Assignment III

Group # 11

Spark Streaming

Ruiman Zhong r0767577

Aiste Mickute r0779700

Tomas Zivatkauskas r0779953

Agbor Dirane Ashu r0637968

Introduction and First Steps

The main aim of Assignment 3 was to build a model using Apache spark *MLlib* which could predict labels ("safe", "unsafe" and "vandal") for the incoming Wikipedia edits stream. This report gives an overview of the main steps taken in order to achieve that and the final results. However, note that only some parts of code are displayed in this document. For the entire code with final outputs the reader should see files Assignment_3_spark_streaming_model.ipynb and Assignment_3_spark_streaming_predicting_real_time.ipynb.

After setting up Spark using the provided instructions and example notebooks, the dataset of Wikipedia edits was built. The edits were coming in every 10 seconds and saved in a separate folder starting with "myoutput" (or any other specified name) and followed by a unique string of numbers, as shown in Figure 1 (left). Each folder then contained an even number of files, usually between 2 and 14 (although sometimes there might be more depending on the number of incoming edits during the time interval). The files were given in two formats: .crc and file with no extension (Figure 1, right). The Wikipedia edit was saved in the latter file as a JSON dictionary. To indicate that the saving was carried out successfully, two files, ._SUCCESS.crc and _SUCCESS (with no file extension) were always contained in the folder even if no edits were made during that time. The total number ofcollected edits was 58848.

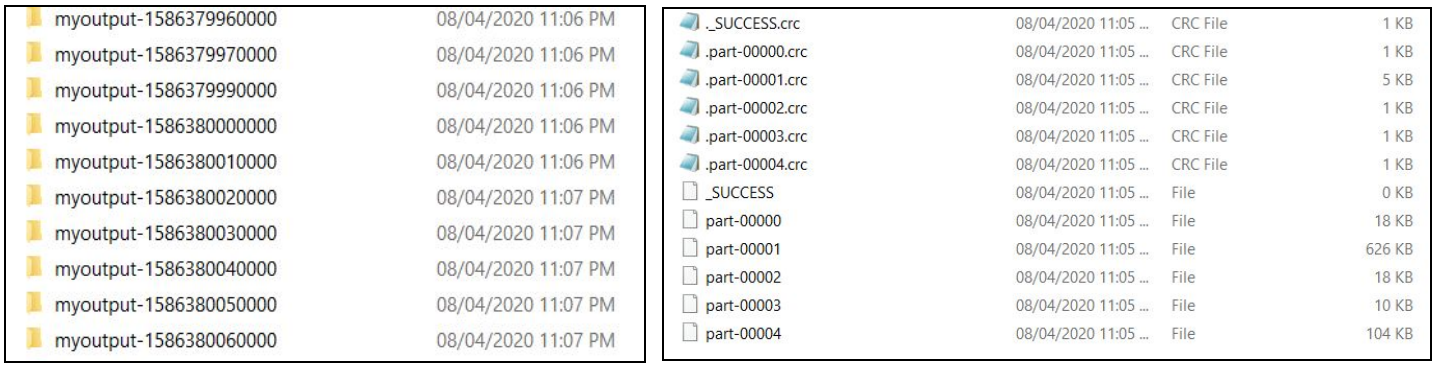


Figure 1. *Saving Spark Streaming Output*

All edits were put into one JSON data frame by looping through the subfolders containing them and using the *spark.read.json* function. A small part of the data frame where each row represents one instance (edit) from Wikipedia is shown in Figure 2 together with the code used to get it.

```
# LOOP THROUGH ALL FILES

import os
rootdir = 'C:/Users/Aistuxxe/Documents/spark/myoutput'

files_list = []

for subdir, dirs, files in os.walk(rootdir):
    for name in files:
        if "part" in name.lower() and not ".crc" in name.lower():
            files_list.append(os.path.join(subdir,name))
```

```
# PUT ALL FILES TO ONE JSON DATAFRAME

df = spark.read.json(sc.textFile(','.join(files_list)))
df.show()
```

```
+--------------------+------+------------------+--------------------+--------------------+--------------------+--------------------+
|             comment| label|         name_user|            text_new|            text_old|          title_page|            url_page|
+--------------------+------+------------------+--------------------+--------------------+--------------------+--------------------+
|        →References|  safe|       KingSkyLord|{{Infobox ice hoc...|{{Infobox ice hoc...|1959–60 Montreal ...|//en.wikipedia.or...|
|→top:missing tem...|  safe|            Pburka|{{Proposed deleti...|{{Proposed deleti...|   Battle of Mpotona|//en.wikipedia.or...|
|        (→Gameplay)|vandal|      86.9.136.196|{{Use British Eng...|{{Use British Eng...|     My Friend Pedro|//en.wikipedia.or...|
|       (Added More.)|unsafe|     AndersonL7333|{{Infobox politic...|{{Infobox politic...|          Janata Dal|//en.wikipedia.or...|
|→Parodies and co...|  safe|      InedibleHulk|{{short descripti...|{{short descripti...|Smells Like Teen ...|//en.wikipedia.or...|
```

