book

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Streszczenie

Słowa kluczowe: Big Data, Spark, AWS, EMR, S3

Summary

Keywords: Big Data, Spark, AWS, EMR, S3

1 Wstęp

Celem niniejszej pracy jest utworzenie infrastruktury w chmurze obliczeniowej AWS pozwalające na wielkoskalową analizy danych w sytemie rozproszonym (ang. *Big Data*).

Do stworzenia przykładowego projektu wykorzystano dane ze strony *Stack Exchange* zawierającej zestawy danych pochodzące z forów społecznościoowych. Analizę ograniczono do danych pochodzących z forum o nazwie *Beer, Wine and Spirits*.

W niniejszej pracy ...

Part I

Wyniki i Dyskusja

Lorem ipsum

2 Load data to data frames

```
from pyspark.sql import SparkSession
import os

PATH="jars/spark-xml_2.12-0.15.0.jar"

spark = SparkSession.builder.master("local[12]").appName("MyApp").config("spark.jars", PATH)
```

```
23/01/06 14:32:55 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform

Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
```

2.1 Users

```
from pyspark.sql.types import *

users_schema = StructType([
    StructField('_AboutMe', StringType(), True),
    StructField('_AccountId', IntegerType(), True),
    StructField('_CreationDate', TimestampType(), True),
    StructField("_DisplayName", StringType(), True),
    StructField("_DownVotes", IntegerType(), True),
    StructField("_Id", IntegerType(), True),
    StructField("_LastAccessDate", TimestampType()),
    StructField("_Location", StringType(), True),
    StructField("_ProfileImageUrl", StringType(), True),
    StructField("_Reputation", IntegerType(), True),
    StructField("_UpVotes", IntegerType(), True),
    StructField("_Views", IntegerType(), True),
    StructField("_WebsiteUrl", StringType(), True)
])

users = spark.read.format('xml').options(rowTag='row').schema(users_schema).load("data/Users
users.show(5)
```

```
+--------------------+----------+--------------------+--------------+----------+---+----------
|            _AboutMe|_AccountId|       _CreationDate|  _DisplayName|_DownVotes|_Id|     _LastA
+--------------------+----------+--------------------+--------------+----------+---+----------
```

```
|<p>Hi, I'm not re...|        -1|2014-01-21 17:45:...|     Community|       478|  -1|2014-01-21
|<p>Dev #2 who hel...|         2|2014-01-21 20:21:...|  Geoff Dalgas|         0|   1|2016-05-06
|<p>Former Stack E...|    109934|2014-01-21 20:22:...|Kasra Rahjerdi|         0|   2|2018-01-29
|\n<p>Developer at...|     37099|2014-01-21 20:22:...|     Adam Lear|         2|   3|2021-06-04
|<p><strong>BY DAY...|    237028|2014-01-21 20:22:...| Arie Litovsky|         0|   4|2016-12-23
+--------------------+----------+--------------------+--------------+----------+----+----------
only showing top 5 rows
```

2.2 Tags

```
tags_schema = StructType([
    StructField('_Count', IntegerType(), True),
    StructField('_ExcerptPostId', IntegerType(), True),
    StructField('_Id', IntegerType(), True),
    StructField("_TagName", StringType(), True),
    StructField("_WikiPostId", IntegerType(), True)
])

tags = spark.read.format('xml').options(rowTag='row').schema(tags_schema).load("data/Tags.xm
tags.show(n=5)
```

```
+------+--------------+---+-----------+-----------+
|_Count|_ExcerptPostId|_Id|   _TagName|_WikiPostId|
+------+--------------+---+-----------+-----------+
|    17|          5062|  1|       hops|       5061|
|    85|          7872|  2|    history|       7871|
|    69|          4880|  4|    brewing|       4879|
|    37|          5109|  5|    serving|       5108|
|    31|           304|  6|temperature|        303|
+------+--------------+---+-----------+-----------+
only showing top 5 rows
```

2.3 Votes

```
votes_schema = StructType([
    StructField('_BountyAmount', IntegerType(), True),
    StructField('_CreationDate', TimestampType(), True),
    StructField('_Id', IntegerType(), True),
    StructField("_PostId", StringType(), True),
    StructField("_UserId", IntegerType(), True),
    StructField("_VoteTypeId", IntegerType(), True)
])

votes = spark.read.format('xml').options(rowTag='row').schema(votes_schema).load("data/Votes
votes.show(n=5)
```

```
+-------------+-------------------+---+-------+-------+-----------+
|_BountyAmount|      _CreationDate|_Id|_PostId|_UserId|_VoteTypeId|
+-------------+-------------------+---+-------+-------+-----------+
|         null|2014-01-21 00:00:00|  1|      1|   null|          2|
|         null|2014-01-21 00:00:00|  2|      1|   null|          2|
|         null|2014-01-21 00:00:00|  3|      4|   null|          2|
|         null|2014-01-21 00:00:00|  4|      1|   null|          2|
|         null|2014-01-21 00:00:00|  5|      4|   null|          2|
+-------------+-------------------+---+-------+-------+-----------+
only showing top 5 rows
```

2.4 Posts

```
posts_schema = StructType([
    StructField('_AcceptedAnswerId', IntegerType(), True),
    StructField('_AnswerCount', IntegerType(), True),
    StructField('_Body', StringType(), True),
    StructField("_ClosedDate", TimestampType(), True),
    StructField("_CommentCount", IntegerType(), True),
    StructField("_CommunityOwnedDate", TimestampType(), True),
    StructField("_ContentLicense", StringType(), True),
    StructField("_CreationDate", TimestampType(), True),
    StructField("_FavoriteCount", IntegerType(), True),
    StructField("_Id", IntegerType(), True),
    StructField("_LastActivityDate", TimestampType(), True),
    StructField("_LastEditDate", TimestampType(), True),
    StructField("_LastEditorDisplayName", StringType(), True),
    StructField("_LastEditorUserId", IntegerType(), True),
    StructField("_OwnerDisplayName", StringType(), True),
    StructField("_OwnerUserId", IntegerType(), True),
    StructField("_ParentId", IntegerType(), True),
    StructField("_PostTypeId", IntegerType(), True),
    StructField("_Score", IntegerType(), True),
    StructField("_Tags", StringType(), True),
    StructField("_Title", StringType(), True),
    StructField("_ViewCount", IntegerType(), True),
])

posts = spark.read.format('xml').options(rowTag='row').schema(posts_schema).load("data/Posts
posts.show(n=1,vertical=True, truncate=False)
```

```
-RECORD 0-------------------------------------------------------------------------------------
 _AcceptedAnswerId      | 4
 _AnswerCount           | 1
 _Body                  | <p>I was offered a beer the other day that was reportedly made with c
 _ClosedDate            | null
 _CommentCount          | 0
 _CommunityOwnedDate    | null
 _ContentLicense        | CC BY-SA 3.0
 _CreationDate          | 2014-01-21 20:26:05.383
 _FavoriteCount         | null
 _Id                    | 1
 _LastActivityDate      | 2014-01-21 22:04:34.977
 _LastEditDate          | 2014-01-21 22:04:34.977
 _LastEditorDisplayName | null
 _LastEditorUserId      | 8
 _OwnerDisplayName      | null
 _OwnerUserId           | 7
 _ParentId              | null
 _PostTypeId            | 1
 _Score                 | 21
 _Tags                  | <hops>
 _Title                 | What is a citra hop, and how does it differ from other hops?
 _ViewCount             | 2434
only showing top 1 row
```

2.5 Post links

```
links_schema = StructType([
    StructField("_CreationDate", TimestampType()),
    StructField("_Id", IntegerType()),
    StructField("_LinkTypeId", IntegerType()),
    StructField("_PostId", IntegerType()),
    StructField("_RelatedPostId", IntegerType())
])

links = spark.read.format('xml').options(rowTag='row').schema(links_schema).load("data/PostL
links.show(n=2,vertical=True, truncate=False)
```

```
-RECORD 0----------------------------------
 _CreationDate  | 2014-01-21 21:04:25.23
 _Id            | 25
 _LinkTypeId    | 3
 _PostId        | 29
 _RelatedPostId | 25
-RECORD 1----------------------------------
 _CreationDate  | 2014-01-21 21:42:09.103
 _Id            | 89
 _LinkTypeId    | 1
 _PostId        | 83
 _RelatedPostId | 50
only showing top 2 rows
```

2.6 Post History

```
history_schema = StructType([
    StructField("_Comment", StringType()),
    StructField("_ContentLicense", StringType()),
    StructField("_CreationDate", TimestampType()),
    StructField("_Id", IntegerType()),
    StructField("_PostHistoryTypeId", IntegerType()),
    StructField("_PostId", IntegerType()),
    StructField("_RevisionGUID", StringType()),
    StructField("_Text", StringType()),
    StructField("_UserDisplayName", StringType()),
    StructField("_UserId", IntegerType()),
])

history = spark.read.format('xml').options(rowTag='row').schema(history_schema).load("data/P
history.show(n=5,vertical=True, truncate=False)
```

```
-RECORD 0-------------------------------------------------------------------------------------
 _Comment           | null
 _ContentLicense    | CC BY-SA 3.0
 _CreationDate      | 2014-01-21 20:26:05.383
 _Id                | 1
 _PostHistoryTypeId | 2
 _PostId            | 1
 _RevisionGUID      | a17002a0-00b0-417b-a404-0d8864bbbca5
 _Text              | I was offered a beer the other day that was reportedly made with citrate
 _UserDisplayName   | null
 _UserId            | 7
-RECORD 1-------------------------------------------------------------------------------------
 _Comment           | null
 _ContentLicense    | CC BY-SA 3.0
 _CreationDate      | 2014-01-21 20:26:05.383
 _Id                | 2
 _PostHistoryTypeId | 1
 _PostId            | 1
 _RevisionGUID      | a17002a0-00b0-417b-a404-0d8864bbbca5
 _Text              | What is a citra hop, and how does it differ from other hops?
 _UserDisplayName   | null
 _UserId            | 7
-RECORD 2-------------------------------------------------------------------------------------
 _Comment           | null
 _ContentLicense    | CC BY-SA 3.0
 _CreationDate      | 2014-01-21 20:26:05.383
 _Id                | 3
 _PostHistoryTypeId | 3
 _PostId            | 1
 _RevisionGUID      | a17002a0-00b0-417b-a404-0d8864bbbca5
 _Text              | <hops>
 _UserDisplayName   | null
 _UserId            | 7
-RECORD 3------------------------------------------------------------------------------------
 _Comment           | null
 _ContentLicense    | CC BY-SA 3.0
 _CreationDate      | 2014-01-21 20:27:29.797
 _Id                | 4
 _PostHistoryTypeId | 2
 _PostId            | 2
 _RevisionGUID      | 128709c5-8789-4d1c-a799-49a7e37da36b
 _Text              | As far as we know, when did humans first brew beer, and where? Around whe
 _UserDisplayName   | null
 _UserId            | 7
-RECORD 4------------------------------------------------------------------------------------
 _Comment           | null
 _ContentLicense    | CC BY-SA 3.0
 _CreationDate      | 2014-01-21 20:27:29.797
 _Id                | 5
 _PostHistoryTypeId | 1
 _PostId            | 2
 _RevisionGUID      | 128709c5-8789-4d1c-a799-49a7e37da36b
 _Text              | When was the first beer ever brewed?
 _UserDisplayName   | null
 _UserId            | 7
only showing top 5 rows
```

2.7 Badges

```
badges_schema = StructType([
    StructField("_Class", IntegerType()),
    StructField("_Date", TimestampType()),
    StructField("_Id", IntegerType()),
    StructField("_Name", StringType()),
    StructField("_TagBased", BooleanType()),
    StructField("_UserId", IntegerType()),
])

badges = spark.read.format('xml').options(rowTag='row').schema(badges_schema).load("data/Bad
badges.show(n=5,vertical=True, truncate=False)
```

```
-RECORD 0---------------------------
 _Class    | 3
 _Date     | 2014-01-21 20:52:16.97
 _Id       | 1
 _Name     | Autobiographer
 _TagBased | false
 _UserId   | 1
-RECORD 1---------------------------
 _Class    | 3
 _Date     | 2014-01-21 20:52:16.97
 _Id       | 2
 _Name     | Autobiographer
 _TagBased | false
 _UserId   | 2
-RECORD 2---------------------------
 _Class    | 3
 _Date     | 2014-01-21 20:52:16.97
 _Id       | 3
 _Name     | Autobiographer
 _TagBased | false
 _UserId   | 6
-RECORD 3---------------------------
 _Class    | 3
 _Date     | 2014-01-21 20:52:16.97
 _Id       | 4
 _Name     | Autobiographer
 _TagBased | false
 _UserId   | 7
-RECORD 4---------------------------
 _Class    | 3
 _Date     | 2014-01-21 20:52:16.97
 _Id       | 5
 _Name     | Autobiographer
 _TagBased | false
 _UserId   | 9
only showing top 5 rows
```

2.8 Clean up text columns

```python
from pyspark.sql.functions import regexp_replace, trim, udf, col

from bs4 import BeautifulSoup
from html import unescape

def tags_remove(s):
    if s is not None:
        soup = BeautifulSoup(unescape(s), 'lxml')
        return soup.text
    else:
        return None
udf_tags_remove = udf(lambda m: tags_remove(m))

users_clean = users.withColumn("_AboutMe_clean", regexp_replace("_AboutMe", "\n|\t|\r", " ")
    .withColumn("_AboutMe_clean", udf_tags_remove(col('_AboutMe_clean'))) \
    .withColumn("_AboutMe_clean", regexp_replace("_AboutMe_clean", "\s{2,}", " ")) \
    .withColumn("_AboutMe_clean", trim("_AboutMe_clean"))


history_clean = history.withColumn("_Text_clean", regexp_replace("_Text", "\n|\t|\r", " "))
    .withColumn("_Text_clean", udf_tags_remove(col('_Text_clean'))) \
    .withColumn("_Text_clean", regexp_replace("_Text_clean", "\s{2,}", " ")) \
    .withColumn("_Text_clean", trim("_Text_clean"))

posts_clean = posts.withColumn("_Body_clean", regexp_replace("_Body", "\n|\t|\r", " ")) \
    .withColumn("_Body_clean", udf_tags_remove(col('_Body_clean'))) \
    .withColumn("_Body_clean", regexp_replace("_Body_clean", "\s{2,}", " ")) \
    .withColumn("_Body_clean", trim("_Body_clean"))
```

