**DAILY LEARNING DOCUMENTATION**

1. CGAN:

* It stands for Conditional Generative Adversial Network.
* It is a type of neural network which uses conditions to generate images which has characteristics similar to the training data sets.
* It gets better results from generator as compared to typical generator.
* One benefit of a CGAN network is that we can give the network context so that it responds appropriately in different situations.
* They play important roles in sector of AI such as - image generation, computer vision, image to font style transformation.
* The architecture and working of CGAN is:

1. **Conditioning in GANs:** GANs can be extended to a conditional model by providing additional information to both the generator and discriminator. The additional information can be of any kind such as class labels.
2. **Generator Architecture:** The generator takes both the prior input noise and the additional information as inputs. These inputs are combined in a joint hidden representation, and the generator produces synthetic samples. The adversarial training framework allows flexibility in how this hidden representation is composed.
3. **Discriminator Architecture:** The discriminator takes both real data and the additional information as inputs. The discriminator's task is to distinguish between real data and synthetic data generated by the generator on condition given.

2.HOW CAN WE PASS CONDITION TO CGAN:

* CONCATENATION WITH INPUT: Here, basically we concatenate the condition vector with the noise vector before passing it to the generator. The disadvantage of using such method is that there is no mathematical logic behind it; often the conditions are introduced as one-hot-encoded vectors.
* USING AUXILLIARY CLASSIFIER: In this the architecture of discriminator is modified to output.
* WITH PROJECTION: Modification of the discriminator to include a projection between the condition and features extracted from the image is done. This projection values measures the similarity between the condition and the image and is added to the discriminator.
* BATCH NORMALIZATION: Conditional batch normalizaion was used for style transfer, where the condition is used to modulate the activation functions of the neural network.

1. MODEL PERFOMANCE AND EVALUATION METRICS:

* The metrics used is loss function- D loss ang G loss
* D- loss stands for discriminator loss which measures how well it distinguishes between real or fake. The loss is computed as binary cross entropy between real or fake.
* G- loss stands for generator loss which measures how it can fool the discriminator.
* For the performance of model MSE AND MAE and RMSE is used.
* On evaluation, between the original dataset and imputed dataset the values are as followed:

Mean Squared Error (MSE): 13.545326409963948

RMSE: 3.680397588571641

Mean Absolute Error (MAE): 0.7078581947592262

1. Number of Neurons in Generator and Discriminator

Generator Model:

* Input Layer: latent\_dim + 1 inputs.
* First Dense Layer: 128 neurons.
* Second Dense Layer: 256 neurons.
* Output Layer: Number of neurons equals the number of features in the input dataset (input\_dim).

Discriminator Model:

* Input Layer: input\_dim + 1
* First Dense Layer: 256 neurons.
* Second Dense Layer: 128 neurons.
* Output Layer: 1 neuron:

1. CONDITIONS APPLIED AND WHY:

* During the imputation process, condition applied is to ensure that the number of missing values matches the length of the imputed values.
* The condition is applied to ensure correct alignment between the number of missing values and the number of imputed values.

1. WHAT IS TARGET COLUMN AND PREDICTED COLUMN?

* Target Column: The column 'Temp' from the dataset, which contains missing values to be imputed.
* Predicted Column: The same column 'Temp', where the generator predicts values for the missing entries.

1. TRAINING OF MODEL:

* The Generator learns to create synthetic data resembling the real data by minimizing the discriminator's ability to differentiate between real and generated data.
* The Discriminator learns to distinguish between real and generated data by minimizing binary cross-entropy loss.
* The iterative process ensures that the generator improves in generating realistic data, while the discriminator becomes better at detecting fake data