Figure 2. *JSON data frame and corresponding code.*

Data Preprocessing

Before building a prediction model, we performed some data preprocessing. Firstly, we used the *ndiff* function from the *difflib* library to get the difference between the columns *text_old* and *text_new*. The code and example differences can be seen in Figure 3. We assumed that taking into account whether the text was added or deleted would not add much value to the prediction of classes. The reasoning behind it was that the deleted text in all three classes would be similar, since there would be no illogical / nonsensical words. Of course, one might hypothesize that the size is what matters in this case, i.e. “vandal” cases usually comprise large chunks of text being deleted. However, after exploring the data and in order to avoid overcomplicating the model, we assumed that plain difference is enough to distinguish between classes, regardless of whether the edit was made to add or delete text.

```
# DIFFERENCE BETWEEN OLD AND NEW TEXT

import difflib
import pyspark.sql.functions as F
from pyspark.sql.types import *

def make_diff(old, new):
    diff = difflib.ndiff(old, new)
    delta = ''.join(x[2:] for x in diff if x.startswith('- ') or x.startswith('+'))
    return delta

#convert to a UDF Function and get difference between columns
udfmake_diff = F.udf(make_diff, StringType())
df_difference = df.withColumn("difference", lit(udfmake_diff("text_old", "text_new")))
df_difference.show()
```

```
+--------------------+------+------------------+--------------------+--------------------+--------------------+--------------------+--------------------+
|             comment| label|         name_user|            text_new|            text_old|          title_page|            url_page|          difference|
+--------------------+------+------------------+--------------------+--------------------+--------------------+--------------------+--------------------+
|        →References|  safe|       KingSkyLord|{{Infobox ice hoc...|{{Infobox ice hoc...|1959–60 Montreal ...|//en.wikipedia.or...|[[Category:1959 i...|
|→top:missing tem...|  safe|            Pburka|{{Proposed deleti...|{{Proposed deleti...|   Battle of Mpotona|//en.wikipedia.or...|            comment=|
|        (→Gameplay)|vandal|     86.9.136.196|{{Use British Eng...|{{Use British Eng...|     My Friend Pedro|//en.wikipedia.or...| I LIKE COCAAAAAA...|
|       (Added More.)|unsafe|     AndersonL7333|{{Infobox politic...|{{Infobox politic...|          Janata Dal|//en.wikipedia.or...|]]                  |
|ideology     ...|
```

Figure 3. *Adding difference between text_old and text_new*

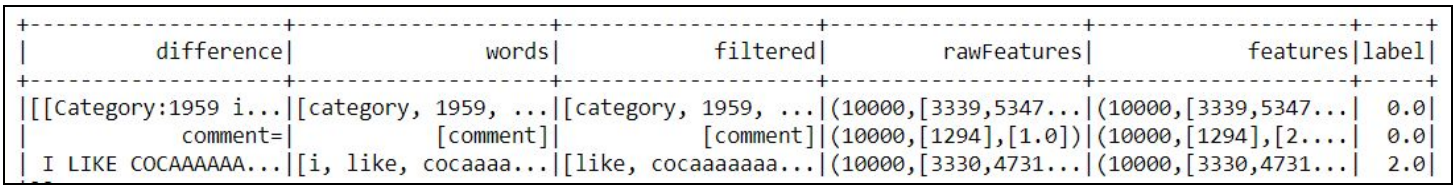
After creating the *difference* column, we transformed it using tokenization (breaking text into words), normalization and stop word removal, using stop words provided by the *Ranks NL*[1]. Then we created TF-IDF feature vectors by hashing the differences using the *HashingTF* function and rescaling them using *IDF*. Each difference was considered as a document and the whole collection of differences as the corpus. The reasoning behind this was that vandalism usually could be indicated by certain keywords, such as 'mom', 'lol', 'Jews', 'follow' ('follow me on TikTok') which were rare among edits but normal words in Wikipedia texts, while safe instances contained popular words, typo fixes, etc. Thus it made more sense to use *difference* and not, for example, *text_old* as the corpus. These TF-IDF vectors were later used as features for our Logistic Regression model.

