

CSE202 Project

February 17, 2006

Choose one of the following problems, and prepare a solution of no more than 10 pages. The report should be typed and is due in class on March 14th.

1 Shortest Path Mod w

Given n nodes, $v_1, \dots, v_n$, with k_i arcs between v_i and v_{i+1} . Each arc has weight $w_{i,j}$, $1 \leq i < n, 1 \leq j \leq k_i$, as in Figure 1.

Create an algorithm to find a minimum cost path from v_1 to v_n . The cost is defined as $\sum_{i=1}^{n-1} w_{i,e_i} \pmod{w}$, where e_i denotes the arc chosen between v_i and v_{i+1} . Discuss the complexity of your algorithm in terms of the number of state variables (the number possible values at a given node), the number of stage variables (the number of nodes), and the number of decision variables (the arcs). Consider the complexity both if $w \in O(n^c)$ for some fixed c , and if $w \in O(c^n)$.

Hint: Consider special cases first, such as $w = 10$ and $k_1 = k_2 = \dots = k_{n-1}$.

2 Bin Packing

Given a sequence $a_1, a_2, \dots, a_n$, describe an algorithm to pack the items in the sequence into bins. Each bin, B , has capacity 1 ($1 \geq \sum_{a_i \in B} a_i$). Each item in the sequence must be placed in a bin before the next item in the sequence will be available. Once an item has been placed in a bin, it cannot be moved. The goal is to minimize the total number of bins needed.

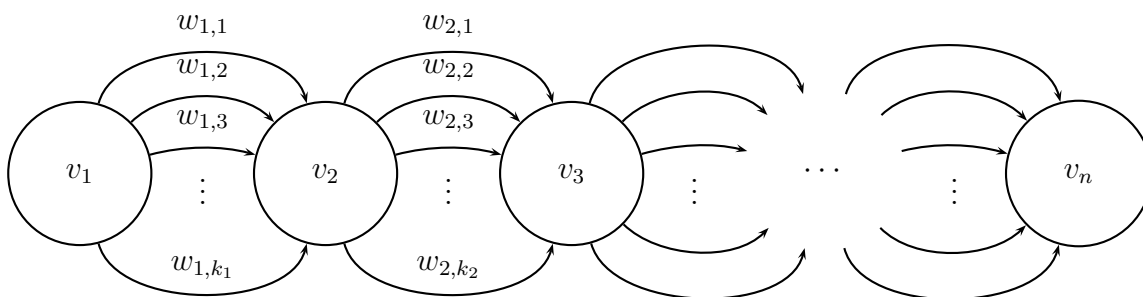


Figure 1: Shortest Path Mod w

Let L be the number of bins used by your algorithm. Let L_{opt} be the optimal number of bins if all items were initially available. Compute $R = \max \lim_{n \rightarrow \infty} \frac{L}{L_{opt}}$, the maximum ratio over all sequences as the length of the sequence goes to infinity.

Your algorithm should categorize each a_i into one of two categories and then place it in a bin accordingly. Describe your algorithm and justify the value of R for your algorithm.