quantum computing

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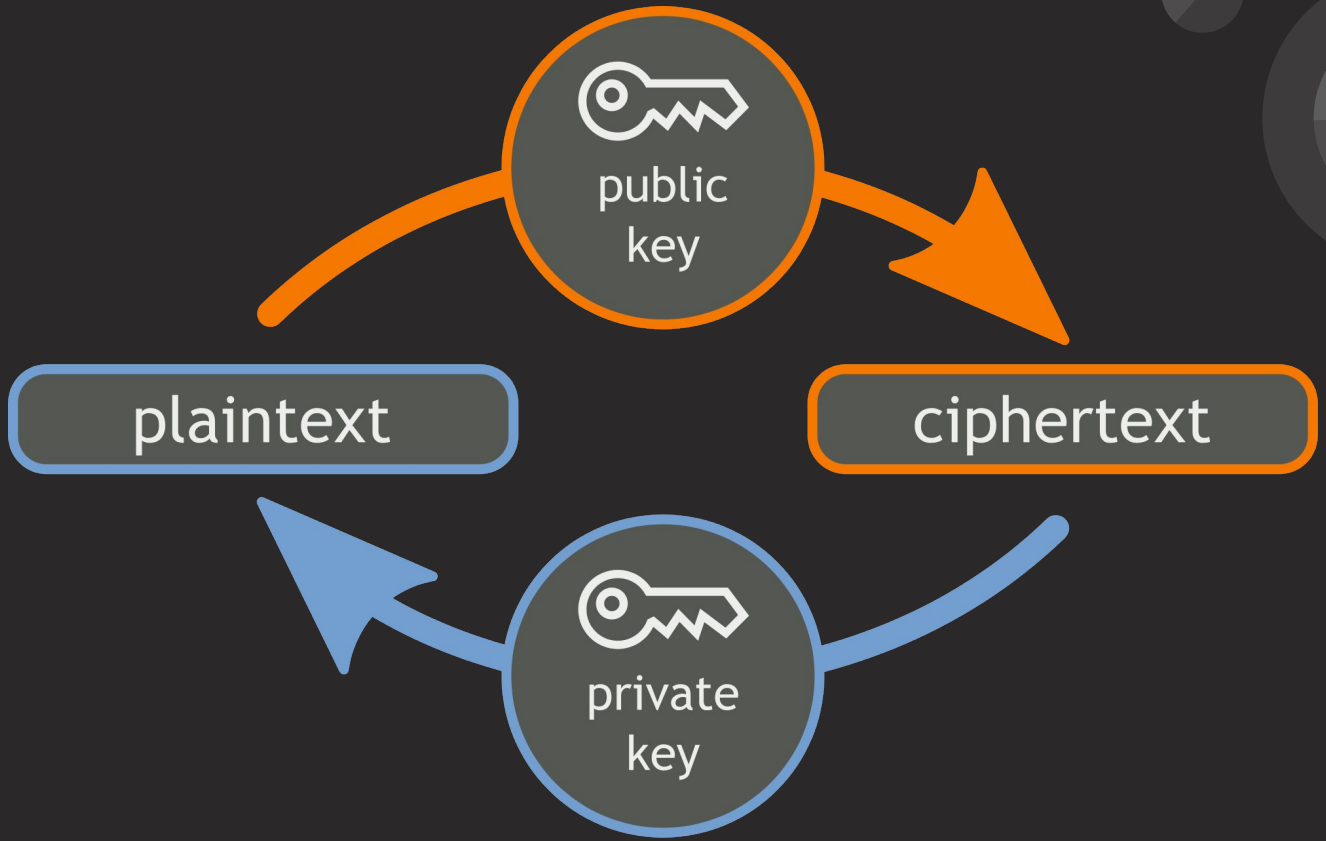
waterford tech meetup 30 may 2018

why quantum ?

