Project #2 – Redis / Key-Value Stores
Due Date: May 10th, 2020

A key-value store is a system that manages a collection of (*key,value*) pairs, where *key* is unique in this universe. Redis – and other systems – allow the value to be a single value (e.g. string, number), a set of values, a list of values, a hash, etc.

Assume a collection of (key, list) pairs, i.e. the value is a list of values, namely strings. Assume that key is a string as well. Let's call such a collection a *Key-List Store (KL Store)*. This is a special case of a multi-map data structure, where several values are mapped to a key.

Example:

Key	**List**
12	[t12, t67]
34	[t87, t12, t98]
…	…
76	[t121, t72, t99, t179]

a Key-List Store

Assume two domains of values D_1 and D_2

e.g. D_1 = {all possible customer ids}, D_2 = {all possible transaction ids}

Assume that there is a process P that generates a collection of (value1, value2) pairs

$S = \{ (u,v): u \in D_1 , v \in D_2\}$

Examples of such processes:

- SELECT custID, transID FROM SALES
- Reading a CSV file and getting for each line forming a pair using columns i and j.
- Running any program that produces a stream of pairs of values

Given a collection S described as above, one can define two KLStores, $KL_1(S)$ and $KL_2(S)$ as follows:

$KL_1(S) = \{(x, L_x), \forall x \in U = \{u: (u,v) \in S\}, L_x$ = the list of values v, such that $(x,v) \in S\}$
$KL_2(S) = \{(x, L_x), \forall x \in V = \{v: (u,v) \in S\}, L_x$ = the list of values u, such that $(u,x) \in S\}$

We want to implement in Python (or some other language) the following functions/methods that get one or more KL stores and "return" (or update) a KL store. All these KL stores should exist in Redis.

Create_KLStore (name, data-source, query-string, position1, position2, direction)

This function creates in Redis a KL store with name <name> using the data source found in <data-source>. Data sources can be found in an XML file described later and for the scope of this project can be either a csv file, a relational database or an excel file. In the case of a csv file, <query-string> is empty and <position1> and <position2> two integer numbers specifying the column positions that will be used to form the (u,v) pairs of S (as described earlier). In the case of an excel, <query-string> contains the index of the worksheet and <position1> and <position2> two integer numbers specifying the column positions that will be used to form the (u,v) pairs of S (as described earlier). In the case of a relational database, <query-string> is an SQL statement in the form SELECT col1, col2 WHERE <etc>. <direction> has the value 1 or 2, specifying whether $KL_1(D)$ or $KL_2(D)$ should be implemented.

Filter_KLStore(name1, expression)

This function gets a KL store in Redis named <name1> and a string called <expression> representing a valid python boolean expression and applies this expression on each element of each list of <name1>. If the return value is **true**, the element remains in the list, otherwise it is removed. Come up with a convention on how the element of the list is mentioned within the <expression>.

Apply_KLStore (name1, func)

This function gets a KL store in Redis named <name1> and a python function named <func> - which gets a string and returns a string – and applies <func> on each element of a list, for all lists of the KL store $<\text{name1}>$, transforming thus the lists of the KL store.

Aggr_KLStore (name1, aggr)

This function gets a KL store in Redis named <name1> and a string named <aggr> that can have one of the values “avg/sum/count/min/max” and aggregates each list of the KL store <name1> according to the specified aggregate, updating the list with just one item, the result of the aggregation. You can implement a more general version of this function that also gets a python function <func> that operates on a list of strings and returns a string; in this case you should modify the signature of Aggr_KLStore appropriately (e.g. Aggr_KLStore (name1, aggr, func), if <aggr> is an empty string then use <func> for aggregation).

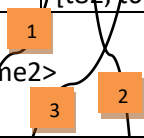
LookUp_KLStore(name1, name2) --- BONUS (10%)

This function gets two KL stores named <name1> and <name2> and for each element e of a list L in <name1>, performs a lookup for e in the keys of <name2>, gets the list L’ of the matched key,

and replaces e in L with the elements of L'. This should happen for all lists in <name1>. This is graphically shown in the figure below.

<name1>

Key	List
12	[t12, t13]
18	[t28]
…	…
56	[t82, t62, t71]



<name2>

Key	List
t11	[120, 67, 98]
t12	[68, 139, 65]
t13	[55, 12]
…	…
t99	[45, 89]

New list for 12 → [68, 139, 65, 55, 12]

Dictionary of Data Sources

There is a dictionary in XML describing data sources. Feel free to change it to JSON if you feel more comfortable with JSON.

```
<datasources Repository="SomeName">
        <datasource name="DSName" id="someID" type="db/excel/csv">
        <dbconnect>
                <username> username </username>
                <password> username </password>
                <request string>
                <database>
        </dbconnect>
        <filename> someFileName </filename>
        <path> somePath </path>
        <delimiter> someDelimiter </delimiter>
        </datasource>
</datasources>
```