

Required Math Concepts

Before we begin to study quantum computing, an understanding of the following math concepts will be needed:

- From linear algebra
 1. What is a vector?
 2. Column vectors and row vectors
 3. Vector multiplication, the Inner Product
 4. The absolute value, norm, or modulus. If $v = (a \ b)$ then $|v| = \sqrt{v \cdot v} = \sqrt{a^2 + b^2}$
 5. Normalization
 6. What is a Basis? Basis vectors. Orthonormality.
 7. What is a matrix?
 8. Matrix multiplication
 9. Multiplying a vector by a matrix. The Operator concept.
 10. The transpose of a matrix, M^T
 11. The inverse of a matrix, M^{-1}
 12. Eigenvalues and Eigenvectors.
- From complex arithmetic
 1. What is a complex number? $z = a + bi$
 2. How to add and multiply
 3. The conjugate, $z^* = a - bi$
 4. The absolute value, norm, or modulus. If $z = a + bi$ then $|z| = \sqrt{(z^*)(z)} = \sqrt{a^2 + b^2}$
 5. Argand diagrams (plotting numbers on the complex plane)
- Complex Vector Spaces (vectors and matrices with complex numbers)
 1. The adjoint of a matrix, M^\dagger
 2. What is a "unitary" matrix? $U^\dagger = U^{-1}$
 3. What is a "Hermitian" matrix? $H = H^\dagger$
- Dirac (bra and ket) notation
 1. For example: $\alpha|0\rangle + \beta|1\rangle$ is just the vector: $\begin{pmatrix} \alpha \\ \beta \end{pmatrix}$