BDCC_Final_Part2_Kenny

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1 ADSP Big Data and Cloud Computing Final Project

1.1 Part 2

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1.2.1 Date: Nov 30, 2024

[1]:
```
# import all libraries here
import os
import subprocess
import datetime
import pandas as pd
import numpy as np

import matplotlib.pyplot as plt
import seaborn as sns

from pyspark.sql import functions as F
from pyspark.sql.types import *
from pyspark.sql.functions import explode, length, count, year, expr,␣
↪countDistinct
from pyspark.sql.functions import col, from_unixtime, to_date, regexp_extract,␣
↪when
from pyspark.sql import SparkSession
from pyspark.sql.functions import max as spark_max, min as spark_min

pd.set_option('display.max_rows', 100)
pd.set_option('display.max_columns', None)
pd.set_option('display.max_colwidth', None)
```

[2]:
```
# Initialize Spark session
spark = SparkSession.builder \
    .appName('GCP Parquet') \
    .config('spark.sql.legacy.timeParserPolicy', 'LEGACY') \
    .getOrCreate()
```

```
spark.conf.set("spark.sql.repl.eagerEval.enabled",True)
```

```
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use
setLogLevel(newLevel).
24/12/02 01:09:38 INFO org.apache.spark.SparkEnv: Registering MapOutputTracker
24/12/02 01:09:38 INFO org.apache.spark.SparkEnv: Registering BlockManagerMaster
24/12/02 01:09:38 INFO org.apache.spark.SparkEnv: Registering
BlockManagerMasterHeartbeat
24/12/02 01:09:38 INFO org.apache.spark.SparkEnv: Registering
OutputCommitCoordinator
```

1.3 Load data into df

[3]:
```
%%time
# define path
cleaned_data = 'gs://msca-bdp-students-bucket/notebooks/jingkaiw/cleaned_data'

# Read data
df_languages = spark.read.parquet(os.path.join(cleaned_data,␣
↪'df_languages_cleaned'))
df_licenses = spark.read.parquet(os.path.join(cleaned_data,␣
↪'df_licenses_cleaned'))
df_commits = spark.read.parquet(os.path.join(cleaned_data,␣
↪'df_commits_cleaned'))
df_contents = spark.read.parquet(os.path.join(cleaned_data,␣
↪'df_contents_cleaned'))
df_files = spark.read.parquet(os.path.join(cleaned_data, 'df_files_cleaned'))
```

```
CPU times: user 14.2 ms, sys: 3 ms, total: 17.2 ms
Wall time: 10.1 s
```

1.3.1 Step 3: What is the timeline of the data? Do you see significant peaks and valleys?

- Do you see any data collection gaps?
- Do you see any outliers? Remove obvious outliers before plotting the timeline
- Do you see any spikes? Are these spikes caused by real activities / events?

[4]:
```
# Show the first 5 rows of the data
df_commits.limit(5)
```

[4]:
```
+--------------------+--------------------+--------------------+----------------
---+--------------------+--------------------+-------------------+--------------
```

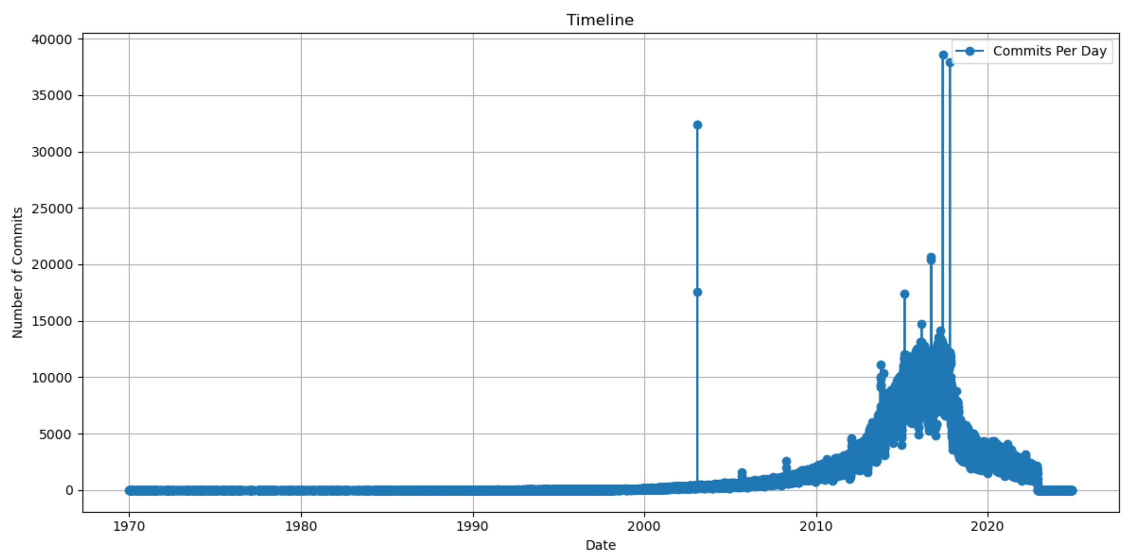
```
------+--------------------+--------------------+
|              commit|         author_name|        author_email|
author_date|      committer_name|     committer_email|     committer_date|
subject|             message|           repo_name|
+--------------------+--------------------+--------------------+----------------
---+--------------------+--------------------+-------------------+--------------
------+--------------------+--------------------+
|a72958075f3fb414a…|Christian Stigen …|09cc4f1a800d3f82e…|2016-11-07
18:48:22|Christian Stigen …|09cc4f1a800d3f82e…|2016-11-07 19:35:25|Reverts
code to v…|Reverts code to v…|       cslarsen/jp2a|
|b05aed33642d4f34d…|            Baptiste|572d88c99bc07fa4b…|2017-01-17
17:15:20|            Baptiste|572d88c99bc07fa4b…|2017-01-17 17:15:20|
change copy|        change copy
|bjacquemet/challe…|
|85a482e45024ac189…|                Mark|f1b5a91d4d6ad523f…|2016-04-16
19:11:35|                Mark|f1b5a91d4d6ad523f…|2016-04-16 19:11:35|Added
breakpoint …|Added breakpoint …|        bhalash/prep|
|5e6e5d7e174e1cdd9…|      Kaivalya Rawal|5ed355aa711409ee1…|2017-02-01
13:03:45|      Kaivalya Rawal|5ed355aa711409ee1…|2017-02-01 13:03:45|
add license|        add license
|kaivalyar/HelloWorld|
|a8d509dc1a10ff226…|     Leonardo Lucena|da2dc9135c3950a07…|2015-02-09
20:28:09|     Leonardo Lucena|da2dc9135c3950a07…|2015-02-09 20:28:09|
Update README.md|    Update README.md|potigol/SublimeTe…|
+--------------------+--------------------+--------------------+----------------
---+--------------------+--------------------+-------------------+--------------
------+--------------------+--------------------+
```

