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QnA

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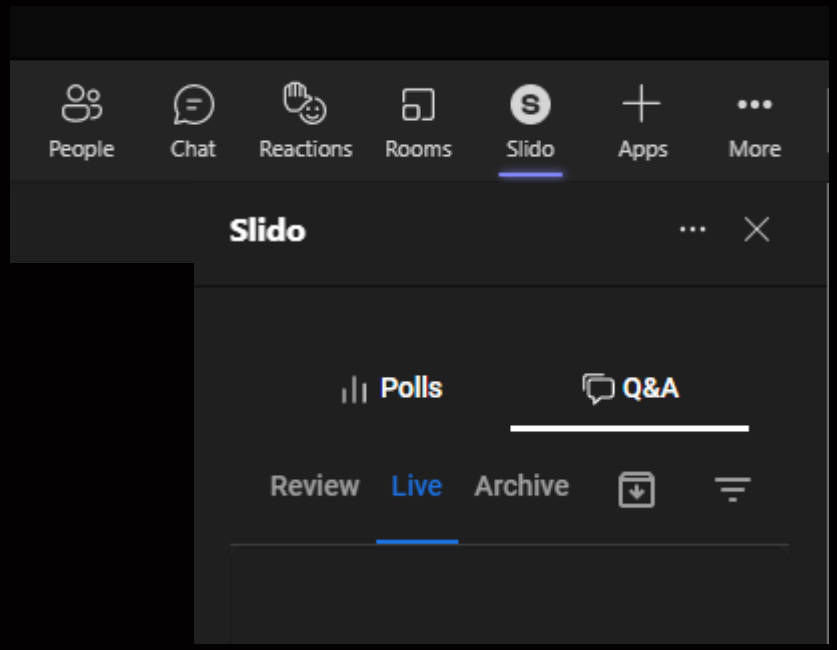


tclarke21 #9 thanks Mahdi,

Latest commit 109d51d 6 hours ago History

2 contributors

Thank you for error correction

51 lines (51 sloc) | 2.09 KB

Raw Blame

Acknowledgements

This educational text simply builds upon the inspiring work of a large number of visionaries. In addition, there are many great minds whose generosity in sharing their insights facilitated much of t`his work. It has been a great honour and privilege to have been supported in this endeavour. As an expression of gratitude, what follows is, in no particular order, a list of thanks:

Thanking Eric (Passawis) for his grammatical corrections to chapters 1,2,3... as well as his encouraging feedback.

Thanking Cris Diaz for his invaluable GitHub support

For his excellent feedback on chapter 1, I would like to thank Ivan Arie De Jesus Caballero Simbaqueba.

For some design suggestions, thanks to Carla Juliana Acosta Zamudio.

As my first student who put up with me rambling through the first two chapters, I'd like to thank Favio Acosta

Letting me know that Assignment 1 had an error in the basis vectors, thank you Giulio Malinverno & Andres Felipe Guerrero.

A few people pointed out in Assignment 1 that $|a\rangle$ was not normalised, I updated it to be $|b\rangle$ instead. Thanks to Giulio Malinverno, Andres Felipe Guerrero & Rajat Kumar.

For pointing out the tensor product $|0+\rangle$ will not change under the standard $CNOT_{a,b}$ I give thanks to Rajat Kumar & Andres Felipe Guerrero, this will help with chapter 6.

Thank you Mahdi Sanagostar for pointing out a mistake in my supposedly corrected CNOT(b,a) on Assignment 1.

Assignment 1

- 9 questions
- 2 optional challenge questions
- Due Monday 12th September
- Can write solutions by hand
- Link to full assignment

Thomas Clarke
Quantum Computing Technical Foundations
September 2, 2022

Assignment 1: Maths for Quantum Computing

Assignment Due: Monday 12th September

Solutions can be handwritten on a separate sheet of paper, typed or done on a tablet. You may print this, write the solutions on it, and then scan and upload it.
Send the completed assignment to tclarke@asesoftware.com If you have any questions or difficulties, please do reach out to the same email.
Challenge Questions are Optional

