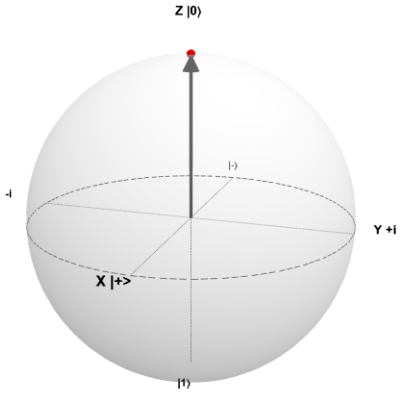
Haritha Weerathunga

Exercise 1 – Bloch sphere

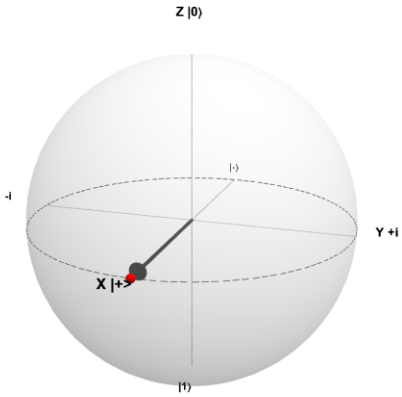
1.

$$|\psi\rangle = \sqrt{1.00}\,|0\rangle + (\sqrt{0.00})e^{i\,0} \quad |1\rangle$$

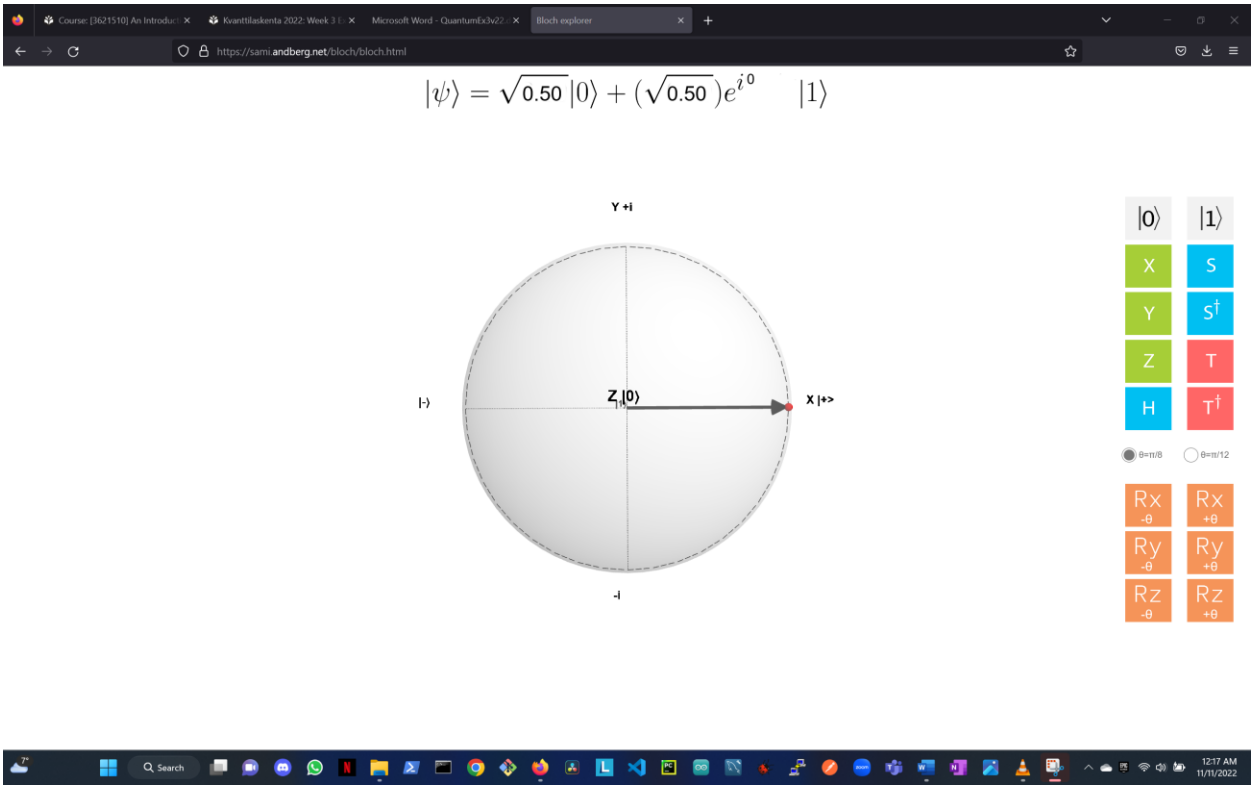


2.

