This quiz has 4 questions, for a total of 10 points.

1. **2 points** What is the output, if any, of the following Python program?

   ```python
   def f1(g, n):
       if n == 0:
           return True
       else:
           return g(f1, n - 1)
   def f2(h, n):
       if n == 0:
           return False
       else:
           return h(f2, n - 1)
   print(f2(f1, 1))
   
   Solution: The output is True.
   ```

2. **3 points** Given the following array, which positions of the array will be read from during a binary search for the number 3? (The number 3 is in position 0.)

   ```python
   [3, 8, 9, 10, 35, 42, 43, 50,]
   ```

   **Solution:** Binary search will read from positions 8/2 = 4, 4/2 = 2, 2/2 = 1, and 0.

3. **3 points** Prove that \((2n + 2)^b \in O(n^b)\).

   **Solution:** We need to show that \(\forall n \geq n_0, \exists c. (2n + 2)^b \leq cn^b\) for some \(n_0\). Choose \(n_0 = 2\) (1 point). Let \(n\) be an arbitrary integer greater or equal to 2. Then we have

   \[
   2n + 2 \leq 3n \quad \text{so} \quad (2n + 2)^b \leq (3n)^b = 3^n n^b \quad \text{(1 point)}
   \]

   We choose \(c = 3^b\), (1 point) and therefore have \((2n + 2)^b \leq cn^b\).

4. **2 points** Suppose we create an algorithm that detects whether two equal-length words are anagrams by going through all of the letters in the first word and, for each letter, performing a linear search for that letter in the second word and checking it off. Which of the following expresses a tight bound on the time complexity of this algorithm, where \(n\) is the length of the two words?
a) $\Theta(n \log n)$

b) $O(n^2)$

c) $\Omega(n^2)$

d) $\Theta(n^2)$

**Solution:** d) $\Theta(n^2)$ is the correct answer. The answer a) is incorrect because it is too low. The answers b) and c) are incorrect because they do not express tight bounds.