1. Provide solutions (using big-Oh or big-Theta) for the following recurrence relations.
   (a) \( T(n) = 3 \, T\left(\frac{n}{2}\right) + n \log n \)
   (b) \( T(n) = 4 \, T\left(\frac{n}{2}\right) + n^2 \)
   (c) \( T(n) = 3 \, T\left(\frac{n}{2}\right) + n^2 \)
   [9 points]

2. Into an initially empty AVL tree, insert the following values:
   10, 30, 40, 25, 15, 2, 42, 43, 44
   [10 points]

3. Insert the values above into an initially empty 2-3-4 tree. Then insert 45, 46, 47. [11 points]

4. What is the run-time of the following pieces of code?
   (a) for i = 1 to n {
               j = 1
               while (j<=i) {
                     sum++
                     j=2*j
               }
         }
   (b) for i = 1 to n*n
       for j = 1 to n*n
            sum++
   [8 points]

5. Write a recursive routine which “flips” a binary tree - it should swap the left and right children of each node. The fields of each node are called key, lchild, rchild, and p (for parent). [12 points]

Total: 50 points