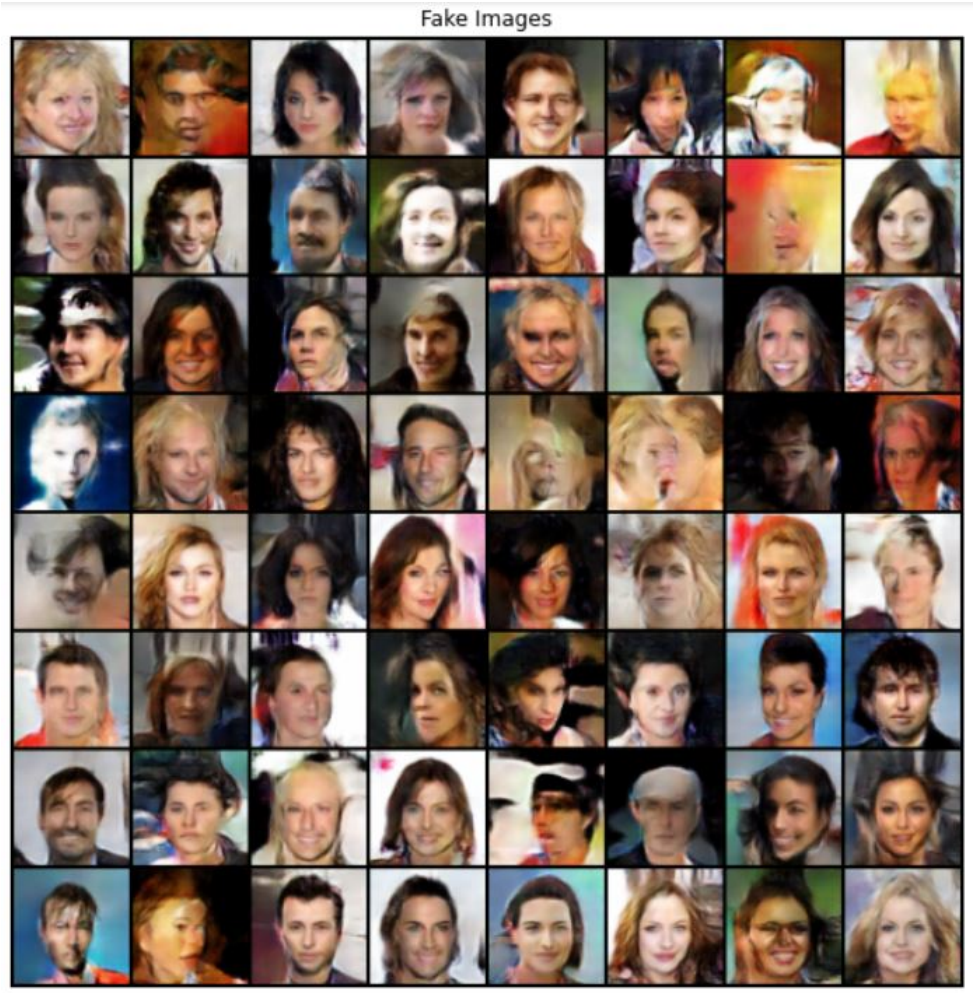

Fig. 2: GAN Output Quality

Graph of Generator and Discriminator output (20 points)

