

**CS3364 – Design and Analysis of Algorithms**  
**Review sheet for test 1**

1. Given the flowing piece of code, in the worst case it is big- $\Theta$  of what (where the input is of size  $n$ )?

```
Foo(A)
1  k = 0
2  for i = 1 to A.length
3    A[i] = A[i] + 1
4    for j = 1 to A.length - i
5      A[j] = A[j] * A[i]
6      if A[j] > 20
7        k = k + 1
8      A[i] = k
9  for i = 1 to  $\lfloor A.length / 2 \rfloor$ 
10   exchange A[i] with A[A.length + 1 - i]
```

2. Know and understand the ordering on different rates of growth on different standard functions (i.e.  $\lg n$  grows slower than  $n$ ,  $n^5$  grows slower than  $2^n$ , etc.)

3. Under what situation might bubble sort run faster than quicksort on a given data set?

4. Given the following data stored in an array in the order given, what would the contents of the array look like after the first application of the partition routine from quicksort used in the book?

17, 42, 12, 8, 34, 16, 9, 4, 22, 43, 13, 19

5. Given the initial data in the order below, show the data after each of the 3 iteration of the radix sort routine:

234, 526, 278, 129, 312, 221, 193, 426

6. The Master Method has the following 3 cases:

1. if  $f(n) = O(n^{(\log_b a) - \epsilon})$  for some constant  $\epsilon > 0$ , then  $T(n) = \Theta(n^{\log_b a})$
2. if  $f(n) = \Theta(n^{\log_b a})$ , then  $T(n) = \Theta(n^{\log_b a} \lg n)$
3. if  $f(n) = \Omega(n^{(\log_b a) + \epsilon})$  for some constant  $\epsilon > 0$  and if  $af(n/b) \leq cf(n)$  for some constant  $c > 1$  and all sufficiently large  $n$ , then  $T(n) = \Theta(f(n))$ .

What is the asymptotic bounds of  $T(n) = 8T(n/2) + n$ ?

7. Describe how the max-heapify routine from heapsort works (make sure to state what assumptions are made on the input).

8. Describe counting sort. When is counting applicable?

9. Other than searching, sorting, and the max sub-array problem given in class, given another problem for which a divide and conquer algorithm would be applicable.
10. Write the code for a sort routine that is  $O(n^2)$ . You may use pseudocode so long as the control flow is understandable.
11. What properties should a good hash function have?