MIDS W205

Lab #	10	Lab Title	OpenRefine -- Introduction
Related Module(s)	10	Goal	Get you started on OpenRefine and Edit Distance
Last Updated	9/27/15	Expected duration	60 minutes

Introduction

This Lab has 3 parts. The first two are involves using OpenRefine to clean up some data files. The third one involves calculating the Levenshtein distance between two strings.

OpenRefine is an open source tool for working with bad data. In this Lab we will give you a quick tour of how you can use it to clean data. This is purposely a short introduction to just get you introduced to the tool. If you want a more comprehensive tutorial you can follow any of the tutorials listed in the resources section. The second part of this lab involves understanding Levenshtein distance calculation using the dynamic programming method.

For the OpenRefine portion we will be using two data sets. One data set has earthquake data and one contains customer complaint data. You can access the dataset from the Github (both datasets are available if you clone or pull) or use the links in the text below. The links are also in the resources sections later in this document.

The first data set contains customer complaints; you can download that data set here.

The second data set is the eq2015 data set which data about earthquakes of magnitude 3 or more during the first 6 months of 2015. You can download the Earthquake data set here. You can fine an earthquake data attribute glossary here. OpenRefine is to a large extent menu driven. But it also allows you to use a language for doing certain types of transformations.

Open Refine

The basic idea in OpenRefine is that you should think of exploring your data in terms of patterns, called facets. Facets help by characterizing data and give you an overview of value ranges, missing values etc. There are a number of facets for different data types as well as plots such as scatter plots. Once you understand the data you can transform the data using pattern matching and transformations. To support this OpenRefine has functions for doing transformations of data. These transformations can be expressed in the language GREL although there are a few other options as well. As an example, you can decide to create a new column based on an existing column but with a transformation applied to the data. GREL allows you to match in regular expressions, but also do common operations like trimming blanks, splitting strings etc. In addition it has control structures such as if-statements. You can even have OpenRefine call out to URLS and insert the results in a column. OpenRefine also support fuzzy matching (clustering) of attribute values. It will suggest values to merge and will let you

choose which one you like to use. You can adjust the way clustering works using parameters such as radius and character block matching.

Instructions, resources and prerequisites

For Step-1 and Step-2 install OpenRefine from here. The lab describe a number of commands to try, but is also poses a few questions we like you to consider and experiment with. For the submissions you should answer the SUBMISSION questions embedded in the Lab description.

For Step-3 make sure you have a working Python installation.

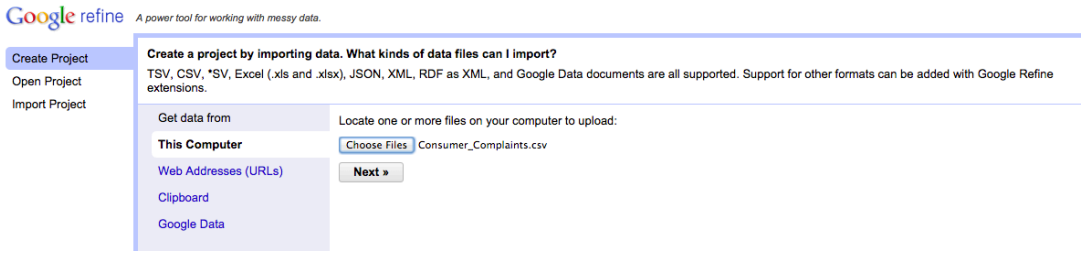
Below are a number of resources that are referred to in this lab, or may be of general interest to you during or after this lab.

Resource	What
http://openrefine.org/	This is where you download OpenRefine.
http://arcadiafalcone.net/GoogleRefineCheatSheets.pdf	A short description of OpenRefine commands.
http://enipedia.tudelft.nl/wiki/OpenRefine_Tutorial	Another tutorial on OpenRefine.
http://davidhuynh.net/spaces/nicar2011/tutorial.pdf	Another tutorial on OpenRefine.
http://schoolofdata.org/handbook/recipes/cleaningdatawithrefine/	Programming guide for the Spark Context object. Here you can find actions available on the Spark Contexts.
https://github.com/OpenRefine/OpenRefine/wiki/General-Refine-Expression-Language	GREL is the language used in OpenRefine for data refinements. This is a reference guide for the GREL language.
http://earthquake.usgs.gov/eart	Explanation of the Earthquake data.
https://pypi.python.org/pypi/python-Levenshtein/0.12.0	A Levenshtein module you can use to check your results in a Python shell.
https://github.com/OpenRefine/OpenRefine/wiki/Clustering-In-Depth	A good quick read on some clustering methods.
Earth Quake Data set	https://github.com/UCBerkeleyISchool/w205labs-exercises/blob/master/lab_10 /dataset/eq2015.csv
Earthquake Data Glossary.	http://earthquake.usgs.gov/earthquakes/feed/v1.0/glossary.php#net
Customer Complaints Data.	https://github.com/UCBerkeleyISchool/w205labs-exercises/blob/master/lab_10/dataset/Consumer_Complaints.csv

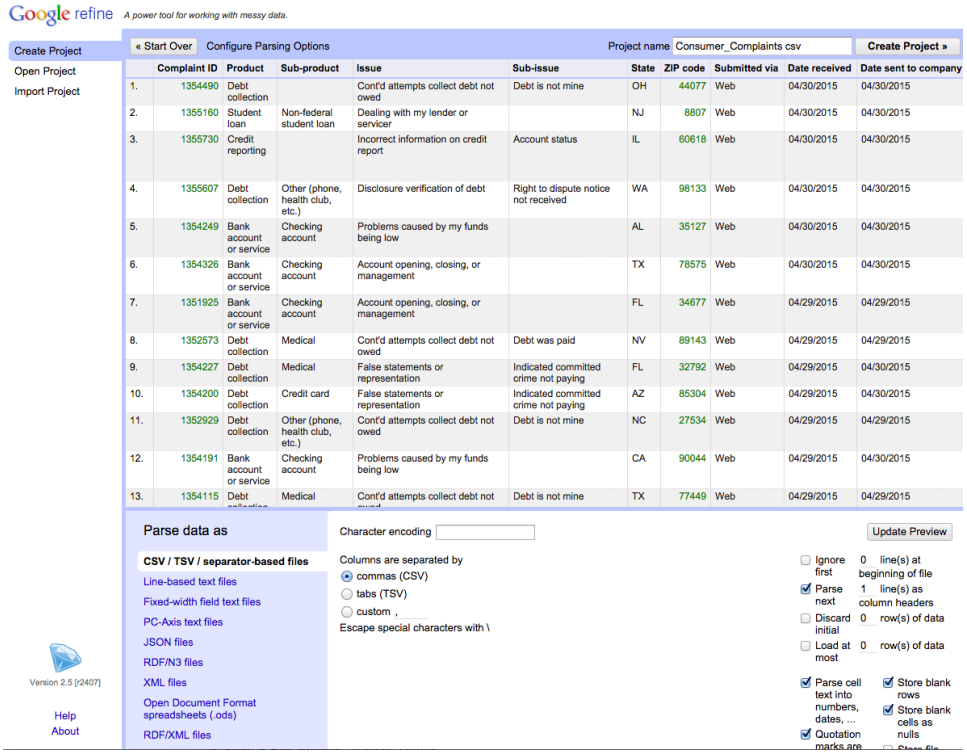
Step-1. Wrangling the Customer Complaints Data