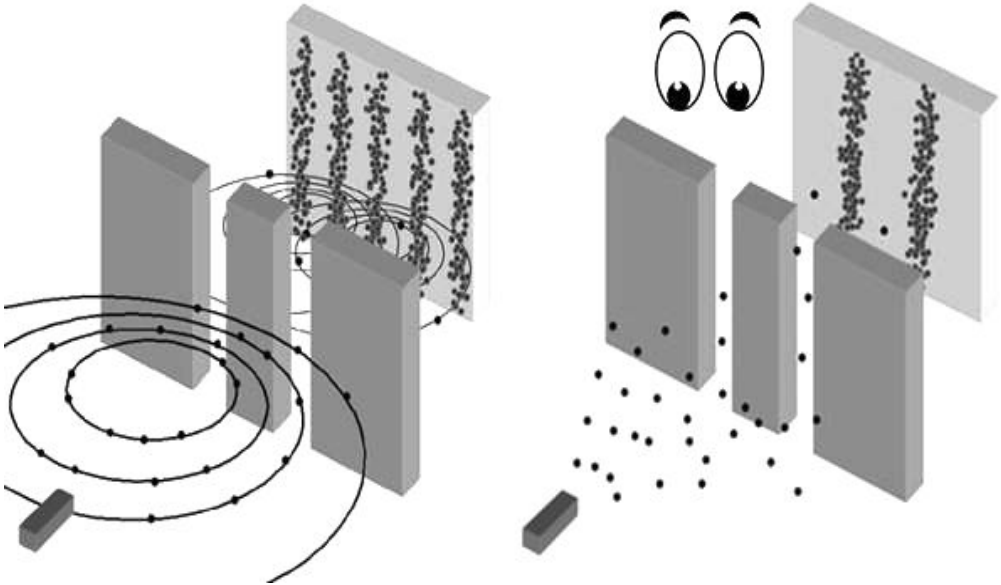

public
key
plaintext
ciphertext
private
key

the quantum landscape

quantum fundamentals (for dummies)