1. Complex Numbers

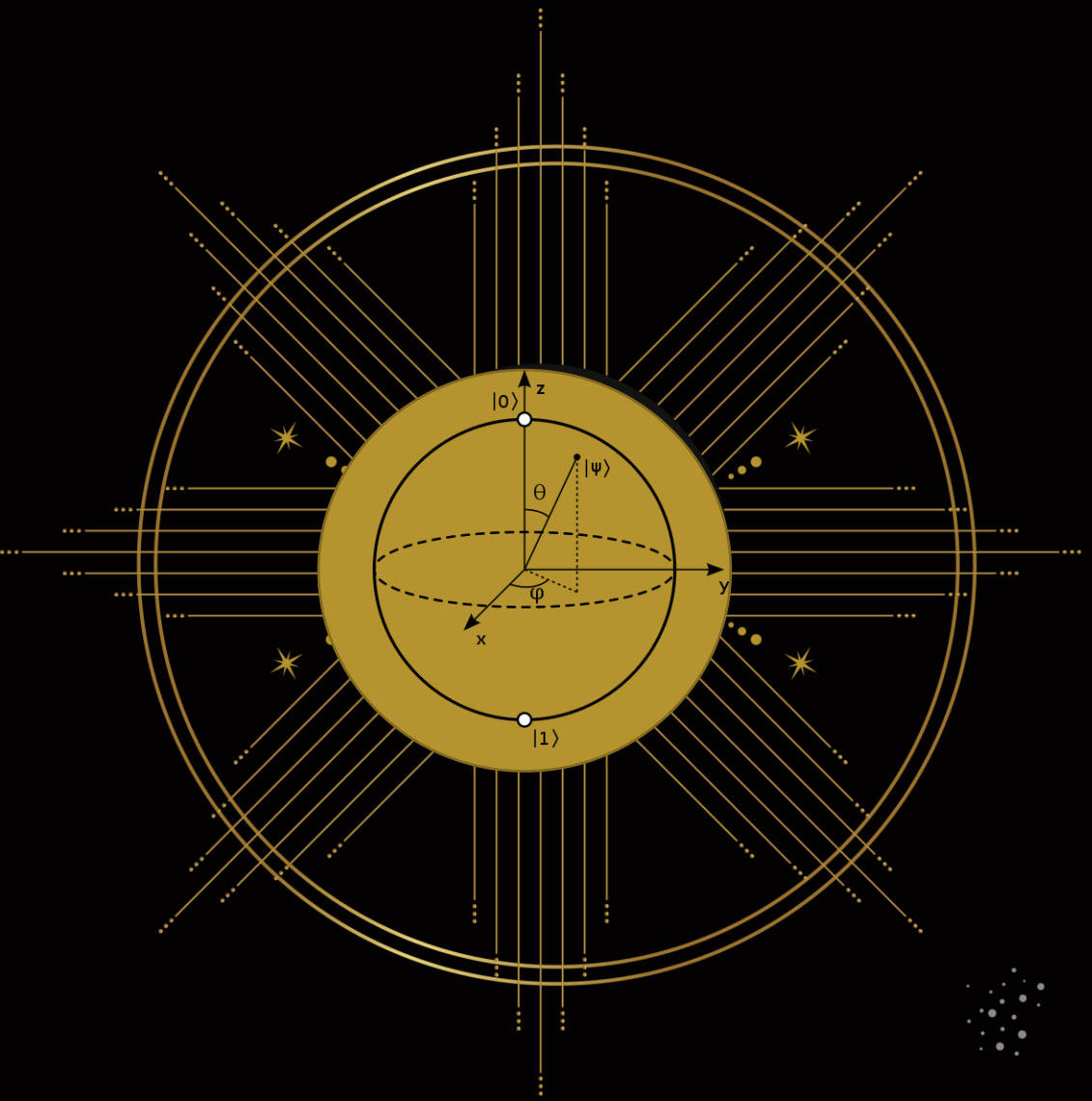
Question 1. Complex number algebra

Simplify the following into the form $a + bi$

1) $(6 + 4i) + (3 + 5i)$
2) $(-6 + 4i) + (-3 + 5i)$
3) $i(2 + 3i)$
4) $(6 + 4i)(6 - 4i)$