Uploading data

After you started OpenRefine you can pick a data set. For this first step choose the Customer Complaints Data set (dataset/Consumer_Complaints.csv)



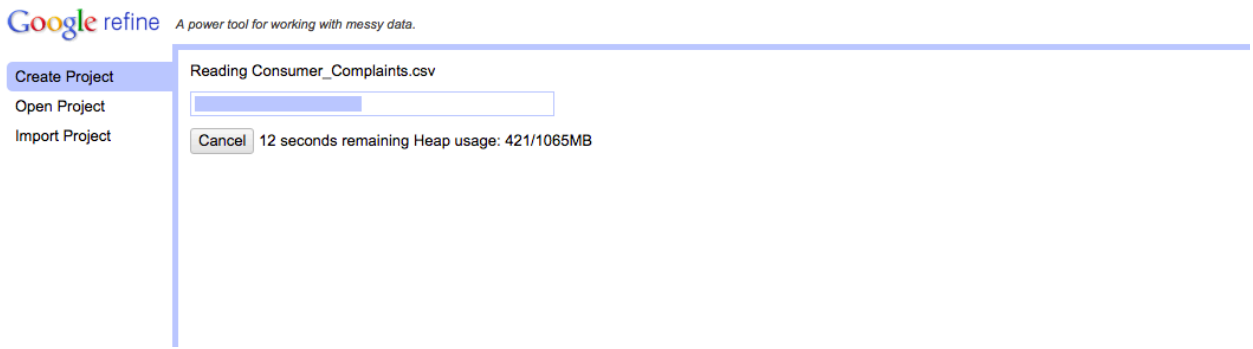
Once the data is read you can inspect it. In this case it looks ok. But lets say that it would have been tab separated rather than comma separate, then OpenRefine would not have identified the structure correctly. You have the opportunity to look at the data here and confirm it is ok. Since we think it looks good and we will now click the “Create Project” button.



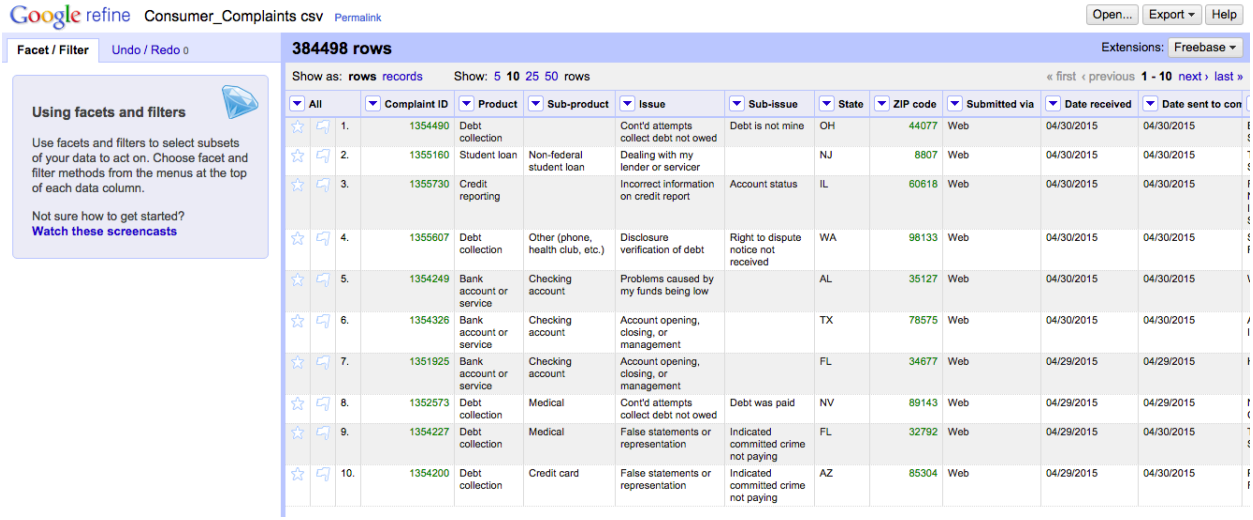
Also note that we specified that the first line should be parsed as column headers.

Creating a project

Next creating the project can take a little time since there are more that 300,000 lines in this file.

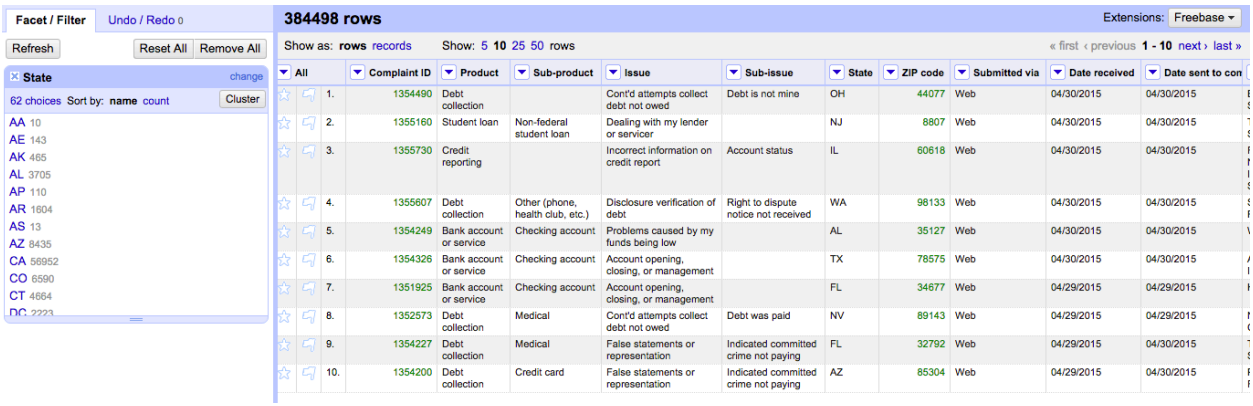


Once the project is created you can see that it has 384498 rows.



Check states with text facet

If you select text facet for ‘State” attribute you will see a summary in the left column pane. It indicates you we have 62 different state values. Try to figure out why.



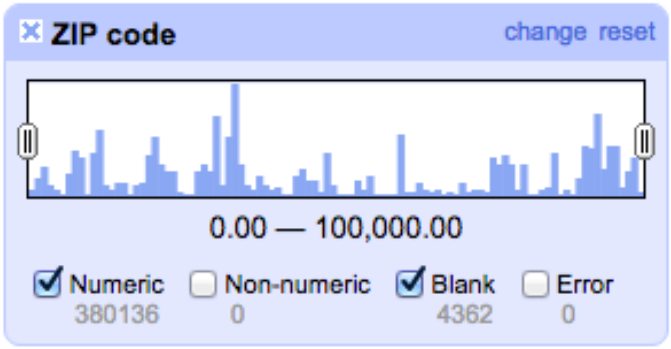
SUBMISSION 1: How many rows are missing value in the “State” column? Explain how you came up with the number?