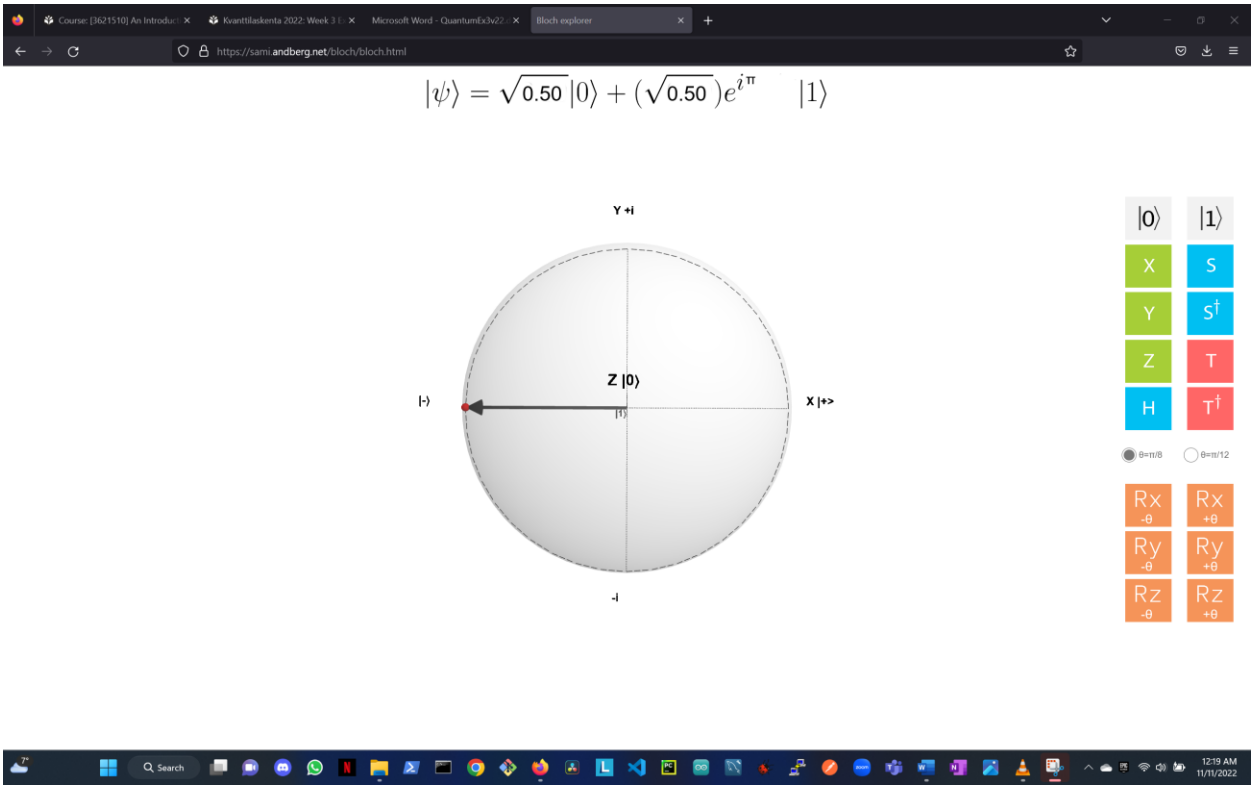
$$|\psi\rangle = \sqrt{0.50}\,|0\rangle + (\sqrt{0.50})e^{i\,0} \quad |1\rangle$$