I’m not a physicist

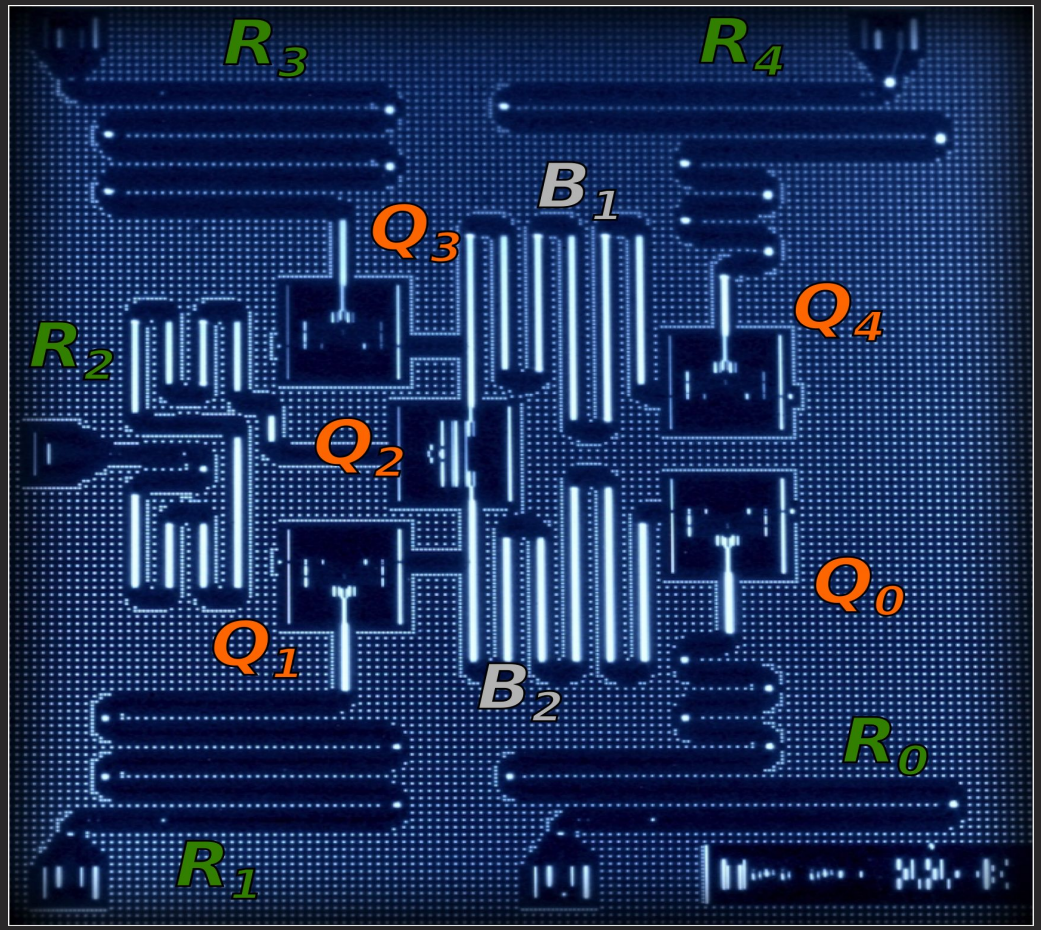
duality of quantum



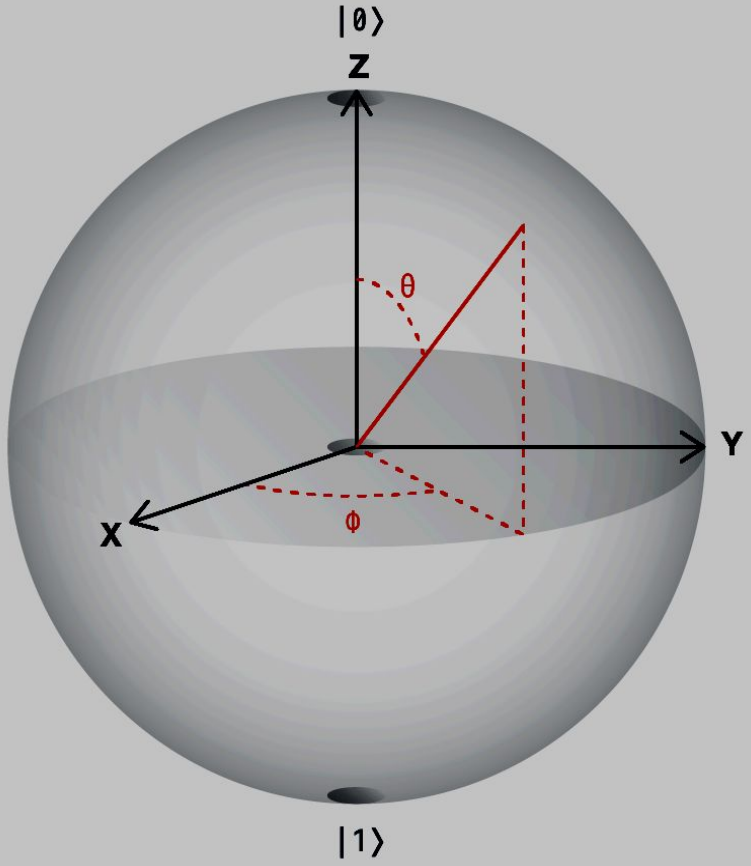
superposition, entanglement and teleportation

quantum hardware

the qubit - josephson junction


R3
R4
B1
Q3
Q4
R2
Q2
Q0
Q1
B2
R0
R1

Qubit



$$|0\rangle = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \qquad |1\rangle = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$$

superposition

$$|\psi\rangle = \alpha|0\rangle + \beta|1\rangle \qquad |\alpha|^2 + |\beta|^2 = 1$$

z.B.