Since the selected model accepted only numeric labels, we converted the categorical *label* column into a numeric one where the labels "safe", "unsafe" and "vandal" corresponded to numeric labels 0, 1 and 2, respectively. Additionally, for convenience we put all of the above steps into a pipeline, trained it on the dataset (the training dataset or the whole dataset depending on whether it was model tuning stage or the final model fitting stage) and saved it to be used for predicting live Spark stream.

The final result of data preprocessing can be seen in Figure 4 where the *difference* column was obtained as explained above, *words* column corresponds to transformed *difference* after tokenization and normalization, *filtered* column is transformed *words* after stop words removal, *rawFeatures* and *features* columns are obtained using *HashingTF* and *IDF* functions,

[1] https://www.ranks.nl/stopwords

respectively, and *label* column is the numerical representative of the categorical *label* column (note, we renamed the categorical *label* column to *label_string* for convenience).



difference	words	filtered	rawFeatures	features	label
[[Category:1959 i...	[category, 1959, ...	[category, 1959, ...	(10000,[3339,5347...	(10000,[3339,5347...	0.0
comment=	[comment]	[comment]	(10000,[1294],[1.0])	(10000,[1294],[2....	0.0
I LIKE COCAAAAAA...	[i, like, cocaaaa...	[like, cocaaaaaaa...	(10000,[3330,4731...	(10000,[3330,4731...	2.0

Figure 4. *Intermediate steps of featurizing the difference column*

Finally, we also observed that the *comment* column had potential of being a good identificator of "safe" / "unsafe" / "vandal" classes, since the latter two cases often included nonsensical or out of the ordinary words or even no comments at all. Thus we preprocessed *comment* in the same way as the *difference* and combined both of them into one *features* column using the *VectorAssembler* function. In the modeling stage we used the features built from *difference* only and the combined *comment* and *difference* features separately, compared the results and then decided which features resulted in better accuracy (see section on Modeling).

Modeling

Before proceeding with the description of the modeling stage we have to note that using all 58848 collected edits to try, train and test the different models would have taken too long. None of our computers were able to handle such a large dataset without overheating and it would have taken over a week of non-stop code running only to select the best model not to mention rerunning the code on the whole dataset to fit the final model (considering that we also had to run codes for other assignments in parallel). Thus we selected a smaller subset of 1665 edits for the model selection and the final model training stages (label distribution can be seen in Table 2). The idea was to show our reasoning even if the final fitted model would not give extremely satisfying results.

Table 2. *The number (percentage) of edits by label in dataset used for model selection*

Safe	Unsafe	Vandal	Total
1405 (84.38%)	233 (13.99%)	27 (1.62%)	1665

In order to select and tune the model, we divided the featurized dataset from Table 2 to train and test sets (70% and 30%, respectively). The label distribution for both of them can be seen in Table 3.

Table 3. *The number (percentage) of edits by label in training and testing datasets*

Label	Safe	Unsafe	Vandal	Total
Training	995 (84.68%)	161 (13.70%)	19 (1.62%)	1175
Testing	410 (83.67%)	72 (14.69%)	8 (1.63%)	490

After some research, multiclass logistic regression was selected as the main model. Since the label classes were very unbalanced, we fitted both unweighted and weighted logistic regression with default parameter values, except for the maximum number of iterations (*maxIter*) which we set to 20 both because it was observed that this number was high enough for the model to converge and to limit the model training time. The corresponding weights used in weighted logistic regression were 1.18, 7.30 and 61.84 for safe, unsafe and vandal classes, respectively. The unweighted and weighted logistic regressions were fitted first using *features* based solely on difference and afterwards using *features* based on both difference and comments. The overall model accuracies and accuracies by label for train and test datasets can be seen in Tables 5 and 6. Accuracy measure here was chosen as a percentage of correctly classified edits (in the whole dataset / per label).