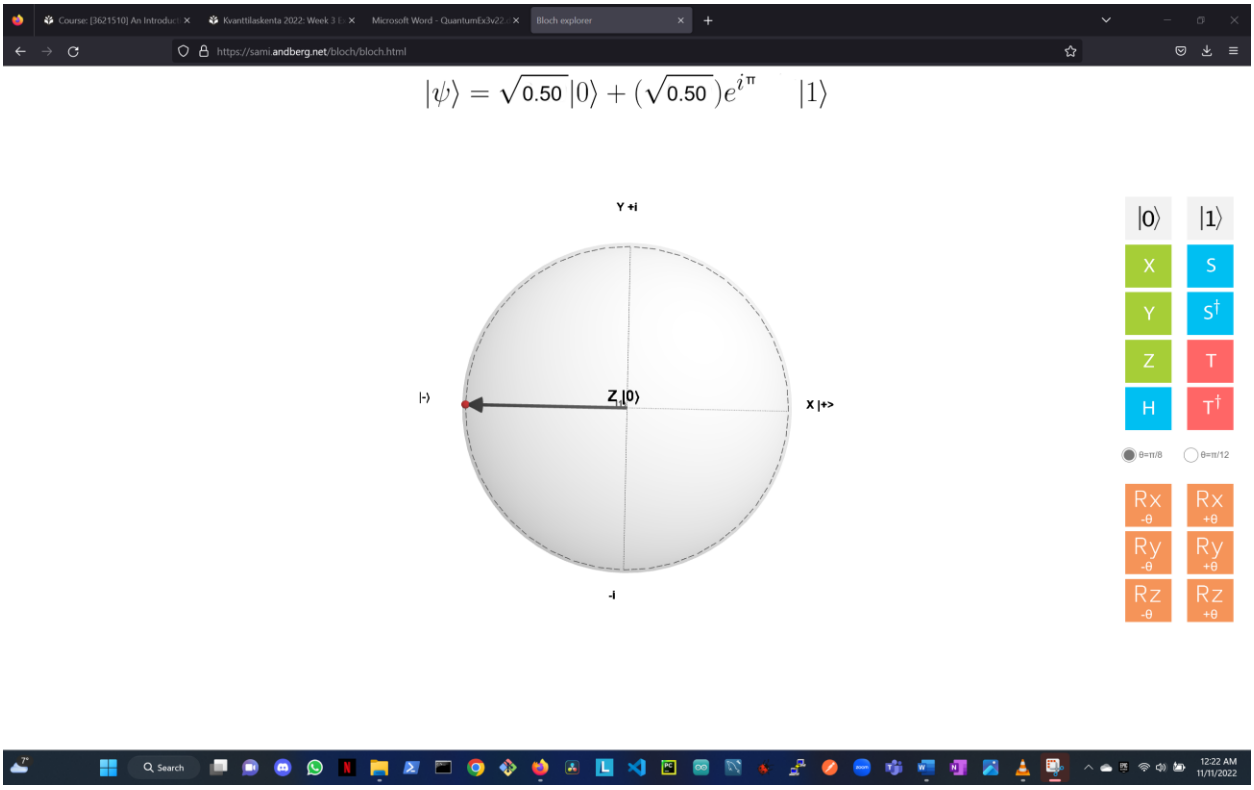
3


https://sami.andberg.net/bloch/bloch.html
$|\psi\rangle = \sqrt{0.50}\,|0\rangle + (\sqrt{0.50})e^{i\,0}\quad|1\rangle$
Y +i
Z |0⟩
|1⟩
|-⟩
X |+⟩
-i
|0⟩
|1⟩
X
S
Y
S†
Z
T
H
T†
θ=π/8
θ=π/12
Rx -θ
Rx +θ
Ry -θ
Ry +θ
Rz -θ
Rz +θ
Search
12:17 AM
11/11/2022

