

How do students make sense of linear algebra in coordination with quantum information science?



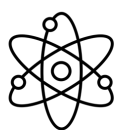
 [#2500569: Student Understanding of Linear Algebra across Quantum Information Science](#)

Motivation

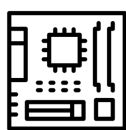


The Quantum Frontier

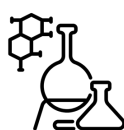
- There is a global investment in QIS research across a spectrum of forefronts and disciplinary fields
- Linear algebra concepts are central in much of QIS
- Deep, interconnected physical and mathematical understanding in QIS is important for students' future access to the quantum workforce



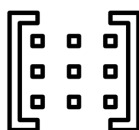
Physics



Computer
Science

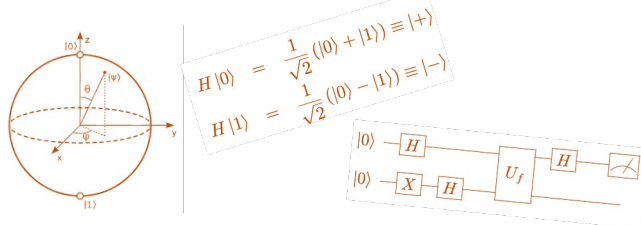


Chemistry



Math

Investigation



$$\text{CNOT}_{12} = |00\rangle\langle 00| + |01\rangle\langle 01| + |10\rangle\langle 11| + |11\rangle\langle 10|$$

$$\text{CNOT}_{12} = |0\rangle\langle 0| \otimes \mathbb{I}_2 + |1\rangle\langle 1| \otimes \text{NOT}$$

How do students make sense of the interconnectedness of core math ideas with QIS beyond disciplinary lines?

$$\text{CNOT}_{21} \begin{array}{c} 00 \rightarrow 10 \\ 01 \rightarrow 01 \\ 10 \rightarrow 00 \\ 11 \rightarrow 11 \end{array} \quad \begin{array}{c} 00 \\ 01 \\ 10 \\ 11 \end{array} \begin{array}{c} 00 \\ 01 \\ 10 \\ 11 \end{array} \begin{array}{c} 00 \\ 01 \\ 10 \\ 11 \end{array} \begin{array}{c} 00 \\ 01 \\ 10 \\ 11 \end{array}$$

$$\begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \end{bmatrix}$$

Methods

Qualitative

Student Interviews

- Interviewing students from 4 QIS courses at VT
- Analyzing student reasoning about linear algebra in QIS with Knowledge in Pieces framework
- Looking for key conceptualizations across contexts

Challenge Area

Supporting Growth

- We already have more data and more interested student researchers than expected! Do you have ideas for additional funds for GRA or URA opportunities?
- Interdisciplinary Quantum Ed is growing – let's connect!