Table 5. *Overall model accuracies and accuracies by label for the training dataset*

	Unweighted Log. Regression		**Weighted Log. Regression**	
	Difference	**Diff. + Comment**	**Difference**	**Diff. + Comment**
Safe	99.50%	99.80%	99.00%	99.60%
Unsafe	92.02%	97.52%	95.71%	98.76%
Vandal	100.00%	100.00%	100.00%	100.00%
Overall	98.48%	99.49%	98.56%	99.49%

Table 6. *Overall model accuracies and accuracies by label for the testing dataset*

	Unweighted Log. Regression		**Weighted Log. Regression**	
	Difference	**Diff. + Comment**	**Difference**	**Diff. + Comment**
Safe	92.67%	90.73%	95.35%	92.93%
Unsafe	27.14%	31.94%	24.29%	33.33%
Vandal	0.00%	0.00%	0.00%	0.00%
Overall	81.22%	80.61%	83.35%	82.65%

Looking at the results for the training set (Table 5), we could see that all of the models learned vandal cases perfectly, which might imply overfitting (however, natural for training set), while the other two classes also had relatively high classification accuracies. However, weighted logistic regression with combined difference and comment features was noticeably better at predicting the other two labels as well. Table 6 indicated that this model was also the best at predicting unsafe cases in the test set although only second best at predicting safe cases. As expected, the underrepresented vandal class had 0% prediction accuracy for the test set, however we could argue that having higher accuracy in the unsafe class means that the model is able to pick up on unusual activity and with a larger training dataset the model would also learn to classify vandal cases better. Thus we selected weighted logistic regression with combined difference and comment features as the best model out of the four.

Since all of the above models were fitted using default parameter values (except for *maxIter*), the next modeling step would be to perform k-fold cross-validation on the selected model to tune its parameters such as *regParam* and *elasticNetParam*. The possible evaluation metrics for tuning parameters using the *MulticlassClassificationEvaluator* function include F1 measure, weighted precision, weighted recall and accuracy. Out of the four only the F1 measure is considered to be a satisfactory metric for imbalanced classification[2] (and it is the default one), while the latter three favour larger classes and neglect the infrequent ones[3]. The code for this step was written, however, the aforementioned limitations of the laptops in our possession prevented us from running it fully and getting the desired results. Thus the final model was selected to be simply the weighted logistic regression with combined difference and comment features. It was trained (together with the pipeline) on the whole dataset mentioned in Table 2 and saved for the real-time predicting of the incoming Spark stream of Wikipedia edits. Note that the pipeline was

[2] https://machinelearningmastery.com/tour-of-evaluation-metrics-for-imbalanced-classification/
[3] https://kawahara.ca/weighted-precision-recall-equation/

trained on the train set in such a way that the new incoming edits would be featurized using corpus from the train set.

Real-Time Predictions

After training and saving the final preprocessing and featurization pipeline, and logistic regression model, they were utilized to predict labels for the live Wikipedia edits data stream. Some of the live preprocessing and label prediction outputs are shown in the next two pages. Each output consists of three tables: the original Wikipedia edit that came in through the stream, the extracted features after preprocessing with the saved pipeline and the final prediction where *label* and *label_string* correspond to the true label, while the *prediction* and *prediction_string* correspond to the label predicted by the saved model.

