Chapter 13 - Algorithm Design and Recursion

From Section 13.6 in Python Programming: An Introduction to Computer Science:

1. True/False: 1-4, 9, 10
   - Problem 1: Linear search requires a number of steps proportional to the size of the list being searched.
   - solution
     True
   - Although this is true, its not just true for lists, its true for any collection with a linear time.

   - Problem 2: The Python operator in performs a binary search.
   - solution
     False
   - Binary searches only work on sorted lists, and it is not guaranteed that each list the in operator is used on will be sorted.

   - Problem 3: Binary search is an n log n algorithm.
   - solution
     False
   - The binary search is a log2n algorithm. Its noted at the bottom of page 430 in your textbooks.

   - Problem 4: Every Python function returns some value
   - solution
     True
   - Even when you are not using the return keyword to return values, by default that function will return a value of None.

   - Problem 9: Merge sort is an example of an n log n algorithm
   - solution
     True
   - Its discussed on the final sentence of the first full paragraph on page 449.

   - Problem 10: Exponential algorithms are generally considered intractable.
   - solution
     True
   - Exponential problems are impossible to solve computationally without the necessary computing power OR a better algorithm, but thats a discussion for another day.

2. Multiple Choice: 1, 2, 7-9
   - Problem 1: Which algorithm requires time directly proportional to the size of the input?
   - solution
     a) linear search
     This answer can be found on page 430 of the textbook in the second full paragraph.

   - Problem 2: Approximately how many iterations will binary search need to find a value in a list of 512 items?
   - solution
     c) 9
     Assuming the list is sorted, binary search only needs log2512 iterations to find its number, and log2512 = 9.
Problem 7: The process of combining two sorted sequences is called solution d) merging
You can remember the name merging because that’s how merge-Sort works: it merges two sorted arrays together.

Problem 8: Recursion is related to the mathematical technique known as solution c) induction
Found on page 447 of your textbook, in the paragraph before the beginning of section 13.3.3.

Problem 9: How many steps would be needed to solve the Towers of Hanoi for a tower of size 5? solution d) 31
The answer can be determined from the table on page 455 in your textbook.

3. Discussion: 1, 5

4. Programming Exercises: 1, 3, 4, 5, 6, 10
   Problem 1: Place these algorithm classes in order from fastest to slowest: n log n, n, n², log n, 2^n Response
   log n
   n
   n log n
   n²
   2^n

   Problem 5: Why are divide-and-conquer algorithms often very efficient? Response
   Divide-and-conquer algorithms split a problem up into two smaller problems, which may be far more easier to solve on their own. Imagine sorting a list of 50 items. If sorting 50 items in a list took 1 hour, but sorting 2 lists of 25 items apiece took 5 minutes, then merging them back together took another 5 minutes, imagine the time I could save!