2.9 Write parquet

```
users_clean.select(
    col("_AboutMe").alias("about_me"),
    col("_AboutMe_clean").alias("about_me_clean"),
    col("_CreationDate").alias("creation_date"),
    col("_DisplayName").alias("display_name"),
    col("_DownVotes").alias("down_votes"),
    col("_Id").alias("id"),
    col("_LastAccessDate").alias("last_access_date"),
    col("_Location").alias("location"),
    col("_ProfileImageUrl").alias("profile_image_url"),
    col("_Reputation").alias("reputatio"),
    col("_UpVotes").alias("up_votes"),
    col("_Views").alias("views"),
    col("_WebsiteUrl").alias("website_url")
).write.mode('overwrite').format('parquet').option('path', "outputs/users").save()
```

```
/config/workspace/.venv/lib/python3.10/site-packages/bs4/__init__.py:435: MarkupResemblesLocato
  warnings.warn(
```

```
tags.select(
    col("_Count").alias("count"),
    col("_ExcerptPostId").alias("excerpt_post_id"),
    col("_Id").alias("id"),
    col("_TagName").alias("tag_name"),
    col("_WikiPostId").alias("wiki_post_id"),
).write.mode('overwrite').format('parquet').option('path', "outputs/tags").save()
```

```
votes.select(
    col("_BountyAmount").alias("bounty_amount"),
    col("_CreationDate").alias("creation_date"),
    col("_Id").alias("id"),
    col("_PostId").alias("post_id"),
    col("_UserId").alias("user_id"),
    col("_VoteTypeId").alias("vote_type_id"),
).write.mode('overwrite').format('parquet').option('path', "outputs/votes").save()
```

```
posts_clean.select(
    col("_AcceptedAnswerId").alias("accepted_answer_id"),
    col("_AnswerCount").alias("answer_count"),
    col("_Body").alias("body"),
    col("_Body_clean").alias("body_clean"),
    col("_ClosedDate").alias("closed_date"),
    col("_CommentCount").alias("comment_count"),
    col("_CommunityOwnedDate").alias("community_owned_date"),
    col("_ContentLicense").alias("content_licence"),
    col("_CreationDate").alias("creation_date"),
    col("_FavoriteCount").alias("favourite_count"),
    col("_Id").alias("id"),
    col("_LastActivityDate").alias("last_activity_date"),
    col("_LastEditDate").alias("last_edit_date"),
    col("_LastEditorDisplayName").alias("last_editor_display_name"),
    col("_LastEditorUserId").alias("last_editor_user_id"),
    col("_OwnerUserId").alias("owner_user_id"),
    col("_PostTypeId").alias("post_type_id"),
    col("_ParentId").alias("parent_id"),
    col("_Score").alias("score"),
    col("_Tags").alias("tags"),
    col("_Title").alias("title"),
    col("_ViewCount").alias("view_count"),
).write.mode('overwrite').format('parquet').option('path', "outputs/posts").save()
```

```
links.select(
    col("_CreationDate").alias("creation_date"),
    col("_Id").alias("id"),
    col("_LinkTypeId").alias("link_type_id"),
    col("_PostId").alias("post_id"),
    col("_RelatedPostId").alias("related_post_id"),
).write.mode('overwrite').format('parquet').option('path', "outputs/post_links").save()
```

```
history_clean.select(
    col("_Comment").alias("comment"),
    col("_ContentLicense").alias("content_license"),
    col("_CreationDate").alias("creation_date"),
    col("_Id").alias("id"),
    col("_PostHistoryTypeId").alias("post_history_type_id"),
    col("_PostId").alias("post_id"),
    col("_RevisionGUID").alias("revision_guid"),
    col("_Text").alias("text"),
    col("_Text_clean").alias("text_clean"),
    col("_UserDisplayName").alias("user_distplay_name"),
    col("_UserId").alias("user_id"),
).write.mode('overwrite').format('parquet').option('path', "outputs/history").save()
```

```
badges.select(
    col("_Class").alias("class"),
    col("_Date").alias("date"),
    col("_Id").alias("id"),
    col("_Name").alias("name"),
    col("_TagBased").alias("tag_based"),
    col("_UserId").alias("user_id"),
).write.mode('overwrite').format('parquet').option('path', "outputs/badges").save()
```

3 Questions/Answers over time

```
from pyspark.sql import (
    SparkSession,
    functions as f
    )
import matplotlib
```

```
spark = SparkSession.builder.master("local[12]").appName("Analytics").getOrCreate()
```

```
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
```

```
23/01/06 14:33:37 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform
23/01/06 14:33:37 WARN Utils: Service 'SparkUI' could not bind on port 4040. Attempting port 40
```

```
posts = spark.read.format('parquet').load("outputs/posts")
posts.show(1, vertical=True)
```

```
-RECORD 0----------------------------------------
 accepted_answer_id       | 4
 answer_count             | 1
 body                     | <p>I was offered ...
 body_clean               | I was offered a b...
 closed_date              | null
 comment_count            | 0
 community_owned_date     | null
 content_licence          | CC BY-SA 3.0
 creation_date            | 2014-01-21 20:26:...
 favourite_count          | null
 id                       | 1
 last_activity_date       | 2014-01-21 22:04:...
 last_edit_date           | 2014-01-21 22:04:...
 last_editor_display_name | null
 last_editor_user_id      | 8
 owner_user_id            | 7
 post_type_id             | 1
 parent_id                | null
 score                    | 21
 tags                         | <hops>
 title                        | What is a citra h...
 view_count                   | 2434
only showing top 1 row
```

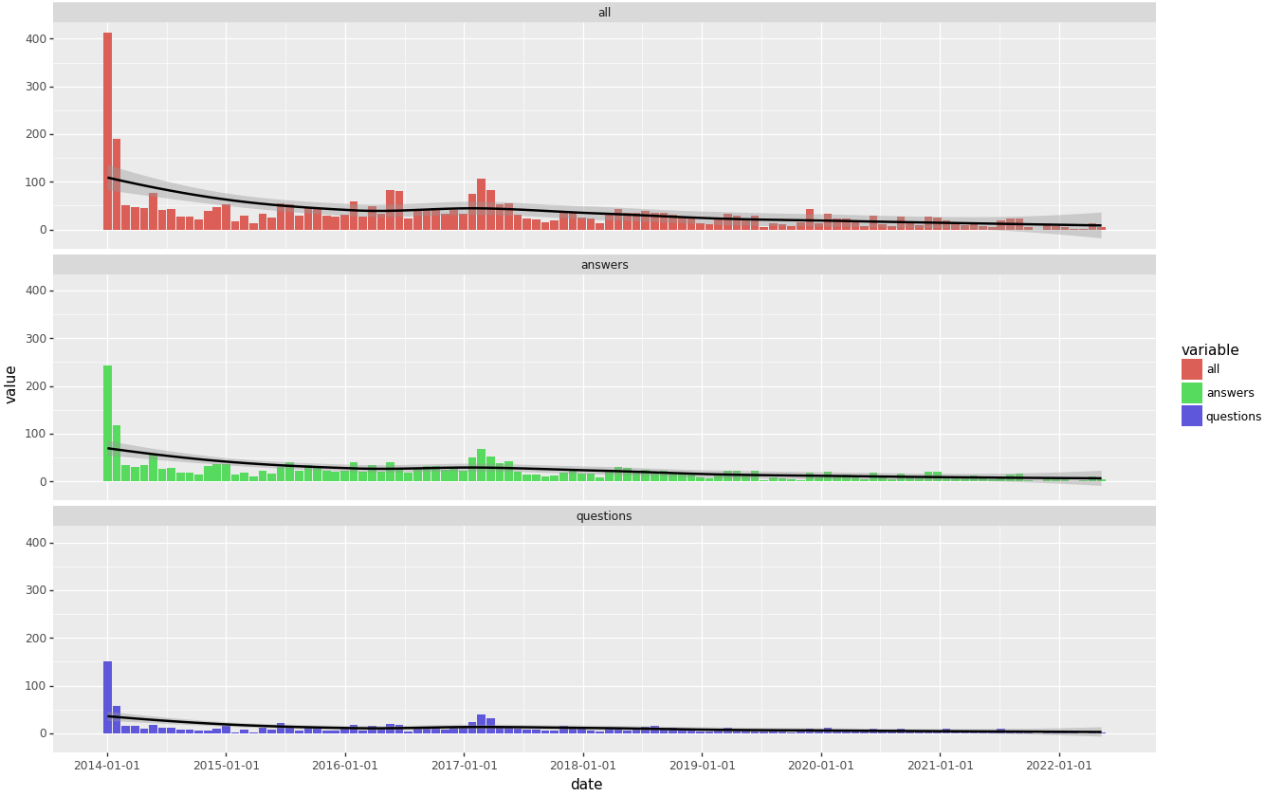
```
posts_grouped = (
    posts
    .filter(f.col('owner_user_id').isNotNull())
    .groupBy(
        f.window('creation_date', '4 weeks')
    )
    .agg(
        f.sum(f.lit(1)).alias('all'),
        f.sum(f.when(f.col('post_type_id') == 1, f.lit(1)).otherwise(f.lit(0))).alias('quest
        f.sum(f.when(f.col('post_type_id') == 2, f.lit(1)).otherwise(f.lit(0))).alias('answe
    )
    # window struct has nested columns 'start' and 'end'
    .withColumn('date', f.col('window.start').cast('date'))
    .orderBy('date')
).toPandas()
```

```
posts_grouped.head()
```

	window	all	questions	answers	date
0	(2014-01-02 00:00:00, 2014-01-30 00:00:00)	413	150	243	2014-01-02
1	(2014-01-30 00:00:00, 2014-02-27 00:00:00)	190	58	118	2014-01-30
2	(2014-02-27 00:00:00, 2014-03-27 00:00:00)	50	16	34	2014-02-27
3	(2014-03-27 00:00:00, 2014-04-24 00:00:00)	47	16	31	2014-03-27
4	(2014-04-24 00:00:00, 2014-05-22 00:00:00)	44	10	34	2014-04-24

```
# posts_grouped.plot(
#     x='date',
#     figsize=(12, 6),
#     title='Number of questions/answers per month (4 weeks)',
#     legend=True,
#     xlabel='Date',
#     ylabel='Count',
#     kind='line'
# )
```

```
from plotnine import aes, facet_wrap, ggplot, scale_x_datetime, options, stat_smooth, geom_c

options.figure_size = (15, 10)

posts_long = posts_grouped.melt(id_vars=('date'), value_vars=('all', 'questions', 'answers')
posts_long.head()

(ggplot(posts_long, aes(x='date', y='value', group='variable'))
+ geom_col(aes(fill='variable'))
+ scale_x_datetime()
+ stat_smooth(method='loess')
+ facet_wrap('variable', ncol=1)
)
```



```
<ggplot: (8788967743071)>
```

3.1 Forum retention - time from account creation to last comments

```
users = spark.read.format('parquet').load("outputs/users").select(f.col('id'), f.col('creati
```

```
users.show()
```

```
+----+--------------------+----------------+
| id|       creation_date|    display_name|
+----+--------------------+----------------+
| -1|2014-01-21 17:45:...|       Community|
|  1|2014-01-21 20:21:...|    Geoff Dalgas|
|  2|2014-01-21 20:22:...|  Kasra Rahjerdi|
|  3|2014-01-21 20:22:...|       Adam Lear|
|  4|2014-01-21 20:22:...|   Arie Litovsky|
|  5|2014-01-21 20:22:...|    Brian Nickel|
|  6|2014-01-21 20:23:...|        Jeremy T|
|  7|2014-01-21 20:24:...|      Tom Medley|
|  8|2014-01-21 20:25:...|LessPop_MoreFizz|
|  9|2014-01-21 20:25:...|     Nick Craver|
| 10|2014-01-21 20:28:...|          ChrisG|
| 11|2014-01-21 20:28:...|        hairboat|
| 12|2014-01-21 20:29:...|        nhaarman|
| 13|2014-01-21 20:29:...|           Shog9|
| 14|2014-01-21 20:32:...|     Ben Collins|
| 15|2014-01-21 20:33:...|             Ana|
| 16|2014-01-21 20:34:...|      Grace Note|
| 17|2014-01-21 20:34:...|     Jon Ericson|
| 18|2014-01-21 20:36:...|         awesame|
| 19|2014-01-21 20:36:...|   Steve Robbins|
+---+--------------------+----------------+
only showing top 20 rows
```

```
posts_by_user = posts.select(f.col('owner_user_id'), f.col('last_activity_date'), f.col('id'
```

```
posts_and_users_joined = (users
    .filter(f.col('id') != -1) # remove bots
    .join(posts_by_user, users.id  == posts_by_user.owner_user_id, how="left" )
    .filter(f.col('post_id').isNotNull()) # remove users that never posted
)

posts_and_users_joined.show()
```

```
+---+--------------------+--------------+-------------+--------------------+-------+
| id|       creation_date|  display_name|owner_user_id|  last_activity_date|post_id|
+---+--------------------+--------------+-------------+--------------------+-------+
|  2|2014-01-21 20:22:...|Kasra Rahjerdi|            2|2014-01-22 00:26:...|     39|
|  2|2014-01-21 20:22:...|Kasra Rahjerdi|            2|2014-01-22 05:50:...|     28|
|  4|2014-01-21 20:22:...| Arie Litovsky|            4|2016-03-06 04:31:...|     85|
|  5|2014-01-21 20:22:...|  Brian Nickel|            5|2014-02-04 23:20:...|    533|
|  5|2014-01-21 20:22:...|  Brian Nickel|            5|2014-01-23 16:41:...|    267|
|  5|2014-01-21 20:22:...|  Brian Nickel|            5|2014-01-22 18:36:...|    217|
|  5|2014-01-21 20:22:...|  Brian Nickel|            5|2018-08-09 15:38:...|     50|
|  5|2014-01-21 20:22:...|  Brian Nickel|            5|2014-01-21 20:59:...|     32|
|  5|2014-01-21 20:22:...|  Brian Nickel|            5|2014-01-21 20:45:...|     17|
|  7|2014-01-21 20:24:...|    Tom Medley|            7|2014-01-29 20:34:...|    426|
|  7|2014-01-21 20:24:...|    Tom Medley|            7|2014-11-19 15:11:...|     82|
|  7|2014-01-21 20:24:...|    Tom Medley|            7|2014-01-21 21:47:...|     70|
|  7|2014-01-21 20:24:...|    Tom Medley|            7|2020-08-28 07:35:...|     59|
|  7|2014-01-21 20:24:...|    Tom Medley|            7|2022-01-14 10:04:...|     38|
|  7|2014-01-21 20:24:...|    Tom Medley|            7|2014-01-22 06:24:...|     35|
|  7|2014-01-21 20:24:...|    Tom Medley|            7|2014-01-22 17:04:...|     10|
|  7|2014-01-21 20:24:...|    Tom Medley|            7|2017-08-24 06:53:...|      8|
|  7|2014-01-21 20:24:...|    Tom Medley|            7|2021-01-15 06:17:...|      7|
|  7|2014-01-21 20:24:...|    Tom Medley|            7|2017-06-07 11:10:...|      5|
|  7|2014-01-21 20:24:...|    Tom Medley|            7|2015-01-29 14:50:...|      3|
+---+--------------------+--------------+-------------+--------------------+-------+
only showing top 20 rows
```

```
posts_and_users_joined.select(f.col('post_id')).count() == posts_and_users_joined.select(f.c
```

```
True
```

```
user_last_post = (posts_and_users_joined
    .groupBy(f.col('id'), f.col('creation_date'))
    .agg(
        f.max(f.col('last_activity_date'))
    )
)

# time from account creation to last activity
user_last_post = user_last_post.withColumn('diff',f.datediff(f.col('max(last_activity_date)'
user_last_post.show()
```