$$|+\rangle = \frac{1}{\sqrt{2}}(|0\rangle + |1\rangle) \qquad |-\rangle = \frac{1}{\sqrt{2}}(|0\rangle - |1\rangle)$$

$$|\circlearrowright\rangle = \frac{1}{\sqrt{2}}(|0\rangle + i|1\rangle) \qquad |\circlearrowleft\rangle = \frac{1}{\sqrt{2}}(|0\rangle - i|1\rangle)$$

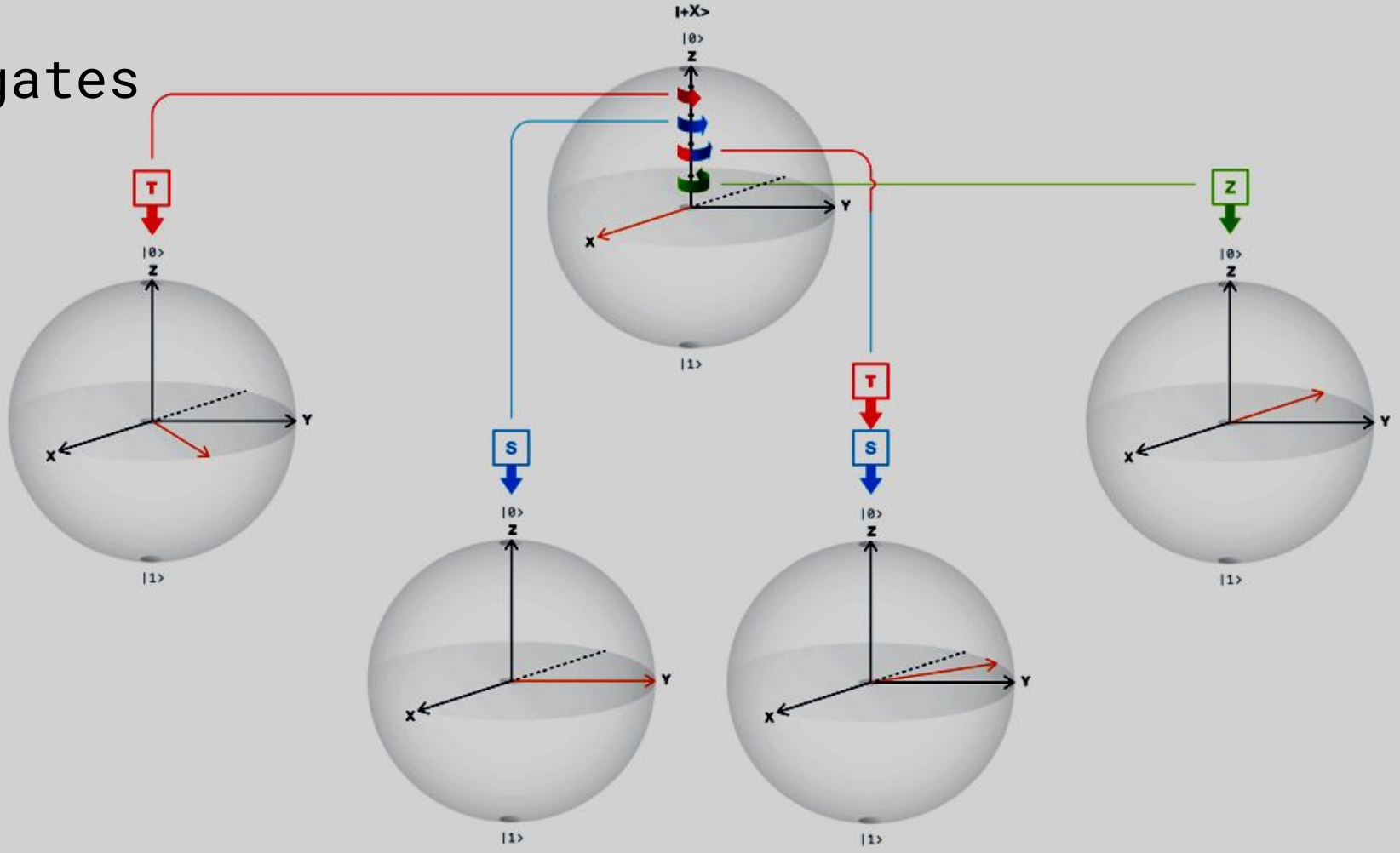
classical computer vs quantum computer

