

# Exercise Set 4

Sep 13th 2022

Quantum Computer Programming - 2022-II

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Exercises from [Asfaw19] 1.4 Single Qubit Gates:

1.

- (a) Write the  $H$ -gate as the outer products of vectors  $|0\rangle, |1\rangle, |+\rangle$  and  $|-\rangle$
- (b) Show that applying the sequence of gates:  $HZH$ , to any qubit state is equivalent to applying an  $X$ -gate.
- (c) Find a combination of  $X, Z$  and  $H$ -gates that is equivalent to a  $Y$ -gate (ignoring global phase).

2.

- (a) If we initialize our qubit in the state  $|+\rangle$ , what is the probability of measuring it in state  $|-\rangle$  ?
- (b) Use Qiskit to display the probability of measuring a  $|0\rangle$  qubit in the states  $|+\rangle$  and  $|-\rangle$  (Hint: you might want to use `.get_counts()` and `plot_histogram()`).
- (c) Try to create a function that measures in the  $Y$ -basis.

## References

[Asfaw19] Abraham Asfaw et al., Learn Quantum Computation Using Qiskit. Qiskit Development Team. 2019