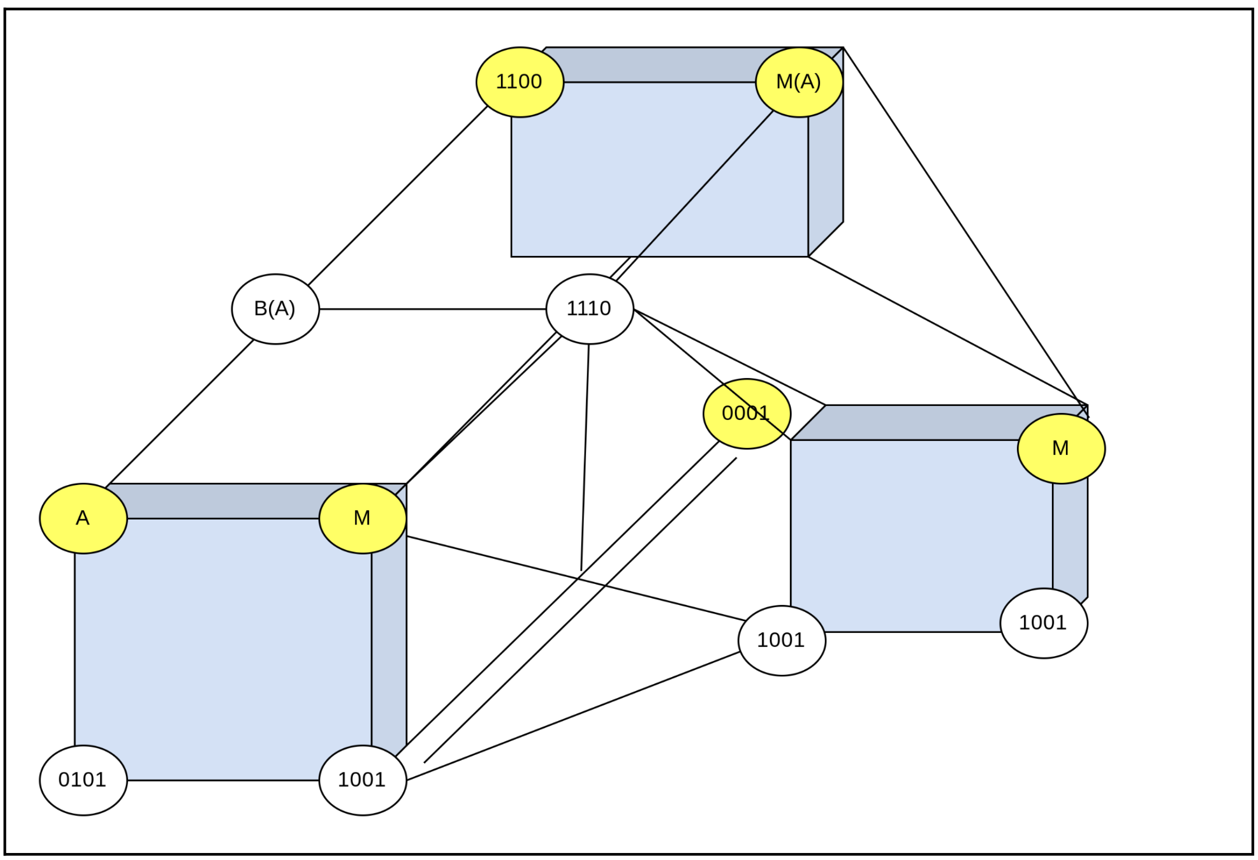
Qubits in higher dimension states

In principle, the theory based on quantum dynamics and quantum cryptography ,the qubits Are placed in vectors in different dimensional spaces.

The main objective is build a comprehensive mathematical and programming model in python To stay close to the idea to change the paradigm of traditional computers and robots breaking Kinematics and motion and give a more amplitude of quantum computing and higher dimensions In cube states because it is necessary to move forward to further visions and steps to formulate in a concise manner with examples how to apply a new computational model to the physical computers. Usually we use computers with 2D-3D or in planar spaces. What I want to achieve Is build a computational model that breaks the 2D-3D dimensional states to work similar as the space algorithms in a given multidimensional system is actually working

For example when you have a qubit in a given space z, the resolution states occur simultaneously across different dimensions. Let's unify quantum cryptography models with higher order dimensions and try to compute it with python in further examples.



