Midterm Project

Deep Learning course

**Question 1 (5 points):**

Understanding and Implementing automatic differentiation (Autograd) in Deep Learning in the three following aspects:

1. Theoretical Component:

* Provide a detailed explanation of automatic differentiation (AD) and its significance in training deep learning models.
* Compare and contrast forward mode and reverse mode automatic differentiation, discussing their advantages and disadvantages.
* Explain the role of computational graphs in automatic differentiation and backpropagation.

1. Practical Implementation:

* Choose a deep learning framework (PyTorch) and implement a simple neural network model from scratch using Autograd capabilities.
* Define a custom loss function and explore how Autograd computes gradients for this function.
* Experiment with different optimization algorithms (e.g., SGD, Adam) and observe their effects on training convergence and performance.

1. Experimental Analysis:

* Conduct experiments to analyze the efficiency and numerical stability of Autograd-based gradient computations.
* Investigate the impact of batch size, learning rate, and network architecture on gradient computation and training dynamics.

**Question 2 (5 points):**

Implement CNN-LSTM models for the problem of Image Captioning with at least two options: with and without using attention mechanism for the decoding process. Training the models on Colab environments using GPU and CPU only.