evaluation

April 11, 2024

1 In this Experiment we have Compared the performance of Apriori algorithm in three different Python libraries (PAMI, mlxtend, efficient-Apriori) using Transactional Database.

1.1 Note:

1. (Transactional_T10I4D100K.csv)is a transactional database downloaded from PAMI and used as a input file for all libraries
2. Minimum support values and seperator are also same.

1.2 Comparing Apriori algorithm using PAMI Library

1.2.1 Step :- 1 Install PAMI Package

[1]:
```
!pip3 install PAMI --break-system-packages
```

```
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~bconvert
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~ami
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~cikit-learn
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~bconvert
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~ami
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~cikit-learn
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
Collecting PAMI
  Using cached pami-2024.4.10.1-py3-none-any.whl.metadata (67 kB)
Requirement already satisfied: psutil in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from PAMI)
(5.9.0)
Requirement already satisfied: pandas in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from PAMI)
(2.1.1)
Requirement already satisfied: plotly in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from PAMI)
(5.17.0)
Requirement already satisfied: matplotlib in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from PAMI)
(3.8.0)
Requirement already satisfied: resource in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from PAMI)
(0.2.1)
```

```
Requirement already satisfied: validators in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from PAMI)
(0.22.0)
Requirement already satisfied: urllib3 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from PAMI)
(1.26.16)
Requirement already satisfied: Pillow in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from PAMI)
(9.3.0)
Requirement already satisfied: numpy in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from PAMI)
(1.26.4)
Requirement already satisfied: sphinx-rtd-theme in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from PAMI)
(1.3.0)
Requirement already satisfied: discord.py in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from PAMI)
(2.3.2)
Requirement already satisfied: networkx in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from PAMI)
(3.0)
Requirement already satisfied: aiohttp<4,>=3.7.4 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
discord.py->PAMI) (3.8.6)
Requirement already satisfied: contourpy>=1.0.1 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
matplotlib->PAMI) (1.1.1)
Requirement already satisfied: cycler>=0.10 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
matplotlib->PAMI) (0.12.0)
Requirement already satisfied: fonttools>=4.22.0 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
matplotlib->PAMI) (4.43.0)
Requirement already satisfied: kiwisolver>=1.0.1 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
matplotlib->PAMI) (1.4.5)
Requirement already satisfied: packaging>=20.0 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
matplotlib->PAMI) (23.1)
Requirement already satisfied: pyparsing>=2.3.1 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
matplotlib->PAMI) (3.1.1)
Requirement already satisfied: python-dateutil>=2.7 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
matplotlib->PAMI) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
pandas->PAMI) (2023.3.post1)
```

```
Requirement already satisfied: tzdata>=2022.1 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
pandas->PAMI) (2023.3)
Requirement already satisfied: tenacity>=6.2.0 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
plotly->PAMI) (8.2.3)
Requirement already satisfied: JsonForm>=0.0.2 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
resource->PAMI) (0.0.2)
Requirement already satisfied: JsonSir>=0.0.2 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
resource->PAMI) (0.0.2)
Requirement already satisfied: python-easyconfig>=0.1.0 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
resource->PAMI) (0.1.7)
Requirement already satisfied: sphinx<8,>=1.6 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx-rtd-theme->PAMI) (7.2.6)
Requirement already satisfied: docutils<0.19 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx-rtd-theme->PAMI) (0.18.1)
Requirement already satisfied: sphinxcontrib-jquery<5,>=4 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx-rtd-theme->PAMI) (4.1)
Requirement already satisfied: attrs>=17.3.0 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
aiohttp<4,>=3.7.4->discord.py->PAMI) (23.1.0)
Requirement already satisfied: charset-normalizer<4.0,>=2.0 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
aiohttp<4,>=3.7.4->discord.py->PAMI) (3.2.0)
Requirement already satisfied: multidict<7.0,>=4.5 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
aiohttp<4,>=3.7.4->discord.py->PAMI) (6.0.4)
Requirement already satisfied: async-timeout<5.0,>=4.0.0a3 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
aiohttp<4,>=3.7.4->discord.py->PAMI) (4.0.3)
Requirement already satisfied: yarl<2.0,>=1.0 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
aiohttp<4,>=3.7.4->discord.py->PAMI) (1.9.2)
Requirement already satisfied: frozenlist>=1.1.1 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
aiohttp<4,>=3.7.4->discord.py->PAMI) (1.4.0)
Requirement already satisfied: aiosignal>=1.1.2 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
aiohttp<4,>=3.7.4->discord.py->PAMI) (1.3.1)
Requirement already satisfied: jsonschema in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
JsonForm>=0.0.2->resource->PAMI) (4.21.1)
```

```
Requirement already satisfied: six>=1.5 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
python-dateutil>=2.7->matplotlib->PAMI) (1.16.0)
Requirement already satisfied: PyYAML in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
python-easyconfig>=0.1.0->resource->PAMI) (6.0)
Requirement already satisfied: sphinxcontrib-applehelp in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (1.0.7)
Requirement already satisfied: sphinxcontrib-devhelp in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (1.0.5)
Requirement already satisfied: sphinxcontrib-jsmath in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (1.0.1)
Requirement already satisfied: sphinxcontrib-htmlhelp>=2.0.0 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (2.0.4)
Requirement already satisfied: sphinxcontrib-serializinghtml>=1.1.9 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (1.1.9)
Requirement already satisfied: sphinxcontrib-qthelp in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (1.0.6)
Requirement already satisfied: Jinja2>=3.0 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (3.1.2)
Requirement already satisfied: Pygments>=2.14 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (2.16.1)
Requirement already satisfied: snowballstemmer>=2.0 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (2.2.0)
Requirement already satisfied: babel>=2.9 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (2.12.1)
Requirement already satisfied: alabaster<0.8,>=0.7 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (0.7.13)
Requirement already satisfied: imagesize>=1.3 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (1.4.1)
Requirement already satisfied: requests>=2.25.0 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (2.28.2)
Requirement already satisfied: MarkupSafe>=2.0 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
Jinja2>=3.0->sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (2.1.1)
```

```
Requirement already satisfied: idna<4,>=2.5 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
requests>=2.25.0->sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (3.4)
Requirement already satisfied: certifi>=2017.4.17 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
requests>=2.25.0->sphinx<8,>=1.6->sphinx-rtd-theme->PAMI) (2023.7.22)
Requirement already satisfied: jsonschema-specifications>=2023.03.6 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
jsonschema->JsonForm>=0.0.2->resource->PAMI) (2023.12.1)
Requirement already satisfied: referencing>=0.28.4 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
jsonschema->JsonForm>=0.0.2->resource->PAMI) (0.33.0)
Requirement already satisfied: rpds-py>=0.7.1 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
jsonschema->JsonForm>=0.0.2->resource->PAMI) (0.18.0)
Using cached pami-2024.4.10.1-py3-none-any.whl (957 kB)
WARNING: Ignoring invalid distribution ~l-dtypes

(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)

WARNING: Ignoring invalid distribution ~etuptools

(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)

WARNING: Ignoring invalid distribution ~bconvert

(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)

WARNING: Ignoring invalid distribution ~ami

(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)

WARNING: Ignoring invalid distribution ~cikit-learn

(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)

Installing collected packages: PAMI
```

```
ERROR: Could not install packages due to an OSError: [Errno 13] Permission
denied: '/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-
packages/PAMI/__init__.py'
Consider using the `--user` option or check the permissions.

WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~bconvert
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~ami
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~cikit-learn
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
```