As expected, the model was very good at predicting safe and unsafe cases. Of course, there were some cases when it predicted a safe edit instead of the unsafe one or vice versa. Regarding the vandal cases, the model usually predicted an unsafe label showing that it picked up on weird activity, but was too weak to detect vandalism. Tuning the model with cross-validation and training it on a larger dataset would possibly fix this issue.

```
ssc_t = StreamingThread(ssc)
ssc_t.start()
```

```
========= 2020-05-31 22:57:20 =========
+--------------------+-----+-----------+--------------------+--------------------+--------------------+--------------------+
|             comment|label|  name_user|            text_new|            text_old|          title_page|            url_page|
+--------------------+-----+-----------+--------------------+--------------------+--------------------+--------------------+
|Adding localshort...| safe|Red Director|{{short descripti...|{{Infobox footbal...|        Masaya Honda|//en.wikipedia.or...|
|→Descriptions in...| safe|Gre regiment|[[File:Fight Pygm...|[[File:Fight Pygm...|Pygmy (Greek myth...|//en.wikipedia.or...|
+--------------------+-----+-----------+--------------------+--------------------+--------------------+--------------------+

+--------------------+--------------------+--------------------+--------------------+--------------------+-----+
|          difference|             comment|       features_diff|    features_comment|            features|label|
+--------------------+--------------------+--------------------+--------------------+--------------------+-----+
|{{short descripti...|Adding localshort...|(10000,[205,964,8...|(10000,[205,2626,...|(20000,[205,2626,...|  0.0|
|               [[]]|→Descriptions in...|       (10000,[],[])|(10000,[2482,7586...|(20000,[2482,7586...|  0.0|
+--------------------+--------------------+--------------------+--------------------+--------------------+-----+

+--------------------+--------------------+--------------------+-----+------------+----------+----------------+
|             comment|          difference|         probability|label|label_string|prediction|prediction_string|
+--------------------+--------------------+--------------------+-----+------------+----------+----------------+
|Adding localshort...|{{short descripti...|[1.0,1.3932052190...|  0.0|        safe|       0.0|            safe|
|→Descriptions in...|               [[]]|[0.54739470418626...|  0.0|        safe|       0.0|            safe|
+--------------------+--------------------+--------------------+-----+------------+----------+----------------+
```

```
========= 2020-05-31 22:57:30 =========
+--------------------+-----+---------+--------------------+--------------------+--------------------+--------------------+
|             comment|label|name_user|            text_new|            text_old|          title_page|            url_page|
+--------------------+-----+---------+--------------------+--------------------+--------------------+--------------------+
|→Qualifications ...| safe| Pokeswap|The '''Chief Priv...|The '''Chief Priv...|Chief privacy off...|//en.wikipedia.or...|
|           →Career| safe|     Ytkr|{{Multiple issues...|{{Multiple issues...|       Sudendu Shah|//en.wikipedia.or...|
+--------------------+-----+---------+--------------------+--------------------+--------------------+--------------------+

+----------+--------------------+-------------+--------------------+--------------------+-----+
|difference|             comment|features_diff|    features_comment|            features|label|
+----------+--------------------+-------------+--------------------+--------------------+-----+
|        }}|→Qualifications ...|(10000,[],[])|(10000,[5396,6319...|(20000,[5396,6319...|  0.0|
|       he |           →Career|(10000,[],[])|(10000,[2566],[4....|(20000,[2566],[4....|  0.0|
+----------+--------------------+-------------+--------------------+--------------------+-----+

+--------------------+----------+--------------------+-----+------------+----------+----------------+
|             comment|difference|         probability|label|label_string|prediction|prediction_string|
+--------------------+----------+--------------------+-----+------------+----------+----------------+
|→Qualifications ...|        }}|[2.93897577671134...|  0.0|        safe|       1.0|          unsafe|
|           →Career|       he |[0.89724028386858...|  0.0|        safe|       0.0|            safe|
+--------------------+----------+--------------------+-----+------------+----------+----------------+
```

```
========= 2020-05-31 22:59:10 =========
+--------------------+------+--------------+--------------------+--------------------+-----------+--------------------+
|             comment| label|     name_user|            text_new|            text_old| title_page|            url_page|
+--------------------+------+--------------+--------------------+--------------------+-----------+--------------------+