quantum speedup

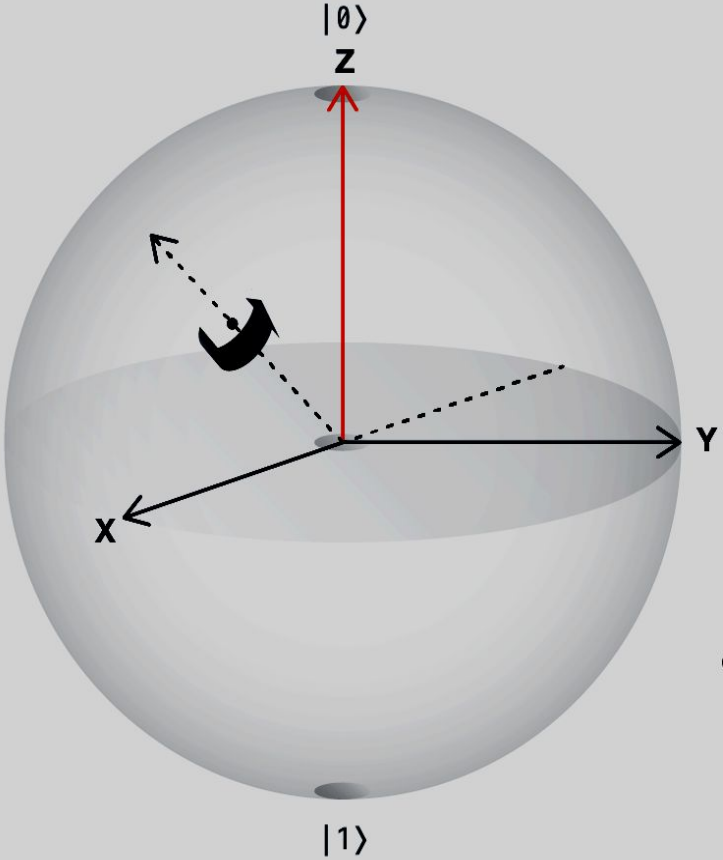
quantum programming

single and multi qubit gates

gates

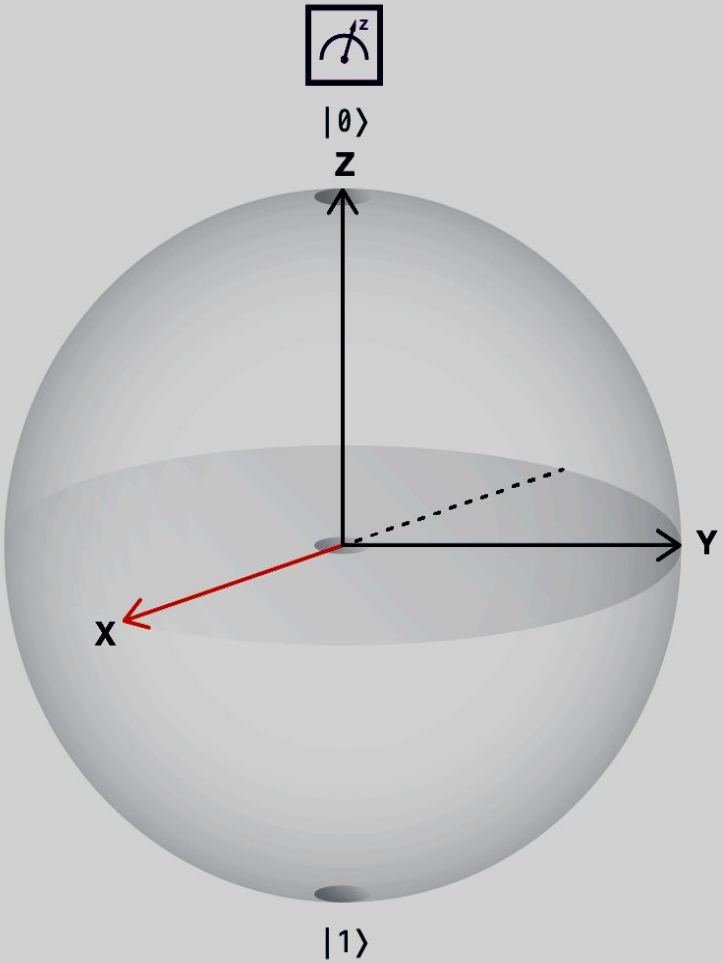


hadamard gate

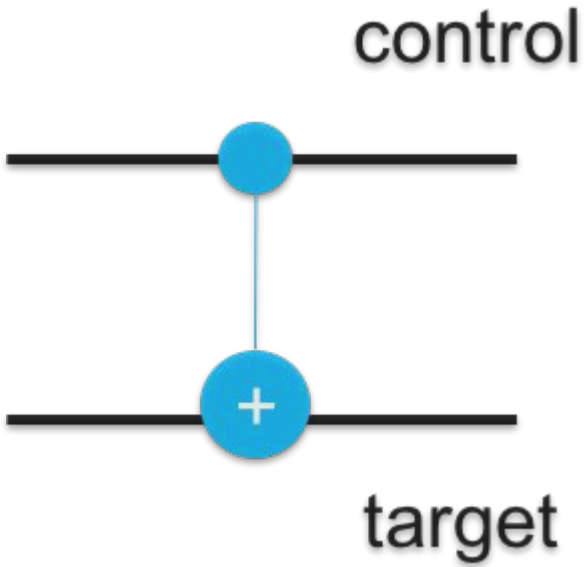


H

π rotation around
X+Z axis:
exchanges X and Z

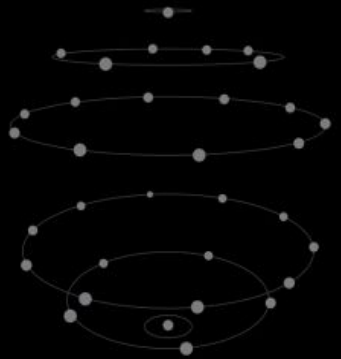


cnot gate



