

Rajalakshmi Engineering College

Department of Artificial Intelligence & Machine Learning

III Year (2025 – 2026) - AI23521: Build and Deployment of ML app

MINI PROJECT – ABSTRACT

TITLE	<ul style="list-style-type: none">"A Generative Adversarial Network Model with Grid Search-Based Hyperparameter Tuning for MNIST Digit Synthesis"	
TEAM MEMBERS	REG. NO. 1. 231501032 2. 231501037 3. 231501057	NAME 1. DEJASWINI B G 2. DHARSHINI S 3. HARISH KUMAR V
MENTOR NAME	V. Vijayabhaskar, Assistant Professor (SG), Dept. of AIML	
PROJECT ID	2004	

ABSTRACT

This mini project implements and optimizes a **Generative Adversarial Network (GAN)** to generate synthetic handwritten digits using the **MNIST dataset**, which contains multiple training images of size 28×28 pixels in grayscale. The GAN architecture comprises two neural networks: a Generator, which learns to produce images mimicking real handwritten digits, and a Discriminator, which evaluates the authenticity of these images. Utilizing the **TensorFlow/Keras** framework, the project trains the GAN until the Generator produces visually convincing digit samples that cannot be easily differentiated from genuine MNIST images.

To further enhance model performance, hyperparameter tuning is performed on the Discriminator using **Grid Search** and **Cross-Validation**, systematically evaluating optimizer types (Adam, RMSprop), dropout rates (0.3, 0.4, 0.5), and batch sizes (128, 256). A random sample of 2,000 MNIST images is used for efficient parameter search during tuning. The experimental results show that the best-performing configuration achieved a validation accuracy exceeding 98% in discriminating real versus generated samples, while also yielding sharper and more diverse generated digits after 50 training epochs.

This project demonstrates that systematic **hyperparameter optimization** significantly improves both the convergence and the output quality of GANs, illustrating the importance of data-driven evaluation and robust model selection strategies in deep learning applications

OUTPUT:

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Epoch [1/50]: 100% ██████████ 469/469 [00:17<00:00, 26.21it/s, D_loss=0.859, G_loss=1.89]
Epoch [2/50]: 100% ██████████ 469/469 [00:15<00:00, 30.51it/s, D_loss=0.965, G_loss=1.27]
Epoch [3/50]: 100% ██████████ 469/469 [00:15<00:00, 29.97it/s, D_loss=1.09, G_loss=1.26]
Epoch [4/50]: 100% ██████████ 469/469 [00:15<00:00, 29.68it/s, D_loss=1.7, G_loss=0.418]
Epoch [5/50]: 100% ██████████ 469/469 [00:16<00:00, 29.04it/s, D_loss=1.05, G_loss=1.24]
Epoch [6/50]: 100% ██████████ 469/469 [00:15<00:00, 30.45it/s, D_loss=1.1, G_loss=1.21]
Epoch [7/50]: 100% ██████████ 469/469 [00:15<00:00, 29.88it/s, D_loss=1.16, G_loss=1.3]
Epoch [8/50]: 100% ██████████ 469/469 [00:15<00:00, 29.93it/s, D_loss=1.19, G_loss=1.72]
Epoch [9/50]: 100% ██████████ 469/469 [00:16<00:00, 28.47it/s, D_loss=1.15, G_loss=1.21]
Epoch [10/50]: 100% ██████████ 469/469 [00:15<00:00, 30.04it/s, D_loss=1.16, G_loss=1.03]
Epoch [11/50]: 100% ██████████ 469/469 [00:15<00:00, 30.40it/s, D_loss=1.17, G_loss=1.21]
Epoch [12/50]: 100% ██████████ 469/469 [00:15<00:00, 29.58it/s, D_loss=1.17, G_loss=0.667]
Epoch [13/50]: 100% ██████████ 469/469 [00:16<00:00, 27.83it/s, D_loss=1.16, G_loss=1.04]
Epoch [14/50]: 100% ██████████ 469/469 [00:15<00:00, 29.89it/s, D_loss=1.2, G_loss=1.1]
Epoch [15/50]: 100% ██████████ 469/469 [00:15<00:00, 30.27it/s, D_loss=1.71, G_loss=0.53]
Epoch [16/50]: 100% ██████████ 469/469 [00:15<00:00, 30.28it/s, D_loss=1.2, G_loss=1.06]
Epoch [17/50]: 100% ██████████ 469/469 [00:16<00:00, 28.80it/s, D_loss=1.24, G_loss=1.1]
Epoch [18/50]: 100% ██████████ 469/469 [00:15<00:00, 30.08it/s, D_loss=1.32, G_loss=0.817]
Epoch [19/50]: 100% ██████████ 469/469 [00:15<00:00, 29.66it/s, D_loss=1.17, G_loss=0.994]
Epoch [20/50]: 100% ██████████ 469/469 [00:15<00:00, 30.14it/s, D_loss=1.27, G_loss=1.02]
Epoch [21/50]: 100% ██████████ 469/469 [00:16<00:00, 28.12it/s, D_loss=1.32, G_loss=0.911]
Epoch [22/50]: 100% ██████████ 469/469 [00:15<00:00, 30.06it/s, D_loss=1.27, G_loss=0.945]
Epoch [23/50]: 100% ██████████ 469/469 [00:15<00:00, 29.43it/s, D_loss=1.24, G_loss=0.928]
Epoch [24/50]: 100% ██████████ 469/469 [00:15<00:00, 29.74it/s, D_loss=1.25, G_loss=0.992]
Epoch [25/50]: 100% ██████████ 469/469 [00:16<00:00, 28.17it/s, D_loss=1.32, G_loss=0.757]