|→Can superflares...|  safe|     Bender235|{{about|the extra...|{{about|the extra...| Superflare|//en.wikipedia.or...|
|                    |unsafe|Invisible Devil|{{Use dmy dates|d...|{{Use dmy dates|d...|Shampa Reza|//en.wikipedia.or...|
+--------------------+------+--------------+--------------------+--------------------+-----------+--------------------+

+--------------------+--------------------+--------------------+--------------------+--------------------+-----+
|          difference|             comment|       features_diff|    features_comment|            features|label|
+--------------------+--------------------+--------------------+--------------------+--------------------+-----+
|         pdfabs.pdf|→Can superflares...|(10000,[789,4115]...|(10000,[20,427,95...|(20000,[20,427,95...|  0.0|
| She is working a...|                    |(10000,[521,1368,...|       (10000,[],[])|(20000,[10521,113...|  1.0|
+--------------------+--------------------+--------------------+--------------------+--------------------+-----+

+--------------------+--------------------+--------------------+-----+------------+----------+----------------+
|             comment|          difference|         probability|label|label_string|prediction|prediction_string|
+--------------------+--------------------+--------------------+-----+------------+----------+----------------+
|→Can superflares...|         pdfabs.pdf|[1.0,1.7906498683...|  0.0|        safe|       0.0|            safe|
|                    | She is working a...|[0.08762688090726...|  1.0|      unsafe|       1.0|          unsafe|
+--------------------+--------------------+--------------------+-----+------------+----------+----------------+
```

```
========= 2020-05-31 23:04:40 =========
+--------------------+------+-----------+--------------------+--------------------+------------------+--------------------+
|             comment| label|  name_user|            text_new|            text_old|        title_page|            url_page|
+--------------------+------+-----------+--------------------+--------------------+------------------+--------------------+
|ReplacedarXivPDF ...|  safe|  Bender235|In geometry, a ''...|In geometry, a ''...|Substitution tiling|//en.wikipedia.or...|
|                    |unsafe|Sourav duir|{{short descripti...|{{short descripti...|          Amit Shah|//en.wikipedia.or...|
+--------------------+------+-----------+--------------------+--------------------+------------------+--------------------+

+------------+--------------------+--------------------+--------------------+--------------------+-----+
|  difference|             comment|       features_diff|    features_comment|            features|label|
+------------+--------------------+--------------------+--------------------+--------------------+-----+
|pdfabspdfabs|ReplacedarXivPDF ...|(10000,[3837],[6....|(10000,[20,1709,2...|(20000,[20,1709,2...|  0.0|
|          20|                    |(10000,[3746],[2....|       (10000,[],[])|(20000,[13746],[2...|  1.0|
+------------+--------------------+--------------------+--------------------+--------------------+-----+

+--------------------+------------+--------------------+-----+------------+----------+----------------+
|             comment|  difference|         probability|label|label_string|prediction|prediction_string|
+--------------------+------------+--------------------+-----+------------+----------+----------------+
|ReplacedarXivPDF ...|pdfabspdfabs|[1.0,4.7480403239...|  0.0|        safe|       0.0|            safe|
|                    |          20|[0.57808647162968...|  1.0|      unsafe|       0.0|            safe|
+--------------------+------------+--------------------+-----+------------+----------+----------------+


========= 2020-05-31 23:07:30 =========
+--------------------+------+--------------------+--------------------+--------------------+--------------------+--------------------+
|             comment| label|           name_user|            text_new|            text_old|          title_page|            url_page|
+--------------------+------+--------------------+--------------------+--------------------+--------------------+--------------------+
| →Response:Wikilink|  safe|           NedFausa|{{distinguish|Bla...|{{distinguish|Bla...|Antifa (United St...|//en.wikipedia.or...|
|    (→Death at sea)|vandal|2601:98a:304:cb40...|{{other people||J...|{{other people||J...|John FitzAlan, 1s...|//en.wikipedia.or...|
|Adding localshort...|  safe|        Red Director|{{short descripti...|{{Infobox footbal...|Kohei Mihara (foo...|//en.wikipedia.or...|
|    →In Lithuania:m|  safe|               Ke an|{{About|the Balti...|{{About|the Balti...|     Forest Brothers|//en.wikipedia.or...|
+--------------------+------+--------------------+--------------------+--------------------+--------------------+--------------------+

+--------------------+--------------------+--------------------+--------------------+--------------------+-----+