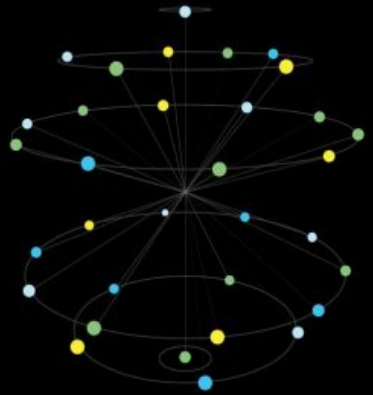
Starting state		Ending State
$\|00\rangle$	→	$\|00\rangle$
$\|10\rangle$	→	$\|10\rangle$
$\|01\rangle$	→	$\|11\rangle$
$\|11\rangle$	→	$\|01\rangle$

Quantum Algorithm



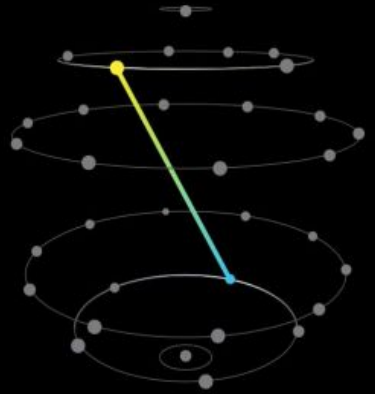
The spread

First part of the algorithm is to make an equal superposition of all 2^n states by applying H gates