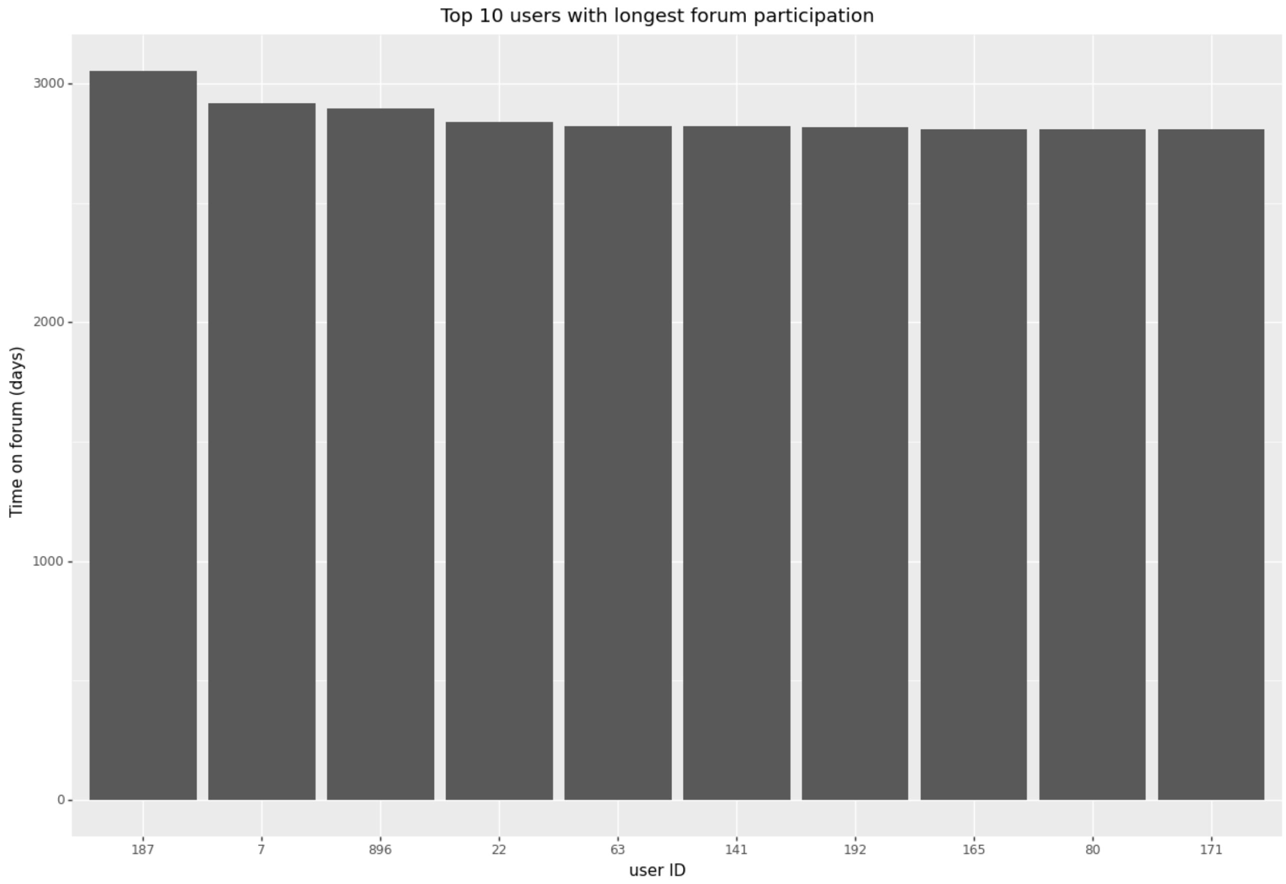
```
+-----+--------------------+-----------------------+----+
|   id|       creation_date|max(last_activity_date)|diff|
+-----+--------------------+-----------------------+----+
| 6696|2017-04-27 18:46:...|   2017-09-18 21:40:...| 144|
| 7212|2017-10-24 01:20:...|   2017-10-24 01:20:...|   0|
| 7311|2017-11-28 23:29:...|   2017-12-23 14:32:...|  25|
|10039|2020-01-17 20:47:...|   2020-03-25 21:19:...|  68|
|  149|2014-01-22 16:41:...|   2014-01-23 08:52:...|   1|
|  736|2014-04-03 13:25:...|   2017-01-27 14:13:...|1030|
| 4197|2015-06-10 19:13:...|   2015-06-10 19:18:...|   0|
| 5654|2016-07-13 09:17:...|   2016-09-02 12:08:...|  51|
| 7154|2017-10-01 06:24:...|   2017-10-01 06:24:...|   0|
| 7286|2017-11-23 11:43:...|   2017-11-24 22:07:...|   1|
| 7936|2018-07-20 09:31:...|   2018-07-24 11:49:...|   4|
|11698|2020-11-12 20:24:...|   2020-11-12 20:24:...|   0|
| 1295|2014-09-10 17:56:...|   2016-10-08 14:17:...| 759|
| 5893|2016-09-11 03:06:...|   2016-09-11 03:07:...|   0|
| 6636|2017-04-06 13:23:...|   2017-04-06 13:23:...|   0|
| 6699|2017-04-28 07:43:...|   2017-11-16 18:08:...| 202|
| 7208|2017-10-22 23:11:...|   2017-10-22 23:48:...|   0|
| 8088|2018-09-15 08:09:...|   2018-09-15 08:19:...|   0|
|  740|2014-04-04 15:58:...|   2016-06-21 13:46:...| 809|
| 1077|2014-07-09 23:08:...|   2018-10-09 20:22:...|1553|
+------+--------------------+-----------------------+----+
only showing top 20 rows
```

```
user_last_post.select(f.col('id')).count() == user_last_post.select(f.col('id')).distinct().
```

```
True
```

```
user_last_post_df = user_last_post.orderBy(f.col('diff').desc()).limit(10).withColumn('id_ca

import pandas as pd
# add sorted categories for pretty plotting
user_last_post_df['id_cat'] = pd.Categorical(user_last_post_df.id_cat, categories=user_last_

from plotnine import labs
(ggplot(user_last_post_df, aes(x='id_cat', y='diff'))
     + geom_col()
     + labs(x='user ID', y='Time on forum (days)', title='Top 10 users with longest forum pa
)
```

```
/config/workspace/.venv/lib/python3.10/site-packages/pyspark/sql/pandas/conversion.py:248: Futu
/config/workspace/.venv/lib/python3.10/site-packages/pyspark/sql/pandas/conversion.py:248: Futu
```



```
<ggplot: (8788915768894)>
```

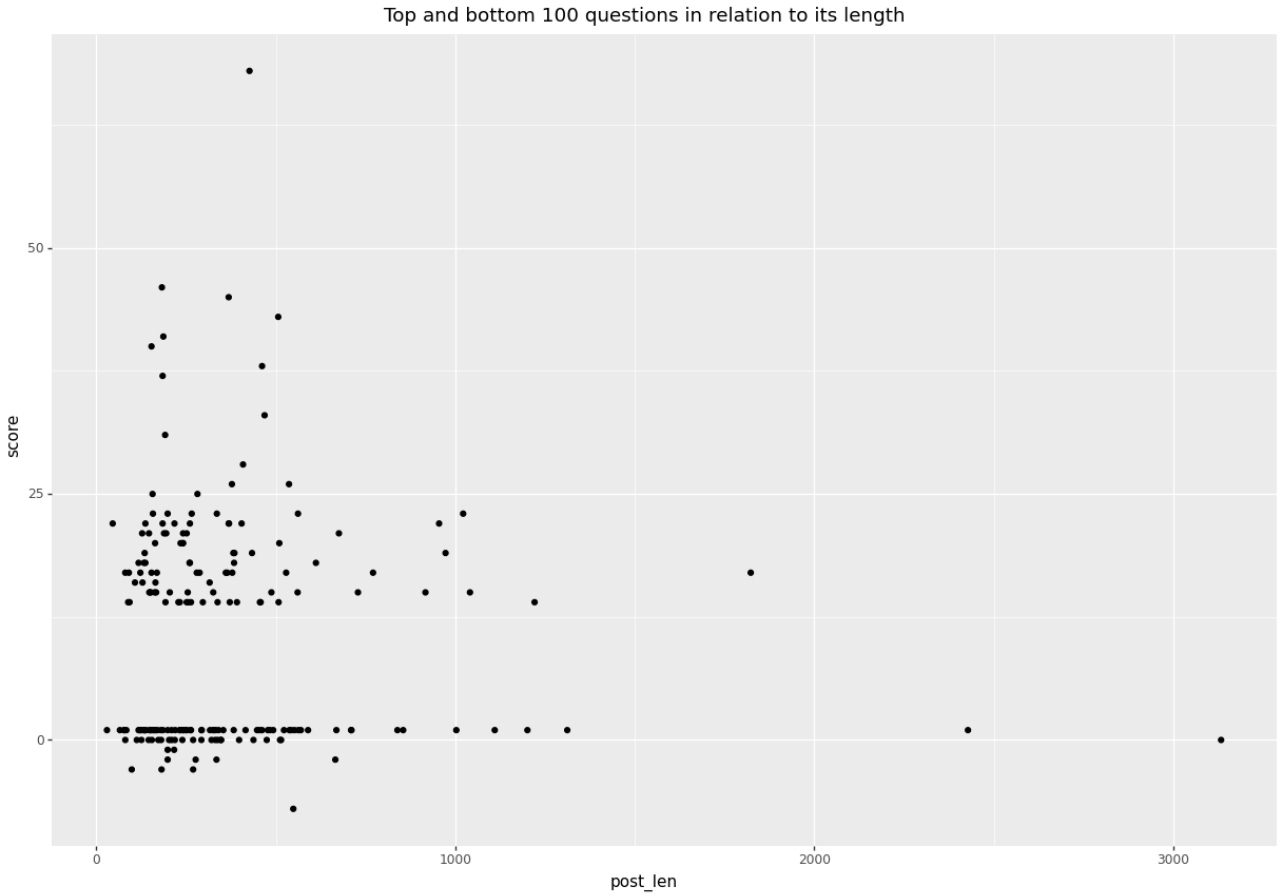
3.2 porównanie najwyżej i najniżej ocenianych pytań (długość, tagi, liczba odpowiedzi)

```
#users2 = spark.read.format('parquet').load("outputs/users").select(f.col('id'), f.col('crea
#posts.show(1, vertical=True)





#1 - Question 2 - Answer 3 - Wiki 4 - TagWikiExcerpt 5 - TagWiki 6 - ModeratorNomination 7 -
questions = posts.select(f.col('id'), f.col('body_clean'), f.col('answer_count'), f.col('vie
    .filter(f.col('post_type_id') == 1)\
    .drop(f.col('post_type_id'))
```

```
n_questions = 100
top_questions = questions.orderBy(f.col('score'), ascending=False).limit(n_questions).withCo
bottom_questions = questions.orderBy(f.col('score'), ascending=True).limit(n_questions).with
edge_questions = top_questions.unionAll(bottom_questions)
```

```
from pyspark.sql.functions import length
edge_questions = edge_questions.withColumn('post_len', f.length(f.col('body_clean')))
edge_questions_pd = edge_questions.toPandas()
```

```
from plotnine import ggplot, aes, geom_point, ggtitle

(ggplot(edge_questions_pd, aes(x = 'post_len', y = 'score') ) \
    + geom_point() \
    + ggtitle(f'Top and bottom {n_questions} questions in relation to its length'))
```

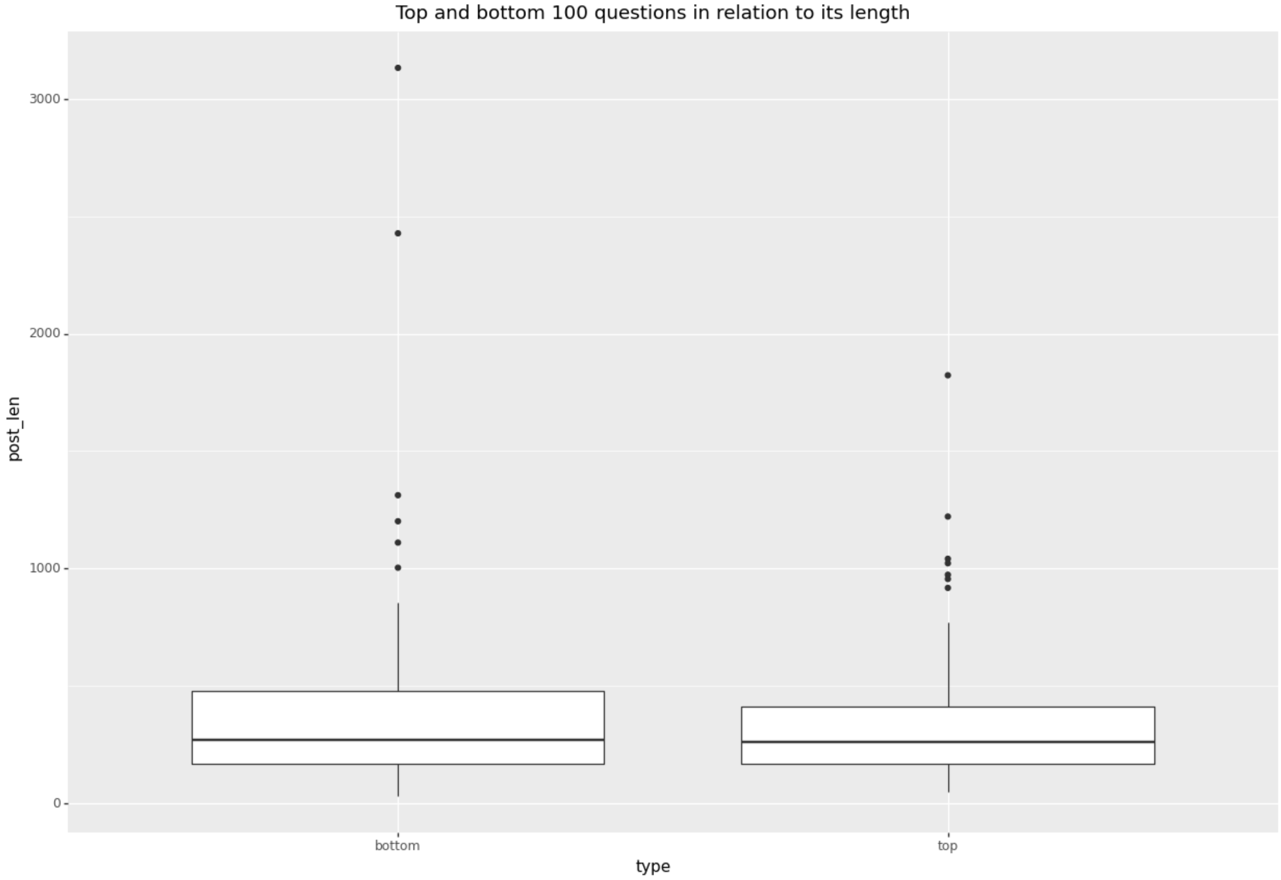


```
<ggplot: (8789056834491)>
```

```
edge_questions.groupby('type')\
    .agg(
        f.max(f.col('post_len')),
        f.min(f.col('post_len')),
        f.mean(f.col('post_len')),
        f.stddev(f.col('post_len')),
        f.percentile_approx(f.col('post_len'), 0.5)
    ).show()
```

