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## PageRank

Consider the following 15 WLU-related websites

1	Wilfrid Laurier University	<a href="http://www.wlu.ca">www.wlu.ca</a>
2	Laurier WebAccess	<a href="http://webaccess.wlu.ca">webaccess.wlu.ca</a>
3	Laurier Library	<a href="http://library.wlu.ca">library.wlu.ca</a>
4	Wilfrid Laurier University Athletics	<a href="http://www.laurierathletics.com">www.laurierathletics.com</a>
5	Laurier Bookstore	<a href="http://www.wlubookstore.com">www.wlubookstore.com</a>
6	Wilfrid Laurier Student Union	<a href="http://www.wlusu.com">www.wlusu.com</a>
7	WLU Faculty Association	<a href="http://www.wlufa.ca">www.wlufa.ca</a>
8	WLU Student Publications	<a href="http://www.wlusp.com">www.wlusp.com</a>
9	Wilfrid Laurier University Press	<a href="http://www.wlupress.wlu.ca">www.wlupress.wlu.ca</a>
10	WLU Student Portal	<a href="http://www.mylaurier.ca">www.mylaurier.ca</a>
11	WLU Conference Services	<a href="http://www.laurierconferences.ca">www.laurierconferences.ca</a>
12	Laurier Alumni	<a href="http://www.laurieralumni.ca">www.laurieralumni.ca</a>
13	Investment Simulations and Competitions	<a href="http://invest.wlu.ca">invest.wlu.ca</a>
14	WLU Graduate Students Association	<a href="http://www.wlugsa.ca">www.wlugsa.ca</a>
15	WLU Career and Co-op	<a href="http://www.lauriercc.ca">www.lauriercc.ca</a>

with the following hyperlink information: (inlinks/outlinks) Site 1 links to sites 2, ..., 15. Site 2 links to sites 1, 3. Site 3 links to sites 1, 2, 5. Site 4 links to site 1. Site 5 links to sites 1, 3. Site 6 links to sites 1, 3, 4, 5, 8, 10, 14, 15. Site 7 links to sites 1, 2, 3, 4, 5, 9, 11. Site 8 links to sites 1, 6, 10, 14. Site 10 links to sites 1, 3, 4, 6, 8. Site 11 links to site 1. Site 12 links to sites 1, 4, 9, 13. Site 13 links to site 1. Site 14 links to sites 1, 3, 8, 9.

- **30 marks** Draw the graph that encodes the hyperlink information in terms of inlinks/outlinks. You can label the nodes by integers from 1 to 15, as per the numbering above. Identify the dangling nodes, if any.
- **30 marks** Compute the PageRank matrices  $H$ ,  $S$  and the Google matrix  $G$  (using  $\alpha = 0.85$ ) corresponding to the graph.
- **40 marks** Compute a reasonably accurate approximation of the PageRank vector  $\pi^T$ . How many iterations did you need to perform, to find a reasonably accurate PageRank vector? You may use a software such as Maple or Matlab to perform the associated computations. Rank the 15 websites, according to their PageRank scores.