Welcome to Homework 20!

Please answer the following questions based on content from Lecture and Lab this week. For students looking for additional challenge problems, we encourage you to try out the optional content in this week's jupyter notebook.

1. **What does Big-O notation represent?**
   A measure for the complexity of an algorithm at large values of N
   The runtime for an algorithm
   The difference in runtime of an algorithm between small and large values of N

2. **Which of the following Big-O notations represents the algorithm with the lowest complexity?**
   O(n)
   O(100)
   $O(n^2 + 100)$
   O(2n)

3. **Which of the following Big-O notations represents the algorithm with the highest complexity?**
   O(n)
   O(100)
   $O(n^2 + 100)$
   O(2n)

4. **Below are the complexities of a classical algorithm and a quantum algorithm for the same task. In which of the cases would the quantum algorithm be faster than the classical one? Note that this is referred to as "quantum advantage."**
   Classical Algorithm Complexity: O(2n), Quantum Algorithm Complexity: O(4n)
   Classical Algorithm Complexity: $O(n^2 + 100)$, Quantum Algorithm Complexity: $O(n^2)$
   Classical Algorithm Complexity: $O(n^2)$, Quantum Algorithm Complexity: O(2n + 1000)

5. **Which of the following quantum algorithms does not use an oracle?**
   Deutsch-Josza Algorithm
   Shor's Algorithm
   Grover Search Algorithm

6. **Which of these combinations of gates could be used to make a balanced, 2 qubit oracle?**
   X gate only
   H gate only
   X gate and CNOT gate
   Z gate only

7. **Which quantum algorithm provided the first theoretical demonstration of quantum advantage?**
   Deutsch-Josza Algorithm
   Shor's Algorithm
   Grover Search Algorithm