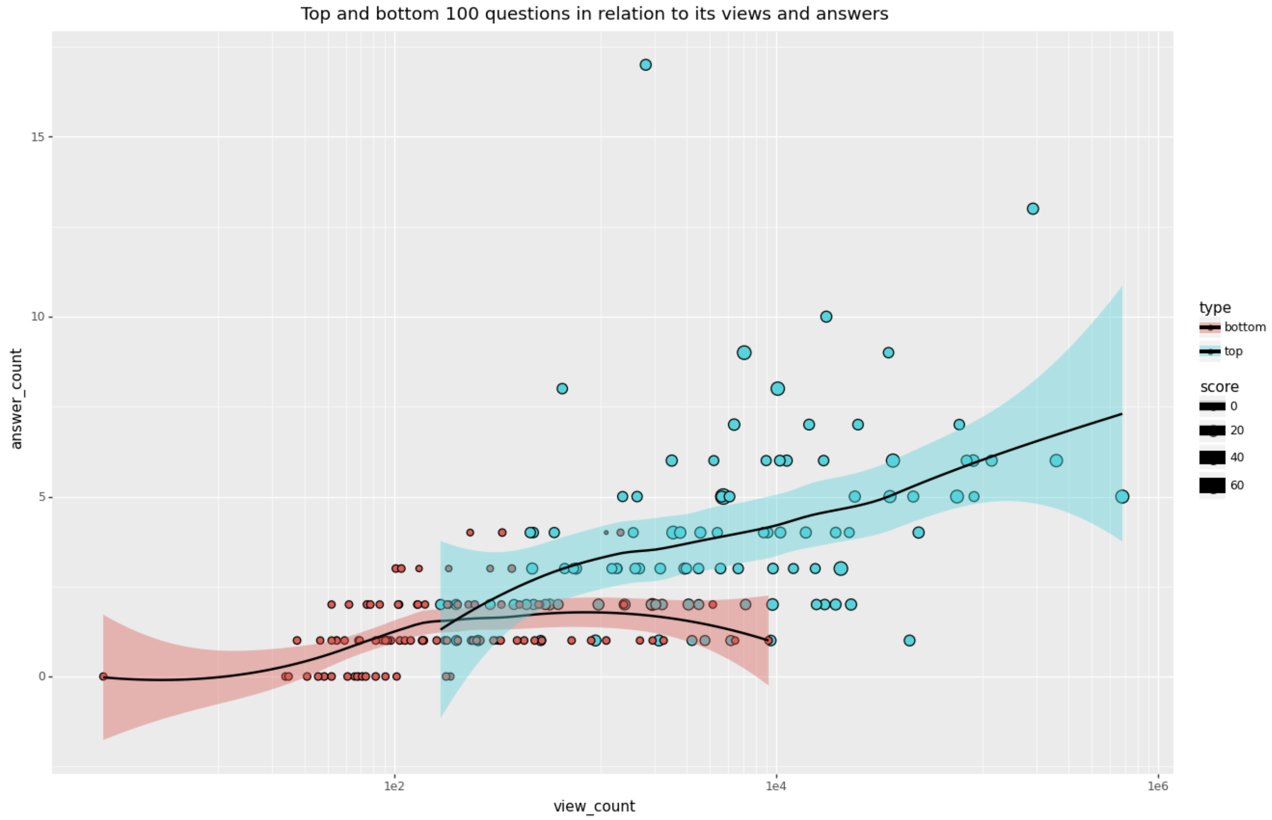
```
+------+-------------+-------------+-------------+---------------------+-----------------------
|  type|max(post_len)|min(post_len)|avg(post_len)|stddev_samp(post_len)|percentile_approx(post_
+------+-------------+-------------+-------------+---------------------+-----------------------
|   top|         1823|           46|       349.08|   275.08858738430234|
|bottom|         3133|           30|       389.26|   424.65483595146975|
+------+-------------+-------------+-------------+---------------------+-----------------------
```

```
from plotnine import ggplot, aes, geom_boxplot, ggtitle

(ggplot(edge_questions_pd, aes(x = 'type', y = 'post_len') ) \
    + geom_boxplot() \
    + ggtitle(f'Top and bottom {n_questions} questions in relation to its length'))
```



```
<ggplot: (8788916144588)>
```

```
from plotnine import ggplot, aes, geom_point, ggtitle, scale_x_log10, geom_smooth

(ggplot(edge_questions_pd, aes(x = 'view_count', y = 'answer_count', fill = 'type', size = '
    + geom_point() \
    + scale_x_log10()\
    + geom_smooth()\
    + ggtitle(f'Top and bottom {n_questions} questions in relation to its views and answers'
```



```
<ggplot: (8788916169164)>
```

```
edge_questions.groupby('type')\
    .agg(
        f.max(f.col('answer_count')),
        f.min(f.col('answer_count')),
        f.mean(f.col('answer_count')),
        f.stddev(f.col('answer_count')),
        f.percentile_approx(f.col('answer_count'), 0.5)
    ).show()
```

```
+------+-----------------+-----------------+-----------------+-------------------------+-------
|  type|max(answer_count)|min(answer_count)|avg(answer_count)|stddev_samp(answer_count)|percent
+------+-----------------+-----------------+-----------------+-------------------------+-------
|   top|               17|                1|             3.96|        2.581675910150324|
|bottom|                4|                0|             1.28|       0.9648363026488436|
+------+-----------------+-----------------+-----------------+-------------------------+-------
```

```
edge_questions.groupby('type')\
    .agg(
        f.max(f.col('view_count')),
        f.min(f.col('view_count')),
        f.mean(f.col('view_count')),
        f.stddev(f.col('view_count')),
        f.percentile_approx(f.col('view_count'), 0.5)
    ).show()
```

```
+------+---------------+---------------+---------------+-----------------------+---------------
|  type|max(view_count)|min(view_count)|avg(view_count)|stddev_samp(view_count)|percentile_appr
+------+---------------+---------------+---------------+-----------------------+---------------
|   top|         648941|            175|       26047.65|      76276.20019090576|
|bottom|           9124|              3|         495.56|     1220.7562924910794|
+------+---------------+---------------+---------------+-----------------------+---------------
```

```
#https://gist.github.com/dannymeijer/be3534470b205280e52dbbcbb19a9670


from pyspark.sql import DataFrame
from pyspark.sql import functions as f


def regexp_extract_all(
    df: DataFrame,
    regex: str,
    no_of_extracts: int,
    input_column_name: str,
    output_column_name: str = "output",
    empty_array_replace: bool = True,
):
    """Pyspark implementation for extracting all matches of a reg_exp_extract

    Background
    ----------
    The regular implementation of regexp_extract (as part of pyspark.sql.functions module)
    is not capable of returning more than 1 match on a regexp string at a time. This
    function can be used to circumvent this limitation.

    How it works
    ------------
    You can specify a `no_of_extracts` which will essentially run the regexp_extract
    function that number of times on the `input_column` of the `df` (`DataFrame`).
    In between extracts, a set of interim columns are created where every
    intermediate match is stored. A distinct array is created from these matches,
    after which the interim columns are dropped. The resulting array is stored in
    the defined `output_column`. Empty strings/values in the resulting array can
    optionally be dropped or kept depending on how `empty_array_replace` is set
    (default is True).

    Usage example
    -------------
    In the below example, we are extracting all email-addresses from a body of text.
    The returned DataFrame will have a new ArrayType column added named `email_addresses`

    > # Assuming `df` is a valid DataFrame containing a column named `text`
    > email_regex = r"[\w.-]+@[\w.-]+\.[a-zA-Z]{1,}"
    > df = regexp_extract_all(df, email_regex, 6, "text", "email_addresses", True)

    Parameters
    ----------
    df: DataFrame
        Input DataFrame

    regex: str
        Regexp string to extract from input DataFrame

    no_of_extracts: int
        Max number of occurrences to extract

    input_column_name: str
        Name of the input column

    output_column_name: str
        Name of the output column (default: output)

    empty_array_replace: bool
        If set to True, will replace empty arrays with null values (default: True)
    """
    repeats = range(0, no_of_extracts)

    # A set of interim columns are created that will be dropped afterwards
    match_columns = [f"___{r}___" for r in repeats]

    # Apply regexp_extract an r number of times
    for r in repeats:
        df = df.withColumn(
            match_columns[r],
            f.regexp_extract(
                f.col(input_column_name),
                # the input regex string is amended with ".*?"
                # and repeated an r number of times
                # r needs to be +1 as matching groups are 1-indexed
                "".join([f"{regex}.*?" for i in range(0, r + 1)]),
                r + 1,
            ),
        )

    # Create a distinct array with all empty strings removed
    df = df.withColumn(
        output_column_name,
        f.array_remove(f.array_distinct(f.array(match_columns)), ""),
    )

    # Replace empty string with None if empty_array_replace was set
    if empty_array_replace:
        df = df.withColumn(
            output_column_name,
            f.when(f.size(output_column_name) == 0, f.lit(None)).otherwise(
                f.col(output_column_name)
            ),
        )

    # Drop interim columns
    for c in match_columns:
        df = df.drop(c)

    return df
```

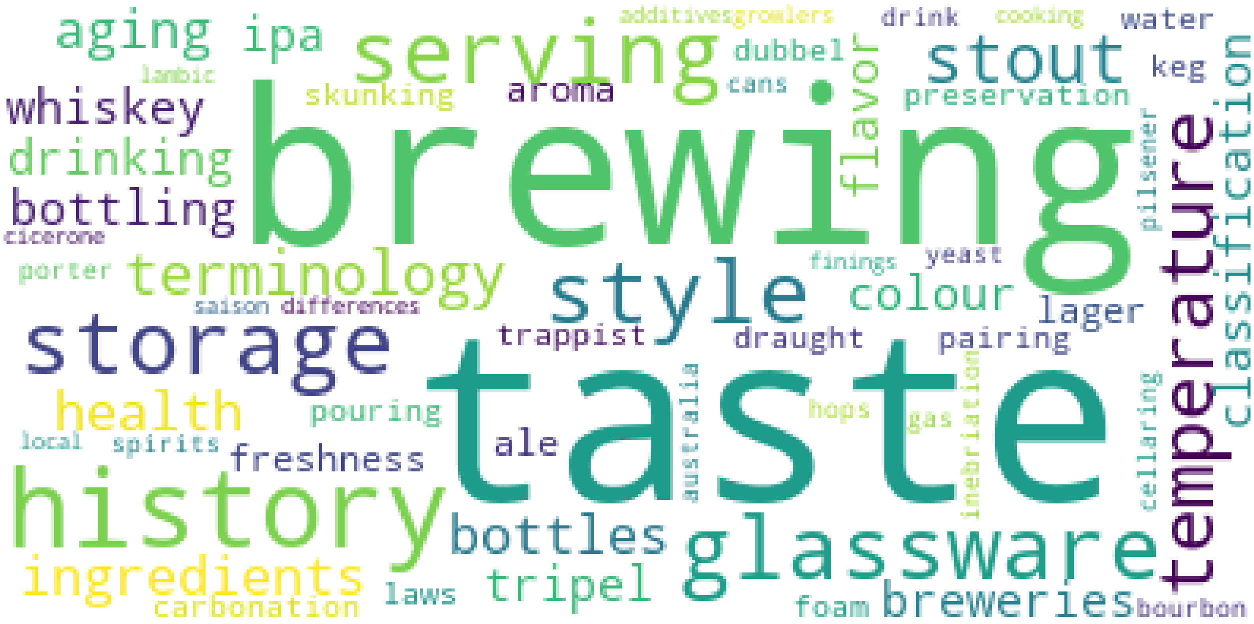
```
#edge_questions.select(f.col('tags')).withColumn('tags_split', f.regexp_extract(f.col('tags'

edge_questions = regexp_extract_all(edge_questions, r'<(\w+)>', 99, "tags", "tags_split", Tr
```

```
import pyspark.rdd as rdd
h = edge_questions.filter(f.col('type') == 'top').select(f.col('tags_split')).rdd
l = edge_questions.filter(f.col('type') == 'bottom').select(f.col('tags_split')).rdd
```

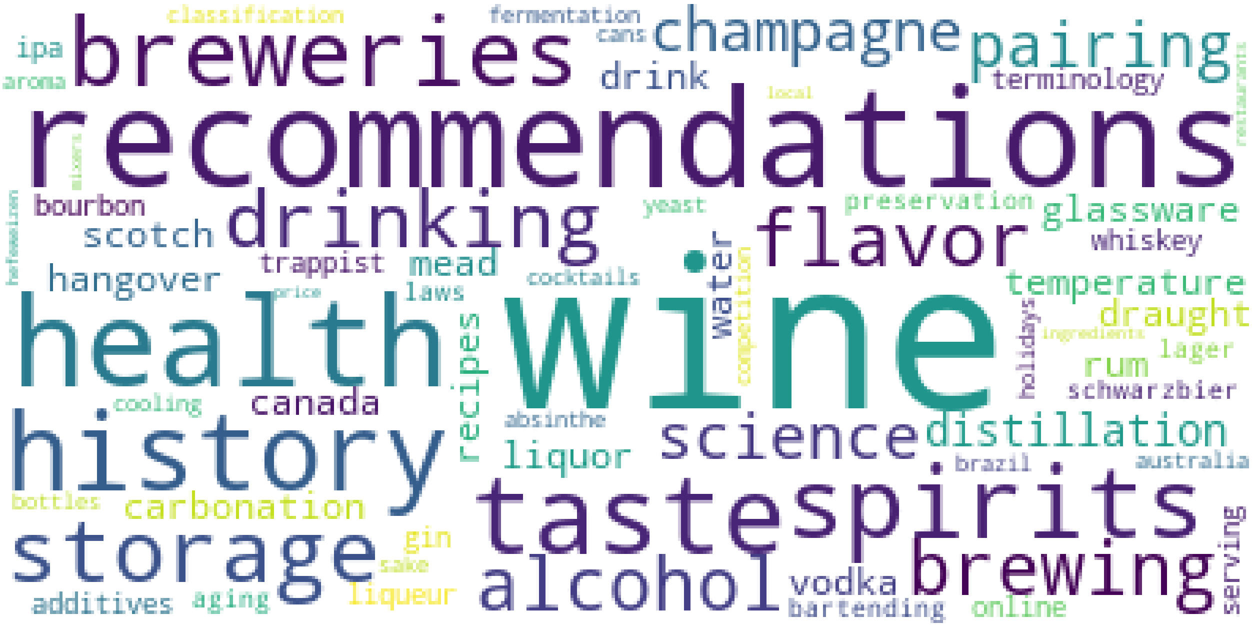
```
h.flatMap(lambda x: [y if y is not None else "" for y in x])\
    .flatMap(lambda x: [x[y] for y in range(0, len(x))])\
    .map(lambda x: (x, 1))\
    .aggregateByKey(0, (lambda acc,x: acc + x ), (lambda acc1,acc2: acc1+acc2))\
    .filter(lambda x: x[1] > 1)\
    .sortBy(lambda x: x[1], ascending=False)\
    .collect()
```

```
[('taste', 17),
 ('brewing', 14),
 ('history', 12),
 ('glassware', 8),
 ('storage', 8),
 ('serving', 8),
 ('style', 8),
 ('temperature', 6),
 ('stout', 5),
 ('terminology', 5),
 ('aging', 4),
 ('health', 4),
 ('bottles', 4),
 ('ingredients', 4),
 ('breweries', 3),
 ('ipa', 3),
 ('classification', 3),
 ('whiskey', 3),
 ('tripel', 3),
 ('drinking', 3),
 ('bottling', 3),
 ('flavor', 3),
 ('colour', 3),
 ('aroma', 2),
 ('freshness', 2),
 ('ale', 2),
 ('lager', 2),
 ('preservation', 2),
 ('foam', 2),
 ('dubbel', 2),
 ('skunking', 2),
 ('laws', 2),
 ('draught', 2),
 ('pouring', 2),
 ('pairing', 2),
 ('keg', 2),
 ('water', 2),
 ('trappist', 2),
 ('carbonation', 2)]
```

```python
tags_rdd = h.flatMap(lambda x: [y if y is not None else "" for y in x])\
    .flatMap(lambda x: [x[y] for y in range(0, len(x))])

x = tags_rdd.collect()
tags_str = ''
for y in range(len(x)):
    tags_str += f"{x[y]} "

from wordcloud import WordCloud
import matplotlib.pyplot as plt
wc = WordCloud(background_color ='white').generate(tags_str)
plt.figure(figsize = (8, 8), facecolor = None)
plt.imshow(wc)
plt.axis("off")
plt.tight_layout(pad = 0)
plt.show()
```



```
tags_rdd = l.flatMap(lambda x: [y if y is not None else "" for y in x])\
    .flatMap(lambda x: [x[y] for y in range(0, len(x))])

x = tags_rdd.collect()
tags_str = ''
for y in range(len(x)):
    tags_str += f"{x[y]} "

from wordcloud import WordCloud
import matplotlib.pyplot as plt
wc = WordCloud(background_color ='white').generate(tags_str)
plt.figure(figsize = (8, 8), facecolor = None)
plt.imshow(wc)
plt.axis("off")
plt.tight_layout(pad = 0)
plt.show()
```



```
l.flatMap(lambda x: [y if y is not None else "" for y in x])\
    .flatMap(lambda x: [x[y] for y in range(0, len(x))])\
    .map(lambda x: (x, 1))\
    .aggregateByKey(0, (lambda acc,x: acc + x ), (lambda acc1,acc2: acc1+acc2))\
    .filter(lambda x: x[1] > 1)\
    .sortBy(lambda x: x[1], ascending=False)\
    .collect()
```

```
[('wine', 20),
 ('recommendations', 14),
 ('health', 11),
 ('taste', 8),
 ('history', 8),
 ('spirits', 7),
 ('breweries', 6),
 ('storage', 5),
 ('drinking', 4),
 ('flavor', 4),
 ('brewing', 4),
 ('alcohol', 4),
 ('pairing', 3),
 ('science', 3),
 ('champagne', 3),
 ('distillation', 3),
 ('temperature', 2),
 ('glassware', 2),
 ('scotch', 2),
 ('hangover', 2),
 ('water', 2),
 ('rum', 2),
 ('liquor', 2),
 ('draught', 2),
 ('vodka', 2),
 ('mead', 2),
 ('carbonation', 2),
 ('canada', 2),
 ('drink', 2),
 ('recipes', 2)]
```

3.3 procent przypadków kiedy najwyżej oceniana odpowiedź to nie zaakceptowana odpowiedź

```
#1 - Question 2 - Answer 3 - Wiki 4 - TagWikiExcerpt 5 - TagWiki 6 - ModeratorNomination 7 -
posts_tmp = posts.select(f.col('id'), f.col("parent_id"), f.col('accepted_answer_id'), f.col
questions = posts_tmp.filter('post_type_id == 1 and answer_count > 0')\
    .select(f.col('id').alias('q_id'), f.col('accepted_answer_id'))

answers = posts_tmp.filter(f.col('post_type_id') == 2)\
    .select(f.col('id').alias('a_id'), f.col('parent_id'), f.col('score'))
```

```
from pyspark.sql import Window

window_partition_agg = Window.partitionBy("q_id")

questions.join(answers, on=questions.q_id == answers.parent_id)\
    .sort(['q_id', 'a_id'])\
    .withColumn("max_score", f.max(f.col("score")).over(window_partition_agg))\
    .filter(f.col("score") == f.col("max_score"))\
    .filter(f.col("accepted_answer_id").isNotNull())\
    .withColumn("is_accepted_best", f.col("accepted_answer_id") == f.col("a_id"))\
    .agg(
        f.sum(f.col("is_accepted_best").cast("integer")).alias("sum"),
        f.count(f.col("q_id")).alias("count")
    )\
    .withColumn("percent", (f.col("count") - f.col("sum")) / f.col("count") * 100).show()
```