Question 2. Complex conjugate

Find the complex conjugate for your answers to the previous question
Hint: the complex conjugate of $z = a + ib$ is $z^* = a - ib$



Single Qubits

The unit of quantum information

Course materials

https://github.com/EquinoxAI/YAItQC/tree/main/Chapters

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tclarke21 Moved ket to linear algebra section #3 — 54ef3de 15 minutes ago — History

..		
Images	#4 added quantum algorithms diagram	3 days ago
0_Acknowledgements.ipynb	#6, #9 Thank you Giulio Malinverno, Andres Felipe	28 minutes ago
10_Grover.ipynb	I renamed 1 folder and everyone loses their minds!	13 days ago
11_Shor.ipynb	Added references, another image #4 #7	9 days ago
12_QML.ipynb	I renamed 1 folder and everyone loses their minds!	13 days ago
1_What_is_quantum.ipynb	#8 Fixed	3 days ago
2_What_is_quantum_computing.ipynb	#4 added quantum algorithms diagram	3 days ago
3.1_Complex_numbers.ipynb	#8 Fixed	3 days ago
3.2_Linear_algebra.ipynb	Moved ket to linear algebra section #3	15 minutes ago
4_Dirac_Notation.ipynb	Moved ket to linear algebra section #3	15 minutes ago
5_Single_Qubits_&_Bloch_Sphere.ipyn	#8 Fixed	3 days ago
6_Multiple_Qubits.ipynb	#8 Fixed	3 days ago
7_Quantum_circuits.ipynb	I renamed 1 folder and everyone loses their minds!	13 days ago
8_Quantum_algorithms.ipynb	I renamed 1 folder and everyone loses their minds!	13 days ago

This week's content

The measure of greatness in a scientific idea is the extent to which it stimulates thought and opens up new lines of research.

— Paul Dirac —

AZ QUOTES

From pictures to kets

$$= \frac{1}{\sqrt{2}} \left(\quad + \quad \right)$$


Measurement: The greatest problem in QM

Operators: A trip to the casino

Operators: A trip to the casino

Gate	Description	Effect on $\|0\rangle$	Effect on $\|1\rangle$	Matrix
I	Identity: do nothing	$\|0\rangle \to \|0\rangle$	$\|1\rangle \to \|1\rangle$	$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$
X	Not: Swaps $\|0\rangle$ with $\|1\rangle$	$\|0\rangle \to \|1\rangle$	$\|1\rangle \to \|1\rangle$	$\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$
Y	Y: Rotation by angle π around the y-axis of the Bloch sphere	$\|0\rangle \to i\,\|1\rangle$	$\|1\rangle \to -i\,\|0\rangle$	$\begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$
Z	Z: Adds a phase of $e^{i\pi}$ to $\|1\rangle$	$\|0\rangle \to \|0\rangle$	$\|1\rangle \to -\|1\rangle$	$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$
H	Hadamard: Creates the superposition state	$\|0\rangle \to \frac{1}{\sqrt{2}}(\|0\rangle + \|1\rangle)$	$\|1\rangle \to \frac{1}{\sqrt{2}}(\|0\rangle - \|1\rangle)$	$\frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$
S	Adds a phase of $e^{\pi/2}$ betweeen $\|0\rangle$ & $\|1\rangle$	$\|0\rangle \to \|0\rangle$	$\|1\rangle \to e^{\pi/2}\,\|1\rangle$	$\begin{bmatrix} 1 & 0 \\ 0 & e^{\pi/2} \end{bmatrix}$
T	Adds a phase of $e^{\pi/4}$ betweeen $\|0\rangle$ & $\|1\rangle$	$\|0\rangle \to \|0\rangle$	$\|1\rangle \to e^{\pi/4}\,\|1\rangle$	$\begin{bmatrix} 1 & 0 \\ 0 & e^{\pi/4} \end{bmatrix}$

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How many rows does our column vector need for n qubits?

ⓘ Start presenting to display the poll results on this slide.

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Is it difficult to simulate a large number of seperated (i.e. not entangled) qubits on a classical computer?

