

Quiz- QPE, Order finding, Shor Results for Prateek Jain

❗ Correct answers are hidden.

Score for this attempt: **16** out of 20

Submitted May 24 at 4:08pm

This attempt took 9 minutes.

Question 1

2 / 2 pts

Select the true statements.



If ϕ is of the form $x/2^t$, then it can be calculated exactly by using t qubits in the first register.



All eigenvalues of a unitary operator have norm 1.



QPE algorithm only works for single-qubit operators U .



The aim of QPE algorithm is to estimate the eigenvector of an operator.

Question 2

2 / 2 pts

If $\phi = 3/16$ and the first register contains 3 qubits, which states do you expect to observe more frequently?



$|011\rangle$ and $|100\rangle$



$|011\rangle$ and $|111\rangle$



$|011\rangle$



$|001\rangle$ and $|010\rangle$

Question 3

2 / 2 pts

How do you initialize the second register in QPE?

- ☐ We leave qubits in the second register in 0 state.
- ☐ We apply H to each qubit in the second register.
- ☒ It is initialized as the eigenvector of the operator U.
- ☐ We apply X and H to each qubit in the second register.

Question 4

2 / 2 pts

Select the eigenvectors and the corresponding eigenvalues of the Z operator.

- ☒ $|1\rangle$ with eigenvalue -1
- ☐ $|-\rangle$ with eigenvalue 1
- ☐ $|+\rangle$ with eigenvalue -1
- ☒ $|0\rangle$ with eigenvalue 1
- ☐ $|0\rangle$ with eigenvalue -1

Question 5

2 / 2 pts

Let $x=4$ and $N=81$. What is r ? (You can compute in Python)

27

Question 6**2 / 2 pts**

Select the true statements.



If U_x is the operator which maps $U_x|y\rangle \rightarrow |xy \bmod N\rangle$ where $x < N$ are relatively prime, its eigenvalues are of the form $e^{\frac{2\pi is}{r}}$.



The second register is initialized as $|1\rangle$ in the order finding algorithm.



We need continued fractions algorithm to extract r out of the estimate for s/r .



Order finding has no use in practice since we don't know how to prepare the eigenvector.



Modular exponentiation can be implemented efficiently in a quantum circuit.



When s and r are not relatively prime, the algorithm needs to be repeated.



At the end of the order finding algorithm, we measure r in the first register.

Question 7**2 / 2 pts**

Given the continued fraction expression

[1,4,2,1] write one of the convergents. (Do not leave any space e.g. write 3/2 instead of 3)

5/4

Question 8**2 / 2 pts**

Select the true statements.

☐

It is proven that no classical algorithm solves the factorization problem in polynomial time.

☒The main advantage of Shor's algorithm is the ability to compute r efficiently.☒If r is not even, then one should pick a new x and repeat the algorithm.☐

Shor's algorithm provides quadratic speedup compared to the best known classical algorithm.

Incorrect**Question 9****0 / 2 pts**

If the quantum state before applying the inverse QFT is the the following state,

$$\frac{1}{\sqrt{2^9}} (|0\rangle|1\rangle + |1\rangle|3\rangle + |2\rangle|9\rangle + |3\rangle|7\rangle + |4\rangle|1\rangle + |5\rangle|3\rangle + |6\rangle|9\rangle + \dots + |2$$

what is r ?

Incorrect

Question 10

0 / 2 pts

If at the end of the Shor's algorithm, the probability of observing state $|k\rangle$ is given by $\left| \frac{1}{\sqrt{85 \cdot 512}} \sum_{x=0}^{84} e^{-\frac{2\pi i(6x+2)k}{512}} \right|^2$, write down a state (except 0 and 256) which is likely to be observed with high probability. (Write it as a decimal number, e.g. 34)

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