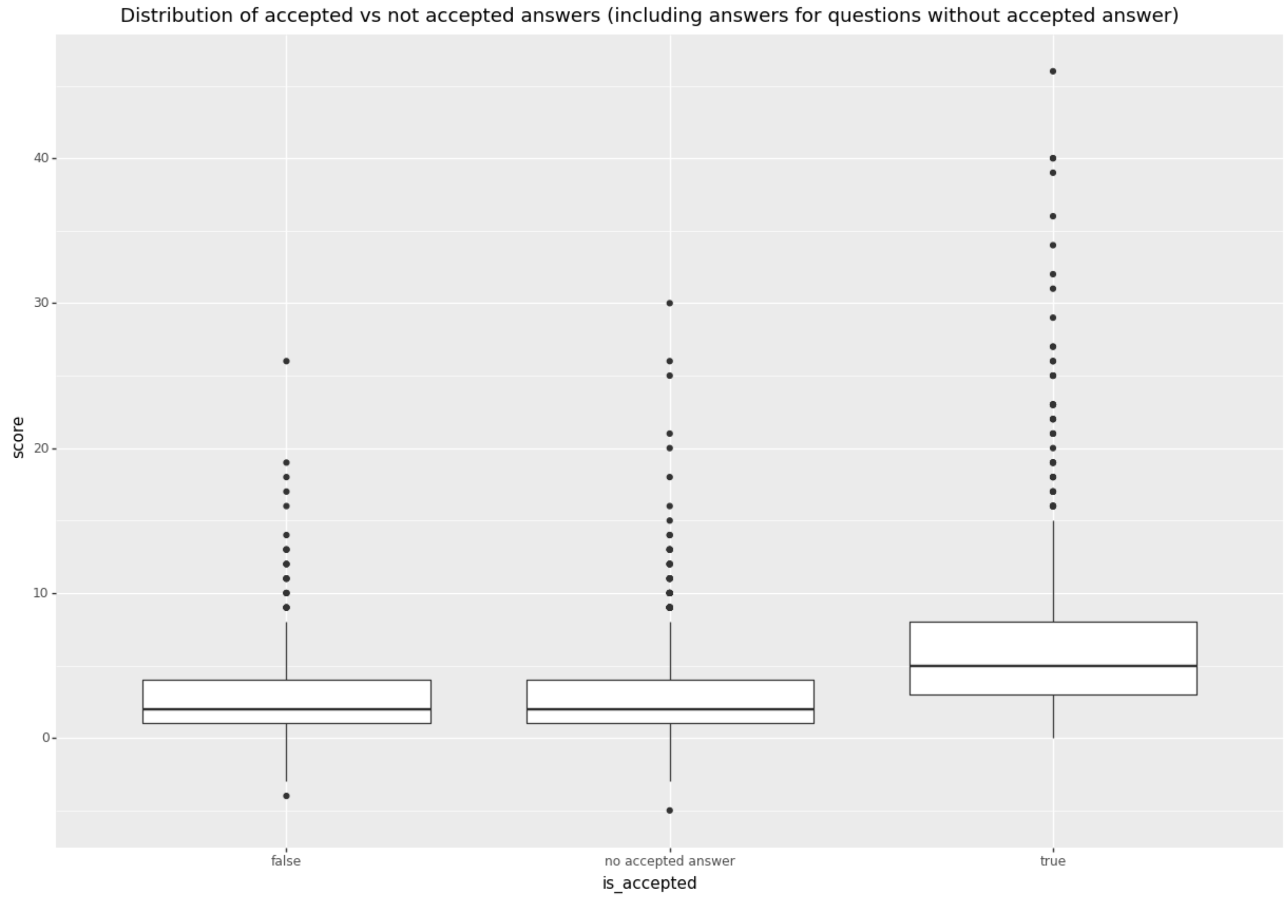
```
+---+-----+------------------+
|sum|count|           percent|
+---+-----+------------------+
|641|  735|12.789115646258503|
+---+-----+------------------+
```

3.4 rozkład ocen odpowiedzi zaakceptowanych vs pozostałych (średnia, odchylenie, minimum, maksimum)

```
window_partition_agg = Window.partitionBy("q_id")

questions.join(answers, on=questions.q_id == answers.parent_id)\
    .sort(['q_id', 'a_id'])\
    .withColumn("is_accepted", f.col("accepted_answer_id") == f.col("a_id"))\
    .groupBy(f.col("is_accepted")).agg(
        f.avg(f.col("score")).alias("avg_score"),
        f.stddev(f.col("score")).alias("std_score"),
        f.min(f.col("score")).alias("min_score"),
        f.max(f.col("score")).alias("max_score"),
        f.count("a_id")
    ).show()
```

```
+-----------+------------------+------------------+---------+---------+-----------+
|is_accepted|         avg_score|         std_score|min_score|max_score|count(a_id)|
+-----------+------------------+------------------+---------+---------+-----------+
|       null|2.7551686615886832|3.1818372333580007|       -5|       30|        919|
|       true| 6.395043731778426| 5.915949387154137|        0|       46|        686|
|      false|2.5841694537346713|2.7353292123298076|       -4|       26|        897|
+-----------+------------------+------------------+---------+---------+-----------+
```

```
accepted_df = questions.join(answers, on=questions.q_id == answers.parent_id)\
    .sort(['q_id', 'a_id'])\
    .withColumn("is_accepted", (f.col("accepted_answer_id") == f.col("a_id")).cast("string")
    .withColumn("is_accepted", f.when(f.col("is_accepted").isNull(), "no accepted answer").o

(ggplot(accepted_df, aes(x="is_accepted", y="score"))\
    +geom_boxplot()\
    +ggtitle("Distribution of accepted vs not accepted answers (including answers for questi
```



```
<ggplot: (8788915990562)>
```

3.5 top N tagów które wygenerowały najwięcej wyświetleń

```
tags_views = posts.select(['tags', 'view_count'])
tags_views_agg = regexp_extract_all(tags_views, r'<(\w+)>', 99, "tags", "tags_split", True)\
    .select([f.explode(f.col('tags_split')).alias("tag"), f.col("view_count")])\
    .filter(f.col("view_count").isNotNull())\
    .groupBy('tag')\
    .agg(
        f.sum("view_count").alias("sum_views")
    )
```

```
tag_top_views = tags_views_agg.orderBy("sum_views", ascending=False).limit(20)
```

```
tag_top_views.show()
```

```
23/01/06 14:35:17 WARN package: Truncated the string representation of a plan since it was too
23/01/06 14:35:17 ERROR CodeGenerator: failed to compile: org.codehaus.janino.InternalCompilerE
org.codehaus.janino.InternalCompilerException: Compiling "GeneratedClass" in "generated.java":
```

```
at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:366)
at org.codehaus.janino.UnitCompiler.access$000(UnitCompiler.java:226)
at org.codehaus.janino.UnitCompiler$1.visitCompilationUnit(UnitCompiler.java:336)
at org.codehaus.janino.UnitCompiler$1.visitCompilationUnit(UnitCompiler.java:333)
at org.codehaus.janino.Java$CompilationUnit.accept(Java.java:363)
at org.codehaus.janino.UnitCompiler.compileUnit(UnitCompiler.java:333)
at org.codehaus.janino.SimpleCompiler.cook(SimpleCompiler.java:235)
at org.codehaus.janino.SimpleCompiler.compileToClassLoader(SimpleCompiler.java:464)
at org.codehaus.janino.ClassBodyEvaluator.compileToClass(ClassBodyEvaluator.java:314)
at org.codehaus.janino.ClassBodyEvaluator.cook(ClassBodyEvaluator.java:237)
at org.codehaus.janino.SimpleCompiler.cook(SimpleCompiler.java:205)
at org.codehaus.commons.compiler.Cookable.cook(Cookable.java:80)
at org.apache.spark.sql.catalyst.expressions.codegen.CodeGenerator$.org$apache$spark$sql$ca
at org.apache.spark.sql.catalyst.expressions.codegen.CodeGenerator$$anon$1.load(CodeGenerat
at org.apache.spark.sql.catalyst.expressions.codegen.CodeGenerator$$anon$1.load(CodeGenerat
at org.sparkproject.guava.cache.LocalCache$LoadingValueReference.loadFuture(LocalCache.java
at org.sparkproject.guava.cache.LocalCache$Segment.loadSync(LocalCache.java:2379)
at org.sparkproject.guava.cache.LocalCache$Segment.lockedGetOrLoad(LocalCache.java:2342)
at org.sparkproject.guava.cache.LocalCache$Segment.get(LocalCache.java:2257)
at org.sparkproject.guava.cache.LocalCache.get(LocalCache.java:4000)
at org.sparkproject.guava.cache.LocalCache.getOrLoad(LocalCache.java:4004)
at org.sparkproject.guava.cache.LocalCache$LocalLoadingCache.get(LocalCache.java:4874)
at org.apache.spark.sql.catalyst.expressions.codegen.CodeGenerator$.compile(CodeGenerator.s
at org.apache.spark.sql.execution.WholeStageCodegenExec.liftedTree1$1(WholeStageCodegenExec
at org.apache.spark.sql.execution.WholeStageCodegenExec.doExecute(WholeStageCodegenExec.sca
at org.apache.spark.sql.execution.SparkPlan.$anonfun$execute$1(SparkPlan.scala:194)
at org.apache.spark.sql.execution.SparkPlan.$anonfun$executeQuery$1(SparkPlan.scala:232)
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at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.inputRDD$lzycompute(ShuffleE
at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.inputRDD(ShuffleExchangeExec
at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.mapOutputStatisticsFuture$lz
at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.mapOutputStatisticsFuture(Sh
at org.apache.spark.sql.execution.exchange.ShuffleExchangeLike.$anonfun$submitShuffleJob$1(
at org.apache.spark.sql.execution.SparkPlan.$anonfun$executeQuery$1(SparkPlan.scala:232)
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at org.apache.spark.sql.execution.exchange.ShuffleExchangeLike.submitShuffleJob(ShuffleExch
at org.apache.spark.sql.execution.exchange.ShuffleExchangeLike.submitShuffleJob$(ShuffleExc
at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.submitShuffleJob(ShuffleExch
at org.apache.spark.sql.execution.adaptive.ShuffleQueryStageExec.shuffleFuture$lzycompute(Q
at org.apache.spark.sql.execution.adaptive.ShuffleQueryStageExec.shuffleFuture(QueryStageEx
at org.apache.spark.sql.execution.adaptive.ShuffleQueryStageExec.doMaterialize(QueryStageEx
at org.apache.spark.sql.execution.adaptive.QueryStageExec.materialize(QueryStageExec.scala:
at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.$anonfun$getFinalPhysicalP
at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.$anonfun$getFinalPhysicalP
at scala.collection.Iterator.foreach(Iterator.scala:943)
at scala.collection.Iterator.foreach$(Iterator.scala:943)
at scala.collection.AbstractIterator.foreach(Iterator.scala:1431)
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    at scala.collection.IterableLike.foreach(IterableLike.scala:74)
    at scala.collection.IterableLike.foreach$(IterableLike.scala:73)
    at scala.collection.AbstractIterable.foreach(Iterable.scala:56)
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.$anonfun$getFinalPhysicalP
    at org.apache.spark.sql.SparkSession.withActive(SparkSession.scala:779)
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.getFinalPhysicalPlan(Adapt
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.withFinalPlanUpdate(Adapti
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.executeCollect(AdaptiveSpa
    at org.apache.spark.sql.Dataset.collectFromPlan(Dataset.scala:3868)
    at org.apache.spark.sql.Dataset.$anonfun$head$1(Dataset.scala:2863)
    at org.apache.spark.sql.Dataset.$anonfun$withAction$2(Dataset.scala:3858)
    at org.apache.spark.sql.execution.QueryExecution$.withInternalError(QueryExecution.scala:51
    at org.apache.spark.sql.Dataset.$anonfun$withAction$1(Dataset.scala:3856)
    at org.apache.spark.sql.execution.SQLExecution$.$anonfun$withNewExecutionId$6(SQLExecution.
    at org.apache.spark.sql.execution.SQLExecution$.withSQLConfPropagated(SQLExecution.scala:16
    at org.apache.spark.sql.execution.SQLExecution$.$anonfun$withNewExecutionId$1(SQLExecution.
    at org.apache.spark.sql.SparkSession.withActive(SparkSession.scala:779)
    at org.apache.spark.sql.execution.SQLExecution$.withNewExecutionId(SQLExecution.scala:64)
    at org.apache.spark.sql.Dataset.withAction(Dataset.scala:3856)
    at org.apache.spark.sql.Dataset.head(Dataset.scala:2863)
    at org.apache.spark.sql.Dataset.take(Dataset.scala:3084)
    at org.apache.spark.sql.Dataset.getRows(Dataset.scala:288)
    at org.apache.spark.sql.Dataset.showString(Dataset.scala:327)
    at java.base/jdk.internal.reflect.NativeMethodAccessorImpl.invoke0(Native Method)
    at java.base/jdk.internal.reflect.NativeMethodAccessorImpl.invoke(NativeMethodAccessorImpl.
    at java.base/jdk.internal.reflect.DelegatingMethodAccessorImpl.invoke(DelegatingMethodAcces
    at java.base/java.lang.reflect.Method.invoke(Method.java:566)
    at py4j.reflection.MethodInvoker.invoke(MethodInvoker.java:244)
    at py4j.reflection.ReflectionEngine.invoke(ReflectionEngine.java:357)
    at py4j.Gateway.invoke(Gateway.java:282)
    at py4j.commands.AbstractCommand.invokeMethod(AbstractCommand.java:132)
    at py4j.commands.CallCommand.execute(CallCommand.java:79)
    at py4j.ClientServerConnection.waitForCommands(ClientServerConnection.java:182)
    at py4j.ClientServerConnection.run(ClientServerConnection.java:106)
    at java.base/java.lang.Thread.run(Thread.java:829)
Caused by: org.codehaus.janino.InternalCompilerException: Code of method "hashAgg_doAggregateWi
    at org.codehaus.janino.CodeContext.makeSpace(CodeContext.java:1051)
    at org.codehaus.janino.CodeContext.write(CodeContext.java:932)
    at org.codehaus.janino.UnitCompiler.writeOpcode(UnitCompiler.java:12101)
    at org.codehaus.janino.UnitCompiler.invoke(UnitCompiler.java:11878)
    at org.codehaus.janino.UnitCompiler.compileGet2(UnitCompiler.java:5186)
    at org.codehaus.janino.UnitCompiler.access$9100(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$16.visitMethodInvocation(UnitCompiler.java:4482)
    at org.codehaus.janino.UnitCompiler$16.visitMethodInvocation(UnitCompiler.java:4455)
    at org.codehaus.janino.Java$MethodInvocation.accept(Java.java:5286)
    at org.codehaus.janino.UnitCompiler.compileGet(UnitCompiler.java:4455)
    at org.codehaus.janino.UnitCompiler.compileGetValue(UnitCompiler.java:5683)
    at org.codehaus.janino.UnitCompiler.compileBoolean2(UnitCompiler.java:4175)
    at org.codehaus.janino.UnitCompiler.access$6600(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$14.visitBinaryOperation(UnitCompiler.java:4008)
    at org.codehaus.janino.UnitCompiler$14.visitBinaryOperation(UnitCompiler.java:3986)
    at org.codehaus.janino.Java$BinaryOperation.accept(Java.java:5077)
    at org.codehaus.janino.UnitCompiler.compileBoolean(UnitCompiler.java:3986)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:2474)
    at org.codehaus.janino.UnitCompiler.access$1900(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1498)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$IfStatement.accept(Java.java:3140)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:2475)
    at org.codehaus.janino.UnitCompiler.access$1900(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1498)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$IfStatement.accept(Java.java:3140)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:2486)
    at org.codehaus.janino.UnitCompiler.access$1900(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1498)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$IfStatement.accept(Java.java:3140)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1598)
    at org.codehaus.janino.UnitCompiler.access$2600(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitDoStatement(UnitCompiler.java:1505)
    at org.codehaus.janino.UnitCompiler$6.visitDoStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$DoStatement.accept(Java.java:3664)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
```

```
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1661)
    at org.codehaus.janino.UnitCompiler.access$2000(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitForStatement(UnitCompiler.java:1499)
    at org.codehaus.janino.UnitCompiler$6.visitForStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$ForStatement.accept(Java.java:3187)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1848)
    at org.codehaus.janino.UnitCompiler.access$2200(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitWhileStatement(UnitCompiler.java:1501)
    at org.codehaus.janino.UnitCompiler$6.visitWhileStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$WhileStatement.accept(Java.java:3245)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:3420)
    at org.codehaus.janino.UnitCompiler.compileDeclaredMethods(UnitCompiler.java:1362)
    at org.codehaus.janino.UnitCompiler.compileDeclaredMethods(UnitCompiler.java:1335)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:807)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:975)
    at org.codehaus.janino.UnitCompiler.access$700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$2.visitMemberClassDeclaration(UnitCompiler.java:392)
    at org.codehaus.janino.UnitCompiler$2.visitMemberClassDeclaration(UnitCompiler.java:384)
    at org.codehaus.janino.Java$MemberClassDeclaration.accept(Java.java:1445)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:384)
    at org.codehaus.janino.UnitCompiler.compileDeclaredMemberTypes(UnitCompiler.java:1312)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:833)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:410)
    at org.codehaus.janino.UnitCompiler.access$400(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$2.visitPackageMemberClassDeclaration(UnitCompiler.java:
    at org.codehaus.janino.UnitCompiler$2.visitPackageMemberClassDeclaration(UnitCompiler.java:
    at org.codehaus.janino.Java$PackageMemberClassDeclaration.accept(Java.java:1594)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:384)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:362)
    ... 84 more
23/01/06 14:35:17 WARN WholeStageCodegenExec: Whole-stage codegen disabled for plan (id=1):
 *(1) HashAggregate(keys=[tag#23691], functions=[partial_sum(view_count#21)], output=[tag#23691
+- *(1) Project [tag#23691, view_count#21]
   +- *(1) Generate explode(tags_split#18439), [view_count#21], false, [tag#23691]
      +- *(1) Project [view_count#21, CASE WHEN (size(tags_split#18336, true) = 0) THEN null E
```

```
         +- *(1) Project [view_count#21, array_remove(array_distinct(array(regexp_extract(tags#
            +- *(1) Filter ((isnotnull(view_count#21) AND (size(CASE WHEN (size(array_remove(ar
               +- *(1) ColumnarToRow
                  +- FileScan parquet [tags#19,view_count#21] Batched: true, DataFilters: [isno

+---------------+---------+
|            tag|sum_views|
+---------------+---------+
|          taste|  1330670|
|         health|  1286001|
|   preservation|   682216|
|        storage|   542860|
|        whiskey|   464756|
|        bourbon|   330268|
|        brewing|   307892|
|            ipa|   291935|
|        spirits|   255328|
|       drinking|   225924|
|    temperature|   218203|
|          drink|   204991|
|        tequila|   196689|
|        alcohol|   188615|
|recommendations|   185154|
|           wine|   181081|
|          style|   168681|
|         flavor|   168594|
|        history|   167414|
|        pairing|   164589|
+---------------+---------+
```