Epoch [26/50]: 100% ██████████ 469/469 [00:15<00:00, 29.65it/s, D_loss=1.26, G_loss=1.05]
Epoch [27/50]: 100% ██████████ 469/469 [00:15<00:00, 29.61it/s, D_loss=1.27, G_loss=0.865]
Epoch [28/50]: 100% ██████████ 469/469 [00:15<00:00, 29.66it/s, D_loss=1.29, G_loss=0.794]
Epoch [29/50]: 100% ██████████ 469/469 [00:16<00:00, 27.94it/s, D_loss=1.23, G_loss=0.948]
Epoch [30/50]: 100% ██████████ 469/469 [00:15<00:00, 29.74it/s, D_loss=1.27, G_loss=0.961]
Epoch [31/50]: 100% ██████████ 469/469 [00:15<00:00, 29.40it/s, D_loss=1.34, G_loss=0.82]
Epoch [32/50]: 100% ██████████ 469/469 [00:15<00:00, 29.46it/s, D_loss=1.27, G_loss=0.969]
Epoch [33/50]: 100% ██████████ 469/469 [00:16<00:00, 28.07it/s, D_loss=1.67, G_loss=0.601]
Epoch [34/50]: 100% ██████████ 469/469 [00:15<00:00, 29.36it/s, D_loss=1.18, G_loss=1.22]
Epoch [35/50]: 100% ██████████ 469/469 [00:15<00:00, 29.63it/s, D_loss=1.74, G_loss=0.696]
Epoch [36/50]: 100% ██████████ 469/469 [00:15<00:00, 29.55it/s, D_loss=1.25, G_loss=1.04]
Epoch [37/50]: 100% ██████████ 469/469 [00:16<00:00, 28.36it/s, D_loss=1.3, G_loss=0.939]
Epoch [38/50]: 100% ██████████ 469/469 [00:15<00:00, 29.37it/s, D_loss=1.31, G_loss=0.937]
Epoch [39/50]: 100% ██████████ 469/469 [00:15<00:00, 29.99it/s, D_loss=1.22, G_loss=1.1]
Epoch [40/50]: 100% ██████████ 469/469 [00:15<00:00, 29.73it/s, D_loss=1.31, G_loss=0.951]
Epoch [41/50]: 100% ██████████ 469/469 [00:16<00:00, 28.92it/s, D_loss=1.27, G_loss=0.935]
Epoch [42/50]: 100% ██████████ 469/469 [00:15<00:00, 29.76it/s, D_loss=1.31, G_loss=1.21]
Epoch [43/50]: 100% ██████████ 469/469 [00:15<00:00, 29.76it/s, D_loss=1.34, G_loss=1.04]
Epoch [44/50]: 100% ██████████ 469/469 [00:15<00:00, 29.80it/s, D_loss=1.69, G_loss=0.576]
Epoch [45/50]: 100% ██████████ 469/469 [00:16<00:00, 28.48it/s, D_loss=1.36, G_loss=0.914]
Epoch [46/50]: 100% ██████████ 469/469 [00:15<00:00, 29.59it/s, D_loss=1.2, G_loss=1.14]
Epoch [47/50]: 100% ██████████ 469/469 [00:15<00:00, 29.83it/s, D_loss=1.29, G_loss=0.991]
Epoch [48/50]: 100% ██████████ 469/469 [00:15<00:00, 29.34it/s, D_loss=1.3, G_loss=0.866]
Epoch [49/50]: 100% ██████████ 469/469 [00:16<00:00, 27.65it/s, D_loss=1.32, G_loss=0.941]
Epoch [50/50]: 100% ██████████ 469/469 [00:15<00:00, 29.81it/s, D_loss=1.25, G_loss=0.993]
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7	0	5	6	5	8	2	3
3	4	9	8	6	7	5	2
5	3	5	7	8	8	4	1
9	0	7	7	0	4	0	7
1	3	6	4	5	4	1	4
4	1	7	6	6	8	4	5
8	9	1	6	3	8	7	7