COP-3530 Data Structures

Programming Assignment 5:
Graph Algorithms

Due Date: July 29 at 11:59 PM

This assignment asks you to use Bellman-Ford Algorithm to find the most profitable exchange sequence between currencies of different countries.

1 Input File

The input file "exchange rates.csv" which is available on Canvas contains a 54×54 table showing the exchange rates between different currencies; e.g. the number stored at the first row and fifth column shows that one "Kuwaiti Dinar" can be exchanged by 2.8081972 "Euros" and the number stored at the fifth row and first column shows that one Euro can be exchanged by 0.35493392 Kuwaiti Dinar. Obviously, the numbers at the main diagonal of this table are all ones (one USD = one USD or one Euro = one Euro).

2 Modeling the Problem to a Single-Source Shortest Path Problem

The problem of finding the most profitable exchange sequence from a source currency to all other currencies can be modeled to a shortest path problem with the following parameters:

- Graph vertices are the currencies (each currency is represented by a vertex of the graph). There are 54 vertices.
- Graph edges are the possible direct exchange operations between any two currencies. In this problem, our assumption is that any pair of currencies can be exchanged directly and therefore, the graph is complete and has 54×54 edges.
- Weight of the edge from currency X to currency Y is equal to $-\log(a)$ where a is the exchange rate for X and Y and it means that each X can be exchanged by a Ys.
- the vertex corresponding to the source currency is considered as the source vertex.
- the shortest path between any two vertices u and v represents the most profitable exchange sequence between the currencies representing u and v; e.g. if $u \to x \to w \to v$ is the shortest path from u to v, then the most profitable exchange sequence from

currency U to currency V will be to convert currency U to currency X, then covert X to W, and then convert W to V.

3 Solving the Problem using Bellman-Ford Algorithm

Bellman-Ford is a very simple algorithm to implement and it solves the shortest path problem given a source in a graph with both negative and positive weights. In this assignment, you need to write a Java program that gets a currency as the source currency from keyboard and finds the rates of most-profitable exchange sequence from the source currency to all other currencies and compare the rates with the direct exchange rates; e.g. if the source currency is "Japanese Yen", your program must print out the following statements:

Source currency is Japanese Yen
Kuwaiti Dinar: max Exchange Rate is 0.0028601845318296086, and direct rate is 0.002837866848366889
Bahraini Dinar: max Exchange Rate is 0.003500871450140875, and direct rate is 0.003477940032170313
Omani Rial: max Exchange Rate is 0.0035832459935054187, and direct rate is 0.0035832459935054187
British Pound: max Exchange Rate is 0.007323709928865302, and direct rate is 0.007232077349904979
Euro: max Exchange Rate is 0.008057563070993524, and direct rate is 0.008057563070993522
Swiss Franc: max Exchange Rate is 0.008661075369424344, and direct rate is 0.008562397496974444
Canadian Dollar: max Exchange Rate is 0.012482677234415887, and direct rate is 0.012456578705116609
Bruneian Dollar: max Exchange Rate is 0.012888696304101829, and direct rate is 0.012695104124445553
Singapore Dollar: max Exchange Rate is 0.012885544737613351, and direct rate is 0.012853790647767907
Libyan Dinar: max Exchange Rate is 0.012961836478694833, and direct rate is 0.01280434543331424
Australian Dollar: max Exchange Rate is 0.01302968160762, and direct rate is 0.012815302178235064
New Zealand Dollar: max Exchange Rate is 0.013974958091842685, and direct rate is 0.013883435131220988
Bulgarian Lev: max Exchange Rate is 0.01574041275348872, and direct rate is 0.01572180923490515
Israeli Shekel: max Exchange Rate is 0.03184158822216103, and direct rate is 0.031289795203893876
Qatari Riyal: max Exchange Rate is 0.03391706687040421, and direct rate is 0.03386433013876335
Emirati Dirham: max Exchange Rate is 0.034201670836562885, and direct rate is 0.03388524377437695
Saudi Arabian Riyal: max Exchange Rate is 0.03493717495516037, and direct rate is 0.034455453697146345
Polish Zloty: max Exchange Rate is 0.03559779472477324, and direct rate is 0.035597794724773237
Romanian New Leu: max Exchange Rate is 0.03892617260129454, and direct rate is 0.03879254887131162
Malaysian Ringgit: max Exchange Rate is 0.039590625712546644, and direct rate is 0.038887558654406185
Brazilian Real: max Exchange Rate is 0.047469812181937764, and direct rate is 0.047373677616107626
Danish Krone: max Exchange Rate is 0.05985455204940522, and direct rate is 0.059557765670796535
Croatian Kuna: max Exchange Rate is 0.06058000107902785, and direct rate is 0.06009023818815385
Trinidadian Dollar: max Exchange Rate is 0.06296294633498072, and direct rate is 0.06281439146956536
Turkish Lira: max Exchange Rate is 0.06377783833034219, and direct rate is 0.063141919571705
Chinese Yuan Renminbi: max Exchange Rate is 0.06514738696591135, and direct rate is 0.06459306421477125
Hong Kong Dollar: max Exchange Rate is 0.07226466596555545, and direct rate is 0.07226466596555543
Swedish Krona: max Exchange Rate is 0.08257303885396591, and direct rate is 0.081077964607962
Norwegian Krone: max Exchange Rate is 0.0850828760473406, and direct rate is 0.08384885459142312
Venezuelan Bolivar: max Exchange Rate is 0.09298676267157745, and direct rate is 0.09133664768576862

