# CS 373: Combinatorial Algorithms, Summer IMCS 2000

http://www-courses.cs.uiuc.edu/~cs373

## Homework 5 (due Sat Jul 29, 2000)

By now you should know what is expected when presenting an algorithm. Make sure you give complete answers.

To submit solutions, *attach* a *postscript* file to an email sent to maharri@cs.uiuc.edu with the subject *cs373hw submit*. You will then get an automatic acknowledgement.

1. (10 pts) In KMP string matching, for each of the following patterns, give the failure function for it, generalize the pattern and give (and justify) a formula for the failure function for the general pattern:
   (a) 'aaaaaaaa'
   (b) 'abcdefgh'
   (c) 'abababab'
   (d) 'abcddcba'
   (e) 'aaabaaaa'

2. (5 pts) String matching with a variable
   Often when doing string matching, you want to match a pattern that has recurring equivalent substrings, i.e., you want your pattern to match pieces that repeat in effect assigning the first match piece to a variable, and then match ing the contens of that variable where it occurs later in the pattern. For example, 'aaXaaXaa' would be found in 'aabababaabababaa' with X='bab', it would not be found in 'aabbbaabbaa', because the substring is not repeated where it should be. Give an efficient algorithm to solve this problem. Hint: use known string matching techniques and dynamic programming.

3. (5 pts) Decision tree for median
   Give an optimum decision tree that finds the median of 5 objects. You need only give those branches of the tree that are unique with respect to isomorphism.

4. (5 pts) Lower Bounds for Sink
   In an undirected graph, a sink is a node that has in degree $n-1$. Prove that, for deciding if a graph has a sink, the lower bound is $\Omega(n)$.