

Chapter 11

Problemas ACM 2

11.1 How Many Dependencies?

In this problem you will need to find out which task has the most number of dependencies. A task A depends on another task B if B is a direct or indirect dependency of A.

For example, if A depends on B and B depends on C, then A has two dependencies, one direct and one indirect.

You can assume there will be no cyclic dependencies in the input.

11.2 Wormholes

In the year 2163, wormholes were discovered. A wormhole is a subspace tunnel through space and time connecting two star systems. Wormholes have a few peculiar properties:

- Wormholes are one-way only.
- The time it takes to travel through a wormhole is negligible.
- A wormhole has two end points, each situated in a star system.
- A star system may have more than one wormhole end point within its boundaries.

- For some unknown reason, starting from our solar system, it is always possible to end up in any star system by following a sequence of wormholes (maybe Earth is the centre of the universe).
- Between any pair of star systems, there is at most one wormhole in either direction.
- There are no wormholes with both end points in the same star system.

All wormholes have a constant time difference between their end points. For example, a specific wormhole may cause the person travelling through it to end up 15 years in the future. Another wormhole may cause the person to end up 42 years in the past.

A brilliant physicist, living on earth, wants to use wormholes to study the Big Bang. Since warp drive has not been invented yet, it is not possible for her to travel from one star system to another one directly. This can be done using wormholes, of course.

The scientist wants to reach a cycle of wormholes somewhere in the universe that causes her to end up in the past. By travelling along this cycle a lot of times, the scientist is able to go back as far in time as necessary to reach the beginning of the universe and see the Big Bang with her own eyes. Write a program to find out whether such a cycle exists.

11.3 FLYING TO FREDERICTON

After being inspired by Salvador Dali's artwork, Brett decided he would like to travel to Fredericton, New Brunswick to visit the Beaverbrook Art Gallery.

Brett lives in Calgary, and would like to find the cheapest flight or flights that would take him to Fredericton. He knows that a direct flight from Calgary to Fredericton, if one exists, would be absurdly expensive, so he is willing to tolerate a certain number of stopovers. However, there are multiple airlines in Canada with so many different flights between different cities now, which makes it very difficult for Brett to find the least expensive way to Fredericton! Can you write a program to help Brett plan his route?

You will be given a list of cities between and including Calgary and Fredericton. The cities will be given in order of "nearest" to "farthest". The first city will always be "Calgary" and the last "Fredericton".

You will also be given a list of flights between pairs of cities, and the associated cost for each flight, taxes included. There will never be a flight from a farther city

to a nearer city - Brett has already discarded those flights, deeming them to be a waste of time and money. Bear in mind, however, that there may be more than one flight between any two cities, as Brett is considering flights from all airlines.

Finally, you are presented with a number of queries. Each query is a single integer indicating the maximum number of stopovers Brett will tolerate. For each query, your program must calculate the least total cost of flights that would take Brett from Calgary to Fredericton with no more than the requested number of stopovers.

11.4 Problem D: XYZZY

The prototypical computer adventure game, first designed by Will Crowther on the PDP-10 in the mid-1970s as an attempt at computer-refereed fantasy gaming, and expanded into a puzzle-oriented game by Don Woods at Stanford in 1976. (Woods had been one of the authors of INTERCAL.) Now better known as Adventure or Colossal Cave Adventure, but the TOPS-10 operating system permitted only six-letter filenames in uppercase. See also vadding, Zork, and Infocom.

11.4.1 the problem

It has recently been discovered how to run open-source software on the Y-Crate gaming device. A number of enterprising designers have developed Advent-style games for deployment on the Y-Crate. Your job is to test a number of these designs to see which are winnable.

Each game consists of a set of up to 100 rooms. One of the rooms is the start and one of the rooms is the finish. Each room has an energy value between -100 and +100. One-way doorways interconnect pairs of rooms.

The player begins in the start room with 100 energy points. She may pass through any doorway that connects the room she is in to another room, thus entering the other room. The energy value of this room is added to the player's energy. This process continues until she wins by entering the finish room or dies by running out of energy (or quits in frustration). During her adventure the player may enter the same room several times, receiving its energy each time.

The input consists of several test cases. Each test case begins with n , the number of rooms. The rooms are numbered from 1 (the start room) to n (the finish room). Input for the n rooms follows. The input for each room consists of one or more lines containing:

- the energy value for room i
- the number of doorways leaving room i
- a list of the rooms that are reachable by the doorways leaving room i

The start and finish rooms will always have energy level 0. A line containing -1 follows the last test case.

In one line for each case, output "winnable" if it is possible for the player to win, otherwise output "hopeless".

11.5 The Postal Worker Rings Once

Graph algorithms form a very important part of computer science and have a lineage that goes back at least to Euler and the famous Seven Bridges of Königsberg problem. Many optimization problems involve determining efficient methods for reasoning about graphs.

This problem involves determining a route for a postal worker so that all mail is delivered while the postal worker walks a minimal distance, so as to rest weary legs.

11.5.1 problem

Given a sequence of streets (connecting given intersections) you are to write a program that determines the minimal cost tour that traverses every street at least once. The tour must begin and end at the same intersection.

The “real-life” analogy concerns a postal worker who parks a truck at an intersection and then walks all streets on the postal delivery route (delivering mail) and returns to the truck to continue with the next route.

The cost of traversing a street is a function of the length of the street (there is a cost associated with delivering mail to houses and with walking even if no delivery occurs).

In this problem the number of streets that meet at a given intersection is called the degree of the intersection. There will be at most two intersections with odd degree. All other intersections will have even degree, i.e., an even number of streets meeting at that intersection.

11.6 Arbitrage

The use of computers in the finance industry has been marked with controversy lately as programmed trading – designed to take advantage of extremely small fluctuations in prices – has been outlawed at many Wall Street firms. The ethics of computer programming is a fledgling field with many thorny issues.

11.7 problem

Arbitrage is the trading of one currency for another with the hopes of taking advantage of small differences in conversion rates among several currencies in order to achieve a profit. For example, if \$1.00 in U.S. currency buys 0.7 British pounds currency, $\text{£}1$ in British currency buys 9.5 French francs, and 1 French franc buys 0.16 in U.S. dollars, then an arbitrage trader can start with \$1.00 and earn 1.64 dollars thus earning a profit of 6.4 percent.

You will write a program that determines whether a sequence of currency exchanges can yield a profit as described above.

To result in successful arbitrage, a sequence of exchanges must begin and end with the same currency, but any starting currency may be considered.