3.6 liczba postów w czasie dla każdego z top N tagów (lineplot/barplot)

```
#1 - Question 2 - Answer 3 - Wiki 4 - TagWikiExcerpt 5 - TagWiki 6 - ModeratorNomination 7 -
posts_tmp = posts.select(f.col('id'), f.col('creation_date'), f.col('tags'))

posts_tags_time = regexp_extract_all(posts_tmp, r'<(\w+)>', 99, "tags", "tags_split", True).

top_posts_tags_time = posts_tags_time.join(tag_top_views, on="tag", how="inner").select(f.co
```

```
from plotnine import geom_bar, ylim

top_posts_tags_time_agg = top_posts_tags_time.groupBy(
        f.window('creation_date', '4 weeks'), f.col("tag")
    ) \
    .agg(
        f.sum(f.lit(1)).alias('count')
    )\
    .withColumn('date', f.col('window.start').cast('date'))

top_posts_tags_time_agg_pd = top_posts_tags_time_agg.toPandas()

(ggplot(top_posts_tags_time_agg_pd, aes("date", "count"))\
    + scale_x_datetime()\
    + geom_col() \
    + facet_wrap("tag", ncol=3) \
    + ylim(0, 15))
```

```
23/01/06 14:35:22 ERROR CodeGenerator: failed to compile: org.codehaus.janino.InternalCompilerE
org.codehaus.janino.InternalCompilerException: Compiling "GeneratedClass" in "generated.java":
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:366)
    at org.codehaus.janino.UnitCompiler.access$000(UnitCompiler.java:226)
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    at org.codehaus.janino.UnitCompiler$1.visitCompilationUnit(UnitCompiler.java:333)
    at org.codehaus.janino.Java$CompilationUnit.accept(Java.java:363)
    at org.codehaus.janino.UnitCompiler.compileUnit(UnitCompiler.java:333)
    at org.codehaus.janino.SimpleCompiler.cook(SimpleCompiler.java:235)
    at org.codehaus.janino.SimpleCompiler.compileToClassLoader(SimpleCompiler.java:464)
    at org.codehaus.janino.ClassBodyEvaluator.compileToClass(ClassBodyEvaluator.java:314)
    at org.codehaus.janino.ClassBodyEvaluator.cook(ClassBodyEvaluator.java:237)
    at org.codehaus.janino.SimpleCompiler.cook(SimpleCompiler.java:205)
    at org.codehaus.commons.compiler.Cookable.cook(Cookable.java:80)
    at org.apache.spark.sql.catalyst.expressions.codegen.CodeGenerator$.org$apache$spark$sql$ca
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    at org.apache.spark.sql.catalyst.expressions.codegen.CodeGenerator$$anon$1.load(CodeGenerat
    at org.sparkproject.guava.cache.LocalCache$LoadingValueReference.loadFuture(LocalCache.java
    at org.sparkproject.guava.cache.LocalCache$Segment.loadSync(LocalCache.java:2379)
    at org.sparkproject.guava.cache.LocalCache$Segment.lockedGetOrLoad(LocalCache.java:2342)
    at org.sparkproject.guava.cache.LocalCache$Segment.get(LocalCache.java:2257)
    at org.sparkproject.guava.cache.LocalCache.get(LocalCache.java:4000)
    at org.sparkproject.guava.cache.LocalCache.getOrLoad(LocalCache.java:4004)
    at org.sparkproject.guava.cache.LocalCache$LocalLoadingCache.get(LocalCache.java:4874)
    at org.apache.spark.sql.catalyst.expressions.codegen.CodeGenerator$.compile(CodeGenerator.s
    at org.apache.spark.sql.execution.WholeStageCodegenExec.liftedTree1$1(WholeStageCodegenExec
    at org.apache.spark.sql.execution.WholeStageCodegenExec.doExecute(WholeStageCodegenExec.sca
    at org.apache.spark.sql.execution.SparkPlan.$anonfun$execute$1(SparkPlan.scala:194)
    at org.apache.spark.sql.execution.SparkPlan.$anonfun$executeQuery$1(SparkPlan.scala:232)
    at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:151)
    at org.apache.spark.sql.execution.SparkPlan.executeQuery(SparkPlan.scala:229)
    at org.apache.spark.sql.execution.SparkPlan.execute(SparkPlan.scala:190)
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.inputRDD$lzycompute(ShuffleE
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.inputRDD(ShuffleExchangeExec
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.mapOutputStatisticsFuture$lz
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.mapOutputStatisticsFuture(Sh
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeLike.$anonfun$submitShuffleJob$1(
    at org.apache.spark.sql.execution.SparkPlan.$anonfun$executeQuery$1(SparkPlan.scala:232)
    at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:151)
    at org.apache.spark.sql.execution.SparkPlan.executeQuery(SparkPlan.scala:229)
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeLike.submitShuffleJob(ShuffleExch
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeLike.submitShuffleJob$(ShuffleExc
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.submitShuffleJob(ShuffleExch
    at org.apache.spark.sql.execution.adaptive.ShuffleQueryStageExec.shuffleFuture$lzycompute(Q
    at org.apache.spark.sql.execution.adaptive.ShuffleQueryStageExec.shuffleFuture(QueryStageEx
    at org.apache.spark.sql.execution.adaptive.ShuffleQueryStageExec.doMaterialize(QueryStageEx
    at org.apache.spark.sql.execution.adaptive.QueryStageExec.materialize(QueryStageExec.scala:
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.$anonfun$getFinalPhysicalP
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.$anonfun$getFinalPhysicalP
    at scala.collection.Iterator.foreach(Iterator.scala:943)
    at scala.collection.Iterator.foreach$(Iterator.scala:943)
    at scala.collection.AbstractIterator.foreach(Iterator.scala:1431)
    at scala.collection.IterableLike.foreach(IterableLike.scala:74)
    at scala.collection.IterableLike.foreach$(IterableLike.scala:73)
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    at org.apache.spark.sql.SparkSession.withActive(SparkSession.scala:779)
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.getFinalPhysicalPlan(Adapt
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.withFinalPlanUpdate(Adapti
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.executeCollect(AdaptiveSpa
    at org.apache.spark.sql.Dataset.$anonfun$collectToPython$1(Dataset.scala:3688)
    at org.apache.spark.sql.Dataset.$anonfun$withAction$2(Dataset.scala:3858)
    at org.apache.spark.sql.execution.QueryExecution$.withInternalError(QueryExecution.scala:51
    at org.apache.spark.sql.Dataset.$anonfun$withAction$1(Dataset.scala:3856)
    at org.apache.spark.sql.execution.SQLExecution$.$anonfun$withNewExecutionId$6(SQLExecution.
    at org.apache.spark.sql.execution.SQLExecution$.withSQLConfPropagated(SQLExecution.scala:16
    at org.apache.spark.sql.execution.SQLExecution$.$anonfun$withNewExecutionId$1(SQLExecution.
    at org.apache.spark.sql.SparkSession.withActive(SparkSession.scala:779)
    at org.apache.spark.sql.execution.SQLExecution$.withNewExecutionId(SQLExecution.scala:64)
    at org.apache.spark.sql.Dataset.withAction(Dataset.scala:3856)
    at org.apache.spark.sql.Dataset.collectToPython(Dataset.scala:3685)
    at java.base/jdk.internal.reflect.NativeMethodAccessorImpl.invoke0(Native Method)
    at java.base/jdk.internal.reflect.NativeMethodAccessorImpl.invoke(NativeMethodAccessorImpl.
    at java.base/jdk.internal.reflect.DelegatingMethodAccessorImpl.invoke(DelegatingMethodAcces
    at java.base/java.lang.reflect.Method.invoke(Method.java:566)
    at py4j.reflection.MethodInvoker.invoke(MethodInvoker.java:244)
    at py4j.reflection.ReflectionEngine.invoke(ReflectionEngine.java:357)
    at py4j.Gateway.invoke(Gateway.java:282)
    at py4j.commands.AbstractCommand.invokeMethod(AbstractCommand.java:132)
    at py4j.commands.CallCommand.execute(CallCommand.java:79)
    at py4j.ClientServerConnection.waitForCommands(ClientServerConnection.java:182)
    at py4j.ClientServerConnection.run(ClientServerConnection.java:106)
    at java.base/java.lang.Thread.run(Thread.java:829)
Caused by: org.codehaus.janino.InternalCompilerException: Code of method "hashAgg_doAggregateWi
    at org.codehaus.janino.CodeContext.makeSpace(CodeContext.java:1051)
    at org.codehaus.janino.CodeContext.write(CodeContext.java:932)
    at org.codehaus.janino.UnitCompiler.writeOpcode(UnitCompiler.java:12101)
    at org.codehaus.janino.UnitCompiler.invoke(UnitCompiler.java:11878)
    at org.codehaus.janino.UnitCompiler.compileGet2(UnitCompiler.java:5186)
    at org.codehaus.janino.UnitCompiler.access$9100(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$16.visitMethodInvocation(UnitCompiler.java:4482)
    at org.codehaus.janino.UnitCompiler$16.visitMethodInvocation(UnitCompiler.java:4455)
    at org.codehaus.janino.Java$MethodInvocation.accept(Java.java:5286)
    at org.codehaus.janino.UnitCompiler.compileGet(UnitCompiler.java:4455)
    at org.codehaus.janino.UnitCompiler.compileGetValue(UnitCompiler.java:5683)
    at org.codehaus.janino.UnitCompiler.compileBoolean2(UnitCompiler.java:4175)
    at org.codehaus.janino.UnitCompiler.access$6600(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$14.visitBinaryOperation(UnitCompiler.java:4008)
    at org.codehaus.janino.UnitCompiler$14.visitBinaryOperation(UnitCompiler.java:3986)
    at org.codehaus.janino.Java$BinaryOperation.accept(Java.java:5077)
    at org.codehaus.janino.UnitCompiler.compileBoolean(UnitCompiler.java:3986)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:2474)
    at org.codehaus.janino.UnitCompiler.access$1900(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1498)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$IfStatement.accept(Java.java:3140)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:2475)
    at org.codehaus.janino.UnitCompiler.access$1900(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1498)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$IfStatement.accept(Java.java:3140)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:2486)
    at org.codehaus.janino.UnitCompiler.access$1900(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1498)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$IfStatement.accept(Java.java:3140)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1598)
    at org.codehaus.janino.UnitCompiler.access$2600(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitDoStatement(UnitCompiler.java:1505)
    at org.codehaus.janino.UnitCompiler$6.visitDoStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$DoStatement.accept(Java.java:3664)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1661)
    at org.codehaus.janino.UnitCompiler.access$2000(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitForStatement(UnitCompiler.java:1499)
    at org.codehaus.janino.UnitCompiler$6.visitForStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$ForStatement.accept(Java.java:3187)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1848)
    at org.codehaus.janino.UnitCompiler.access$2200(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitWhileStatement(UnitCompiler.java:1501)
    at org.codehaus.janino.UnitCompiler$6.visitWhileStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$WhileStatement.accept(Java.java:3245)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:3420)
    at org.codehaus.janino.UnitCompiler.compileDeclaredMethods(UnitCompiler.java:1362)
    at org.codehaus.janino.UnitCompiler.compileDeclaredMethods(UnitCompiler.java:1335)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:807)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:975)
    at org.codehaus.janino.UnitCompiler.access$700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$2.visitMemberClassDeclaration(UnitCompiler.java:392)
    at org.codehaus.janino.UnitCompiler$2.visitMemberClassDeclaration(UnitCompiler.java:384)
    at org.codehaus.janino.Java$MemberClassDeclaration.accept(Java.java:1445)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:384)
    at org.codehaus.janino.UnitCompiler.compileDeclaredMemberTypes(UnitCompiler.java:1312)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:833)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:410)
    at org.codehaus.janino.UnitCompiler.access$400(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$2.visitPackageMemberClassDeclaration(UnitCompiler.java:
    at org.codehaus.janino.UnitCompiler$2.visitPackageMemberClassDeclaration(UnitCompiler.java:
    at org.codehaus.janino.Java$PackageMemberClassDeclaration.accept(Java.java:1594)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:384)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:362)
    ... 80 more
23/01/06 14:35:22 WARN WholeStageCodegenExec: Whole-stage codegen disabled for plan (id=1):
 *(1) HashAggregate(keys=[tag#23691], functions=[partial_sum(view_count#34545)], output=[tag#23
+- *(1) Project [tag#23691, view_count#34545]
   +- *(1) Generate explode(tags_split#18439), [view_count#34545], false, [tag#23691]
      +- *(1) Project [view_count#34545, CASE WHEN (size(tags_split#18336, true) = 0) THEN nul
         +- *(1) Project [view_count#34545, array_remove(array_distinct(array(regexp_extract(ta
            +- *(1) Filter ((isnotnull(view_count#34545) AND (size(CASE WHEN (size(array_remove
               +- *(1) ColumnarToRow
                  +- FileScan parquet [tags#34543,view_count#34545] Batched: true, DataFilters:

23/01/06 14:35:23 ERROR CodeGenerator: failed to compile: org.codehaus.janino.InternalCompilerE
org.codehaus.janino.InternalCompilerException: Compiling "GeneratedClass" in "generated.java":
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:366)
    at org.codehaus.janino.UnitCompiler.access$000(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$1.visitCompilationUnit(UnitCompiler.java:336)
    at org.codehaus.janino.UnitCompiler$1.visitCompilationUnit(UnitCompiler.java:333)
    at org.codehaus.janino.Java$CompilationUnit.accept(Java.java:363)
    at org.codehaus.janino.UnitCompiler.compileUnit(UnitCompiler.java:333)
    at org.codehaus.janino.SimpleCompiler.cook(SimpleCompiler.java:235)
    at org.codehaus.janino.SimpleCompiler.compileToClassLoader(SimpleCompiler.java:464)
    at org.codehaus.janino.ClassBodyEvaluator.compileToClass(ClassBodyEvaluator.java:314)
    at org.codehaus.janino.ClassBodyEvaluator.cook(ClassBodyEvaluator.java:237)
    at org.codehaus.janino.SimpleCompiler.cook(SimpleCompiler.java:205)
    at org.codehaus.commons.compiler.Cookable.cook(Cookable.java:80)
    at org.apache.spark.sql.catalyst.expressions.codegen.CodeGenerator$.org$apache$spark$sql$ca
    at org.apache.spark.sql.catalyst.expressions.codegen.CodeGenerator$$anon$1.load(CodeGenerat
    at org.apache.spark.sql.catalyst.expressions.codegen.CodeGenerator$$anon$1.load(CodeGenerat
    at org.sparkproject.guava.cache.LocalCache$LoadingValueReference.loadFuture(LocalCache.java
    at org.sparkproject.guava.cache.LocalCache$Segment.loadSync(LocalCache.java:2379)
    at org.sparkproject.guava.cache.LocalCache$Segment.lockedGetOrLoad(LocalCache.java:2342)
    at org.sparkproject.guava.cache.LocalCache$Segment.get(LocalCache.java:2257)
    at org.sparkproject.guava.cache.LocalCache.get(LocalCache.java:4000)
    at org.sparkproject.guava.cache.LocalCache.getOrLoad(LocalCache.java:4004)
    at org.sparkproject.guava.cache.LocalCache$LocalLoadingCache.get(LocalCache.java:4874)
    at org.apache.spark.sql.catalyst.expressions.codegen.CodeGenerator$.compile(CodeGenerator.s
    at org.apache.spark.sql.execution.WholeStageCodegenExec.liftedTree1$1(WholeStageCodegenExec
    at org.apache.spark.sql.execution.WholeStageCodegenExec.doExecute(WholeStageCodegenExec.sca
    at org.apache.spark.sql.execution.SparkPlan.$anonfun$execute$1(SparkPlan.scala:194)
    at org.apache.spark.sql.execution.SparkPlan.$anonfun$executeQuery$1(SparkPlan.scala:232)
    at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:151)
    at org.apache.spark.sql.execution.SparkPlan.executeQuery(SparkPlan.scala:229)
    at org.apache.spark.sql.execution.SparkPlan.execute(SparkPlan.scala:190)
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.inputRDD$lzycompute(ShuffleE
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.inputRDD(ShuffleExchangeExec
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.mapOutputStatisticsFuture$lz
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.mapOutputStatisticsFuture(Sh
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeLike.$anonfun$submitShuffleJob$1(
    at org.apache.spark.sql.execution.SparkPlan.$anonfun$executeQuery$1(SparkPlan.scala:232)
    at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:151)
    at org.apache.spark.sql.execution.SparkPlan.executeQuery(SparkPlan.scala:229)
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeLike.submitShuffleJob(ShuffleExch
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeLike.submitShuffleJob$(ShuffleExc
    at org.apache.spark.sql.execution.exchange.ShuffleExchangeExec.submitShuffleJob(ShuffleExch
    at org.apache.spark.sql.execution.adaptive.ShuffleQueryStageExec.shuffleFuture$lzycompute(Q
    at org.apache.spark.sql.execution.adaptive.ShuffleQueryStageExec.shuffleFuture(QueryStageEx
    at org.apache.spark.sql.execution.adaptive.ShuffleQueryStageExec.doMaterialize(QueryStageEx
    at org.apache.spark.sql.execution.adaptive.QueryStageExec.materialize(QueryStageExec.scala:
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.$anonfun$getFinalPhysicalP
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.$anonfun$getFinalPhysicalP
    at scala.collection.Iterator.foreach(Iterator.scala:943)
    at scala.collection.Iterator.foreach$(Iterator.scala:943)
    at scala.collection.AbstractIterator.foreach(Iterator.scala:1431)
    at scala.collection.IterableLike.foreach(IterableLike.scala:74)
    at scala.collection.IterableLike.foreach$(IterableLike.scala:73)
    at scala.collection.AbstractIterable.foreach(Iterable.scala:56)
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.$anonfun$getFinalPhysicalP
    at org.apache.spark.sql.SparkSession.withActive(SparkSession.scala:779)
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.getFinalPhysicalPlan(Adapt
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.withFinalPlanUpdate(Adapti
    at org.apache.spark.sql.execution.adaptive.AdaptiveSparkPlanExec.executeCollect(AdaptiveSpa
    at org.apache.spark.sql.Dataset.$anonfun$collectToPython$1(Dataset.scala:3688)
    at org.apache.spark.sql.Dataset.$anonfun$withAction$2(Dataset.scala:3858)
    at org.apache.spark.sql.execution.QueryExecution$.withInternalError(QueryExecution.scala:51
    at org.apache.spark.sql.Dataset.$anonfun$withAction$1(Dataset.scala:3856)
    at org.apache.spark.sql.execution.SQLExecution$.$anonfun$withNewExecutionId$6(SQLExecution.
    at org.apache.spark.sql.execution.SQLExecution$.withSQLConfPropagated(SQLExecution.scala:16
    at org.apache.spark.sql.execution.SQLExecution$.$anonfun$withNewExecutionId$1(SQLExecution.
    at org.apache.spark.sql.SparkSession.withActive(SparkSession.scala:779)
    at org.apache.spark.sql.execution.SQLExecution$.withNewExecutionId(SQLExecution.scala:64)
    at org.apache.spark.sql.Dataset.withAction(Dataset.scala:3856)
    at org.apache.spark.sql.Dataset.collectToPython(Dataset.scala:3685)
    at java.base/jdk.internal.reflect.NativeMethodAccessorImpl.invoke0(Native Method)
    at java.base/jdk.internal.reflect.NativeMethodAccessorImpl.invoke(NativeMethodAccessorImpl.
    at java.base/jdk.internal.reflect.DelegatingMethodAccessorImpl.invoke(DelegatingMethodAcces
    at java.base/java.lang.reflect.Method.invoke(Method.java:566)
    at py4j.reflection.MethodInvoker.invoke(MethodInvoker.java:244)
    at py4j.reflection.ReflectionEngine.invoke(ReflectionEngine.java:357)
    at py4j.Gateway.invoke(Gateway.java:282)
    at py4j.commands.AbstractCommand.invokeMethod(AbstractCommand.java:132)
    at py4j.commands.CallCommand.execute(CallCommand.java:79)
    at py4j.ClientServerConnection.waitForCommands(ClientServerConnection.java:182)
    at py4j.ClientServerConnection.run(ClientServerConnection.java:106)
    at java.base/java.lang.Thread.run(Thread.java:829)
Caused by: org.codehaus.janino.InternalCompilerException: Code of method "hashAgg_doAggregateWi
    at org.codehaus.janino.CodeContext.makeSpace(CodeContext.java:1051)
    at org.codehaus.janino.CodeContext.write(CodeContext.java:947)
    at org.codehaus.janino.CodeContext.writeShort(CodeContext.java:1072)
    at org.codehaus.janino.UnitCompiler.writeConstantInterfaceMethodrefInfo(UnitCompiler.java:1
    at org.codehaus.janino.UnitCompiler.invoke(UnitCompiler.java:11879)
    at org.codehaus.janino.UnitCompiler.compileGet2(UnitCompiler.java:5186)
    at org.codehaus.janino.UnitCompiler.access$9100(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$16.visitMethodInvocation(UnitCompiler.java:4482)
    at org.codehaus.janino.UnitCompiler$16.visitMethodInvocation(UnitCompiler.java:4455)
    at org.codehaus.janino.Java$MethodInvocation.accept(Java.java:5286)
    at org.codehaus.janino.UnitCompiler.compileGet(UnitCompiler.java:4455)
    at org.codehaus.janino.UnitCompiler.compileGetValue(UnitCompiler.java:5683)
    at org.codehaus.janino.UnitCompiler.compileBoolean2(UnitCompiler.java:4175)
    at org.codehaus.janino.UnitCompiler.access$6600(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$14.visitBinaryOperation(UnitCompiler.java:4008)
    at org.codehaus.janino.UnitCompiler$14.visitBinaryOperation(UnitCompiler.java:3986)
    at org.codehaus.janino.Java$BinaryOperation.accept(Java.java:5077)
    at org.codehaus.janino.UnitCompiler.compileBoolean(UnitCompiler.java:3986)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:2474)
    at org.codehaus.janino.UnitCompiler.access$1900(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1498)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$IfStatement.accept(Java.java:3140)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:2475)
    at org.codehaus.janino.UnitCompiler.access$1900(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1498)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$IfStatement.accept(Java.java:3140)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:2486)
    at org.codehaus.janino.UnitCompiler.access$1900(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1498)
    at org.codehaus.janino.UnitCompiler$6.visitIfStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$IfStatement.accept(Java.java:3140)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1598)
    at org.codehaus.janino.UnitCompiler.access$2600(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitDoStatement(UnitCompiler.java:1505)
    at org.codehaus.janino.UnitCompiler$6.visitDoStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$DoStatement.accept(Java.java:3664)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1661)
    at org.codehaus.janino.UnitCompiler.access$2000(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitForStatement(UnitCompiler.java:1499)
    at org.codehaus.janino.UnitCompiler$6.visitForStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$ForStatement.accept(Java.java:3187)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1559)
    at org.codehaus.janino.UnitCompiler.access$1700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1496)
    at org.codehaus.janino.UnitCompiler$6.visitBlock(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$Block.accept(Java.java:2969)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:1848)
    at org.codehaus.janino.UnitCompiler.access$2200(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$6.visitWhileStatement(UnitCompiler.java:1501)
    at org.codehaus.janino.UnitCompiler$6.visitWhileStatement(UnitCompiler.java:1490)
    at org.codehaus.janino.Java$WhileStatement.accept(Java.java:3245)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:1490)
    at org.codehaus.janino.UnitCompiler.compileStatements(UnitCompiler.java:1573)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:3420)
    at org.codehaus.janino.UnitCompiler.compileDeclaredMethods(UnitCompiler.java:1362)
    at org.codehaus.janino.UnitCompiler.compileDeclaredMethods(UnitCompiler.java:1335)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:807)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:975)
    at org.codehaus.janino.UnitCompiler.access$700(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$2.visitMemberClassDeclaration(UnitCompiler.java:392)
    at org.codehaus.janino.UnitCompiler$2.visitMemberClassDeclaration(UnitCompiler.java:384)
    at org.codehaus.janino.Java$MemberClassDeclaration.accept(Java.java:1445)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:384)
    at org.codehaus.janino.UnitCompiler.compileDeclaredMemberTypes(UnitCompiler.java:1312)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:833)
```
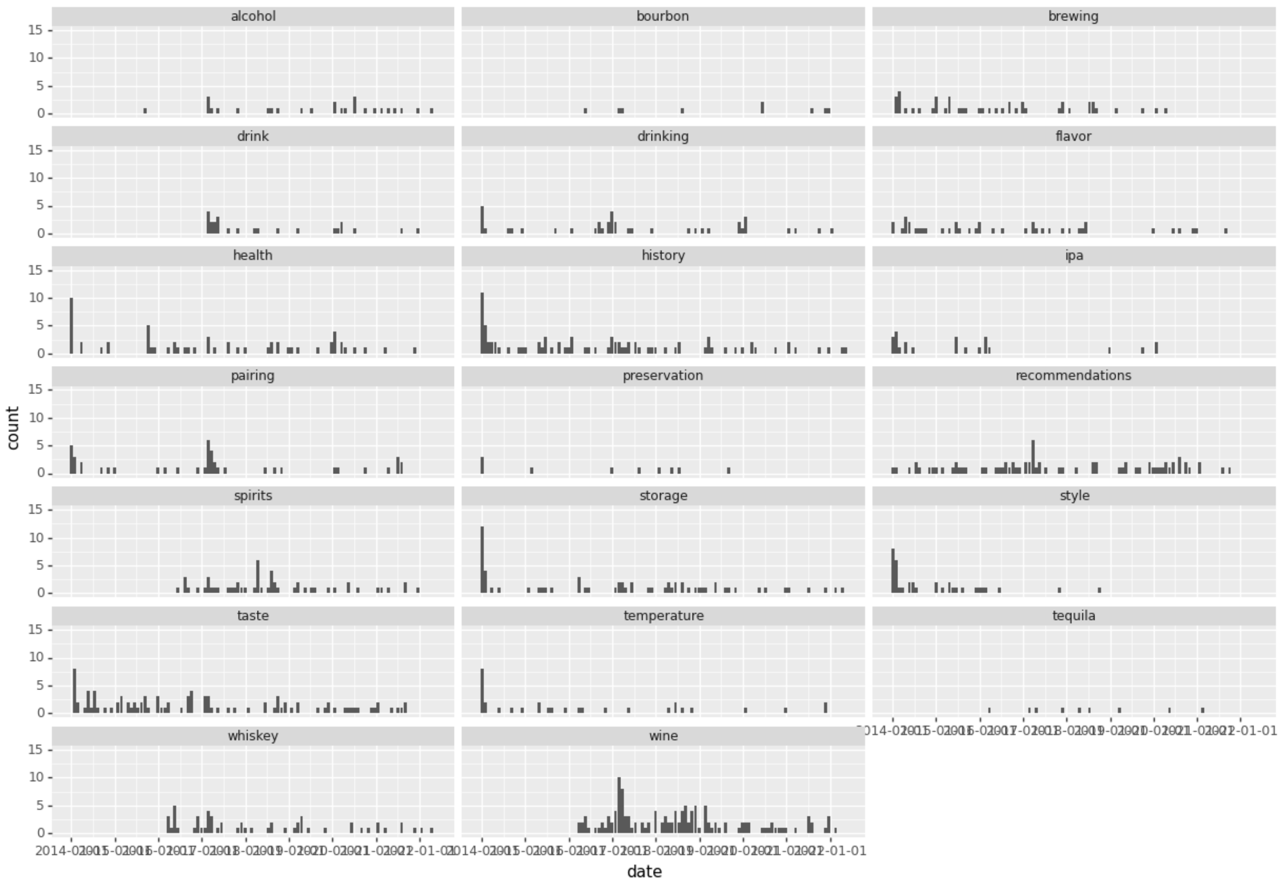

```
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:410)
    at org.codehaus.janino.UnitCompiler.access$400(UnitCompiler.java:226)
    at org.codehaus.janino.UnitCompiler$2.visitPackageMemberClassDeclaration(UnitCompiler.java:
    at org.codehaus.janino.UnitCompiler$2.visitPackageMemberClassDeclaration(UnitCompiler.java:
    at org.codehaus.janino.Java$PackageMemberClassDeclaration.accept(Java.java:1594)
    at org.codehaus.janino.UnitCompiler.compile(UnitCompiler.java:384)
    at org.codehaus.janino.UnitCompiler.compile2(UnitCompiler.java:362)
    ... 80 more
23/01/06 14:35:23 WARN WholeStageCodegenExec: Whole-stage codegen disabled for plan (id=4):
 *(4) HashAggregate(keys=[id#10, tag#34518, creation_date#8], functions=[], output=[id#10, tag#
+- *(4) Project [id#10, tag#34518, creation_date#8]
   +- *(4) BroadcastHashJoin [tag#34518], [tag#23691], Inner, BuildRight, false
      :- *(4) Filter isnotnull(tag#34518)
      :  +- *(4) Generate explode(tags_split#29166), [id#10, creation_date#8], false, [tag#3451
      :     +- *(4) Project [id#10, creation_date#8, CASE WHEN (size(tags_split#29062, true) =
      :        +- *(4) Project [id#10, creation_date#8, array_remove(array_distinct(array(regex
      :           +- *(4) Filter ((isnotnull(creation_date#8) AND (size(CASE WHEN (size(array_r
      :              +- *(4) ColumnarToRow
      :                 +- FileScan parquet [creation_date#8,id#10,tags#19] Batched: true, Data
      +- BroadcastQueryStage 1
         +- BroadcastExchange HashedRelationBroadcastMode(List(input[0, string, false]),false),
            +- *(3) Filter isnotnull(tag#23691)
               +- TakeOrderedAndProject(limit=20, orderBy=[sum_views#23697L DESC NULLS LAST], o
                  +- *(2) HashAggregate(keys=[tag#23691], functions=[sum(view_count#34545)], ou
                     +- AQEShuffleRead coalesced
                        +- ShuffleQueryStage 0
                           +- Exchange hashpartitioning(tag#23691, 200), ENSURE_REQUIREMENTS, [
                              +- *(1) HashAggregate(keys=[tag#23691], functions=[partial_sum(vi
                                 +- *(1) Project [tag#23691, view_count#34545]
                                    +- *(1) Generate explode(tags_split#18439), [view_count#345
                                       +- *(1) Project [view_count#34545, CASE WHEN (size(tags_
                                          +- *(1) Project [view_count#34545, array_remove(array
                                             +- *(1) Filter ((isnotnull(view_count#34545) AND (
                                                +- *(1) ColumnarToRow
                                                   +- FileScan parquet [tags#34543,view_count#3

/config/workspace/.venv/lib/python3.10/site-packages/plotnine/layer.py:391: PlotnineWarning: po
```



```
<ggplot: (8788912962425)>
```