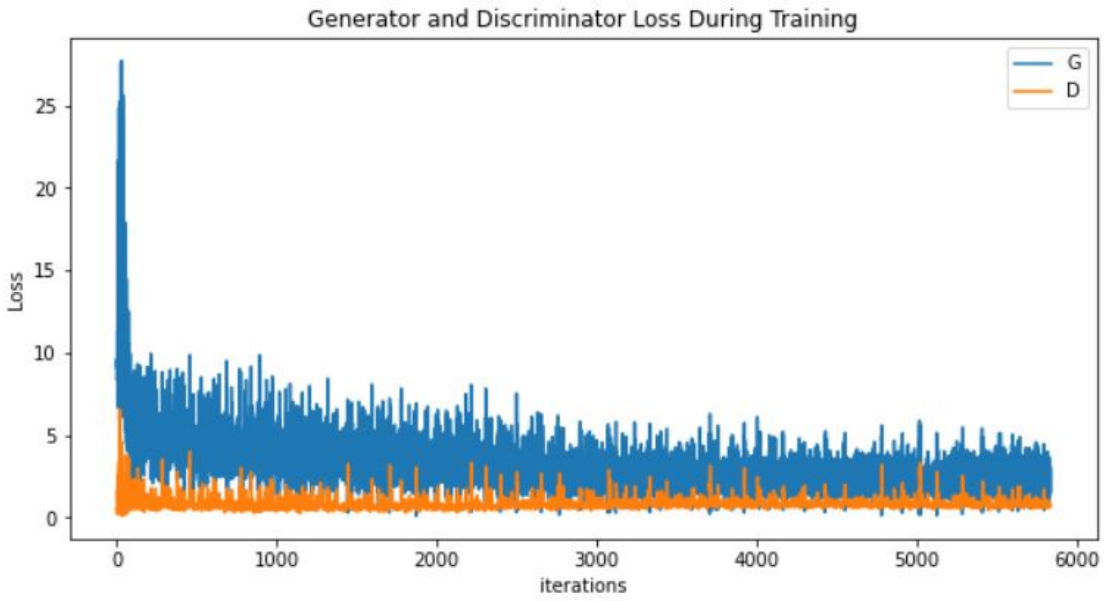

Fig. 3: Graph of Discriminator and Generator Output

GAN Extra Credit (5 points) If you are able to get an image grid to match this quality you will receive a 5 point bonus.

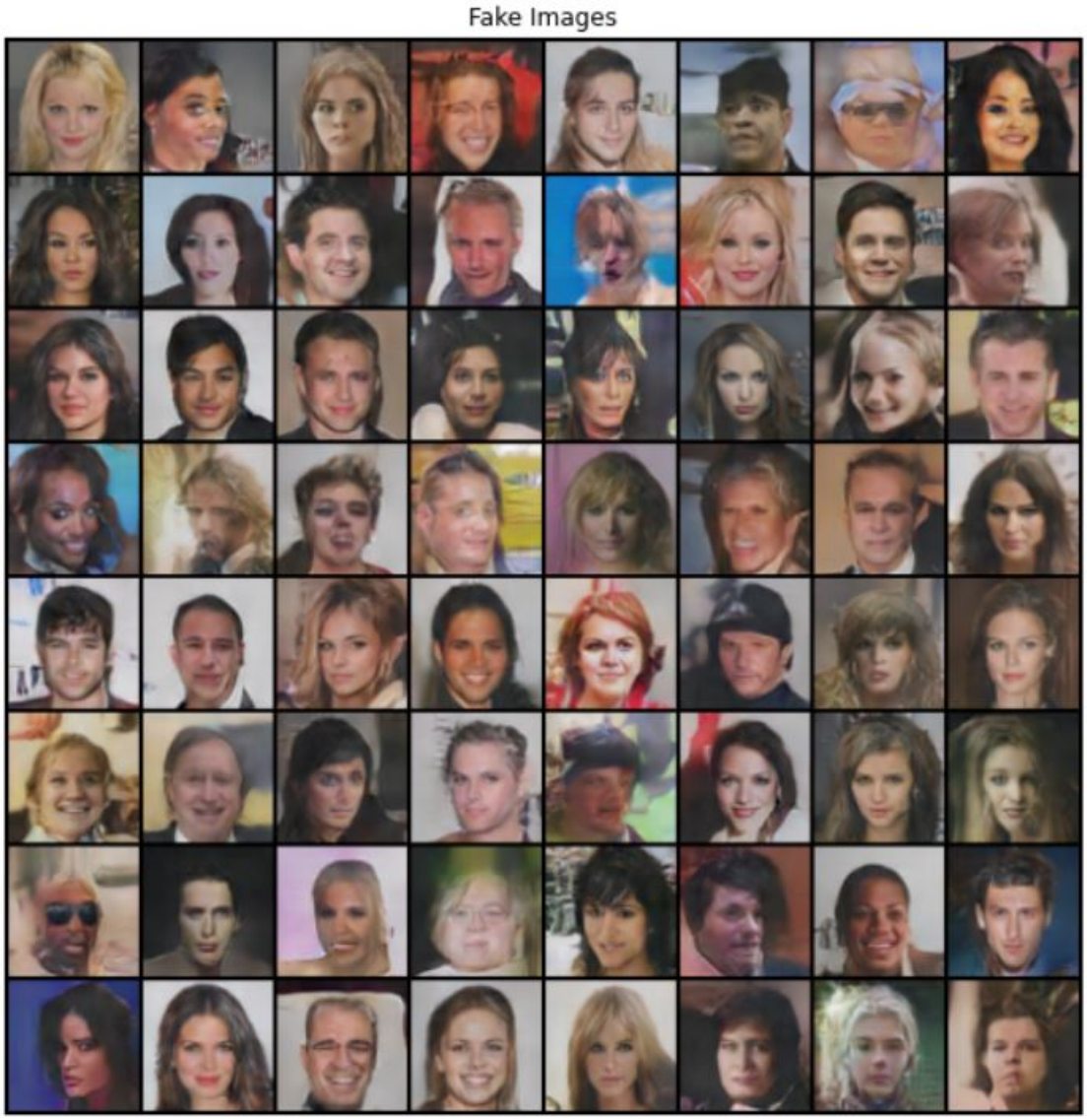

Fig. 4: GAN Extra Credit Quality