**Weekly Task Documentation**

# **Introduction**

This document outlines the deliverables completed for the assigned weekly tasks including mathematical theory presentations and four technical projects. The content is structured for easy navigation, clarity, and reference. Supporting visual assets and code repositories follow the CyArt formatting standards for professional documentation.

# **1. Mathematics Presentations**

## **1.1 Linear Algebra Presentation**

- **Core Topics Covered:**  
 • Vector spaces  
 • Linear transformations  
 • Eigenvalues and Eigenvectors  
 • Singular Value Decomposition (SVD)

- **Engineering Application:**  
 • Principal Component Analysis (PCA) for dimensionality reduction

- **Deliverables:**  
 • Slide deck (PDF)  
 • Worked example with SVD and PCA  
 • **References:**  
 - https://www.youtube.com/playlist?list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE\_ab  
 - https://rksmvv.ac.in/wp-content/uploads/2021/04/Gilbert\_Strang\_Linear\_Algebra\_and\_Its\_Applicatio\_230928\_225121.pdf

## **1.2 Calculus Presentation**

- **Core Topics Covered:**  
 • Limits, Derivatives, Integrals  
 • Fundamental Theorem of Calculus  
 • Multivariate Gradients

- **Practical Example:**  
 • Numerical differentiation/integration with NumPy

- **Deliverables:**  
 • Slide deck (PDF)  
 • Python notebook with NumPy implementation  
 • **References:**  
 - https://www.youtube.com/playlist?list=PLZHQObOWTQDMsr9K-rj53DwVRMYO3t5Yr  
 - https://archive.org/details/Calculus\_201701

# **2. GitHub Repository Structure**

**Repository Structure:**  
├── Task1/  
├── Task2/  
├── Task3/  
├── Task4/  
├── Presentation/  
└── README.md

- **Main README.md:**  
 • Overview of the repository  
 • Environment setup instructions

- **Each Task Folder:**  
 • Task-specific README  
 • Steps to run code  
 • Required scripts, notebooks, or data

- **Presentation Folder:**  
 • Slide decks  
 • Screenshots  
 • Supporting content

# **3. Task Summaries**

## **Task 1: Neural-Net Regression (NumPy)**

- **Core Features:**  
 • Manual forward, backward pass  
 • Custom SGD optimizer  
 • MSE loss function  
 • Trained on noisy cubic function

- **Deliverables:**  
 • model.py  
 • train.ipynb  
 • **README** with model architecture and loss plots

## **Task 2: NLTK-Powered Text Analytics Web App**

- **Features:**  
 • Tokenization, POS tagging, lemmatization  
 • Frequency & sentiment analysis  
 • Streamlit-based web interface  
 • Interactive data upload & dashboard

- **Deliverables:**  
 • streamlit\_app.py  
 • nlp\_pipeline.py  
 • Sample dataset, screenshots  
 • User guide

## **Task 3: High-Performance Time Series Transformation**

- **Implemented Techniques:**  
 • Rolling window stats with NumPy & pandas  
 • EWMA, FFT-based filters  
 • Stride tricks and Numba for acceleration

- **Deliverables:**  
 • timeseries\_utils.py  
 • benchmark.py  
 • Results CSV, Performance Report

## **Task 4: Complex Data Munging & Statistical Modeling**

- **Data Operations:**  
 • Cleaning, imputation, type conversion  
 • Pivoting, multi-index creation  
 • Feature engineering and **modeling**  
 • Inference using **statsmodels**

- **Deliverables:**  
 • data\_prep.ipynb  
 • modeling.ipynb

# **4. Formatting and Visuals Used**

- Font: Arial, 11pt (Body), 16pt (Heading 1), 14pt (Heading 2)  
- Line spacing: 1.5  
- Alignment: Left for body, centered for headings  
- Image Captions and Credits provided where external media is used

# **5. Final Checklist ✅**

- [x] Clear section headings and logical document structure  
- [x] Visuals (plots, charts, screenshots) added with captions  
- [x] README files included for all subfolders  
- [x] External resources and references properly cited  
- [x] Document reviewed for spelling and grammar

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Documentation Format: CyArt Standard

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