3.7 najczęściej pojawiające się słowa w tytułach (z pominięciem stopwords

```
from bs4 import BeautifulSoup
from html import unescape
from pyspark.sql.functions import udf, regexp_replace
from pyspark.sql.types import *
# remove html tags
def tags_remove(s):
    soup = BeautifulSoup(unescape(s), 'lxml')
    return soup.text

udf_tags_remove = udf(lambda m: tags_remove(m))

titles = posts.filter(f.col("title").isNotNull()).select(f.col("title"))\
    .withColumn("title_clean", f.lower(f.col("title")))\
    .withColumn("title_clean", regexp_replace('title_clean', "[^a-zA-Z\\s]", " "))

from pyspark.ml.feature import Tokenizer, StopWordsRemover
from nltk.stem.snowball import SnowballStemmer
udf_filter_length = udf(lambda row: [x for x in row if len(x) > 1], ArrayType(StringType()))

stemmer = SnowballStemmer(language='english')
stemmer_udf = udf(lambda token: stemmer.stem(token), StringType())

tokenizer = Tokenizer(inputCol='title_clean', outputCol='words_token')
title_tokens = tokenizer.transform(titles).withColumn('words_token', udf_filter_length(f.col






remover = StopWordsRemover(inputCol='words_token', outputCol='words_no_stop')
title_tokens_no_stop = remover.transform(title_tokens)
exploded = title_tokens_no_stop.withColumn("words", f.explode(f.col("words_no_stop")))

title_stem = exploded.withColumn('words_stem', stemmer_udf("words"))

word_lookup = title_stem.select([f.col("words"), f.col("words_stem")]).distinct()
word_lookup.show() # TODO aggregate this
title_stem.groupBy("words_stem").agg(f.count("title").alias('count')).orderBy('count', ascen
```

```
+---------------+-----------+
|          words| words_stem|
+---------------+-----------+
|         opened|       open|
|antidepressants|antidepress|
|          taken|      taken|
|    alternative|     altern|
|       learning|      learn|
|         sherry|     sherri|
|      regionali|  regionali|
|      archetype|   archetyp|
|      inhibitor|  inhibitor|
|        outside|     outsid|
|            bay|        bay|
|        sangria|    sangria|
|         invest|     invest|
|        togther|    togther|
|           fake|       fake|
|         kahlua|     kahlua|
|       imported|     import|
|         tables|       tabl|
|         desire|      desir|
|        bavaria|    bavaria|
+---------------+-----------+
only showing top 20 rows

+----------+-----+
|words_stem|count|
+----------+-----+
|      beer|  476|
|      wine|  147|
|     drink|  104|
|   alcohol|   88|
|    differ|   72|
|     bottl|   68|
|       use|   50|
|      tast|   47|
|      brew|   43|
|      make|   41|
|      good|   33|
|  cocktail|   29|
|       age|   27|
| recommend|   26|
|       ale|   26|
|      like|   24|
|      made|   23|
|   whiskey|   23|
|    spirit|   23|
|       one|   22|
+----------+-----+
only showing top 20 rows
```

