Quantum - Corpus

quantum info ← extension from classical info

Descriptions of quantum info:

1 simplified description
- Quantum states represented by vectors
  - operations represented by unitary matrices
- enough for most quantum algorithms

2 General description
- quantum states rep. by density matrices.
- includes both simplified + classical info (including prob states) as special case.

[classical info]

consider physical sys. of info "x"

Let x be in 1 of a finite n # of classical states at each moment.

Let $\Sigma = \{n \in \text{Classical finite states}\}$

if x - bit: $\Sigma = \{0, 1\}$

if x - 6 sided dice: $\Sigma = \{1, \ldots, 6\}$

Σ cannot be empty (release 2 pos. states)

E.g. if X is a bit:

Assume $0 \to P: \frac{3}{4}$ and $1 \to P: \frac{1}{4}$

Probabilistic state $\begin{cases} Pr(X=0) = \frac{3}{4} \; \& \\ Pr(X=1) = \frac{1}{4} \end{cases}$

→ column vector: $\begin{pmatrix} 3/4 \\ 1/4 \end{pmatrix} \begin{matrix} \leftarrow 0 \\ \leftarrow 1 \end{matrix}$ } Probability vector

$\forall u \in \vec{P}$, $u \in \mathbb{R}^+$ s.t u is a probability

Assumption 1 entry for each possible state.

Dirac Notation

Context: Classical info

Let Σ be any classical state set, assume

$\forall u \in \Sigma$, u is in corr. with $\mathbb{N}$: $1, \dots, |\Sigma|$

Denote $|a\rangle$ - column vector s.t $\begin{cases} 1 & \text{if } x = a \\ 0 & \text{if } x \in \Sigma \setminus \{a\} \end{cases}$ $x \in \Sigma$

If $\Sigma = \{0, 1\}$, then:

$$|0\rangle = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \begin{matrix} -0 \\ -1 \end{matrix} \text{ and } |1\rangle = \begin{pmatrix} 0 \\ 1 \end{pmatrix} \begin{matrix} -0 \\ -1 \end{matrix}$$