Checking zip codes

Try the text facet on “ZIP code”, what happens? You can see that there are 24748 different zip codes in this data set. Is that reasonable? Eye ball the data, does all zip codes look valid? You may need to research valid zip codes on the internet to determine if the values are reasonable.

Now try the numeric facet. With the numeric facet the zip code attribute is treated is a numeric value. What would you say the scalar type is for zip codes, can be treated as a numeric attribute? Histogram below shows the distribution when the attribute is treated as numeric. By unchecking numeric you can get a list of row that are missing.

SUBMISSION 2: How many rows with missing zip codes do you have?



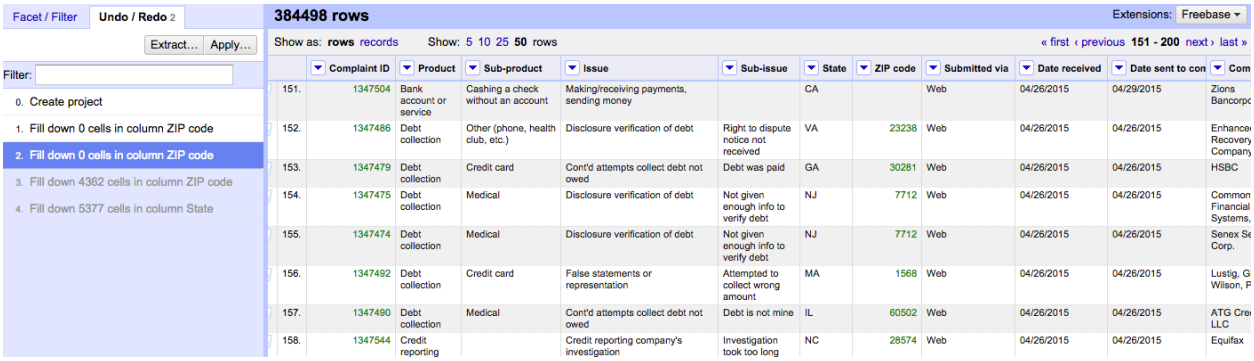
One way of filling in missing values is to take the previous value and use that to set subsequent empty cells. In OpenRefine it is called fill-down. Find a row that is blank. Apply fill down to the fill down by:

```
Edit Cell->Fill Down
```

What happened to the empty cell? Is this a valid way filling in missing Zip codes. Can you think of a better way?

64.	1349391	Credit reporting		Credit reporting company's investigation	Problem with statement of dispute	TX	75181	Web	04/27/2015	04/27/2015
65.	1349369	Debt collection	Other (phone, health club, etc.)	Cont'd attempts collect debt not owed	Debt was paid	CO	80122	Web	04/27/2015	04/27/2015
66.	1347783	Bank account or service	Checking account edit	Account opening, closing, or management		CO	60008	Web	04/27/2015	04/29/2015
67.	1347685	Credit reporting		Incorrect information on credit report	Account status	KY	40219	Web	04/27/2015	04/27/2015
68.	1347775	Mortgage	Conventional fixed mortgage	Loan servicing, payments, escrow account		OH	43551	Web	04/27/2015	04/27/2015
69.	1347700	Debt collection		Cont'd attempts collect debt not owed	Debt is not mine	NY	12303	Phone	04/27/2015	04/28/2015
70.	1347687	Credit reporting		Incorrect information on credit report	Reinserted previously deleted info	VT	5468	Web	04/27/2015	04/27/2015

If you need to undo the operation, switch to the Undo/Redo tab. Select the previous state for the data. In this example I went back to state 2. As you can see in this screen shot row 151 has a missing zip code, so presumably the fill downs for Zip code and State has been un-done. Observe that the list in Undo/Redo can look different for you if you have been issuing more or different commands than we have so far in this lab.



Lets create a new column called “ZipCode5” with all zip codes that contain 5 digits preserved. All other rows should have the zip code 99999. (Technically speaking the 4-digit zip codes may be valid zip codes; we do this more to illustrate transformations).

Transformations are generally expressed in some language. OpenRefine supports a few alternative languages for transform, we will be using GREL. You can find a link to a language reference in the resources section. For this simple transformation we will be using an if-statement.

expression	result
`if("internationalization".length() > 10, "big string", "small string")`	`big string`
`if(mod(37, 2) == 0, "even", "odd")`	`odd`

For the ZIP code column select:

```
Edit Column -> Add column based on this column.
```

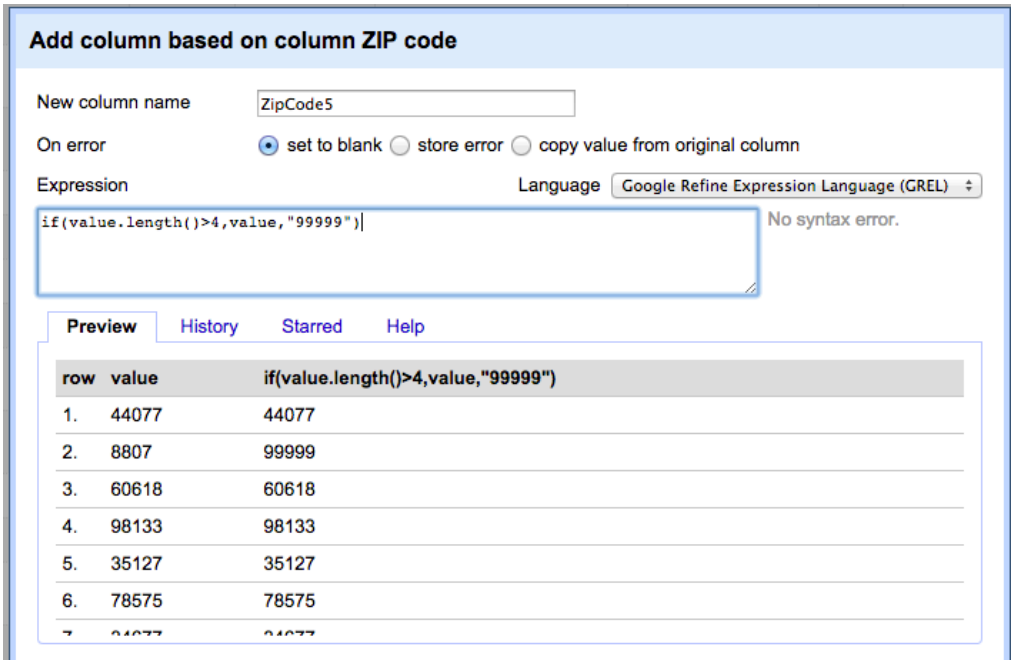
You will get the dialogue below. Insert the name of the new column and the expression:

