Nullclass AI Internship – Final Report

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Internship Duration: 19 June 2025 – 19 August 2025
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1. Introduction

The Nullclass AI Internship involved completing multiple AI/ML tasks ranging from NLP tokenization to Generative Adversarial Networks (GANs), dataset analysis, and fine-tuning text-to-image models. The program's objective was to enhance both theoretical and practical understanding of modern AI techniques, while developing deployable, reproducible solutions.

This report details the completed tasks, methodologies, results, and skills gained during the internship.

2. Objectives

- Gain hands-on experience in training and evaluating AI/ML models.
- Implement advanced generative models for text, image, and mixed modalities.
- Work with real-world datasets and preprocessing pipelines.
- Optimize models for performance and deployment.
- Document the work in a professional, reproducible manner.

Task	Description	Tools/Libraries	Outcome
Task 1	Text tokenization & preprocessing	NLTK, SpaCy, Python	Tokenized multiple corpora for downstream NLP tasks.
Task 2	Conditional GAN (CGAN) on shape dataset	PyTorch, torchvision	Generated synthetic shapes (circle, square, triangle, star) conditioned on class labels.

Task 3	Dataset analysis (Oxford Flowers)	Pandas, Matplotlib, Seaborn	Provided visual insights on class distribution, sample images, and metadata.
Task 4	Stable Diffusion + LoRA fine-tuning	diffusers, transformers	Fine-tuned SD 1.5 model for Pokémon dataset; generated high-quality images.
Task 5	End-to-end text-to-image pipeline	PyTorch, Gradio	Built a CGAN-based text-to-image generator with GUI; trained classifier achieving >90% accuracy.

4. Methodology & Implementation

4.1 Task 1 – Tokenization & Preprocessing

- Implemented text normalization (lowercasing, punctuation removal, stopword filtering).
- Used **NLTK** and **SpaCy** for word and sentence tokenization.
- Exported clean token lists for later tasks.

4.2 Task 2 – Conditional GAN on Shapes

- Created a synthetic dataset using Python drawing utilities.
- Trained CGAN with label embeddings to condition generation.
- Achieved clear differentiation in generated samples.

4.3 Task 3 – Dataset Analysis

- Imported the **Oxford Flowers 102** dataset.
- Visualized class balance, example images, and data split ratios.
- Highlighted potential class imbalance for model training.

4.4 Task 4 – Stable Diffusion + LoRA Fine-tuning

- Used **LoRA (Low-Rank Adaptation)** to efficiently fine-tune **Stable Diffusion v1.5**.
- Trained on Pokémon dataset to learn domain-specific visual features.
- Generated high-resolution images from simple text prompts.

4.5 Task 5 – Text-to-Image CGAN Pipeline

- Implemented CGAN to map label embeddings + noise to images.
- Added a shape classifier to evaluate generation quality (Accuracy: **92%**).
- Built a **Gradio GUI** for interactive generation.

5. Skills & Tools Learned

- AI/ML Frameworks: PyTorch, Hugging Face Transformers, Diffusers.
- Generative Models: GANs, Conditional GANs, Stable Diffusion, LoRA.
- NLP: Tokenization, text preprocessing.
- Data Visualization: Matplotlib, Seaborn.
- Deployment: Gradio apps for model interaction.
- Version Control: Git & GitHub for collaborative workflow.

6. Challenges & Solutions

Challenge	Solution
Library version conflicts (Task 4)	**Used separate virtual environments for conflicting dependencies.**

Long training time for Stable Diffusion	**Used LoRA for parameter-efficient fine-tuning.**
GAN instability during training	**Tuned learning rates, added label smoothing.**

7. Conclusion

The Nullclass Internship provided in-depth exposure to modern AI/ML workflows, covering both foundational techniques and state-of-the-art models. The completion of five tasks demonstrated the ability to preprocess data, train and evaluate generative models, fine-tune large-scale diffusion models, and deploy them via interactive GUIs.

8. References

- Hugging Face Transformers Documentation
- PyTorch Official Tutorials
- Diffusers LoRA Training Guide
- NLTK and SpaCy Documentation