[5]:
```
# Extract Only date
df_commits = df_commits.withColumn('author_date_only',␣
↪to_date(col('author_date'), 'yyyy-MM-dd')) \
                        .withColumn('committer_date_only',␣
↪to_date(col('committer_date'), 'yyyy-MM-dd'))

# Aggregate date with only date and count
df_date = df_commits.groupBy('author_date_only') \
                     .agg(count('*').alias('count')) \
                     .orderBy('author_date_only')

# print out
df_date.limit(5)
```

[5]:
```
+----------------+-----+
|author_date_only|count|
+----------------+-----+
```

```
|      1970-01-01|   17|
|      1970-01-02|    3|
|      1970-01-03|    1|
|      1970-01-04|    4|
|      1970-01-06|    3|
+----------------+-----+
```

[6]:
```
# Convert to Pandas
df_date_pd = df_date.toPandas()

# Plot the data
plt.figure(figsize=(12, 6))
plt.plot(df_date_pd['author_date_only'],
         df_date_pd['count'], marker='o', linestyle='-', label='Commits Per␣
 ↪Day')
plt.title('Timeline')
plt.xlabel('Date')
plt.ylabel('Number of Commits')
plt.grid(True)
plt.legend()
plt.tight_layout()
plt.show()
```



What is the timeline of the data? The timeline start before 1970, and extends to 2024. The most of the activity mainly forcus between 2008 to 2018. ##### Do you see significant peaks and valleys?¶ For the significant peaks, it is during 2015-2017, which exceed 30,000 commits. And as for the valleys, the significant valleys are very obvious at the timeline before 2000, the early timeline, and towards the end, after around 2018. ##### Do you see any data collection gaps? For the data collection before 2007, it indicates that the limited GitHub usage or incomplete data recording. Besides, after ~2018, a sharp decline in commits, which may because of the reduction in activity or gaps in the dataset.

Do you see any outliers? Remove obvious outliers before plotting the timeline

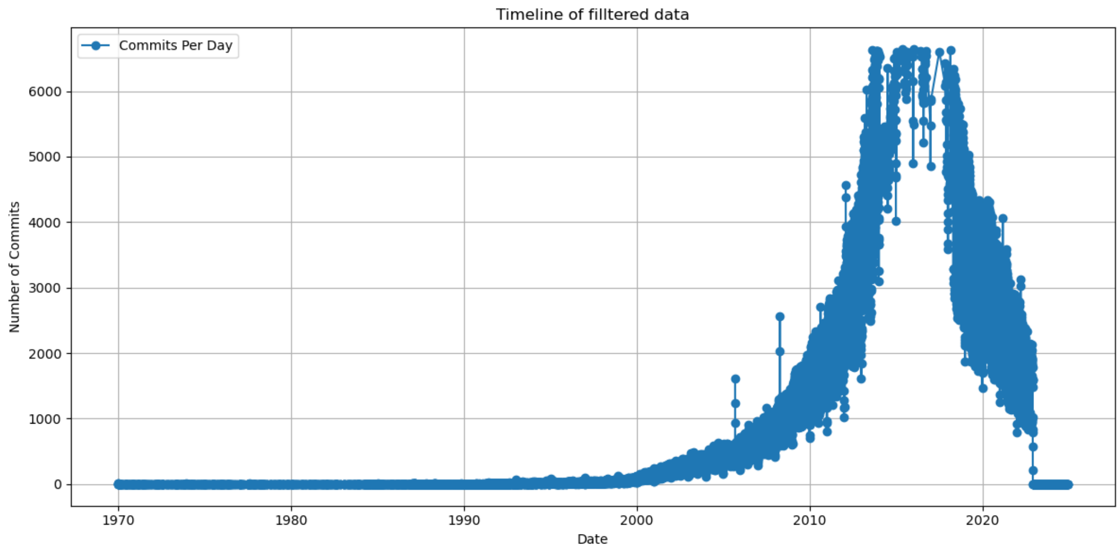
[7]:
```
# Use describe to compare the median and mean
df_date_pd.describe()
```

[7]:

	count
count	12916.000000
mean	2023.757510
std	3155.712893
min	1.000000
25%	18.000000
50%	431.000000
75%	2666.250000
max	38560.000000

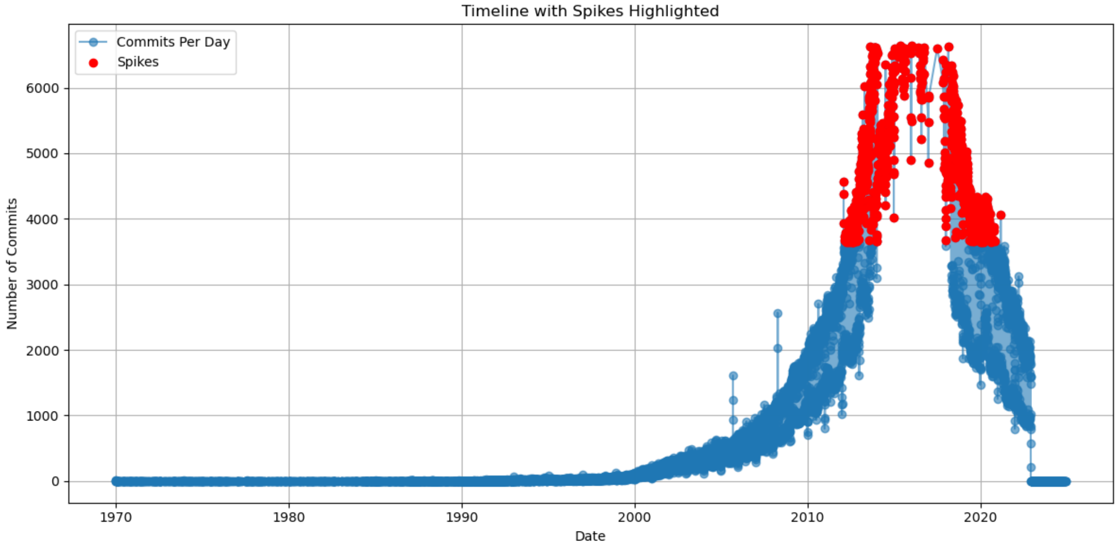
[8]:
```
# Remove the outliers
# Compute statistics for commit counts
q1 = np.percentile(df_date_pd['count'], 25)
q3 = np.percentile(df_date_pd['count'], 75)
IQR = q3 - q1

# Define outlier thresholds
lower_bound = q1 - 1.5 * IQR
upper_bound = q3 + 1.5 * IQR

# Filter out outliers
df_date_pd_fil = df_date_pd[
    (df_date_pd['count'] >= lower_bound) &
    (df_date_pd['count'] <= upper_bound)
]

# Make the plot again with filltered data
plt.figure(figsize=(12, 6))
plt.plot(df_date_pd_fil['author_date_only'],
         df_date_pd_fil['count'], marker='o', linestyle='-', label='Commits Per␣
 ↪Day')
plt.title('Timeline of filltered data')
plt.xlabel('Date')
plt.ylabel('Number of Commits')
plt.grid(True)
plt.legend()
plt.tight_layout()
```

```
plt.show()
```