Botswana Pula: max Exchange Rate is 0.10753244925929176, and direct rate is 0.10606788298589258
South African Rand: max Exchange Rate is 0.15318844582802926, and direct rate is 0.15249110977420413
Mexican Peso: max Exchange Rate is 0.20739086648357752, and direct rate is 0.20739086648357752
Czech Koruna: max Exchange Rate is 0.21225910815145133, and direct rate is 0.21193267388614212
Taiwan New Dollar: max Exchange Rate is 0.27404932325548226, and direct rate is 0.27247260731934997
Thai Baht: max Exchange Rate is 0.29428037964513243, and direct rate is 0.291466605013617
Mauritian Rupee: max Exchange Rate is 0.37268859183511893, and direct rate is 0.37240701821109207
Philippine Peso: max Exchange Rate is 0.4601367137455285, and direct rate is 0.4517144629833383
Russian Ruble: max Exchange Rate is 0.6633818496975654, and direct rate is 0.6584043863191521
Argentine Peso: max Exchange Rate is 0.6689961844982243, and direct rate is 0.6635655872131515
Indian Rupee: max Exchange Rate is 0.6947563370436517, and direct rate is 0.6942936467676881
Japanese Yen: max Exchange Rate is 1.0, and direct rate is 1.0
Nepalese Rupee: max Exchange Rate is 1.1170386579605172, and direct rate is 1.1014781993603313
Icelandic Krona: max Exchange Rate is 1.268481458905697, and direct rate is 1.267295526570507
Pakistani Rupee: max Exchange Rate is 1.5621489966646618, and direct rate is 1.555532629668921
Sri Lankan Rupee: max Exchange Rate is 1.7312382452173862, and direct rate is 1.702650351609146
Hungarian Forint: max Exchange Rate is 2.7988768979325687, and direct rate is 2.7740990154141882
Kazakhstani Tenge: max Exchange Rate is 3.8451278773382795, and direct rate is 3.8277633696001314
Chilean Peso: max Exchange Rate is 7.1647025130833715, and direct rate is 7.1361898629042715
South Korean Won: max Exchange Rate is 11.146722600042272, and direct rate is 11.115008875431304
Colombian Peso: max Exchange Rate is 33.798166907008024, and direct rate is 33.398111183349265
Indonesian Rupiah: max Exchange Rate is 136.4389619987805, and direct rate is 134.75622208127137
Iranian Rial: max Exchange Rate is 1896.0966554685174, and direct rate is 1878.2112446117392
USD: max Exchange Rate is 0.009304993120579785, and direct rate is 0.009189606664574732

4 Submissions

You need to submit a *.zip* file compressing the following folder:

- all the Java source file(s).
- A readme.txt file containing a sample program output for inputs USD, Euro, and British Pound.