Week 8 – Workshop

COMP90084 Quantum Software Fundamentals

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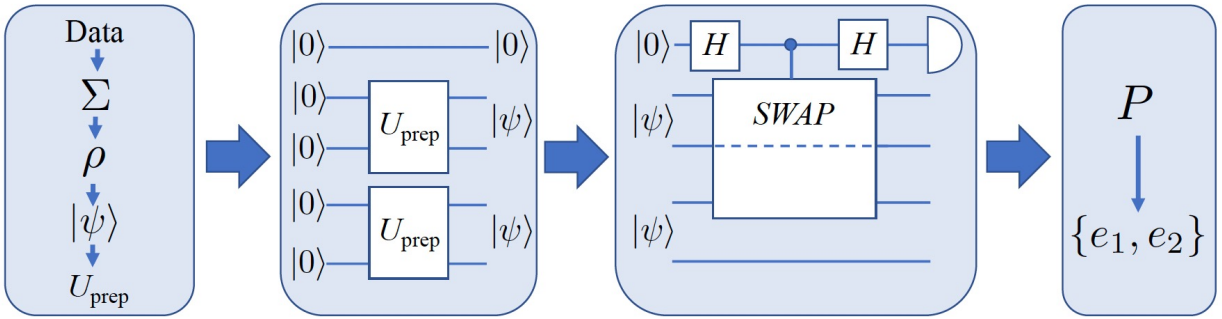
Quantum Principal Component Analysis

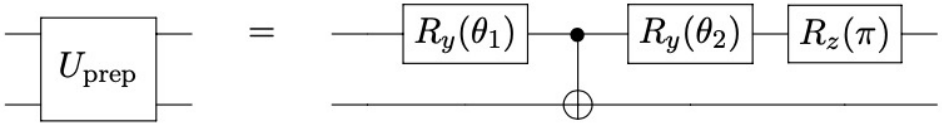
- Code up the two-qubit example we looked at in lectures:



- Use the data well-known Iris dataset (available from http://archive.ics.uci.edu/ml/index.php) for Iris Setosa. Calculate the 2x2 covariance matrix for the sepal length and the petal width (both in cm) (columns 1 and 4) using:

$$\text{Covariance (X,Y)} = \Sigma = \text{Cov(X,Y)} = \frac{\sum_{i=1}^{n}(X_i - E[X])(Y_i - E[Y])}{n-1}$$

- Implement the U_{prep} gate from lectures and verify that U_{prep} does indeed give the normalised covariance matrix when we trace out one qubit.



The partial trace is defined as:

$$\rho = (I \otimes \langle 0|)\ |\psi\rangle\langle\psi|\ (\ I \otimes |0\rangle\ ) \ +\ (I \otimes \langle 1|)\ |\psi\rangle\langle\psi|\ (\ I \otimes |1\rangle\ )$$

- Run the above circuit to estimate the eigenvalues for this 2x2 covariance matrix. Verify that we find the correct eigenvalues when detecting $|0\rangle$ and $|1\rangle$ on the top qubit.