Do you see any spikes? Are these spikes caused by real activities / events?

[9]:
```
# Filter the spike dates
spike = np.percentile(df_date_pd_fil['count'], 90)
spike_dates = df_date_pd_fil[df_date_pd_fil['count'] > spike]

# Plot the spikes
plt.figure(figsize=(12, 6))
plt.plot(df_date_pd_fil['author_date_only'], df_date_pd_fil['count'],
 ↪label='Commits Per Day', linestyle='-', marker='o', alpha=0.6)
plt.scatter(spike_dates['author_date_only'], spike_dates['count'], color='red',
 ↪label='Spikes', zorder=5)
plt.title('Timeline with Spikes Highlighted')
plt.xlabel('Date')
plt.ylabel('Number of Commits')
plt.grid(True)
plt.legend()
plt.tight_layout()
plt.show()
```



Most spikes appear to be caused by real activities, like collaborative development on popular repositories. And Some spikes in earlier years, may result from data inconsistencies or automated processes.

1.3.2 Step 4: What are the most popular programming languages on GitHub?

- Did the trend of most popular programming languages change over time?

[10]:
```
# Display the original df
df_languages.show(5)
```

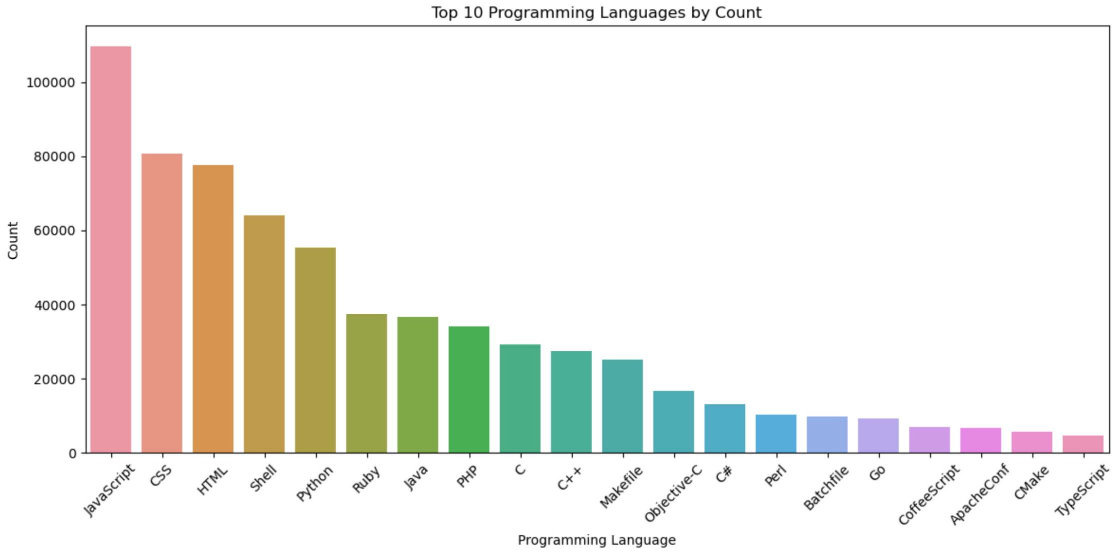
```
+--------------------+----------+-----+
|           repo_name|  language|bytes|
+--------------------+----------+-----+
|      nagypet/helios|         C| 1840|
|osaetinevbuoma/tw…|ApacheConf| 3073|
|kalimist123/adapt…|       CSS|   37|
|songzhw/android-t…|FreeMarker| 4195|
|gusztavvargadr/in…|      Ruby|63513|
+--------------------+----------+-----+
only showing top 5 rows
```

[11]:
```
# Aggregate total bytes by language
df_languages_pop = df_languages.groupBy('language') \
                                .agg(count('*').alias('language_count')) \
                                .orderBy(col('language_count').desc())


# Display the top 10
```

```
df_languages_pop.show(10)
```

```
[Stage 24:=======================================================> (48 + 1) / 49]

+----------+--------------+
|  language|language_count|
+----------+--------------+
|JavaScript|        109714|
|       CSS|         80595|
|      HTML|         77700|
|     Shell|         63961|
|    Python|         55297|
|      Ruby|         37438|
|      Java|         36749|
|       PHP|         34108|
|         C|         29251|
|       C++|         27592|
+----------+--------------+
only showing top 10 rows
```

