

## Assignment (2)

### 24-789 Deep Learning for engineers

**Out Date: 2024/3/19 (Tue)**

**Due Date: 2024/3/27 (Wed) @ 11:59 pm EST**

All exercises should be submitted to [Gradescope](#). There are 2 assignments in Gradescope for this homework, one where you will submit a PDF of your answers and another where you will submit a zipped file containing your code and any additional files (including the PDF of your submission) as supplemental material. DO NOT include the dataset in the code submission. Please make sure to include all relevant code and plots in the PDF. Please have a new page for each solution, and box your answers (if applicable). Please use [Piazza](#) for any questions about the assignment.

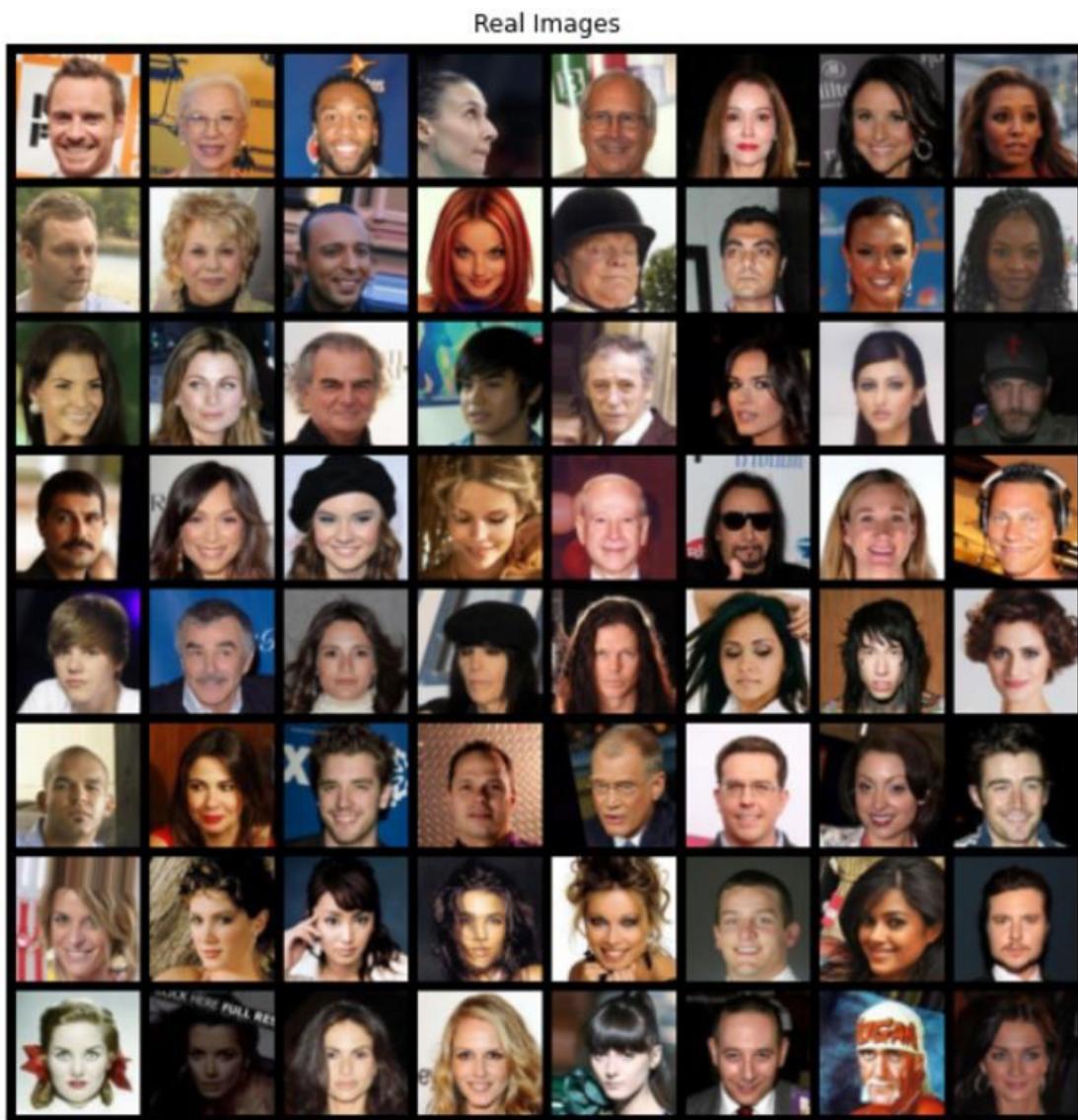
## Programming Exercises (50 points)