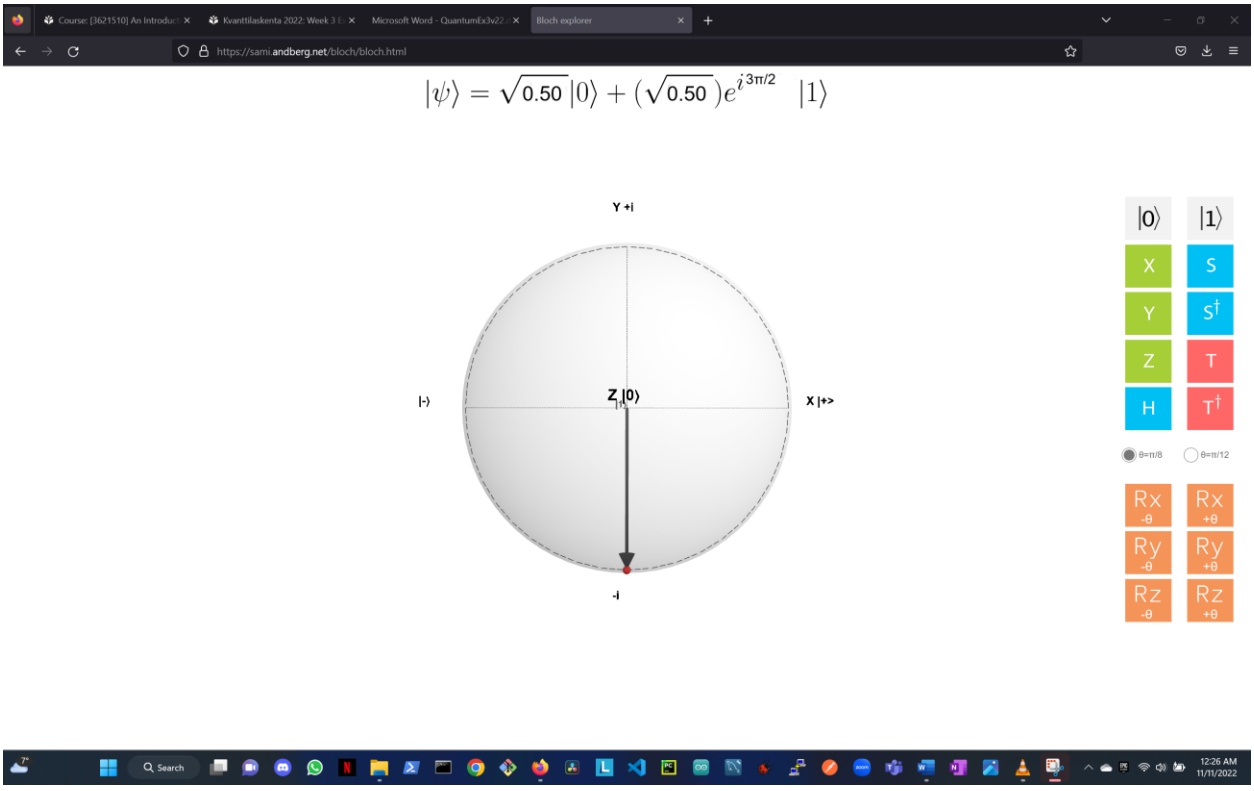
4


https://sami.andberg.net/bloch/bloch.html
$|\psi\rangle = \sqrt{0.50}\,|0\rangle + (\sqrt{0.50})e^{i\,\pi}\quad|1\rangle$
Y +i
Z |0⟩
|1⟩
|-⟩
X |+⟩
-i
|0⟩
|1⟩
X
S
Y
S†
Z
T
H
T†
θ=π/8
θ=π/12
Rx -θ
Rx +θ
Ry -θ
Ry +θ
Rz -θ
Rz +θ
Search
12:19 AM
11/11/2022