[12]:
```
# Convert to pandas
df_languages_pop_pd = df_languages_pop.toPandas()

# Make the plot
plt.figure(figsize=(12, 6))
sns.barplot(x='language', y='language_count', data=df_languages_pop_pd[:20])
plt.title('Top 10 Programming Languages by Count')
plt.xlabel('Programming Language')
plt.ylabel('Count')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```



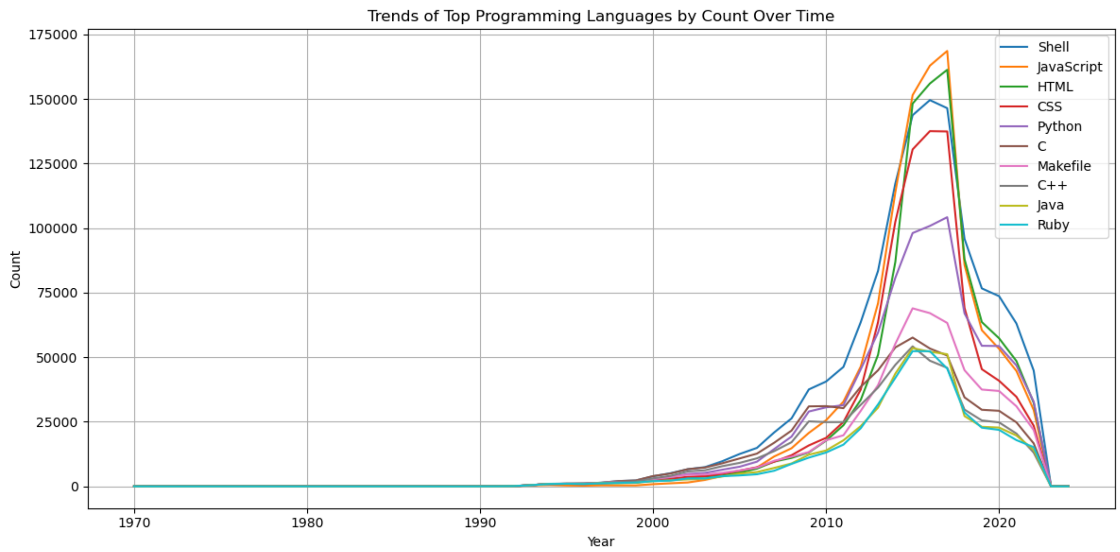
JavaScript, CSS, HTML, Shell, and Python are the most popular programming languages on GitHub.

[13]:
```python
# Extract year in df_commits and convert repo_name to string
df_commits = df_commits.withColumn('year', year(col('author_date_only')))

# Join the language with commits year
df_languages_year = df_languages.join(df_commits.select('repo_name', 'year'),
                                      on='repo_name', how='inner')

# Aggregate the counts for years
df_languages_pop_trends = df_languages_year.groupBy('year', 'language') \
                                           .agg(count('*').alias('count')) \
                                           .orderBy('year', col('count').desc())

# Display top 10
df_languages_pop_trends.show(10)
```

```
[Stage 36:=====================================================>  (64 + 3) / 67]

+----+------------+-----+
|year|    language|count|
+----+------------+-----+
|1970|  JavaScript|   49|
|1970|        HTML|   48|
|1970|         CSS|   48|
|1970|       Shell|   47|
|1970|    Makefile|   47|
|1970|      Python|   47|
|1970|         C++|   47|
```

```
|1970|CoffeeScript|   47|
|1970|        VimL|   46|
|1970|    Assembly|   46|
+----+------------+-----+
only showing top 10 rows
```

[14]:
```python
# Convert to Pandas
df_languages_pop_trends_pd = df_languages_pop_trends.toPandas()

# Filter for the top 10 languages
top_languages = df_languages_pop_trends_pd.groupby('language')['count'].sum().
↪nlargest(10).index
df_top_language_trends =␣
↪df_languages_pop_trends_pd[df_languages_pop_trends_pd['language'].
↪isin(top_languages)]

# Plot trends over time
plt.figure(figsize=(12, 6))
for language in top_languages:
    language_data = df_top_language_trends[df_top_language_trends['language']␣
↪== language]
    plt.plot(language_data['year'], language_data['count'], label=language)

plt.title('Trends of Top Programming Languages by Count Over Time')
plt.xlabel('Year')
plt.ylabel('Count')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```



Ruby maintains consistent popularity until ~2015, and JavaScript and HTML exceed it.

1.3.3 Step 5: What is the distribution of licenses across GitHub repositories?

- Any certain programming languages that are more likely to be associated with a particular license?

[15]:
```python
# Show the df_license
df_licenses.limit(5)
```

[15]:
```
+--------------------+------------+
|           repo_name|     license|
+--------------------+------------+
|otokunaga2/schedu…|artistic-2.0|
|denormal/perl-Cla…|artistic-2.0|
|vsbuffalo/bioinfo…|artistic-2.0|
|Arabidopsis-Infor…|artistic-2.0|
|         oslugr/0agit|artistic-2.0|
+--------------------+------------+
```

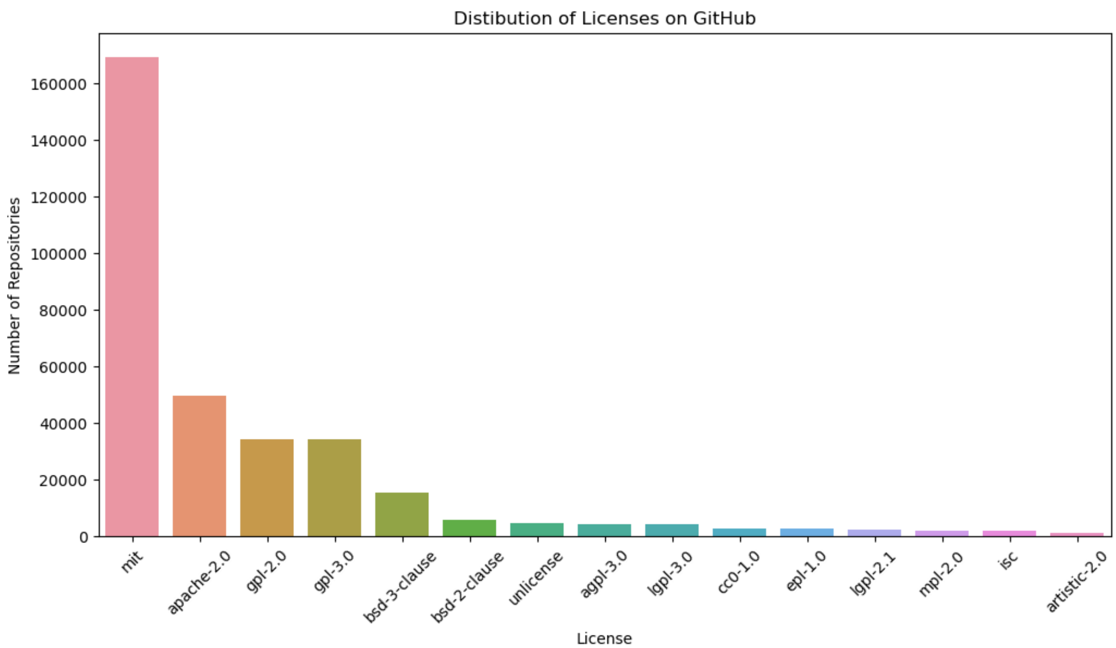
[16]:
```python
# Aggregate the licenses with count
df_lincenses_dis = df_licenses.groupBy('license') \
                              .count().orderBy(F.desc('count'))

df_lincenses_dis.show()
```

```
+------------+------+
|     license| count|
+------------+------+
```

```
|         mit|169267|
|  apache-2.0| 49659|
|     gpl-2.0| 34128|
|     gpl-3.0| 34065|
|bsd-3-clause| 15182|
|bsd-2-clause|  5429|
|   unlicense|  4596|
|    agpl-3.0|  4183|
|    lgpl-3.0|  3946|
|     cc0-1.0|  2698|
|     epl-1.0|  2386|
|    lgpl-2.1|  2272|
|     mpl-2.0|  1880|
|         isc|  1749|
|artistic-2.0|   814|
+------------+------+
```

