CSC 225 SUMMER 2016
ALGORITHMS AND DATA STRUCTURES I
ASSIGNMENT 2
UNIVERSITY OF VICTORIA

1. Describe how to implement the stack ADT using two queues. What is the running time of the push() and pop() methods in this case?

2. Show the various steps of Selection Sort, Bubble Sort and Insertion Sort on the example array, $A = \{5, 7, 0, 3, 4, 2, 6, 1\}$.

3. An Array A contains $n - 1$ unique integers in the range $[0, n - 1]$. That is, there is one number in this range that is not in A. Describe in pseudo-code an $O(n)$-time algorithm for finding that number. You are only allowed to use $O(log\ n)$ bits of additional space besides the array A itself.

4. Consider an implementation of a stack using an extendible array. That is, instead of giving up with a "StackFullException" when the stack becomes full, we replace the current array S of size N with a larger one of size $f(N)$ and continue processing the push operations. Suppose that we are given two possible choices to increase the size of the array: (1) $f(N) = N + c$ (for convenience, we start with an initial array of size 0) (2) $f(N) = 2N$ (we start with an initial array of size 1). Compare the two strategies and decide which one is better.

   To analyze the two choices, assume the following cost model: A "regular" push operation costs one unit of time. A "special" push operation, when the current stack is full, costs $f(N) + N + 1$ units of time. That is, we assume a cost of $f(N)$ units to create the new array, N units of time to copy the N elements and one unit of time to copy the new element.

5. Characterize each of the following recurrence equations using the master method (assuming that $T(n) = c$ for $n < d$, for constants $c > 0$ and $d \geq 1$).
   a. $T(n) = 2T(n/2) + \log n$
   b. $T(n) = 8T(n/2) + n^2$
   c. $T(n) = 16T(n/2) + (n \log n)^4$
   d. $T(n) = 7T(n/3) + n$
   e. $T(n) = 9T(n/3) + n^3 \log n$