**Problem Setting**

**Problem:** Generating realistic synthetic faces using Generative Adversarial Networks (GANs).

**Problem Type:** Optimization Problem

**Objective:** To develop a generative model capable of producing realistic, high-quality synthetic faces indistinguishable from real faces.

**Description:** The purpose of this project is to construct realistic synthetic faces using a Generative Adversarial Network (GAN). GANs are composed of two neural networks: a generator and a discriminator. The generator generates synthetic images, while the discriminator validates their authenticity by comparing them to real ones.

*To achieve the objective, the Generative Adversarial Network will perform the following steps:*

1. Assign random weights to the generator and discriminator networks
2. Using the generator, create a batch of synthetic faces
3. Train the discriminator to recognize the difference between genuine faces (from a dataset) and synthetic ones created by the generator
4. Based on the feedback from the discriminator, update the generator to generate more realistic faces

The purpose of this approach is to reduce the difference between the created synthetic faces and genuine faces, as evaluated by the discriminator's ability to accurately identify them. The generator and discriminator networks are always working to improve their respective performances, with the generator seeking to generate more realistic faces and the discriminator attempting to classify genuine faces and synthetic faces.

*The problem can be formalized using the following objective functions:*

*Generator objective*: Minimize the loss function that measures the difference between the synthetic faces and the real faces, as judged by the discriminator.

*Discriminator objective:* Maximize the accuracy of classifying real faces as real and synthetic faces as synthetic.

This is an optimization problem in which a Generative Adversarial Network aims to generate realistic synthetic faces by minimizing the loss function of the generator and maximizing the accuracy of the discriminator. The agent iteratively improves the generator and discriminator networks to achieve this goal.