The problem

The second part is to encode the problem into this states; put phases on all 2^n states

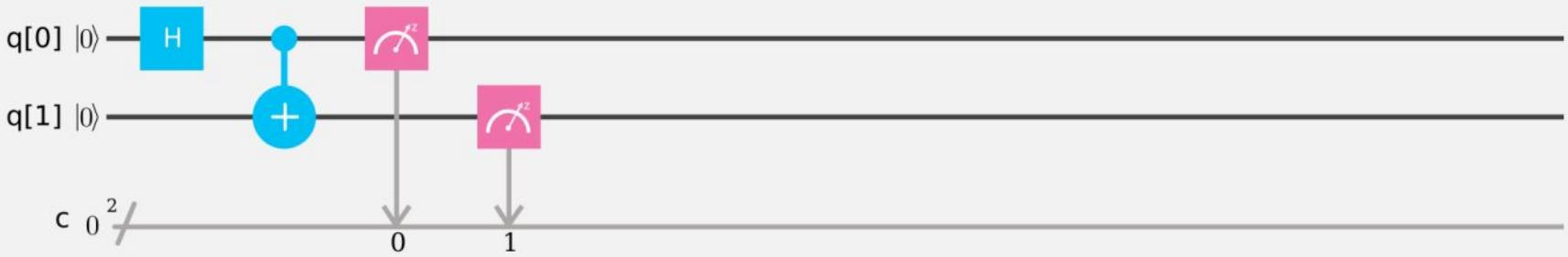


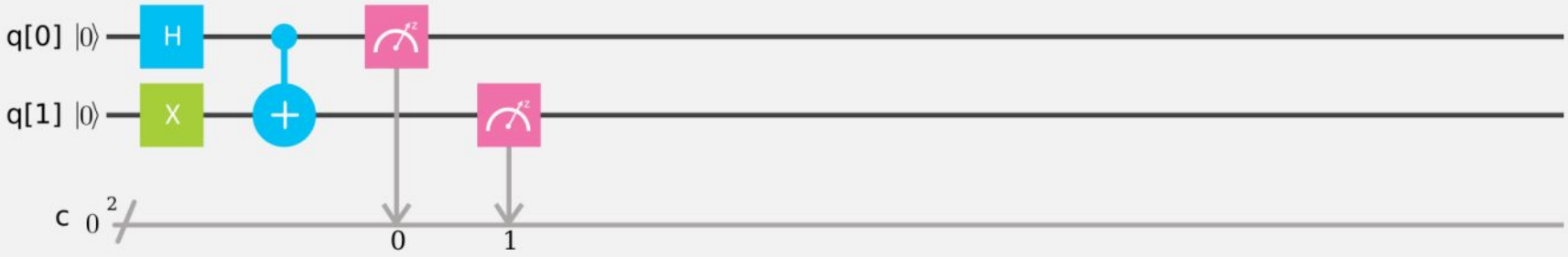
The magic

The magic of quantum algorithms is to interfere all these states back to a few outcomes containing the solution