[17]:

```
# Convert to Pandas for visualization
df_lincenses_dis_pd = df_lincenses_dis.toPandas()

# Plot the distribution of licenses
plt.figure(figsize=(12, 6))
sns.barplot(x='license', y='count', data=df_lincenses_dis_pd)
plt.title('Distibution of Licenses on GitHub')
plt.xlabel('License')
plt.ylabel('Number of Repositories')
plt.xticks(rotation=45)
plt.show()
```



[18]:

```
# Join df_languages and df_licenses
df_licenses_lan = df_licenses.join(df_languages, on='repo_name', how='inner')

# Aggregate the count
df_licenses_lan = df_licenses_lan.groupBy('license', 'language') \
                                 .count().orderBy(F.desc('count'))

# Display
df_licenses_lan.show(10)
```

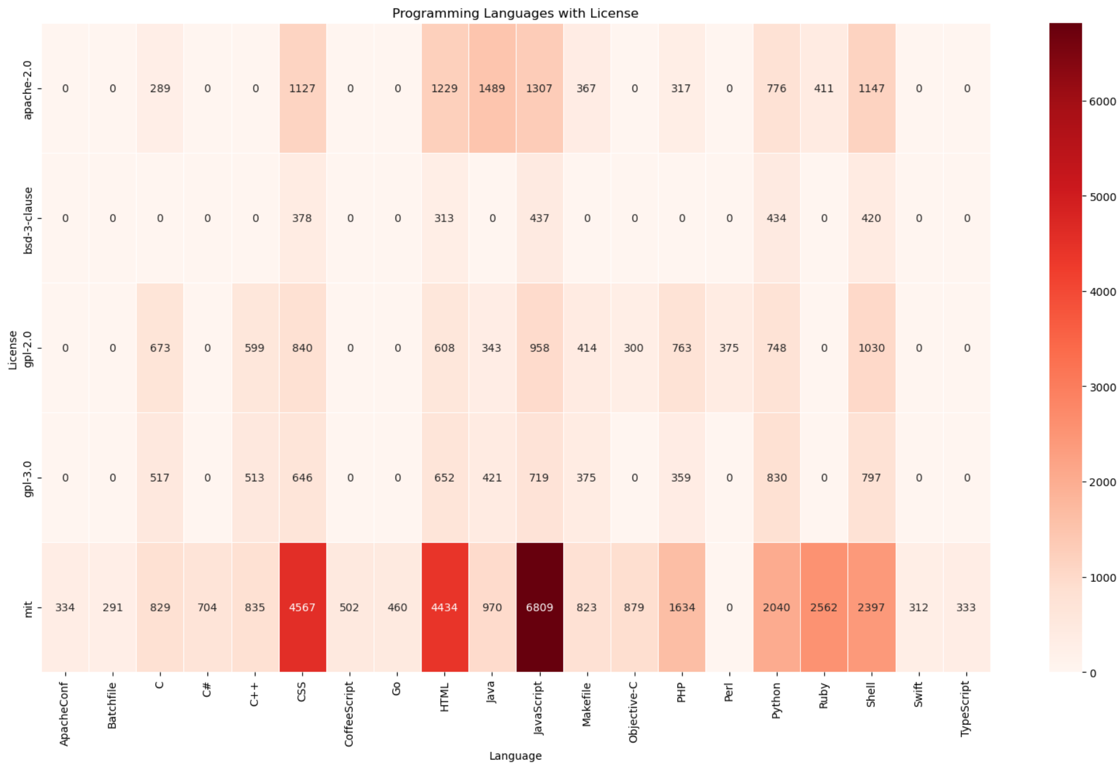
```
[Stage 62:=====================================================> (48 + 1) / 49]

+----------+----------+-----+
|   license|  language|count|
+----------+----------+-----+
|       mit|JavaScript| 6809|
|       mit|       CSS| 4567|
|       mit|      HTML| 4434|
|       mit|      Ruby| 2562|
|       mit|     Shell| 2397|
|       mit|    Python| 2040|
|       mit|       PHP| 1634|
|apache-2.0|      Java| 1489|
|apache-2.0|JavaScript| 1307|
|apache-2.0|      HTML| 1229|
+----------+----------+-----+
only showing top 10 rows
```

[19]:
```python
# Convert Spark DataFrame to Pandas DataFrame
df_licenses_lan_pd = df_licenses_lan.toPandas()

# check the mean
df_licenses_lan_pd.describe()
```

[19]:

	count
count	1864.000000
mean	42.150751
std	262.869392
min	1.000000
25%	1.000000
50%	3.000000
75%	10.250000
max	6809.000000

[20]:
```python
# filter the count > mean
df_licenses_lan_pd_fil = df_licenses_lan_pd[df_licenses_lan_pd['count'] >= 272]

# Create a pivot table for heatmap
df_pivot = df_licenses_lan_pd_fil.pivot(index='license', columns='language',␣
↪values='count').fillna(0)

# Plot heatmap
plt.figure(figsize=(16, 10))
sns.heatmap(df_pivot, annot=True, fmt='.0f', cmap='Reds', linewidths=0.5)
plt.title('Programming Languages with License')
plt.xlabel('Language')
plt.ylabel('License')
plt.tight_layout()
plt.show()
```



JavaScript,HTML, and CSS are more likely to be associated with mit.

