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Quantum Computing
Assignment 1
(Play with Vector, Matrix, and Complex Number in Python)

THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

Section 1

Working with Python in Colab Open your Google Account here https://colab.research.google.com (Refer the video for additional functionalities of Colab https://www.youtube.com/watch?v=rNgswRZ2C1Y) Students can refer to https://www.pythonpool.com/python-vector/ or any other website to learn how to use vectors in Python.

- Import NumPy and math package.
- Create variables by considering $a = 1/\sqrt{2}$ and $b = 1/\sqrt{2}$
- Create a vector or One-dimensional array using variables a and b.
- Check whether the vector is normalized or not. Vector is normalized if $a^2 + b^2 = 1$ in this particular case.
- Find the length of a vector.

Section 2

Vector in Python Create a new notebook and add the following functionalities in the Colab notebook:

- Create a vector and read the elements of the vector from the keyboard.
- Write a function that will check whether the function is normalized or not.
- Write a function to find the dot and cross product of two vectors (A and B) using NumPy.
- Write a function to find a unit vector corresponding to vector A.

Section 3

Matrices in Python Create a new notebook and add the following functionalities in the Colab notebook using NumPy:

- Read a matrix from the Keyboard.
- Find the transpose of a matrix.
- Find the Determinant of a matrix (Using linalg.det in NumPy).
- Find Rank of a matrix (Using $linalg.matrix_rank$ in numpy).
- Find Trace of the matrix
- Find Eigenvalue and Eigenvectors of a square matrix (Use linalg.eig).
- Find the Inverse of a matrix.

Section 4

Complex Number in Python Refer to https://realpython.com/python-complex-numbers/using-python-complex-numbers-as-2d-vectors or any other site to read how to use complex numbers in python. for Create a new notebook and add the following functionalities in the Colab notebook:

- Read a complex number from the keyboard.
- Find the complex conjugate of the complex number.
- Addition, subtraction, multiplication, and divisions of complex numbers.
- understands the concept of a complex number as a 2D vector.
- Find the length or magnitude of a complex number.

Section 5

Account Creation on IBM Q Experience Create your login id https://quantum-computing.ibm.com/

- After Login, go through the interface with the following two options:
  - Launch Composer: working with IBM composer (Drag and drop Options).
  - Working with IBM Qiskit (refer to https://qiskit.org/textbook/content/ch-ex/)