5

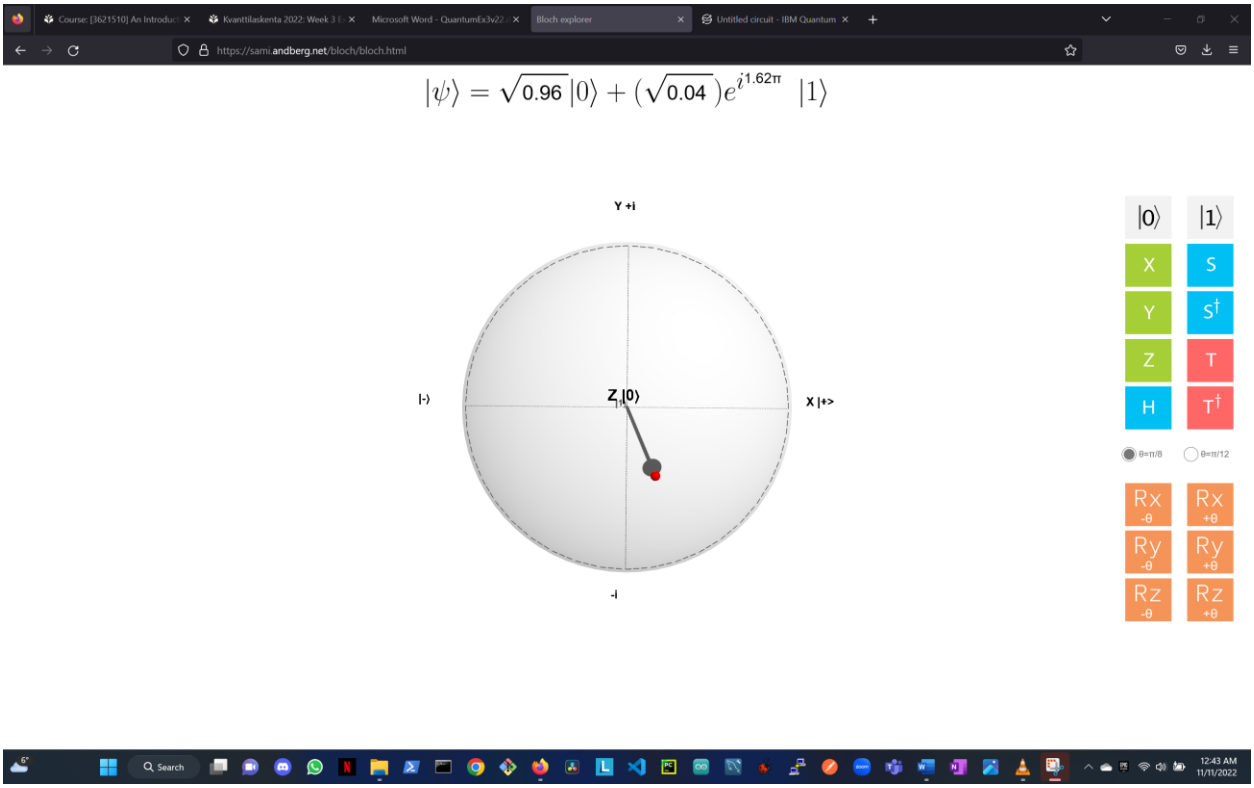

https://sami.andberg.net/bloch/bloch.html
$|\psi\rangle = \sqrt{0.50}\,|0\rangle + (\sqrt{0.50})e^{i\pi}\ \ |1\rangle$
Y +i
-i
|-⟩
X |+⟩
Z |0⟩
|0⟩
|1⟩
X
S
Y
S†
Z
T
H
T†
θ=π/8
θ=π/12
Rx -θ
Rx +θ
Ry -θ
Ry +θ
Rz -θ
Rz +θ
Search
12:22 AM
11/11/2022

6


https://sami.andberg.net/bloch/bloch.html
$|\psi\rangle = \sqrt{0.50}\,|0\rangle + (\sqrt{0.50})e^{i3\pi/2}\ \ |1\rangle$
Y +i
-i
|-⟩
X |+⟩
Z |0⟩
|0⟩
|1⟩
X
S
Y
S†
Z
T
H
T†
θ=π/8
θ=π/12
Rx -θ
Rx +θ
Ry -θ
Ry +θ
Rz -θ
Rz +θ
Search
12:26 AM
11/11/2022

With two T gates

7



This was achieved by pytting Rx(Theta+) gate with Rz(Theta+) gate.

No it was not possible to achieve this state using gates from Clifford group

Exercise 2 – Phase kickback

This is a very simple video I found while searching for Phase kickback explanations. https://www.youtube.com/watch?v=h9LSfUpzGmA . The mathematical explanation starts from 0:46.