1.3.4 Step 6: What can you tell about the most popular and most rapidly growing repositories?

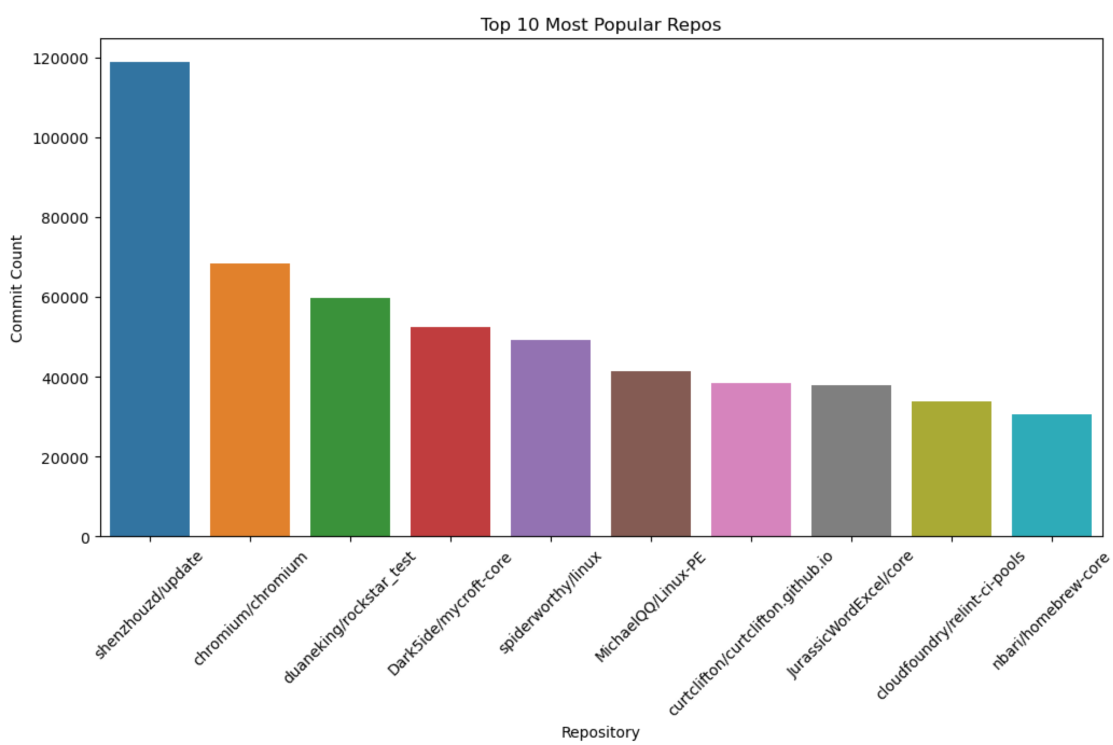
- Is there certain technology that is driving popularity or explosive growth?
- Are these associated with Big TechLinks to an external site., who are open sourcing the technology?
- Are there any technological breakthroughs that are driving this brisk adoption?

[21]:
```
# Aggregate the commit to find the most popular
df_repo = df_commits.groupBy('repo_name') \
                    .agg(count('commit').alias('commit_count'),
                         countDistinct('author_email').alias('author_count')) \
                    .orderBy(F.desc('commit_count'))

df_repo.limit(10)
```

[21]:
```
+--------------------+------------+------------+
|           repo_name|commit_count|author_count|
+--------------------+------------+------------+
|   shenzhouzd/update|      118733|           2|
```

```
|   chromium/chromium|       68329|        3676|
|duaneking/rocksta…|       59817|           2|
|Dark5ide/mycroft-…|       52517|           3|
|  spiderworthy/linux|       49332|           1|
|  MichaelQQ/Linux-PE|       41336|        5127|
|curtclifton/curtc…|       38500|           1|
|JurassicWordExcel…|       37756|         688|
|cloudfoundry/reli…|       33825|          40|
| nbari/homebrew-core|       30648|        2887|
+--------------------+------------+------------+
```

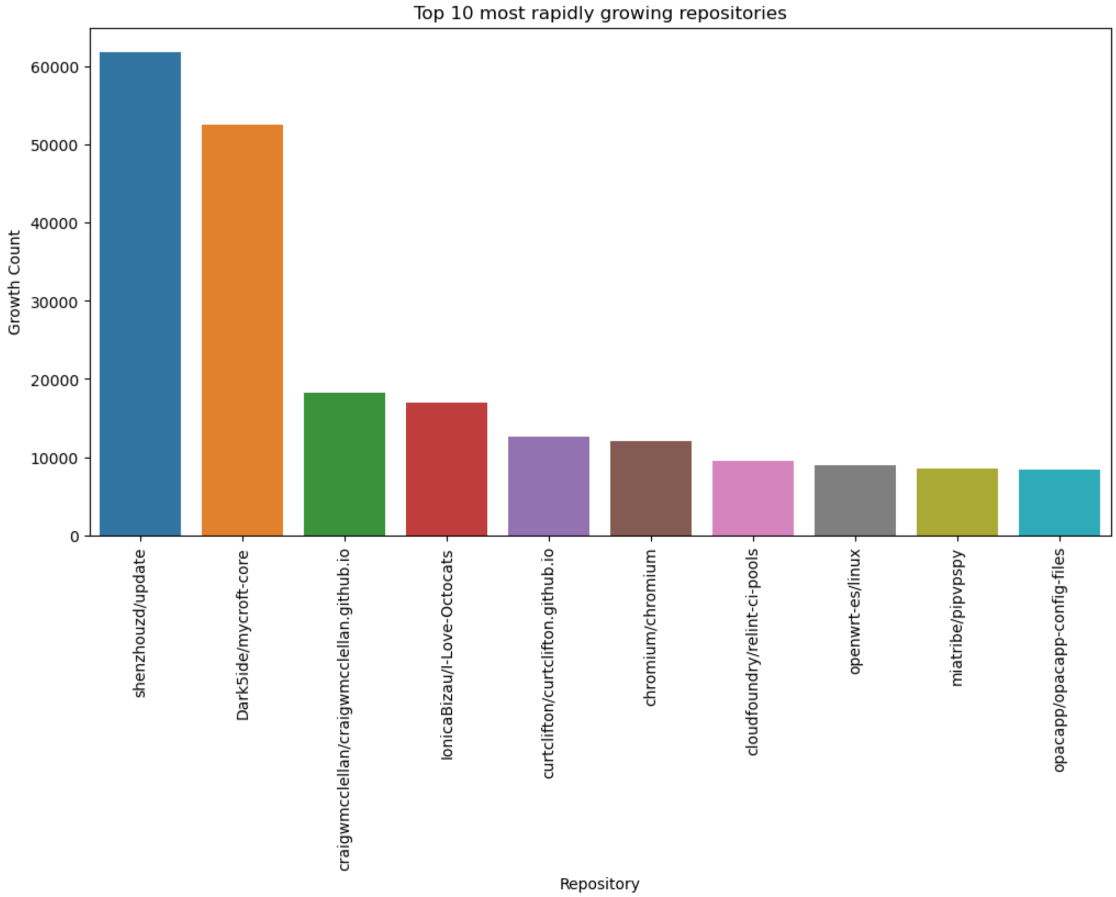
[22]:
```python
# convert to pandas
df_repo_pd = df_repo.toPandas()

# Plot the most popular repos
plt.figure(figsize=(12, 6))
sns.barplot(x='repo_name', y='commit_count', data=df_repo_pd[:10])
plt.title('Top 10 Most Popular Repos')
plt.xlabel('Repository')
plt.ylabel('Commit Count')
plt.xticks(rotation=45)
plt.show()
```



