COL 757 Model Centric Algorithm Design
Problem Sheet 1

1. (i) Given n elements and $n^{3/2}$ CRCW processors, show how to compute the minimum in $O(1)$ time.
   (ii) Extend the previous idea to computing minimum of n elements in $O(1)$ time using $n^{1+\varepsilon}$ CRCW processors for any $0 < \varepsilon < 1$.

2. Show how to compute the minimum of n elements with n CRCW processors in $O(1)$ expected time using a randomized algorithm.

3. Given an array of n elements $a_1, a_2 \ldots a_n$, the *nearest smaller value* of any element a_i is defined as $\arg\min_{j>i}\{a_j < a_i\}$. The all nearest value problem (ANSV) is to compute for each element a_j, its *nearest smaller value*.

   (i) Design a linear time sequential algorithm for ANSV.
   (ii) Design a polylog time $O(n)$ processors CRCW PRAM algorithm for ANSV problem.

4. (i) Show how to obtain a better processor-time bound for the two versions of the prefix computation. Recall that the first algorithm uses $n \log n$ processors and the second one uses n processors to obtain the same parallel time bound of $O(\log n)$.

   (ii) Generalize the technique of clubbing k (a parameter between 1 and n) contiguous values, compute the prefix recursively and then generate the missing values as a function of k and n.

   Verify if these algorithms can be done using EREW model.

5. Show how to sort n integers in the range $[1..\sqrt{n}]$ using $\sqrt{n}$ processors in $O(\sqrt{n})$ parallel steps. Specify which PRAM model is used.