CSI2114 - Spring 2006 - Assignment 1

Due: May 25, 2006 by 5 pm

Exercise 1. [10 points] Using the definition of $big - Oh$, **prove** that:

- $f(n) = 2^{n+1}$ is $O(2^n)$
- $f(n) = 10\ n^3 \log n + 15\ n^2$ is $O(n^4)$.

Exercise 2. [10 points] Order the following functions by asymptotic growth rate.

$4n \log n + 2n$	2^{10}	$2^{\log n}$
$3n + 100 \log n$	$4n$	2^n
$n^2 + 10n$	n^3	$n \log n$

Exercise 3. [10 points] Al and Bill are arguing about the performance of their sorting algorithms. Al claims that his $O(n \log n)$-time algorithm is always faster than Bills $O(n^2)$-time algorithm. To settle this issue, they implement and run the two algorithms on many randomly generated data sets. To Al's dismay, they find that if $n < 100$, the $O(n^2)$-time algorithm actually runs faster, and only when $n \geq 100$ is the $O(n \log n)$-time one better. Explain why this scenario is possible. You may give numerical examples.

Exercise 4. [10 points] Provide a recursive pseudo-code routine that reverses the elements in a queue Q, using only the operations *isEmpty*, *size*, *enqueue*, and *dequeue*.

Exercise 5. [10 points] Provide a non-recursive pseudo-code routine that reverses the elements in a queue Q, using only the operations *isEmpty*, *size*, *enqueue*, and *dequeue*. You are allowed to use a second auxiliary queue R but no other auxiliary data structure.

Exercise 6. [10 points] Describe the output for the following sequence of deque operations: *insertFirst(3)*, *insertLast(8)*, *insertLast(9)*, *insertFirst(5)*, *removeFirst()*, *removeLast()*, *first()*, *insertLast(7)*, *removeFirst()*, *last()*, *removeLast()*.