

# SYDE 572 Winter 2024 Assignment 5 Due Monday April 1

## Introduction

Prepare a short write-up for the assignment to be submitted to Learn in PDF format. You may LaTeX your equations, or handwrite and photograph/scan, then crop + paste into your write-up (make sure the equations are clearly readable). Use clear concise writing, (point form when appropriate). Submit a separate file for each question to Crowdmark. Submit the link to your Colab notebook as instructed on Crowdmark.

## Question 1

1. Considering how neural network design influence performance (under what situation one family of architecture might have an advantage, and why)  
Compare and contrast using Transformer-based neural architecture vs Recurrent Neural Network (RNN)-based neural network for next word prediction. [2pts]
2. Compare and contrast using Transformer-based neural network vs Convolutional Neural Network (CNN)-based neural network for image classification. [2pts]
3. How many trainable parameters are there in the following neural network layer (standard implementation)? A single simple RNN layer without linear layer for output. e.g. `torch.nn.SimpleRNN`. With input dimension 100, hidden dimension 200. [1pt]
4. How many trainable parameters are there in the following neural network layer (standard implementation)? A convolutional filter with 64 filters, kernel size  $3 \times 3$ , with 3 input channels. [1pt]
5. What is the computational complexity of the Transformer in terms of sequence length  $l$ , and hidden/latent dimension  $d$  in big O notation? [1pts]

## Question 2

Compare two different methods of style transfer. Starting with the content image of Yellow Labrador and the abstract style image found [here](#), also feel free to find other content and style images to perform additional experiment.

Perform a comparative report of the Gram Matrix style transfer method [here](#), and the Sliced Wasserstein Distance style transfer method [here](#).

Prepare a "tutorial" notebook write-up similar to the TensorFlow tutorial as linked above.

1. Prepare a presentation and analysis of results with simply instructions on how to duplicate (include more comparisons and metrics than the TensorFlow tutorial). Find numerical metrics to compare image quality. [15pts] (You are expected to perform a reasonable experiments and add on top of the Tensorflow tutorial notebook; either with additional experiments on what convolutional layers and number of layers to transfer on or experiments on balancing content and style weights. Control your experiments; change one thing at a time and verify its effects.)
2. Show that you understand both methods [15pts]. What is being trained, how, and why does it work.  
(Explain style transfer, the two loss functions, the terms inside the loss functions. Additionally, briefly explain the numerical metrics you used. SSIM is a good starting point, but understand that it was not designed for style transfer: visual inspection is still extremely important for style transfer. )