### PROBLEM 1

#### 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 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 provided. The zip file needs to be unzipped first. 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 images like shown in the Figure 1.

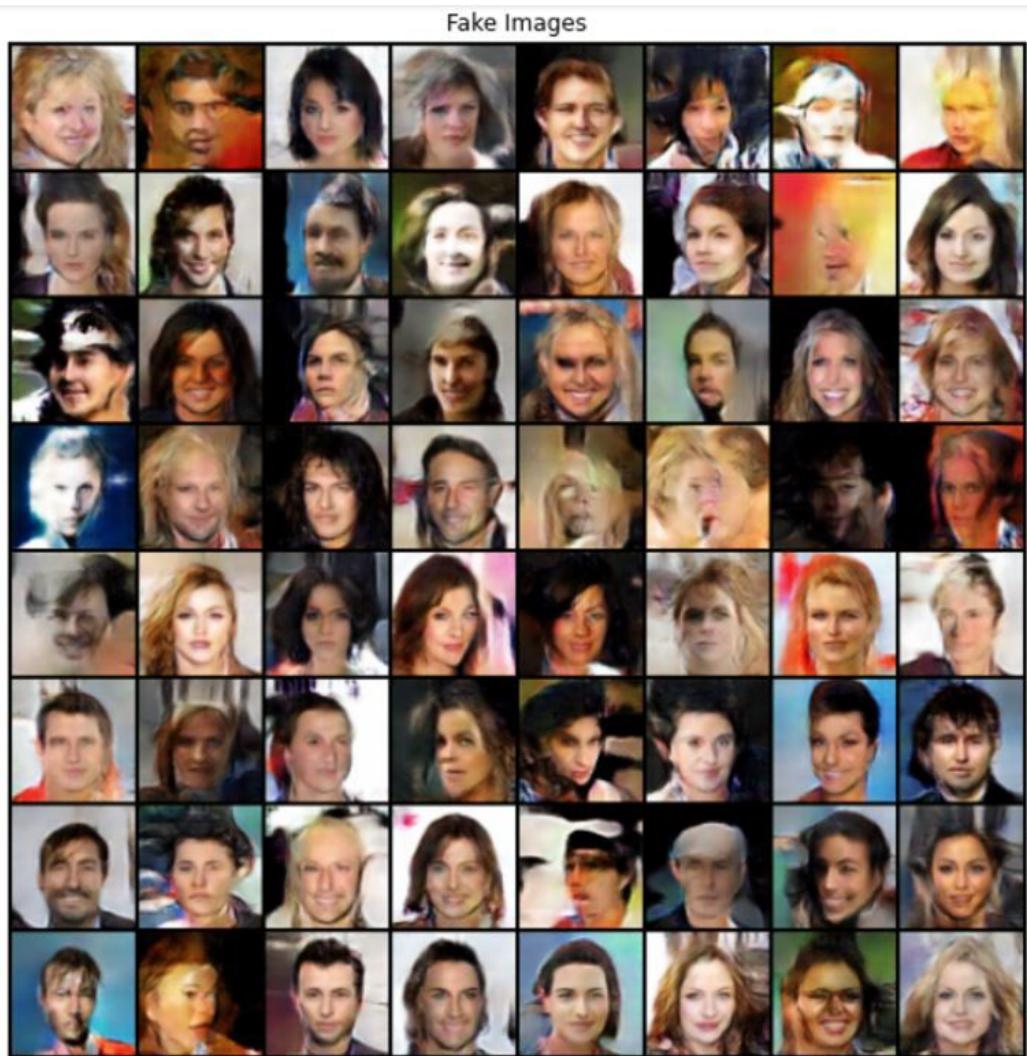


*Fig. 1: Samples from dataset.*

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:**

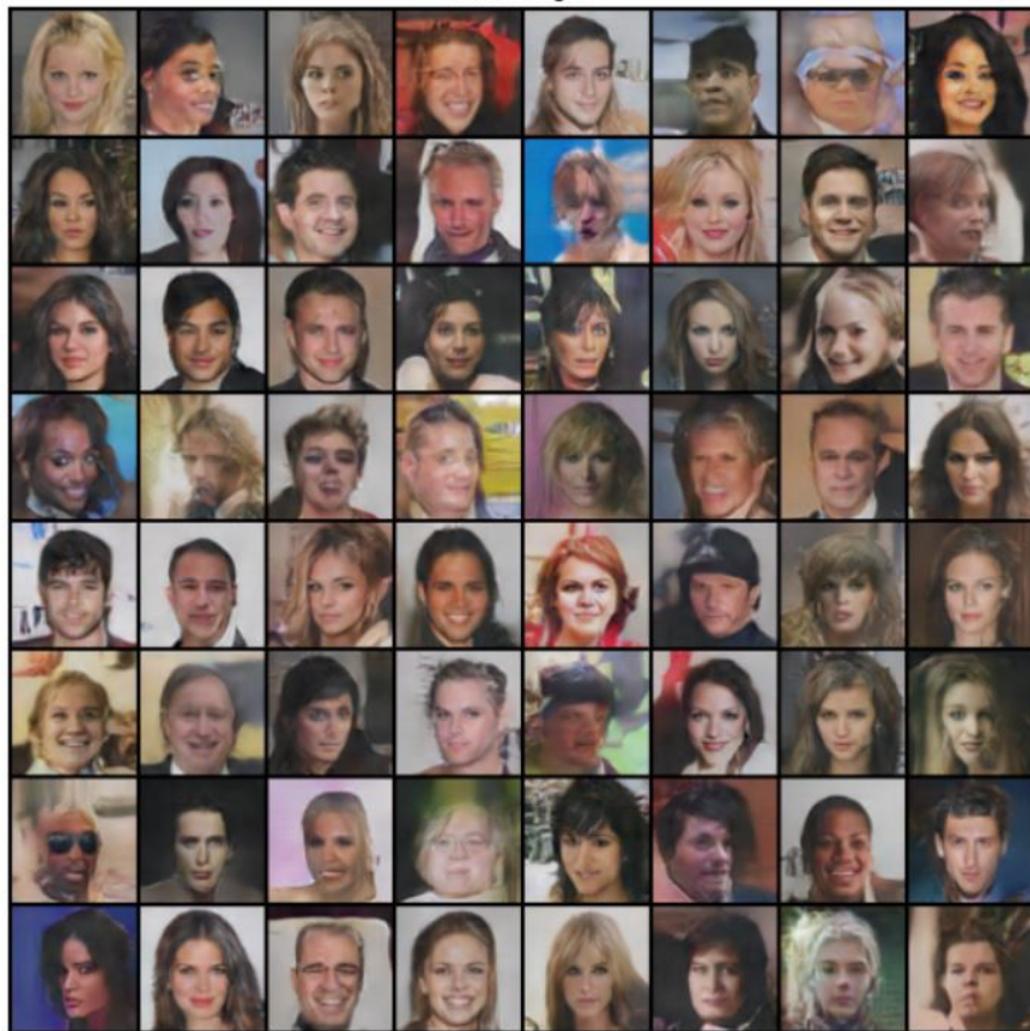
With the data loaded above, follow the instructions provided in the sample code to build your own GAN model. A sample GAN skeleton is built in the python script for reference. You should refer to the python file for more detail.



*Fig. 2: Samples generated by GAN.*

You should build your own model and create a celebrity face that looks similar to or better than the one in Figure 2 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 ones above.
- Plot your loss versus iterations for the generator and discriminator.
- **10 point bonus** if you can match the quality of the GAN output in Figure 3.

**Fake Images****Fig. 3:** Higher quality generation.