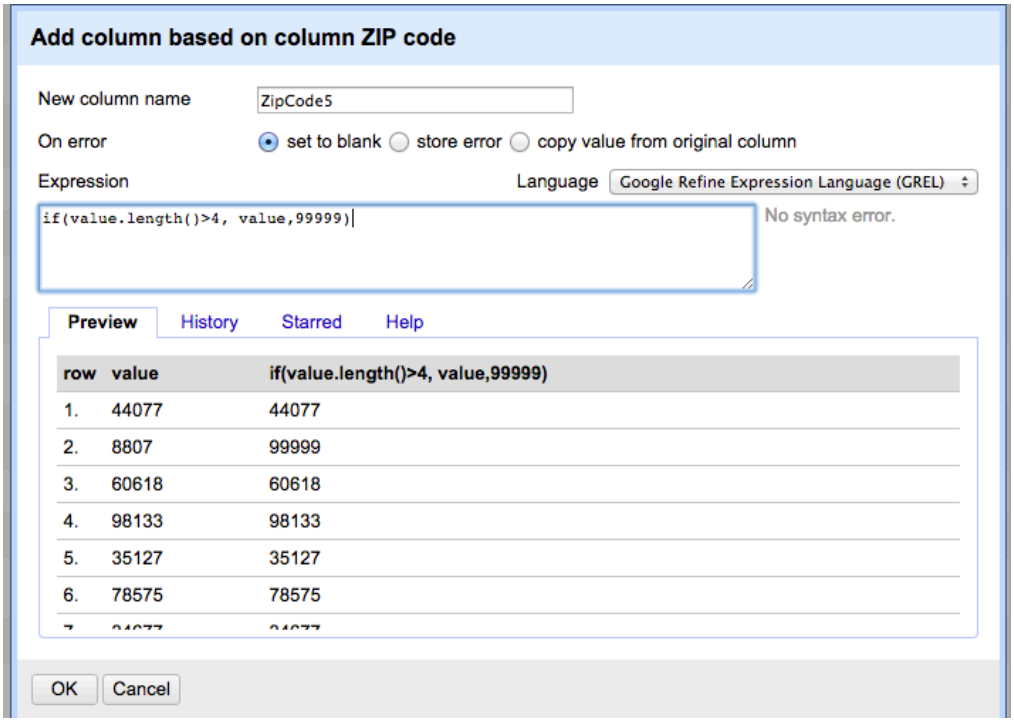
```
If(value.length() > 4, value, “99999”)
```

This expression states that if the length of value is more than 4 insert value, otherwise insert the string “99999”.

Look at the result, this it do what you wanted? What seems to be wrong with that? What happens if you instead insert a numeric value using the following expression?

```
If(value.length() > 4, value, 99999)
```





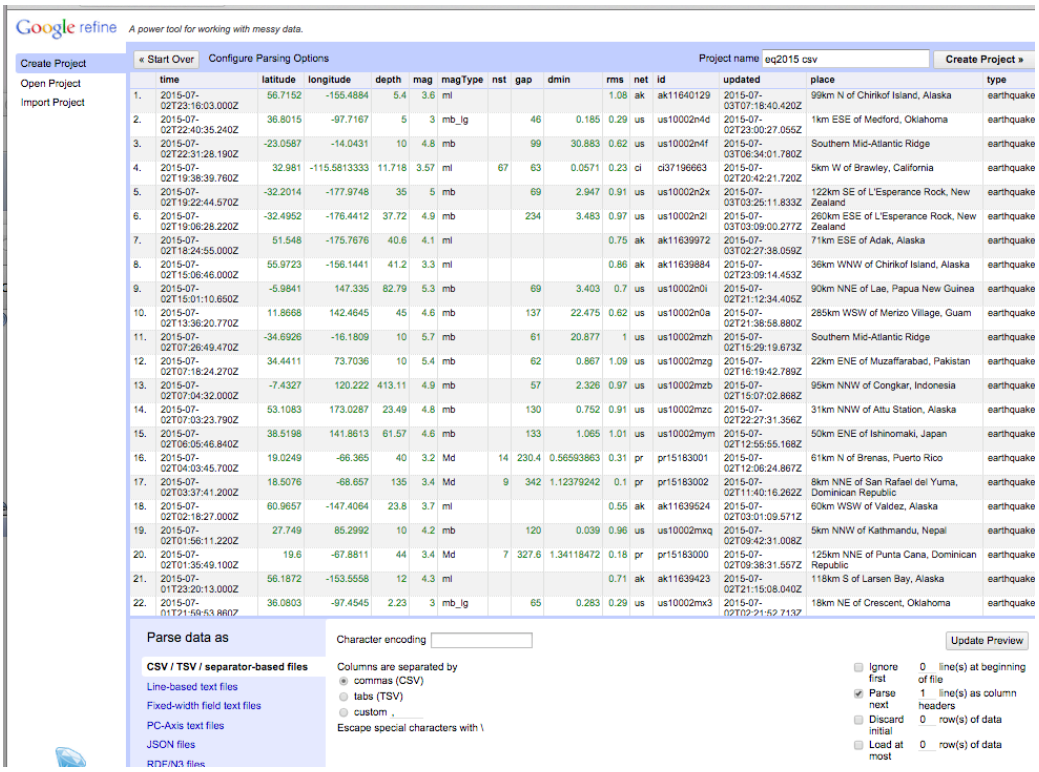
You should now have the same type for all cells in the created column. As an example the result should look something like the following.

All	Complaint ID	Product	Sub-product	Issue	Sub-issue	State	ZIP code	ZipCode5	Submitted via	Date received
66.	1347783	Bank account or service	Checking account	Account opening, closing, or management			60008	60008	Web	04/27/2015
91.	1348023	Money transfers	International money transfer	Other transaction issues				99999	Phone	04/27/2015
116.	1348625	Credit reporting		Credit reporting company's investigation	Inadequate help over the phone		777	99999	Web	04/27/2015
286.	1345142	Credit reporting		Unable to get credit report/credit score	Problem getting my free annual report		22043	22043	Web	04/24/2015
322.	1345678	Bank account or service	Checking account	Problems caused by my funds being low				99999	Referral	04/23/2015
329.	1343115	Credit reporting		Unable to get credit report/credit score	Problem getting my free annual report		19428	19428	Web	04/23/2015

SUBMISSION 3: If you consider all zip codes less than 99999 valid zip codes. How many valid and invalid zip codes do you have respectively?

Step-2. Cleaning up eq2015 Data.