[23]:
```python
# Aggregate to measure the growth
df_repo_growth = df_commits.groupBy('repo_name', 'year') \
                           .agg(count('commit').alias('commit_count')) \
                           .orderBy(col('repo_name'), col('year'))

# Calculate growth rate for each repository
df_repo_growth = df_repo_growth.groupBy('repo_name') \
                               .agg((spark_max('commit_count') -␣
 ↪spark_min('commit_count')).alias('growth_count')) \
                               .orderBy(F.desc('growth_count'))

# Display
df_repo_growth.limit(10)
```

[23]:
```
+--------------------+------------+
|           repo_name|growth_count|
+--------------------+------------+
|   shenzhouzd/update|       61896|
|Dark5ide/mycroft-…|       52511|
|craigwmcclellan/c…|       18249|
|IonicaBizau/I-Lov…|       17024|
|curtclifton/curtc…|       12582|
|   chromium/chromium|       12030|
|cloudfoundry/reli…|        9552|
|    openwrt-es/linux|        8881|
|   miatribe/pipvpspy|        8486|
|opacapp/opacapp-c…|        8392|
+--------------------+------------+
```

[24]:
```python
# convert to pandas
df_repo_growth_pd = df_repo_growth.toPandas()

# Plot the most rapidly growing repos
plt.figure(figsize=(12, 6))
sns.barplot(x='repo_name', y='growth_count', data=df_repo_growth_pd[:10])
plt.title('Top 10 most rapidly growing repositories')
plt.xlabel('Repository')
plt.ylabel('Growth Count')
plt.xticks(rotation=90)
plt.show()
```



The most polular repos is `shenzhouzd/update`, most rapidly growing repos is also `shenzhouzd/update`

Is there certain technology that is driving popularity or explosive growth?

[25]:
```
# Join df_repo and df_languages
df_repo_lan = df_repo.join(df_languages, on='repo_name', how='inner')
df_repo_lan = df_repo_lan.groupBy('language') \
                         .agg(countDistinct('repo_name').alias('count')) \
                         .orderBy(F.desc('count'))

# Display
df_repo_lan.limit(10)
```

[25]:
```
+----------+-----+
|  language|count|
+----------+-----+
|JavaScript|68080|
```

```
|       CSS|50427|
|      HTML|49280|
|     Shell|38091|
|    Python|34188|
|      Ruby|22512|
|      Java|21608|
|       PHP|20708|
|         C|16683|
|       C++|15994|
+----------+-----+
```

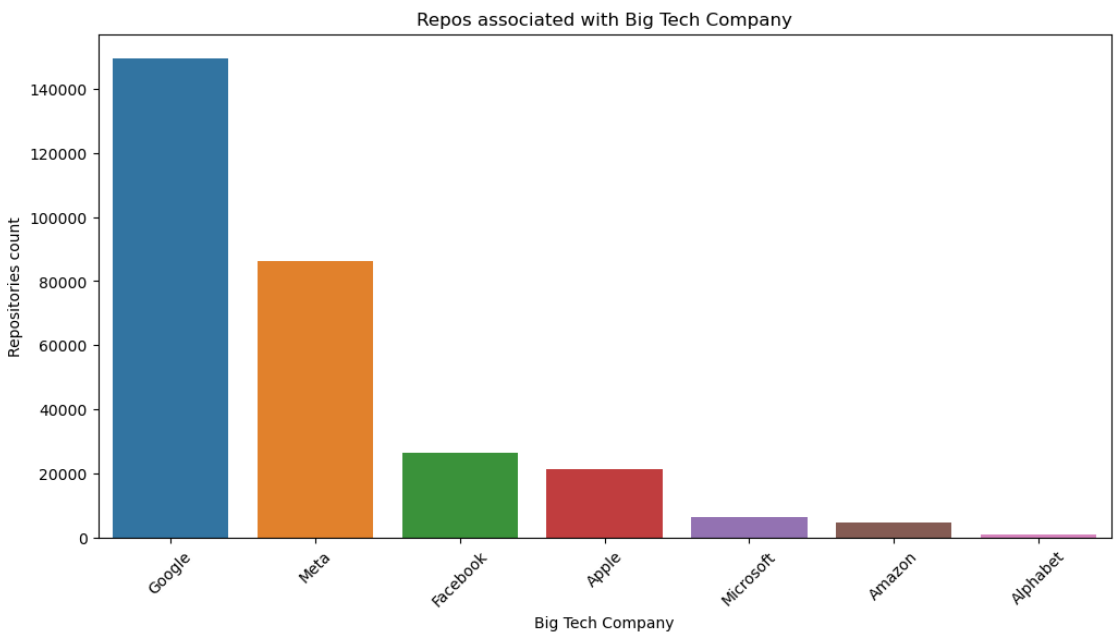
Are these associated with Big TechLinks to an external site., who are open sourcing the technology?

