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.

2) 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.

3) 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.