

# Math 443/543 PageRank problem sheet

November 7, 2014

1) Let  $A$  be a link matrix for a web with no dangling nodes. Show that if we are able to compute rankings using only the link matrix (that is, we take  $m = 0$ ), then adding a new page that links only into the previous web does not change the rankings, and the new page is ranked last.

2) Suppose  $x = (1, 0, 0, \dots, 0)^T$ . Let  $A$  be the link matrix for a web and  $M = (1 - m)A + mS$  the matrix used for PageRank. Describe an interpretation of  $A^n x$  and  $M^n x$  in terms of the interpretation of  $A$  and  $M$  as a matrix of probabilities (this is similar to the interpretation of powers of the adjacency matrix).

3) Using the probabilistic interpretation of  $M$ , discuss why you would want a small value of  $m$  instead of a large one. What happens if  $m = 1$ ?