The structure of the mathematical tree I propose here is to build a model based on algorithmic regression and higher dimensions combinatorics of sets in three dimensional states with logarithmic regression in scikit-learn. To gain solidity of the structure I need to show some examples of qubits and quantum cryptography and higher order dimensional states with diagrams, academic papers and programming.

Application

The materials to build computers in different dimensional spaces, the materials and the data it might be so big than one small star computational process.

Quantum in computing models

We have qubits vector module in python or Scikit and we can represent vectors with two-three dimensional states and the product of the vectors with XOR operations and the generic meaning Of v given v|w spaces

Note that the inner product of two vectors $|v_1\rangle, |v_2\rangle \in \mathbb{C}^d$ is in general a complex number. Later on, we shall see that the modulus squared of the inner product $|\langle v_1|v_2\rangle|^2$ is of much significance. As an example, let us consider the inner product of the vector $|v\rangle$ given in (2) and

$$|w\rangle = \begin{pmatrix} 2 \\ 3 \end{pmatrix} . \tag{6}$$

We have

$$\langle v|w\rangle = (1\ 0)\begin{pmatrix} 2 \\ 3 \end{pmatrix} = 1\cdot 2 + 0\cdot 3 = 2 . \tag{7}$$

Tensor product inside higher dimensions

We can compute products of qubits inside different tridimensional or quatro dimensional spaces across different theories. The Nearest Neighbors search and the number of training data points With the input dimension and the output dimension give us the tool to compute qubits as data points in higher dimensions. The problem is to calculate the output errors, but we have estimators in Scikit to calculate the output states of the qubits.

The HLLE algorithm comprises three stages:

1. **Nearest Neighbors Search**. Same as standard LLE
2. **Weight Matrix Construction**. Approximately $O[DNk^3] + O[Nd^6]$. The first term reflects a similar cost to that of standard LLE. The second term comes from a QR decomposition of the local hessian estimator.
3. **Partial Eigenvalue Decomposition**. Same as standard LLE

The overall complexity of standard HLLE is $O[D\log(k)N\log(N)] + O[DNk^3] + O[Nd^6] + O[dN^2]$.

- N : number of training data points
- D : input dimension
- k : number of nearest neighbors
- d : output dimension

where $|x\rangle$ are d-dimensional vectors

$$|x\rangle = \begin{pmatrix} 0 \\ \vdots \\ 1 \\ \vdots \\ 0 \end{pmatrix} \longrightarrow i\text{-th position.} \tag{24}$$

Let us summarize our discussion in the following definition of an n qubit quantum state.

Definition 0.2.6 An n-qubit state $|\psi\rangle \in \mathbb{C}^d$ with $d = 2^n$ can be written as a superposition of standard basis elements

$$|\psi\rangle = \sum_{x\in\{0,1\}^n} \alpha_x |x\rangle, \qquad \text{where } \forall x, \alpha_x \in \mathbb{C} \text{ and } \sum_{x\in\{0,1\}^n} |\alpha_x|^2 = 1. \tag{25}$$

Let us now consider two examples of two qubit states. The first is so famous it carries a special name and we will see it very frequently in the course of these notes.

■ **Example 0.2.2** Consider two qubits A and B, in the two qubit state known as the *EPR pair* [2], one can label the joint state as AB

$$|\text{EPR}\rangle_{AB} = \frac{1}{\sqrt{2}}(|00\rangle_{AB} + |11\rangle_{AB}) = \frac{1}{\sqrt{2}}\left(\begin{pmatrix}1\\0\\0\\0\end{pmatrix} + \begin{pmatrix}0\\0\\0\\1\end{pmatrix}\right) = \frac{1}{\sqrt{2}}\begin{pmatrix}1\\0\\0\\1\end{pmatrix}. \tag{26}$$

which is an equal superposition between the vectors $|00\rangle_{AB}$ and $|11\rangle$. The length of this vector is given by the (square root of) inner product