CSCI3104: Algorithms, Fall 2017

Midterm Exam Review

1. What is the asymptotic solution to the recurrence relation $T(n) = T(n/2) + cn^2$

2. For the recurrence $T(n) = 3T(n/2) + cn$, what is the cost of the i^{th} level, below the root, in the recurrence tree?

3. For the following sorting algorithm, what is the best-case asymptotic run time on array A containing n elements? How many swaps are required to sort the array, A = [9, 7, 5, 11, 12, 2, 14, 3, 10, 6]?

```
i = 1
while i < length(A)
    j = i
    while j > 0 and A[ j - 1 ] > A[ j ]
        swap A[ j ] and A[ j - 1 ]
        j = j - 1
    end while
    i = i + 1
end while
```

4. Using the input array A = [9, 7, 5, 11, 12, 2, 14, 3, 10, 6] and the MergeSort algorithm, how many times is MergeSort called recursively before the first call to merge. Use the MergeSort algorithm from the lecture notes. In the exam, we would provide the MergeSort algorithm for this question.

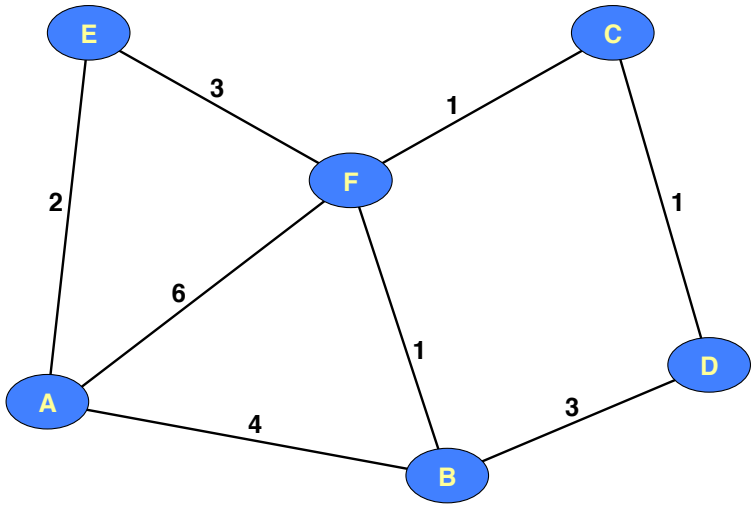
5. Using the input array A = [9, 7, 5, 11, 12, 2, 14, 3, 10, 6] and the QuickSort algorithm, what are the two subarrays generated after the first partition? Use the last element in the array as the partition value.

6. Using the array in the previous question and the QuickSort algorithm, list all values used as the pivot value to sort the array.

7. For the bottom-up-cut-rod algorithm in section 15.1 of your textbook, identify a loop invariant for the algorithm, and then use the loop invariant to show the correctness of the algorithm.

8. What is the asymptotic runtime behavior of the bottom-up-cut-rod algorithm?

9. For the graph below, which are the 3rd and 4th edges added to the minimum spanning tree if Kruskal's algorithm is used? if Prim's algorithm is used and starts with node A?



10. From the textbook: Problems 2-1, 2-2, 3-4, 4-3, 11-4a; Exercises 7.2-2, 7.2-3, 7.4-1, 11.2-1, 11.2-2, 11.2-5, 11.3-4, 16.3-4, 16.3-5, 16.3-7, 23.1-1, 23.1-3