|          difference|             comment|       features_diff|    features_comment|            features|label|
+--------------------+--------------------+--------------------+--------------------+--------------------+-----+
|               [[]]| →Response:Wikilink|       (10000,[],[])|(10000,[1164,2445...|(20000,[1164,2445...|  0.0|
| it said i could ...|    (→Death at sea)|(10000,[1310,1850...|(10000,[5416,7275...|(20000,[5416,7275...|  2.0|
|{{short descripti...|Adding localshort...|(10000,[205,964,8...|(10000,[205,2626,...|(20000,[205,2626,...|  0.0|
|              left||    →In Lithuania:m|(10000,[1662],[5....|(10000,[6178,6638...|(20000,[6178,6638...|  0.0|
+--------------------+--------------------+--------------------+--------------------+--------------------+-----+

+--------------------+--------------------+--------------------+-----+------------+----------+----------------+
|             comment|          difference|         probability|label|label_string|prediction|prediction_string|
+--------------------+--------------------+--------------------+-----+------------+----------+----------------+
| →Response:Wikilink|               [[]]|[0.99999997224121...|  0.0|        safe|       0.0|            safe|
|    (→Death at sea)| it said i could ...|[3.94059564690059...|  2.0|      vandal|       1.0|          unsafe|
|Adding localshort...|{{short descripti...|[1.0,1.3932052190...|  0.0|        safe|       0.0|            safe|
|    →In Lithuania:m|              left||[0.99998163200471...|  0.0|        safe|       0.0|            safe|
+--------------------+--------------------+--------------------+-----+------------+----------+----------------+


========= 2020-06-01 00:12:20 =========
+--------------------+------+----------------+--------------------+--------------------+--------------------+--------------------+
|             comment| label|       name_user|            text_new|            text_old|          title_page|            url_page|
+--------------------+------+----------------+--------------------+--------------------+--------------------+--------------------+
|(→First-person s...|unsafe|  190.178.207.227|{{short descripti...|{{short descripti...|         Game engine|//en.wikipedia.or...|
|                    |  safe|        Arkhandar|{{short descripti...|{{short descripti...|    Rosalina (Mario)|//en.wikipedia.or...|
|          →Military|  safe|      RickMoretti|{{short descripti...|{{short descripti...|         French name|//en.wikipedia.or...|
|typo(s) fixed: Tr...|  safe|Chris the speller|{{about|the direc...|{{about|the direc...|Mayor of Greater ...|//en.wikipedia.or...|
|updated figure to...|  safe|         Scheng23|{{DISPLAYTITLE:''...|{{DISPLAYTITLE:''...|            O-GlcNAc|//en.wikipedia.or...|
+--------------------+------+----------------+--------------------+--------------------+--------------------+--------------------+

+--------------------+--------------------+--------------------+--------------------+--------------------+-----+
|          difference|             comment|       features_diff|    features_comment|            features|label|
+--------------------+--------------------+--------------------+--------------------+--------------------+-----+
|             RONALDO|(→First-person s...|(10000,[1069],[6....|(10000,[3183,5778...|(20000,[3183,5778...|  1.0|
|Super 3DParty10World|                    |(10000,[1340,2659...|       (10000,[],[])|(20000,[11340,126...|  0.0|
|Superiors address...|          →Military|(10000,[126,398,8...|(10000,[5877],[5....|(20000,[5877,1012...|  0.0|
|- _Express|Transp...|typo(s) fixed: Tr...|(10000,[579,8962]...|(10000,[1139,1188...|(20000,[1139,1188...|  0.0|
|   bright|alt=|alt=
|updated figure to...|(10000,[1456,5196...|(10000,[2288,3587...|(20000,[2288,3587...|  0.0|
+--------------------+--------------------+--------------------+--------------------+--------------------+-----+

+--------------------+--------------------+--------------------+-----+------------+----------+----------------+
|             comment|          difference|         probability|label|label_string|prediction|prediction_string|
+--------------------+--------------------+--------------------+-----+------------+----------+----------------+
|(→First-person s...|             RONALDO|[1.43211468765088...|  1.0|      unsafe|       1.0|          unsafe|
|                    |Super 3DParty10World|[0.96418490742483...|  0.0|        safe|       0.0|            safe|
|          →Military|Superiors address...|[0.99999999984646...|  0.0|        safe|       0.0|            safe|
|typo(s) fixed: Tr...|- _Express|Transp...|[1.0,7.1168850024...|  0.0|        safe|       0.0|            safe|
|updated figure to...|   bright|alt=|alt=
|[0.99999999738693...|  0.0|        safe|       0.0|            safe|
+--------------------+--------------------+--------------------+-----+------------+----------+----------------+
```