[27]:
```python
# Create the big_tech list
big_tech_keywords = ['google', 'microsoft', 'facebook',
                     'amazon', 'apple', 'meta', 'alphabet']

# Filter repositories associated with Big Tech
df_big = df_commits.withColumn(
    'big_tech',
    when(col('repo_name').rlike('google'), 'Google')
    .when(col('repo_name').rlike('microsoft'), 'Microsoft')
    .when(col('repo_name').rlike('facebook'), 'Facebook')
    .when(col('repo_name').rlike('amazon'), 'Amazon')
    .when(col('repo_name').rlike('apple'), 'Apple')
    .when(col('repo_name').rlike('meta'), 'Meta')
    .when(col('repo_name').rlike('alphabet'), 'Alphabet')
).filter(col('big_tech').isNotNull()) # drop not big tech data

# Count total commits by Big Tech repositories
df_big_repo = df_big.groupBy('big_tech') \
                    .agg(count('repo_name').alias('count')) \
                    .orderBy(F.desc('count'))

df_big_repo.limit(10)
```

[27]:
```
+---------+------+
| big_tech| count|
+---------+------+
|   Google|149695|
|     Meta| 86154|
| Facebook| 26388|
|    Apple| 21157|
|Microsoft|  6366|
```

```
|   Amazon|  4683|
| Alphabet|   969|
+---------+------+
```

[28]:
```
# convert to pandas
df_big_repo_pd = df_big_repo.toPandas()

# Plot the data
plt.figure(figsize=(12, 6))
sns.barplot(x='big_tech', y='count', data=df_big_repo_pd)
plt.title('Repos associated with Big Tech Company')
plt.xlabel('Big Tech Company')
plt.ylabel('Repositories count')
plt.xticks(rotation=45)
plt.show()
```



Are there any technological breakthroughs that are driving this brisk adoption?

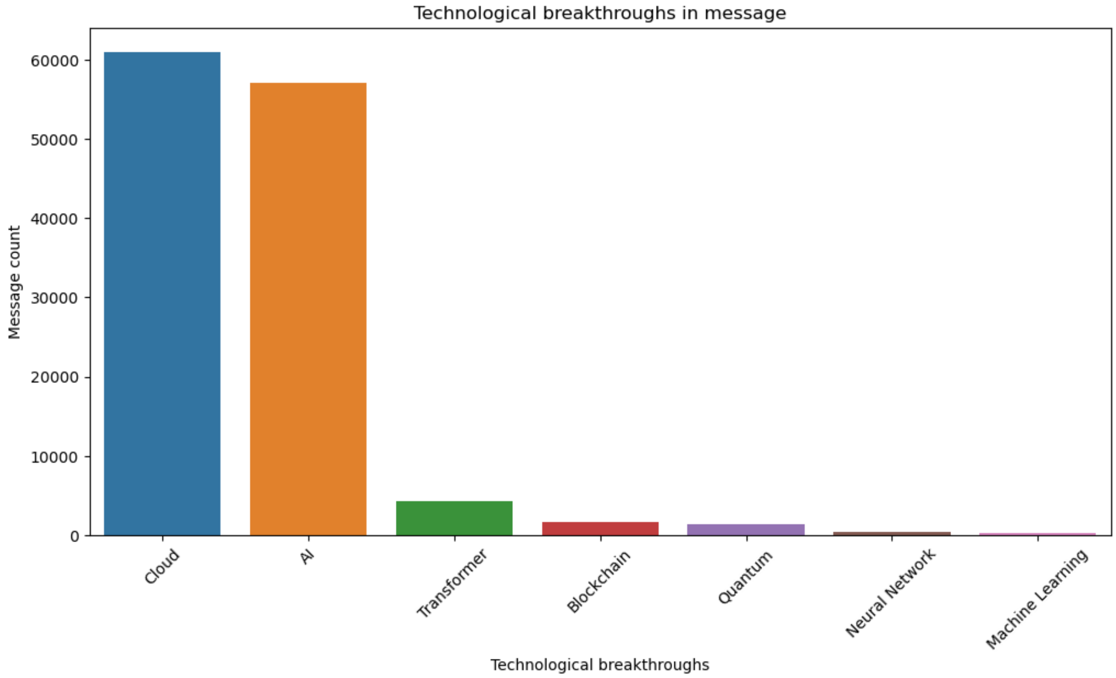
[29]:
```
# Analyze commit messages for keywords indicating breakthroughs
tech_break = ['AI', 'blockchain', 'cloud', 'quantum',
                'machine learning', 'transformer', 'neural network']

# Add a column to identify which breakthrough keyword is mentioned
df_tech_break = df_commits.withColumn(
    'tech_break',
```

```python
    when(col('message').rlike('AI'), 'AI')
    .when(col('message').rlike('blockchain'), 'Blockchain')
    .when(col('message').rlike('cloud'), 'Cloud')
    .when(col('message').rlike('quantum'), 'Quantum')
    .when(col('message').rlike('machine learning'), 'Machine Learning')
    .when(col('message').rlike('transformer'), 'Transformer')
    .when(col('message').rlike('neural network'), 'Neural Network')
).filter(col('tech_break').isNotNull())

# Aggregate by repository and keyword
df_tech_break_repo = df_tech_break.groupBy('tech_break') \
                                  .agg(F.count('message').alias('count')
).orderBy(F.desc('count'))

# Show the most mentioned breakthroughs
df_tech_break_repo.show()
```

```
[Stage 174:=================================================>      (59 + 8) / 67]

+----------------+-----+
|      tech_break|count|
+----------------+-----+
|           Cloud|60955|
|              AI|57043|
|     Transformer| 4334|
|      Blockchain| 1585|
|         Quantum| 1352|
|  Neural Network|  388|
|Machine Learning|  302|
+----------------+-----+
```

[30]:

```python
# convert to pandas
df_tech_break_repo_pd = df_tech_break_repo.toPandas()

# Make the plot
plt.figure(figsize=(12, 6))
sns.barplot(x='tech_break', y='count', data=df_tech_break_repo_pd)
plt.title('Technological breakthroughs in message')
plt.xlabel('Technological breakthroughs')
plt.ylabel('Message count')
plt.xticks(rotation=45)
plt.show()
```



[ ]:

```
[31]: import datetime
import pytz

datetime.datetime.now(pytz.timezone('US/Central')).strftime("%a, %d %B %Y %H:%M:
 ↪%S")
```

[31]: 'Sun, 01 December 2024 19:13:09'

[ ]: