

CSE208: Data Structures and Algorithms II Sessional

Online week 5: Currency trading (A1/A2)

Time: 35 minutes

Shortest path algorithms can be applied in currency trading. Let c_1, c_2, \dots, c_n be various currencies; for instance, c_1 might be dollars, c_2 pounds, and c_3 lire. For any two currencies c_i and c_j , there is an exchange rate $r_{i,j}$; this means that you can purchase $r_{i,j}$ units of currency c_j in exchange for one unit of c_i . These exchange rates satisfy the condition that $r_{i,j} \cdot r_{j,i} < 1$, so that if you start with a unit of currency c_i , change it into currency c_j and then convert back to currency c_i , you end up with less than one unit of currency c_i (the difference is the cost of the transaction).

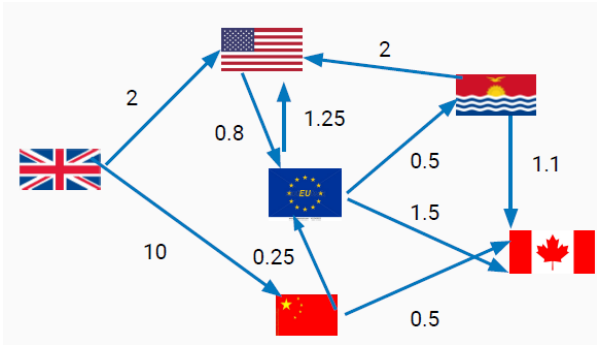
- (a) Give an efficient algorithm for the following problem: Given a set of exchange rates $r_{i,j}$, and two currencies s and t , find the most advantageous sequence of currency exchanges for converting currency s into currency t . Toward this goal, you should represent the currencies and rates by a graph whose edge lengths are real numbers.

The exchange rates are updated frequently, reflecting the demand and supply of the various currencies. Occasionally the exchange rates satisfy the following property: there is a sequence of currencies $c_{i_1}, c_{i_2}, \dots, c_{i_k}$ such that $r_{i_1, i_2} \cdot r_{i_2, i_3} \cdots r_{i_{k-1}, i_k} \cdot r_{i_k, i_1} > 1$. This means that by starting with a unit of currency c_{i_1} and then successively converting it to currencies $c_{i_2}, c_{i_3}, \dots, c_{i_k}$, and finally back to c_{i_1} , you would end up with more than one unit of currency c_{i_1} . Such anomalies last only a fraction of a minute on the currency exchange, but they provide an opportunity for risk-free profits.

- (b) Give an efficient algorithm for detecting the presence of such an anomaly. Use the graph representation you found above.

Input: The first line of the input file will contain the number of currencies n (≤ 1000) and the number of possible trades m (≤ 10000) followed by m lines each containing first currency u , second currency v and exchange rate r (≤ 100000) of an edge of the directed graph. The last line will contain a source currency s and a target currency d .

Sample input and output:

<pre> 6 10 0 1 2 0 2 10 1 3 0.8 2 3 0.25 2 5 0.5 3 1 1.25 3 4 0.5 3 5 1.5 4 1 2 4 5 1.1 0 5 </pre>	<p>There are no anomalies Best exchange rate: 5 0 -> 2 -> 5</p> 
<pre> 6 10 0 1 2 0 2 10 1 3 0.8 2 3 0.25 2 5 0.5 3 1 1.5 3 4 0.5 3 5 1.5 4 1 2 4 5 1.1 0 5 </pre>	<p>There is an anomaly</p>