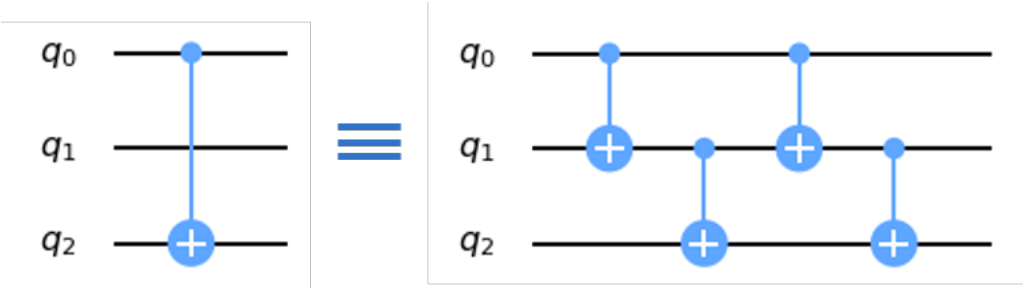
Spring 2025 CIS 492/593/694 – Quantum Machine Learning Assignment 1

Note: Attached PDF that has the rubric on the guidelines towards the grading/expectations for these Assignment 1 exercises

1. The gates available in Qiskit are only small part of quantum gates one can apply in quantum circuits. In this exercise, create the following gate and apply on a one qubit system using the operator method in qiskit. Also provide the screenshot of the Python code

$$A = \frac{1}{\sqrt{2}}(\sigma_x + \sigma_y) = \begin{pmatrix} 0 & \frac{(1-i)}{\sqrt{2}} \\ \frac{(1+i)}{\sqrt{2}} & 0 \end{pmatrix}$$

2. Show using the unitary simulator in Qiskit that the following two circuits are equivalent. Tip: You can show that they are equivalent using the difference in their unitary. Also provide the screenshot of the Python code



3. Using Python code, perform the following Tensor operations.: Find $u \otimes v$ and $v \otimes u$ for the given vectors $u = \begin{bmatrix} -2 \\ -1 \\ 0 \\ 1 \end{bmatrix}$ and $v = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$

   Also provide the screenshot of the Python code.