**Assignment Title:**

Course: CIS 1210 - Assignment: Exam 1

**Q1 Local Maximum**

You are given an integer array $A[1..n]$ with the following properties: \\
- Integers in adjacent positions are different \\
- $A[1] < A[2]$ \\
- $A[n - 1] > A[n]$ \\
\noindent A position $i$ is referred to as a local maximum if $A[i - 1]
< A[i]$ and $A[i] > A[i + 1]$. You may assume $n > 2$.\\
\noindent \textbf{Example:} You have an array $[0, 1, 5, 3, 6, 3, 2]$. There are multiple local
maxes at 5 and 6.\\
\noindent Design an $O(\lg n)$ algorithm to find a local maximum and return its index.

**Q2 Largest Continuous Sum**

You are given an integer array, with both positive and negative elements. Design an $O(n \lg n)$ algorithm to return the sum of the continuous subarray with the maximum sum.

**Q3 Recurrence Relation**

Find the $\Theta$ bound for $T(n)$. Assume $n$ is a power of 2.
\[
T(n) =
\begin{cases}
2T(\frac{n}{2}) + n^2 & n > 1 \\
1 & \text{otherwise}
\end{cases}
\]

**Q4 Code Snippet**

Provide a running time analysis of the following loop. That is, find both Big-$O$ and Big-$\Omega$:
\begin{verbatim}
for(int i = 0; i < n; i++)
for (int j = i; j <= n; j++)
for (int k = i; k <= j; k++)
sum++;
\end{verbatim}