

Deeplearning Concept Refresher Assignment

CS435 Generative AI: Security, Ethics, and Governance

Instructor: Dr. Adnan Masood

Assignment Overview

You have been provided with a collection of Jupyter (Colab) Notebooks covering essential topics in Generative AI, Deep Learning, and their related areas. This assignment serves as a **refresher** to revisit and reinforce the concepts learned throughout the course.

Your task is to:

- Review each notebook carefully.
- Run all cells within each notebook (including the *Acknowledgement Cell*).
- Complete the sample exercises in each notebook.
- Convert the *executed* notebook into a PDF document.
- Submit all 16 PDF files (one per notebook).

Notebook Details

Below is the list of notebooks (with their new filenames), along with a brief description of what each covers. You will submit one PDF for each of the following:

1. **DL Demystified 0 - Building a Strong Base - Linear Algebra.ipynb**
Covers foundational linear algebra concepts necessary for understanding deep learning.
2. **DL Demystified 1 - Single Neuron Fundamentals - The Perceptron.ipynb**
Introduces the perceptron model, basic neuron functionality, and linear classification.
3. **DL Demystified 2 - Going Deeper - The Multilayer Perceptron.ipynb**
Explores multilayer perceptrons (MLPs), hidden layers, and training fundamentals.
4. **DL Demystified 3 - The Nonlinear Key - Activation Functions.ipynb**
Reviews various activation functions (ReLU, sigmoid, tanh) and their roles in deep networks.

5. **DL Demystified 4 - Training Deep Networks - Backpropagation & Vanishing Gradients.ipynb**
Explains the backpropagation algorithm and common training challenges such as vanishing gradients.
6. **DL Demystified 5 - Computer Vision - Convolutional Neural Networks.ipynb**
Focuses on CNN architectures, convolutional layers, and image processing fundamentals.
7. **DL Demystified 6 - Learning Sequences - Recurrent Neural Networks.ipynb**
Introduces RNNs and how they are used to handle sequential data and language modeling.
8. **DL Demystified 7 - Capturing Long Dependencies - LSTMs.ipynb**
Delves into LSTMs, their gating mechanisms, and how they alleviate long-term dependency issues.
9. **DL Demystified 8 - Language Essentials - Tokenization & Embeddings.ipynb**
Examines text preprocessing techniques, tokenization schemes, and word embeddings.
10. **DL Demystified 9 - The Next Frontier - Transformers.ipynb**
Presents the Transformer model, attention mechanisms, and the shift from recurrent structures.
11. **DL Demystified 10 - Transformers Extended - Additional Insights.ipynb**
Expands on Transformers with extra case studies and in-depth discussions of attention-based methods.
12. **DL Demystified 11 - Under the Hood - Transformer Architecture Explained.ipynb**
Breaks down the Transformer architecture layer-by-layer, covering encoders and decoders in detail.
13. **DL Demystified 12 - Tuning Large Models - Instruction vs Fine-Tuning.ipynb**
Discusses various ways to adapt large language models, comparing instruction tuning and fine-tuning.
14. **DL Demystified 13 - Model Compression - Quantization, LoRA & QLoRA.ipynb**
Looks at approaches to reduce model size and complexity, including quantization and LoRA-based methods.
15. **DL Demystified 14 - The Human Touch - RLHF.ipynb**
Provides an overview of Reinforcement Learning from Human Feedback (RLHF) for steering model outputs.
16. **DL Demystified 15 - Evaluating ML Systems - MMLU Benchmarks.ipynb**
Explains how to evaluate language models on a variety of tasks using MMLU benchmarks.

What You Need to Do

1. **Open and Execute Each Notebook:**

Make sure to run every cell, including those for environment setup and the Acknowledgement Cell **with your name!**.

2. **Complete Sample Exercises:**

Where prompted, modify code, provide answers, or experiment with hyperparameters.

3. **Convert to PDF:**

After executing all cells, export the notebook as a *PDF* (so outputs are clearly displayed).

4. **Submit 16 PDFs:**

Each notebook should be turned in as a *separate* PDF, resulting in a total of 16 submissions in a zip file.

Evaluation Criteria

- **Completion of Exercises:** Have you addressed the sample tasks in each notebook?
- **Code & Output Clarity:** Do all cells run without errors, and are the outputs visible in the PDF?
- **Organization & Submission:** Are all 16 PDFs submitted, labeled clearly, and submitted on time?

Recommendations & Tips

- **Dependency Checks:** If a notebook requires specific packages, run any `!pip install` cells first.
- **Read Markdowns:** Each notebook has explanations that can clarify complex concepts.
- **Backup Frequently:** In Google Colab, create copies in your Drive to avoid losing work.

Good luck with your reviews! This thorough revisit of each notebook will help strengthen your understanding of Generative AI, its foundational deep learning concepts, and the nuances of Security, Ethics, and Governance in AI development.