Upload the data file dataset/eq2015.csv. After you checked that the data looks ok, create the project.



	time	latitude	longitude	depth	mag	magType	nst	gap	dmin	rms	net	id	updated	place	type
1.	2015-07-02T23:16:03.000Z	56.7152	-155.4884	5.4	3.6	ml				1.08	ak	ak11640129	2015-07-03T07:18:40.420Z	99km N of Chirikof Island, Alaska	earthquake
2.	2015-07-02T22:40:35.240Z	36.8015	-97.7167	5	3	mb_lg		46	0.185	0.29	us	us10002n4d	2015-07-02T23:00:27.055Z	1km ESE of Medford, Oklahoma	earthquake
3.	2015-07-02T22:31:28.190Z	-23.0587	-14.0431	10	4.8	mb		99	30.883	0.62	us	us10002n4f	2015-07-03T06:34:01.780Z	Southern Mid-Atlantic Ridge	earthquake
4.	2015-07-02T19:38:39.760Z	32.981	-115.5813333	11.718	3.57	ml	67	63	0.0571	0.23	ci	ci37196663	2015-07-02T20:42:21.720Z	5km W of Brawley, California	earthquake
5.	2015-07-02T19:22:44.570Z	-32.2014	-177.9748	35	5	mb		69	2.947	0.91	us	us10002n2x	2015-07-03T03:25:11.833Z	122km SE of L'Esperance Rock, New Zealand	earthquake
6.	2015-07-02T19:06:28.220Z	-32.4952	-176.4412	37.72	4.9	mb		234	3.483	0.97	us	us10002n2l	2015-07-03T03:09:00.277Z	260km ESE of L'Esperance Rock, New Zealand	earthquake
7.	2015-07-02T18:24:55.000Z	51.548	-175.7676	40.6	4.1	ml				0.75	ak	ak11639972	2015-07-03T02:27:38.059Z	71km ESE of Adak, Alaska	earthquake
8.	2015-07-02T15:06:46.000Z	55.9723	-156.1441	41.2	3.3	ml				0.86	ak	ak11639884	2015-07-02T23:09:14.453Z	36km WNW of Chirikof Island, Alaska	earthquake
9.	2015-07-02T15:01:10.650Z	-5.9841	147.335	82.79	5.3	mb		69	3.403	0.7	us	us10002n0i	2015-07-02T21:12:34.405Z	90km NNE of Lae, Papua New Guinea	earthquake
10.	2015-07-02T13:36:20.770Z	11.8668	142.4645	45	4.6	mb		137	22.475	0.62	us	us10002n0a	2015-07-02T21:38:58.880Z	285km WSW of Merizo Village, Guam	earthquake
11.	2015-07-02T07:26:49.470Z	-34.6926	-16.1809	10	5.7	mb		61	20.877	1	us	us10002mzh	2015-07-02T15:29:19.673Z	Southern Mid-Atlantic Ridge	earthquake
12.	2015-07-02T07:18:24.270Z	34.4411	73.7036	10	5.4	mb		62	0.867	1.09	us	us10002mzg	2015-07-02T16:19:42.789Z	22km ENE of Muzaffarabad, Pakistan	earthquake
13.	2015-07-02T07:04:32.000Z	-7.4327	120.222	413.11	4.9	mb		57	2.326	0.97	us	us10002mzb	2015-07-02T15:07:02.868Z	95km NNW of Congkar, Indonesia	earthquake
14.	2015-07-02T07:03:23.790Z	53.1083	173.0287	23.49	4.8	mb		130	0.752	0.91	us	us10002mzc	2015-07-02T22:27:31.356Z	31km NNW of Attu Station, Alaska	earthquake
15.	2015-07-02T06:05:46.840Z	38.5198	141.8613	61.57	4.6	mb		133	1.065	1.01	us	us10002mym	2015-07-02T12:55:55.168Z	50km ENE of Ishinomaki, Japan	earthquake
16.	2015-07-02T04:03:45.700Z	19.0249	-66.365	40	3.2	Md	14	230.4	0.56593863	0.31	pr	pr15183001	2015-07-02T12:06:24.867Z	61km N of Brenas, Puerto Rico	earthquake
17.	2015-07-02T03:37:41.200Z	18.5076	-68.657	135	3.4	Md	9	342	1.12379242	0.1	pr	pr15183002	2015-07-02T11:40:16.262Z	8km NNE of San Rafael del Yuma, Dominican Republic	earthquake
18.	2015-07-02T02:18:27.000Z	60.9657	-147.4064	23.8	3.7	ml				0.55	ak	ak11639524	2015-07-02T03:01:09.571Z	60km WSW of Valdez, Alaska	earthquake
19.	2015-07-02T01:56:11.220Z	27.749	85.2992	10	4.2	mb		120	0.039	0.96	us	us10002mxq	2015-07-02T09:42:31.008Z	5km NNW of Kathmandu, Nepal	earthquake
20.	2015-07-02T01:35:49.100Z	19.6	-67.8811	44	3.4	Md	7	327.6	1.34118472	0.18	pr	pr15183000	2015-07-02T09:38:31.557Z	125km NNE of Punta Cana, Dominican Republic	earthquake
21.	2015-07-01T23:20:13.000Z	56.1872	-153.5558	12	4.3	ml				0.71	ak	ak11639423	2015-07-02T21:15:08.040Z	118km S of Larsen Bay, Alaska	earthquake
22.	2015-07-01T21:59:53.860Z	36.0803	-97.4545	2.23	3	mb_lg		65	0.283	0.29	us	us10002mx3	2015-07-02T02:21:52.713Z	18km NE of Crescent, Oklahoma	earthquake

As you can see the column “nst” is missing quite a few values. Look up the “nst” attribute in the glossary. What would happen if we just ignored row with missing values? Is there an obvious strategy for filling in the missing values? What would you suggest we do with the column?

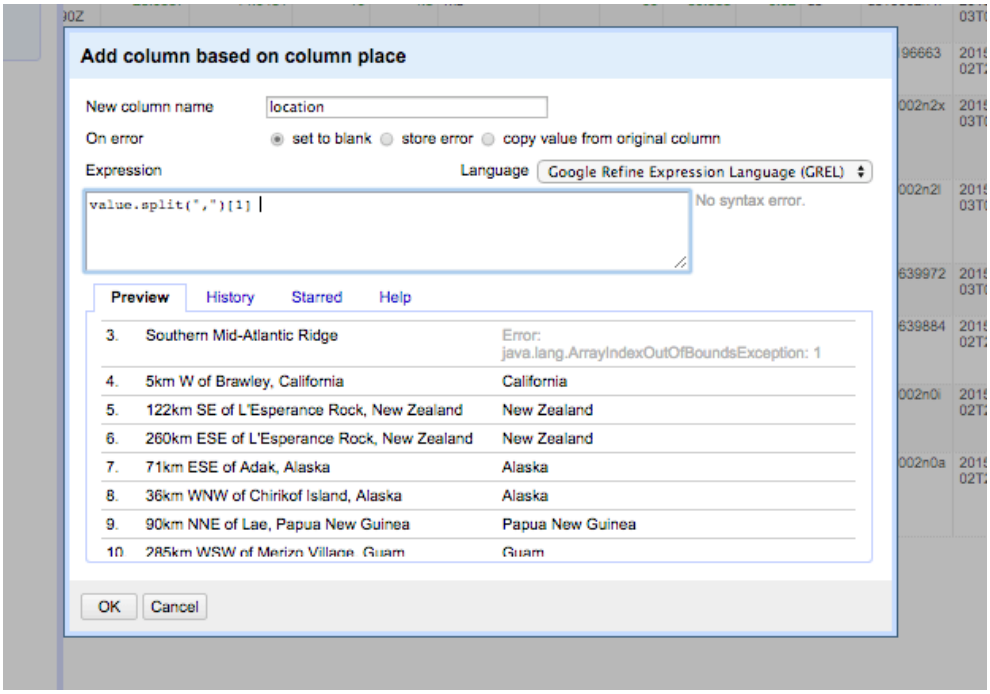
Next we like to extract an approximate area from the “place” column. We would like to have a State or Country, and we like to store that information in a separate column we like to call “location”.

