15-396A Science of the Web
Assignment 6
Due October 21, 2008 @ 11:59pm

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1. Rankmaniac (60 Points + 20 EC)

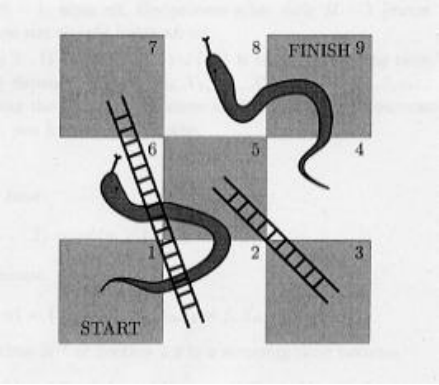
In this problem, you are asked to attempt to beat us (Luis and the invincible TAs) by creating a webpage which will, after a period of time (1 month), be ranked higher than the page we will create.

Your webpage should contain, among other content, the phrase "<Your name> is a rankmaniac". Your goal is to get google to rank that webpage as high as possible in the search results to the search query "rankmaniac".

In your writeup (worth 30 points), explain **what** techniques you tried in boosting the page rank of your page and **why** these techniques would work theoretically.

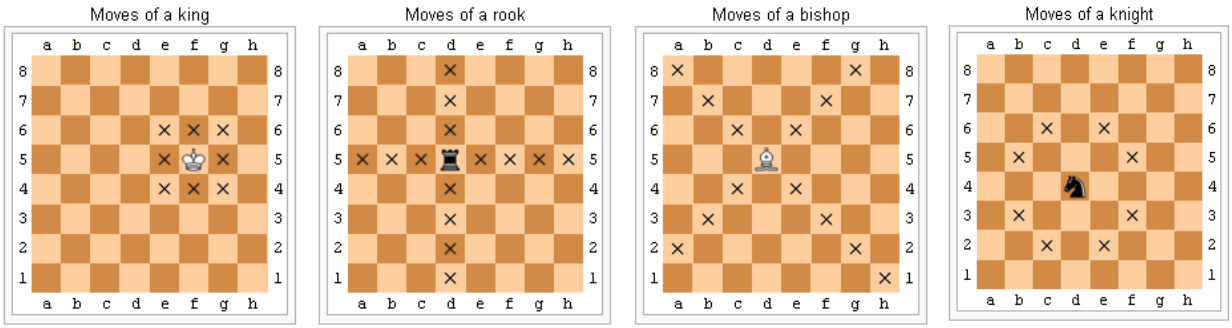
The rest of the points are based on the ranking of your page on google under the search query "rankmaniac". If you page shows up on google when we search for "rankmaniac", you will get 10 points automatically. If you beat the ranking of our page, you will get an additional 20 points. After that, extra credit score is based on 22-2***N*** for the 10 people who have their webpage ranked the highest, where ***N*** is their rank (e.g., 20 extra credit points for the top poster, 18 for the second place, etc.).

2. Markov Chains and Games (20 Points)



(a) The Snake and Ladder game in the figure above works as follows. Starting in the "START" square, you will roll a die and advance a certain number of steps *s* depending on the die roll. If the square you landed on (after advancing *s* steps) has the bottom of the ladder, you follow the ladder to a higher-numbered square. On the other hand, if the square has the head of the snake, you must follow the snake towards the tail to a lower-numbered square.

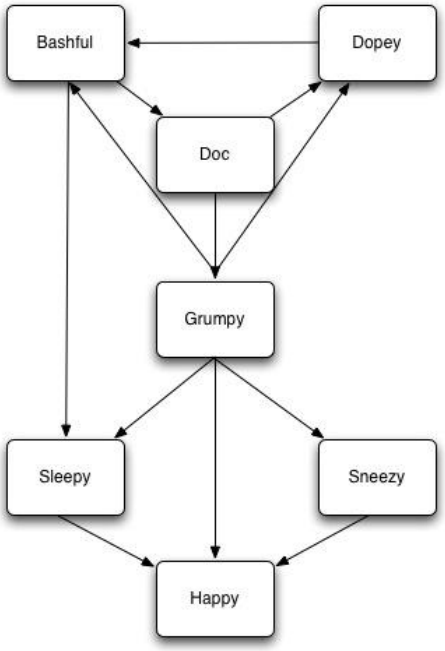
Model the game as a Markov chain. What are the states? What is the transition probability matrix? What is the probability of a player who has reached square 4 to complete the game without slipping back to square 1?



(b) The figure above shows the legal moves of a king, a rook, a bishop and a knight in chess. Consider a chessboard where the "king" is placed randomly on the chess board and repeatedly picks one of its legal moves uniformly at random. Is the corresponding Markov chain irreducible and aperiodic? Explain why. Repeat the same question in the case of the rook, the bishop and the knight.

3. PageRank (20 Points)

Consider the following network of webpages of the seven dwarves below:



(a) Find the matrix H for this network. Is H stochastic, irreducible and aperiodic? Please explain.

(b) Find the google matrix G, assuming that $\alpha=0.85$

(c) Write a small program to find the pageranks of these webpages using the power method. (This should only be a few lines of code!) Report on the ranking.