Quiz- QPE, Order finding, Shor Results for SevdanurGenc

Correct answers are hidden.

Score for this attempt: **14.5** out of 20

Submitted Jun 15 at 8:35pm

This attempt took 20 minutes.

Question 1

2 / 2 pts

[D03-02] Let U be the quantum operator such that $U|\psi\rangle = e^{2\pi i\phi}|\psi\rangle$. Let $k > 0$ be an integer. We apply CU^k operator to the state. What is the resulting state.

- ○ $\frac{1}{\sqrt{2}}(e^{2\pi i\phi}|0\rangle|\psi\rangle + e^{2\pi i\phi}|1\rangle|\psi\rangle)$
- ○ $\frac{1}{\sqrt{2}}(|0\rangle|\psi\rangle - e^{2\pi ik\phi}|1\rangle|\psi\rangle)$
- ○ $\frac{1}{\sqrt{2}}(e^{2\pi ik\phi}|0\rangle|\psi\rangle + |1\rangle|\psi\rangle)$
- ◉ $\frac{1}{\sqrt{2}}(|0\rangle|\psi\rangle + e^{2\pi ik\phi}|1\rangle|\psi\rangle)$

Question 2

2 / 2 pts

[D03-03] Select the steps of the QPE algorithm.

- [x] Apply inverse QFT to the first register.
- [ ] Initialize first register as the eigenvector of the operator U.
- [ ] Apply X gates to the all qubits in the first register.
- [x] Apply Hadamard gate to the first register.
- [x] Apply CU^k operator where the target is the second register.

Question 3

2 / 2 pts

[D03-07] Write the code to define i'th power of the operator CU and store inside the variable CUi.

```
phase = 2/7

CU = CZPowGate(exponent=phase*2)

CUi = ...
```

CU**i

Incorrect

Question 4

0 / 2 pts

[D03-06] If $\phi = 3/16$ and the first register contains 3 qubits, which states do you expect to observe more frequently?

- $|011\rangle$ and $|100\rangle$
- $|001\rangle$ and $|010\rangle$
- $|011\rangle$
- (selected) $|011\rangle$ and $|111\rangle$

Question 5

2 / 2 pts

[D04-01] Let x=4 and N=81. What is r ? (You can compute in Python)

27

Partial

Question 6

0.5 / 2 pts

[D04-02] Select the true statements.

- [ ] When s and r are not relatively prime, the algorithm needs to be repated.
- [x] We need continued fractions algorithm to extract r out of the estimate for s/r.
- [ ] If U_x is the operator which maps $U_x|y\rangle \rightarrow |xy \mod N\rangle$ where $x < N$ are relatively prime, its eigenvalues are of the form $e^{\frac{2\pi is}{r}}$.
- [x] The second register is initialized as |1⟩ in the order finding algorithm.
- [ ] At the end of the order finding algorithm, we measure r in the first register.
- [x] Modular exponentiation is the name of the procedure in which the powers of the operator CU are computed.
- [ ] Order finding has no use in practice since we don't know how to prepare the eigenvector.

Question 7

2 / 2 pts

[D04-03] 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 / 2)

16/13

Question 8

2 / 2 pts

[D05-01] Select the true statements.

- [ ] Shor's algorithm provides quadratic speedup compared to the best known classical algorithm.
- [x] If r is not even, then one should pick a new x and repeat the algorithm.
- [ ] It is proven that no classical algorithm solves the factoriazation problem in polynomial time.
- [x] The main advantage of Shor's algorithm is the ability to compute r efficiently.

Question 9

2 / 2 pts

[D05-02] If the quantum state before applying the inverse QFT is the the following state,

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

what is r ?

4

Incorrect

Question 10

0 / 2 pts

[D06-01] 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)

1/2

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