**Problem Set 1**

Due Time**:**

* Friday, March 2 ( **12thEsfand** ) , **23:59 PM**

Notes:

* Solution should be submitted in : ***http://Courses.iust.ac.ir/***(Where you may get this problem set )
* If you can’t solve a problem, **Don’t copy** It’s answer.
* Format of file name : **ProblemSet1\_[Student ID].zip/rar**
* All problems will be solved in our next class, on **Saturday, 12-13:15 . Don’t miss it.**

**Additional Resources:**

* **CLRS** 3rd – Chapter 2,3,4
* **Foundations of Algorithms** 3rdEdition – Chapter 1

**Exercises:**

1. Observe that the INSERTION-SORT procedure, uses a linear search to scan (backward) through the sorted subarray A[1 .. j -1] to find proper place of A[j]. Can we use a binary search instead to improve the overall worst-case running time of insertion sort to θ(n lg n) ?Why ?**(2.3-6)**
2. Is 2n+1 = O( 2n ) ?Is22n = O( 2n ) ?(Prove)**(3.1-4)**
3. Prove that the running time of an algorithm is θ(g(n)) if and only if its worst-case running time is O(g(n)) and its best-case running time is Ω(g(n)) .**(3.1-6)**
4. Is the function ⎾lg n⏋! polynomially bounded? Is the function ⎾lg lg n⏋! polynomiallybounded?(Prove)**(3.2-4 \*\*)**

(We say that a function f(n) is ***Polynomially*** bounded if *f (n) = O( nk )* for some constant k )

1. Which is asymptotically larger: lg( lg∗ n) or lg∗( lg n) ? (Show with an example)**(3.2-5)**
2. Let f(n) and g(n) be asymptotically positive functions. Prove or disprove each of the following conjectures :**(3-4)**
   1. f(n) + g(n) =θ (min(f(n), g(n))) .
   2. f(n) = O ((f(n))2) .
   3. f(n) =θ(f(n/2)) .
   4. f(n) +o(f(n)) = θ(f(n)) .
3. Use the master method, to show that the solution to the recurrence T(n) = 4T(n/3) + n is T(n) = θ(n log34). Then show that a substitution proof with the assumption T(n) c n log34fails and show how to subtract off a lower-order term to make a substitution proof work. **(4.3-7 \*)**
4. Use the master method, to show that the solution to the recurrence T(n) = 4T(n/2) + n2 is T(n) = θ(n2). Then show that a substitution proof with the assumption T(n) c n2 fails and show how to subtract off a lower-order term to make a substitution proof work. **(4.3-8 \*)**

**Emad Aghajani**