

CSI 445/660 – Network Science – Fall 2015

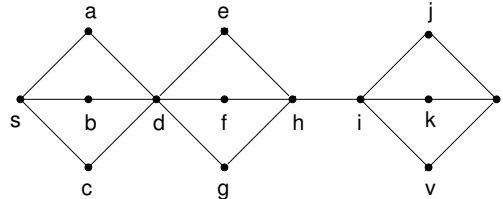
Homework IV

Date given: Nov. 3, 2015

Due date: Nov. 12, 2015

**Instructions:** All students must do Problems 1 and 2. Undergraduate and graduate students in Computer Science must also do Problem 3.

**Problem 1:** Consider the following graph.



The problem has three parts.

- (a) Compute the total number of shortest paths between nodes  $s$  and  $t$  using the top-down algorithm discussed in class.
- (b) Compute the total number of shortest paths between nodes  $s$  and  $t$  that don't contain node  $v$ , again using the top-down algorithm discussed in class.
- (c) Using the answers from (a) and (b), compute the total number of shortest paths between nodes  $s$  and  $t$  that contain node  $v$ .

**Problem 2:** The following table shows the values of functions  $f(x)$  and  $g(x)$  for various values of the independent variable  $x$ .

$x$	$f(x)$
5.00	252822.43
7.50	84599.77
11.25	28308.89
16.88	9472.76
25.31	3169.79
37.97	1060.68
56.95	354.93
85.43	118.77
128.14	39.74
192.22	13.30

$x$	$g(x)$
3.00	5824779.30
5.10	1185913.90
8.67	347172.77
14.74	114200.30
25.06	40746.59
42.60	17235.83
72.41	69248.85
123.10	384.66
209.27	10.41
355.76	0.13

By plotting these functions suitably, determine whether each of the above functions exhibits a power-law behavior. If yes, determine the power-law exponent.

**Problem 3:** Suppose  $G$  is a connected undirected graph. Let  $\rho$  and  $\Delta$  denote respectively the radius and diameter of  $G$ . Prove that  $\Delta \leq 2\rho$ .