3.8 procent użytkowników którzy nigdy nic nie zapostowali

```
# users.show(2)
# posts.show(2)

users_posts = (users.join(
    (posts.select(f.col('id').alias('post_id'), f.col('owner_user_id'))), on=[users.id == po
    .filter("id IS NOT NULL and NOT id = -1")
    )

users_posts.select([f.col('id'), f.col('post_id')])\
    .groupBy("id")\
        .agg(
            f.count(f.col('post_id')).alias('post_count')
        )\
    .agg(
        f.sum(f.when(f.col('post_count') == 0, f.lit(1)).otherwise(f.lit(0))).alias("not_pos
        f.count('id').alias('all')
    ) \
    .withColumn('% not posted', (f.col("not_posted") / f.col('all') * 100)).show()

# (users.join(
#     (posts.select(f.col('id').alias('post_id'), f.col('owner_user_id'))), on=[users.id ==
#     .filter(f.col('id').isNotNull() & f.col('post_id').isNull())\
#     .select([f.col('id'), f.col('display_name')]).distinct()\
#     .show()
#     )
```

```
+----------+----+-----------------+
|not_posted| all|     % not posted|
+----------+----+-----------------+
|      7691|8947|85.96177489661339|
+----------+----+-----------------+
```

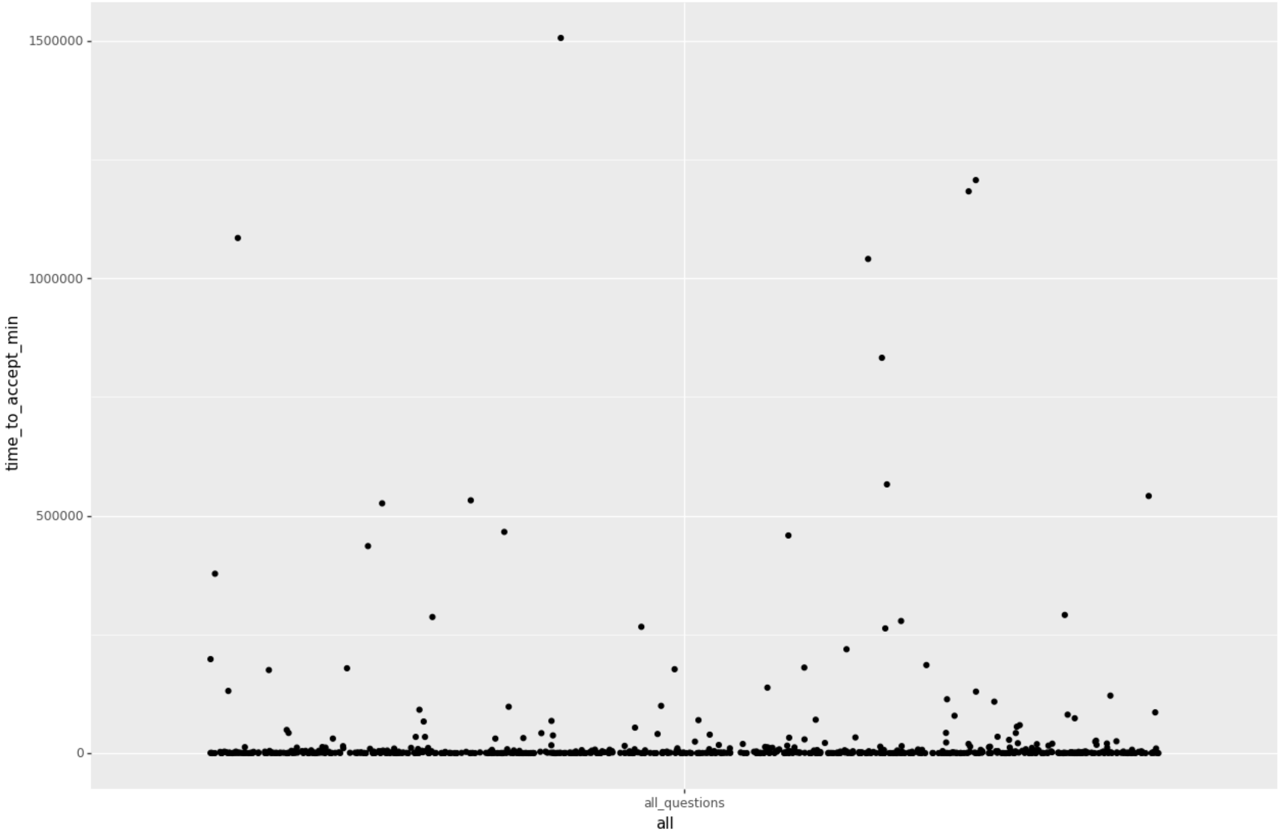
3.9 średni czas od pojawienia się pytania do pojawienia się zaakceptowanej odpowiedzi

```
# keep only questions with answers
questions = posts.filter(f.col('post_type_id') == 1).filter(f.col('answer_count') > 0).selec
answers  = posts.filter(f.col('post_type_id') == 2).select([f.col('id').alias('a_id'), f.col
#posts.show(1, vertical=True)
time_to_accept = questions.join(answers, on=[questions.accepted_answer_id==answers.a_id])\
    .withColumn('time_to_accept_sec', f.unix_timestamp('a_creation_date') - f.unix_timestamp
    .withColumn('time_to_accept_min', f.round(f.col('time_to_accept_sec') / 60, 2))

time_to_accept.agg(
        f.avg('time_to_accept_min'),
        f.stddev('time_to_accept_min'),
        f.percentile_approx("time_to_accept_min", [0.25, 0.5, 0.75], 1000000).alias("quantil
    ).show(truncate=False)


time_to_accept_pd = time_to_accept.withColumn('all', f.lit("all_questions")).toPandas()

from plotnine import geom_jitter
(ggplot(time_to_accept_pd, aes(x='all', y="time_to_accept_min"))\
    +geom_jitter())
```

```
+-----------------------+-------------------------------+------------------------+
|avg(time_to_accept_min)|stddev_samp(time_to_accept_min)|quantiles               |
+-----------------------+-------------------------------+------------------------+
|25244.9435714286       |123338.6325101642              |[141.53, 753.25, 3605.8]|
+-----------------------+-------------------------------+------------------------+
```

```
/config/workspace/.venv/lib/python3.10/site-packages/pyspark/sql/pandas/conversion.py:248: Futu
```

```
/config/workspace/.venv/lib/python3.10/site-packages/pyspark/sql/pandas/conversion.py:248: Futu
```

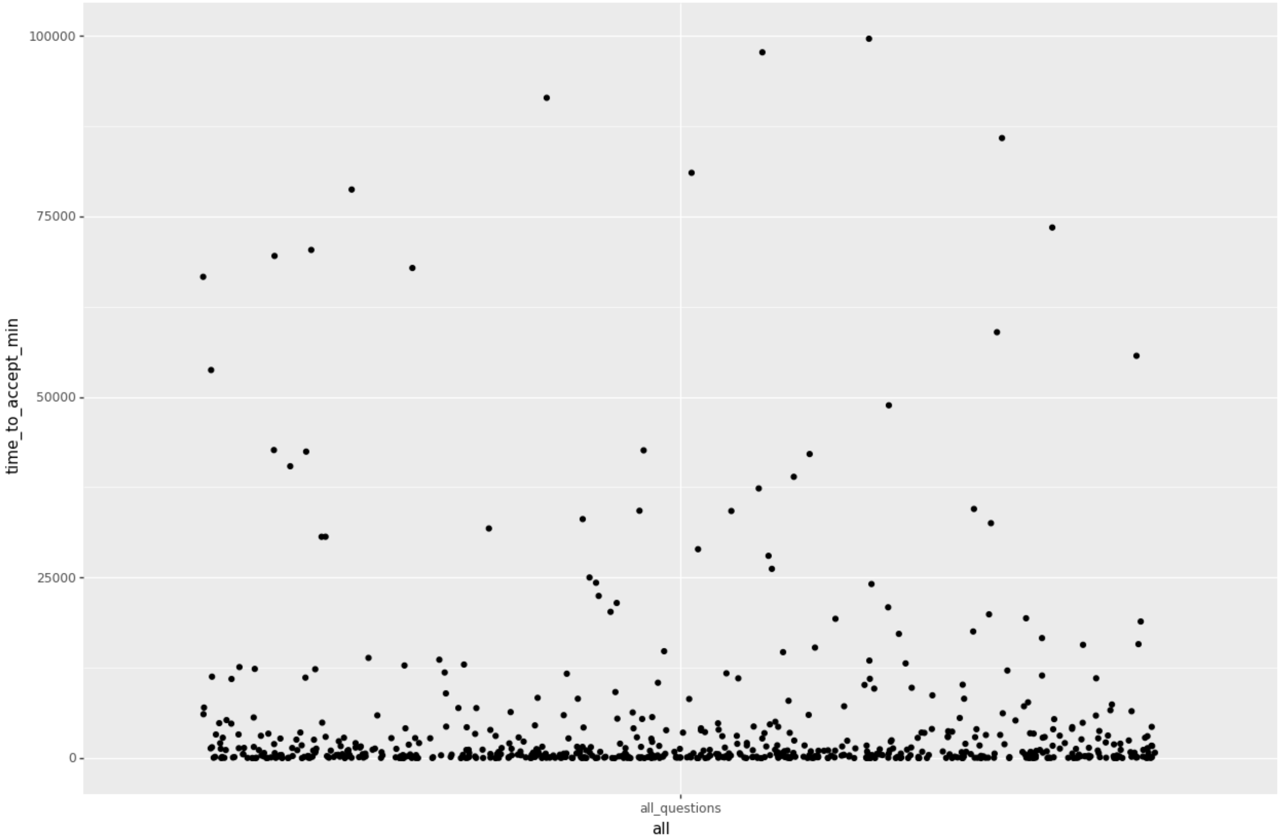


```
<ggplot: (8788909444688)>
```

3.9.1 remove outliers

```
no_outliers = time_to_accept.filter(f.col('time_to_accept_min') < 100000)

no_outliers.agg(
        f.avg('time_to_accept_min'),
        f.stddev('time_to_accept_min'),
        f.percentile_approx("time_to_accept_min", [0.25, 0.5, 0.75], 1000000).alias("quantil
    ).show(truncate=False)

no_outliers_pd = no_outliers.withColumn('all', f.lit("all_questions")).toPandas()
(ggplot(no_outliers_pd, aes(x='all', y="time_to_accept_min"))\
    +geom_jitter())
```

```
+-----------------------+-------------------------------+-------------------------+
|avg(time_to_accept_min)|stddev_samp(time_to_accept_min)|quantiles                |
+-----------------------+-------------------------------+-------------------------+
|4769.308792048925      |12694.627623679486             |[127.72, 644.93, 2922.82]|
+-----------------------+-------------------------------+-------------------------+
/config/workspace/.venv/lib/python3.10/site-packages/pyspark/sql/pandas/conversion.py:248: Futu
/config/workspace/.venv/lib/python3.10/site-packages/pyspark/sql/pandas/conversion.py:248: Futu
```



```
<ggplot: (8788909380107)>
```

References