As we review the “place” column we notice that the cell seems to be consisting two commas separated components. The components are: a direction and distance; and a general location.

Select the command:

```
Edit Column -> Add Column based on this column
```

You should see a pop-up dialogue box looking as follows. We typed in the column name of the new column “location”



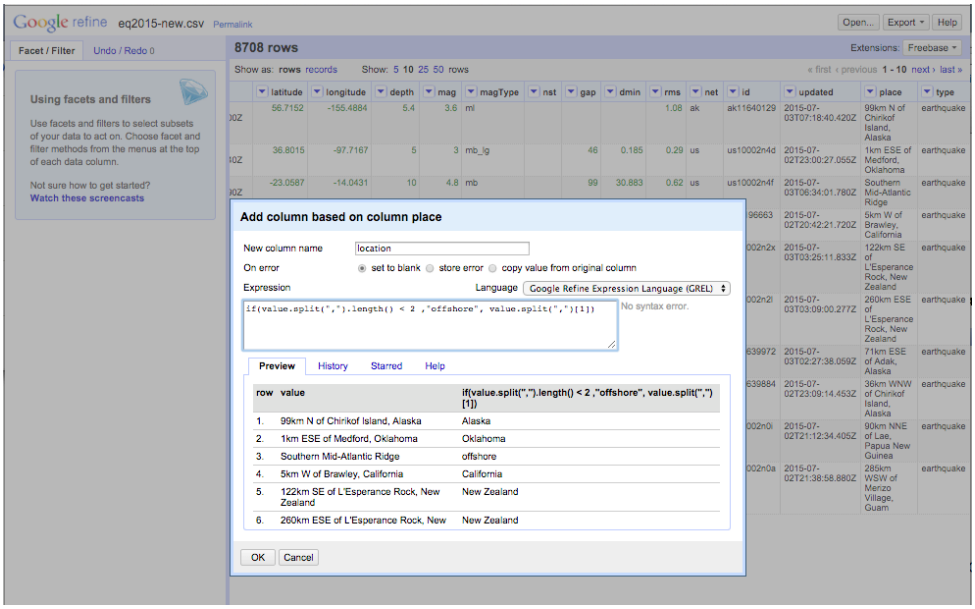
Since we noticed the cells have two comma-separated components, and the second is a location we defined the following expression.

```
value.split(",")[1]
```

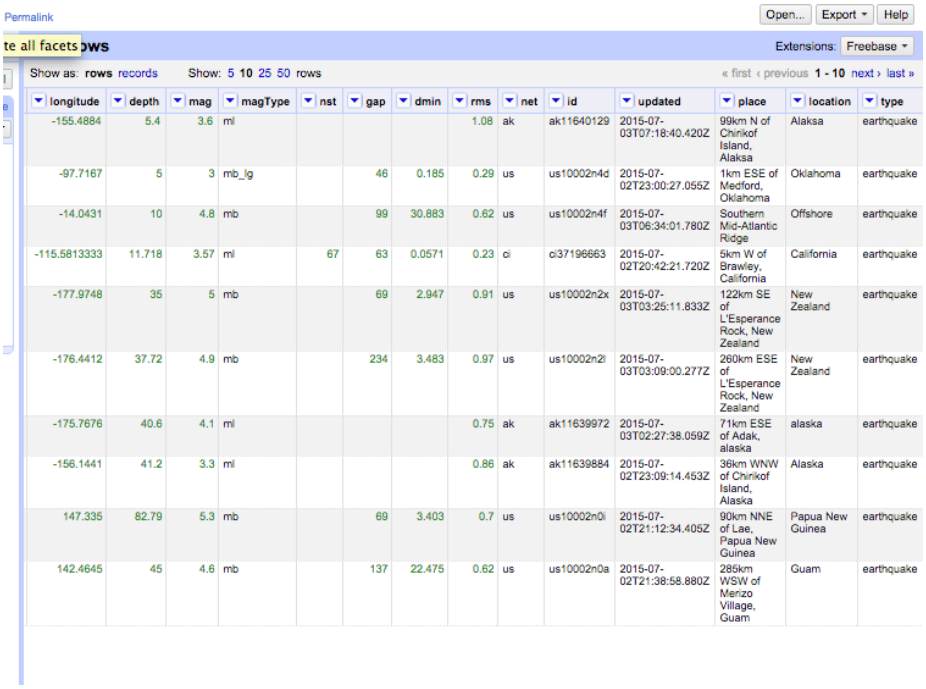
But as you probably notice that did not work so well. In fact, not all cells have the two components. If you look at the data more closely it seems that if the place was offshore the location component was missing. So we modify the expression as follows.

```
if(value.split(",").length() < 2 ,"Offshore",
value.split(",")[1])
```

If only has one component we assume it was Offshore and put that value in the location column.



Check the resulting data. Does it seem reasonable, or are more adjustments needed?



