

CS 570
Analysis of Algorithms
Summer 2007
Final Exam Solutions

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Question 1

- [FALSE] If A is linear time reducible to B ($A \leq B$), and B is NP-complete, then A must be NP-complete.
- [FALSE] If B is linear time reducible to A ($B \leq A$), and B is NP-complete, then A must be NP-complete.
- [TRUE] If any integer programming optimization problem can be converted in polynomial time to an equivalent linear programming problem, then $P = NP$.
- [FALSE] It has been determined that NP Complete problems cannot be solved in polynomial time.
- [FALSE] If $P = NP$, then there are still some NP complete problems that cannot be solved in polynomial time.
- [TRUE] When we say that a problem X is NP Complete, then it means that every NP complete problem can be reduced to X .

Question 2

Suppose that there is an ordered list of n words. The length of the i -th word is w_i , that is the i -th word takes up w_i spaces. The objective is to break this ordered list of words into lines, this is called a layout. The length of a line is the sum of the lengths of the words on that line. The ideal line length is L . No line may be longer than L , although it may be shorter. The penalty for having a line of length K is $L - K$. The total penalty is the maximum of the line penalties. The problem is to find a layout that minimizes the total penalty. Prove or disprove that the following greedy algorithm correctly solves this problem.

```
For i = 1 to n
  If the i-th word fits on the current line
    Place the i-th word on the current line
  else
    place the i-th word on a new line
```