Course
CS-E3190
Course materials
Your points

This course has already ended.
The latest instance of the course can be found at: Principles of Algorithmic Techniques: 2023 Autumn

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Vertex cover

Exercise: Vertex cover

This exercise asks you to implement an algorithm that computes a low-cost vertex cover. More precisely, the input consists of an n-vertex, m-edge undirected graph with a positive integer cost associated to each vertex. A set of vertices is called a *vertex cover* if each edge has at least one end-vertex in the set. The *cost* of a vertex cover is the sum of the costs of its vertices. The *optimum cost* OPT of a vertex cover is the minimum cost of a vertex cover, where the minimum is taken over all possible vertex covers. The algorithm must output a vertex cover S with cost at most $2 \cdot \mathrm{OPT}$. For example, an implementation of the primal-dual vertex cover algorithm suffices for this purpose.

Your task in this exercise is to complete the subroutine

> `void solver(int n, int m, const int *e, const int *c, int &k, int *s)`

which should compute the size `k` and the elements `s` of a vertex cover as described in the previous paragraph from the given input consisting of positive integers `n` and `m`, as well as the arrays `c` and `e`, whose format is as follows.

The array `e` concatenates the m edges in the input graph. That is, the m edges of the graph are $\{e[0], e[1]\}, \{e[2], e[3]\}, \ldots, \{e[2m-2], e[2m-1]\}$, with $\{e[2i], e[2i+1]\} \subseteq \{0, 1, \ldots, n-1\}$ and $e[2i] < e[2i+1]$ for all $i = 0, 1, \ldots, m-1$. The array `c` contains the cost $c[i] \geq 1$ of each vertex $i = 0, 1, \ldots, n-1$.

The output of the subroutine should be as follows. To give as output a vertex cover $S = \{j_0, j_1, \ldots, j_{k-1}\}$, set `k` equal to k and the element `s[i]` equal to j_i for all $i = 0, 1, \ldots, k-1$. You may assume that $2 \leq n \leq 524288$, $1 \leq m \leq 52428800$, $1 \leq k \leq n$, and that the array s has capacity for at least n elements. To locate the subroutine quickly, you can search for "`???`" in the source file.

Grading. This exercise awards you up to 10 points in the course grading. The number of points awarded is the maximum points times the number of tests passed over the total number of tests, rounded up. To successfully complete a test, your implementation must use no more than 7 seconds of wall clock time and 512 MiB of memory. Each test will in general require the successful solution of one or more problem instances. In each batch of scaling tests, the first failed test will cause all subsequent tests in the batch to be skipped.

Points **6 / 10** My submissions **2 / 10** Deadline Tuesday, 29 November 2022, 20:00
To be submitted alone

⚠ This course has been archived (Friday, 30 December 2022, 16:00).

Vertex cover

1. Download the template source file vertex-cover.cpp.
2. Study the problem description above.
3. Complete your solution in the template.
4. Test your solution with the unit tests available in the template.
   Recall that the Scratchpad is available for compiling and running your solution.
5. Submit your solution for grading using the dialog below.
   See here for a quick guide to the grader output.

vertex-cover.cpp

Choose File No file chosen

Submit

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