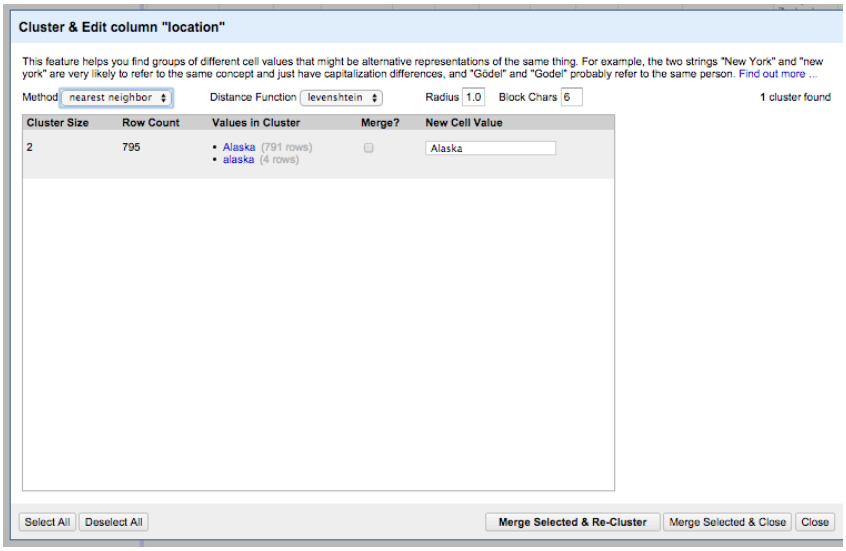
longitude	depth	mag	magType	nst	gap	dmin	rms	net	id	updated	place	location	type
-155.4884	5.4	3.6	ml				1.08	ak	ak11640129	2015-07-03T07:18:40.420Z	99km N of Chirikof Island, Alaksa	Alaksa	earthquake
-97.7167	5	3	mb_lg		46	0.185	0.29	us	us10002n4d	2015-07-02T23:00:27.055Z	1km ESE of Medford, Oklahoma	Oklahoma	earthquake
-14.0431	10	4.8	mb		99	30.883	0.62	us	us10002n4f	2015-07-03T06:34:01.780Z	Southern Mid-Atlantic Ridge	Offshore	earthquake
-115.5813333	11.718	3.57	ml	67	63	0.0571	0.23	ci	ci37196663	2015-07-02T20:42:21.720Z	5km W of Brawley, California	California	earthquake
-177.9748	35	5	mb		69	2.947	0.91	us	us10002n2x	2015-07-03T03:25:11.833Z	122km SE of L'Esperance Rock, New Zealand	New Zealand	earthquake
-176.4412	37.72	4.9	mb		234	3.483	0.97	us	us10002n2l	2015-07-03T03:09:00.277Z	260km ESE of L'Esperance Rock, New Zealand	New Zealand	earthquake
-175.7676	40.6	4.1	ml				0.75	ak	ak11639972	2015-07-03T02:27:38.059Z	71km ESE of Adak, alaska	alaska	earthquake
-156.1441	41.2	3.3	ml				0.86	ak	ak11639884	2015-07-02T23:09:14.453Z	36km WNW of Chirikof Island, Alaska	Alaska	earthquake
147.335	82.79	5.3	mb		69	3.403	0.7	us	us10002n0i	2015-07-02T21:12:34.405Z	90km NNE of Lae, Papua New Guinea	Papua New Guinea	earthquake
142.4645	45	4.6	mb		137	22.475	0.62	us	us10002n0a	2015-07-02T21:38:58.880Z	285km WSW of Merizo Village, Guam	Guam	earthquake

Check the value by using a text facet on the column. You may notice that there appears to be multiple strings that look like Alaska, but appears to be misspelled.

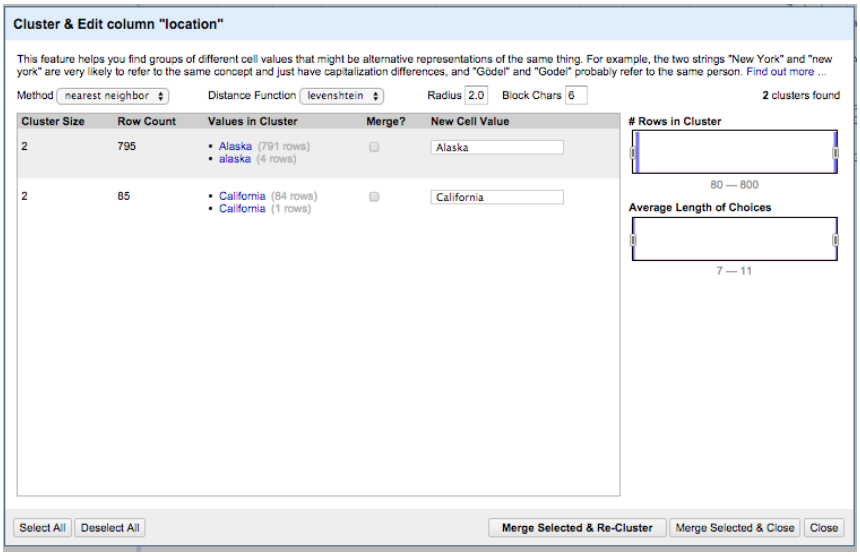
Clustering may help us detect more of these kinds of situations. Run clustering by pushing the Cluster button on the facet or use the column pop-up menu and select:

```
Edit Cell->Cluster and edit
```

Try key collision what do you see? Try nearest neighbor, Levenshtein what do you see? You can change the parameters such as Radius and Block Chars. Radius provides a threshold for how close (in terms of distance measure) the strings should be to be considered representing the same entity. The Block Char parameter may behave a little counter intuitive. Blocking defines blocks within which the string distance method is applied. It helps with scalability, as we will not compare strings cross the whole data set. OpenRefine blocking parameter defines the size of a substring S, such that all strings that share S will be in a common block. So a smaller S will likely result in bigger blocks and more computation required.



Change radius to 2.0, what happens?

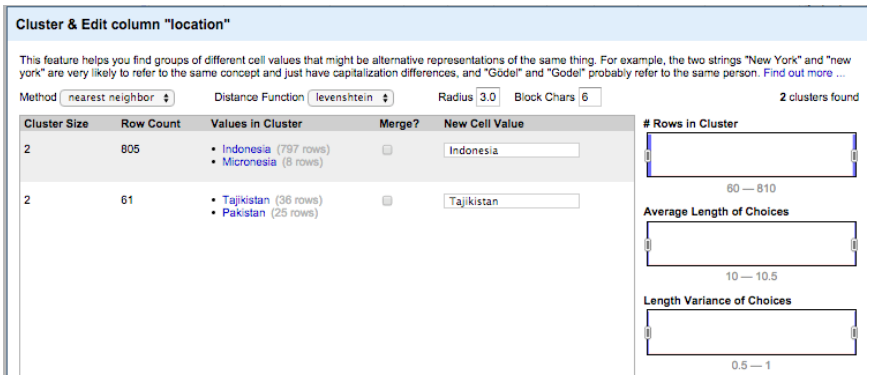


SUBMISSION 5: Change radius to 3.0, what happens? Do you want to merge any of the resulting matches?

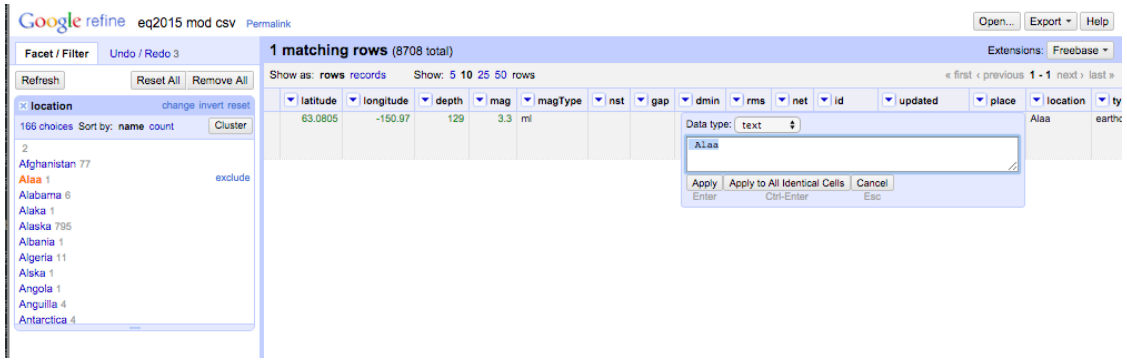
Change block size to 2 and run the clustering.

