These problems are about topics covered at the end of the quarter, too late for graded homework. This will not be collected or graded, and will not be on the final exam.

**Problem H-1001.** These problems refer to the graph shown to the right.

(a) Determine the number of closed walks of length 4, starting and ending at vertex 1. Note that a shortcut for computing $A^4$ is $(A^2)^2$.

(b) Determine the number of walks of length 4 from vertex 2 to vertex 4.

**Problem H-1002.** See the lecture slides on “Ranking and Unranking.” This problem concerns permutations listed in lexicographic order on their form in one-line notation.

(a) What is the rank of 3, 2, 1, 4?

(b) What permutation in this tree has rank 8?

(c) Determine the permutation of [7] with rank 500.

(d) For permutations of [n], what are the smallest and largest ranks, and what are the permutations achieving those ranks?