quantum sdk

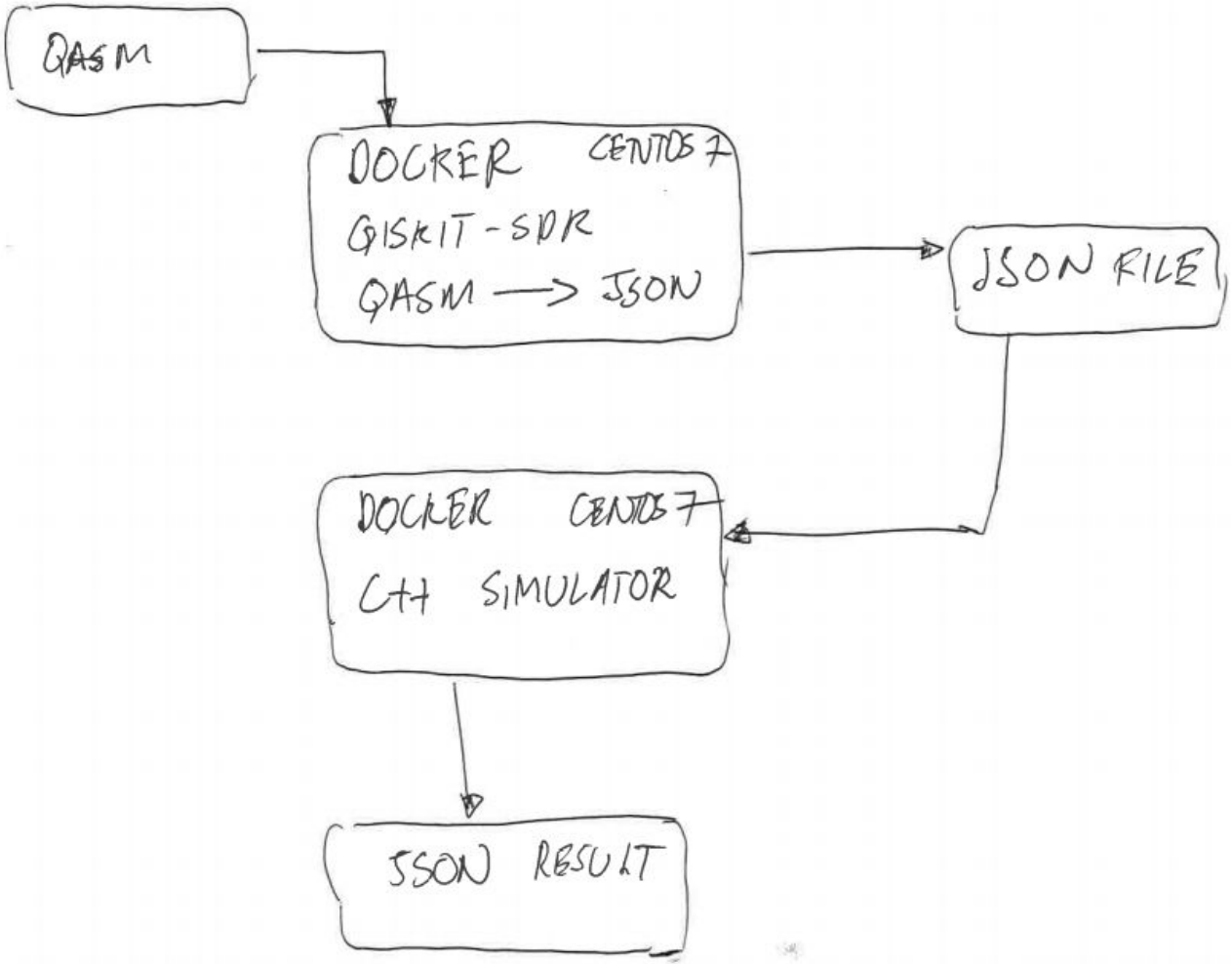
quantum assembly language qasm
qiskit-sdk


q[0] |0⟩
H
q[1] |0⟩
c 0 2
0
1


q[0] |0⟩
H
q[1] |0⟩
X
c 0 2
0
1

demo using qiskit and qasm

grover's algorithm


QASM
DOCKER CENTOS 7
QISKIT-SDK
QASM → JSON
JSON FILE
DOCKER CENTOS 7
C++ SIMULATOR
JSON RESULT

applications

medicine and materials

applications

artificial intelligence

applications

cloud security

applications

quantum as service
sdn networks

applications

supply chain and logistics

applications

financial services

conclusion

thank you

q&a