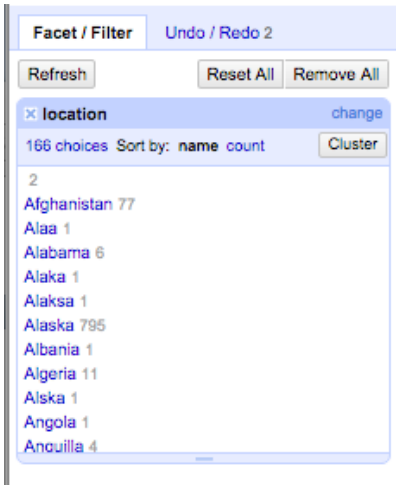
SUBMISSION 6: Change block size to 2. Give 2 examples of new clusters that may be worthwhile merging.

You can try different parameters to see if you can catch the issues you see. If not you can also note that there are a few misspellings of Alaska that only occurs once. Hence, it is doable to go in and edit them by hand.



If you review the facet you may still see values that seems wrong and that were not caught. If these are single values the easiest if probably just to go in an edit those cells and fix the values. You can access the values by clicking on the facet widget.





Consider if you had a very large data set and you wanted to automate the cleaning. Expecting manual editing would not be feasible.

The place column strings are significantly longer that the strings for location. Try to do nearest neighbor clustering on “place’ column. What happens and why? How does the user experience compare with the clustering of location?

SUBMISSION 7: Explain in words what happends when you cluster place, and why you think that happened? What additional functionality could OpenRefine provide to possibly deal with the situation.

Hint…it takes a long time; you may in fact want to cancel the run.

Step-3 Levenshtein Distance

Introduction

In this part of the lab we will go over a simple example of Levenshtein distance calculation. We will then ask you to calculate the distance for two strings gumbarrel" and "gunbarell". We will point you to a python implementation of the Levenshtein distance that you can use to check your result.

Installing Levenshtein python module

The following steps will just clone and build a Python Levenshtein module in a directory. It does not fully install the module. But you can use it to run a distance function from your shell to check your results by running the python shell in the Levenshtein sub-directory.

```
$ git clone https://github.com/ztane/python-Levenshtein/
$ cd python-Levenshtein/
$ python setup.py build
$ cd Levenshtein/
$ python
>>> from  Levenshtein import *
>>> distance("hej","hei")
1
>>> distance("monthgomery st","montgomery street")
5
```

Example: Levenshtein Calculation

Lets step through the calculation of distance between the words `LOYOLA` and `LAJOLLA`. We will denote a cell with the `d[i,j]`, where `i` is the row and `j` is the column. The dark column and row indicates the indice number we will be using for the actual calculation matrix.

As a reminder the algorithms is as follows:

Denote the row by r and column by c. We have n rows and m columns.
d[i,j] denotes the value on row i and columns j.

$cost\ [i,j] = 1\ if\ c[i]\ !=\ r[j]$
$cost\ [i,j] = 0\ if\ c[i]\ ==\ r[j]$

d[i,j] is to be set to the minimum of: d[i-1,j]+1 or d[i,j-1]+1 or d[i-1, j-1]+cost[i,j]
Distance is found in the resulting value d[n,m]

We first set up the matrix. The dark row and column just contains the i and j values. We then insert values `0-m` in first row `i==1` and `0-n` in the column `j==1`.

		1	2	3	4	5	6	7
			L	O	Y	O	L	A
1		0	1	2	3	4	5	6
2	L	1						
3	A	2						
4	J	3						
5	O	4						
6	L	5						
7	L	6						
8	A	7						

Lets calculate the `d[i,2]`. Meaning the value for each row in the column 2.

```
d[2,2], cost is 0, minimum is d[1,1]+0=>0
d[3,2], cost is 1, minimum is d[2,2]+1=>1
d[4,2], cost is 1, minimum is d[3,2]+1=>2
d[5,2], cost is 1, minimum is d[4,2]+1=>3
d[6,2], cost is 0, minimum is d[5,1]+0=>4, or d[5,2]+1
d[7,2], cost is 0, minimum is d[6,2]+0=>5, or d[6,2]+1
d[8,2], cost is 1, minimum is d[7,2]+1=>6
```

		1	2	3	4	5	6	7
			L	O	Y	O	L	A
1		0	1	2	3	4	5	6
2	L	1	0					
3	A	2	1					
4	J	3	2					
5	O	4	3					
6	L	5	4					
7	L	6	5					
8	A	7	6					

Lets calculate the `d[i,3]`. Meaning the value for each row in the column 3.

```
d[2,3], cost is 1, minimum is d[2,2]+1=>1
d[3,3], cost is 1, minimum is d[2,2]+1=>1
d[4,3], cost is 1, minimum is d[3,2]+1=>2, or d[3,3]+1
d[5,3], cost is 0, minimum is d[4,2]+0=>2
d[6,3], cost is 1, minimum is d[5,3]+1=>3
d[7,3], cost is 1, minimum is d[6,2]+1=>4, or d[6,3]+1
d[8,3], cost is 1, minimum is d[7,2]+1=>4
```

		1	2	3	4	5	6	7
			L	O	Y	O	L	A
1		0	1	2	3	4	5	6
2	L	1	0	1				
3	A	2	1	1				
4	J	3	2	2				
5	O	4	3	2				
6	L	5	3	3				
7	L	6	3	4				
8	A	7	4	4				

If you do the same thing for the remaining columns we will get the following matrix. You see the calculated edit distance in the cell `d[8,7]`.

		1	2	3	4	5	6	7
			L	O	Y	O	L	A
1		0	1	2	3	4	5	6
2	L	1	0	1	2	3	4	5
3	A	2	1	1	2	3	4	4
4	J	3	2	2	2	3	4	5
5	O	4	3	2	3	2	3	4
6	L	5	3	3	3	3	2	3
7	L	6	3	4	4	4	3	3
8	A	7	4	4	5	5	4	**3**

If you use the Levenshtein function to check the result you will see the following result.

```
>>> distance("loyola","lajolla")
3
```

So we are assuming we got the calculation right.

Calculation: gumbarrel v.s gunbarell

Now calculate the edit distance between the words: “gumbarrel” and “gunbarell". After you done that use the python Levenshtein function to check you result.

		1	2	3	4	5	6	7	8	9	10
			G	U	M	B	A	R	R	E	L
1		0	1	2	3	4	5	6	7	8	9
2	G	1									
3	U	2									
4	N	3									
5	B	4									
6	A	5									
7	R	6									
8	E	7									
9	L	8									
10	L	9									

SUBMISSION 8: submit a representation of the resulting matrix from the leveshtein edit distance calculation. The resulting value should be correct.