ⓘ Start presenting to display the poll results on this slide.

Assignment 2

- 5 regular questions
- 5 optional challenge questions
- Due Friday 16th September
- Link to the assignment

Thomas Clarke
Quantum Computing Technical Foundations
September 8, 2022

Assignment 2: Single Qubits

Assignment Due: Friday 16th September

Solutions can be handwritten on a separate sheet of paper, typed or done on a tablet. You can print this, write the solutions on it, and then scan and upload it.
Send the completed assignment to tclarke@asesoftware.com If you have any questions or difficulties, please do reach out to the same email.
Challenge Questions are Optional

Question 1. ___ does not play dice

A dice has 6 faces numbered 1,2,3,4,5,6. For this question we will count from 1. Rather than a 2-level system like a qubit, this is a 6-level system. We'll call each state by the number on the face. For instance $|3\rangle$ is the state of the dice with face with 3 up.
When we toss the dice, let's say it's in the superposition state similar to $|+\rangle$ for the qubit.

$$|+_6\rangle = \frac{1}{\sqrt{6}}(|1\rangle + |2\rangle + |3\rangle + |4\rangle + |5\rangle + |6\rangle)$$

What is the expectation value of the dice?
Hint: rather than computing a 6x6 matrix-vector product, you can do the sum
$\langle N\rangle = \sum_{j=1}^{6} |\langle j|+_6\rangle|^2$

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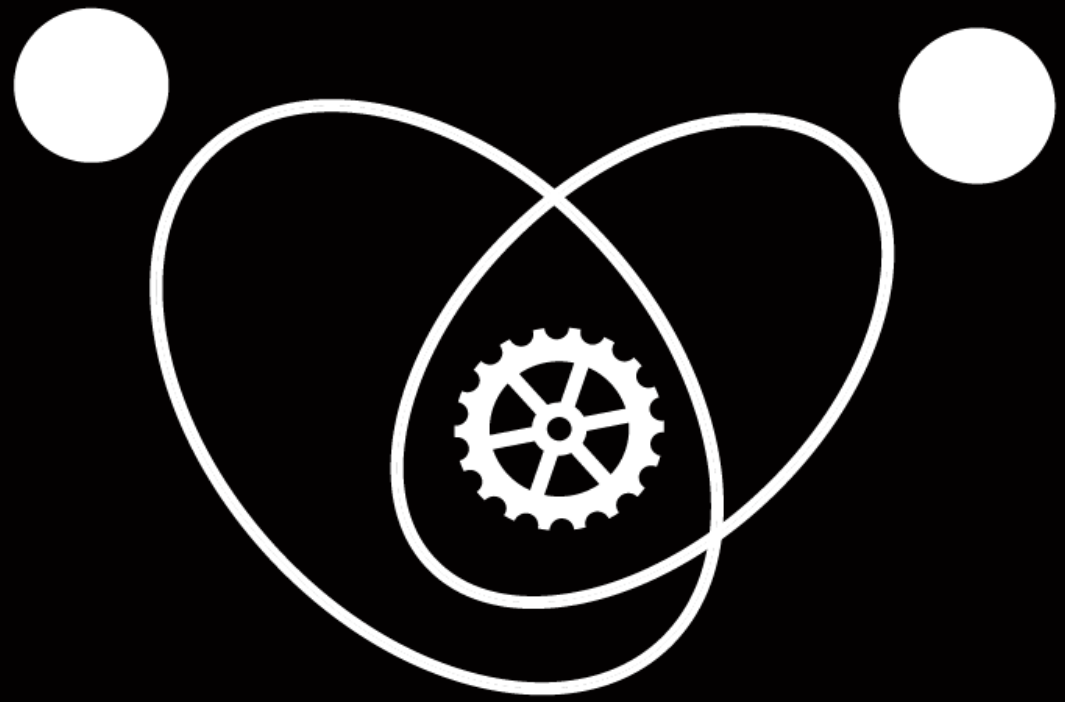
Audience Q&A Session

ⓘ Start presenting to display the audience questions on this slide.

G R A C I A S



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