1.2.2 Step :- 2 Download the Transactional Database and setup different minimum pattern support conditions

[2]:
```
!wget "https://u-aizu.ac.jp/~udayrage/datasets/transactionalDatabases/
  ↪Transactional_T10I4D100K.csv"

inputFile = "Transactional_T10I4D100K.csv"
minimumSupportCountList = [600,700,800,900,1000]
seperator = "\t"
```

```
--2024-04-11 04:20:37--  https://u-aizu.ac.jp/~udayrage/datasets/transactionalDa
```

```
tabases/Transactional_T10I4D100K.csv
Resolving u-aizu.ac.jp (u-aizu.ac.jp)… 150.31.244.160, 150.95.161.176
Connecting to u-aizu.ac.jp (u-aizu.ac.jp)|150.31.244.160|:443… connected.
HTTP request sent, awaiting response… 200 OK
Length: 4019277 (3.8M) [text/csv]
Saving to: ‘Transactional_T10I4D100K.csv.2’

Transactional_T10I4 100%[===================>]   3.83M  17.8MB/s    in 0.2s

2024-04-11 04:20:37 (17.8 MB/s) - ‘Transactional_T10I4D100K.csv.2’ saved
[4019277/4019277]
```

1.2.3 Step :- 3 Create dataframes to store results

[3]:
```
import pandas as pd

result1 = pd.DataFrame(columns=['algorithm', 'minSup', 'patterns', 'runtime',␣
 ↪'memory'])
result2 = pd.DataFrame(columns=['algorithm', 'minSup', 'patterns', 'runtime',␣
 ↪'memory'])
result3 = pd.DataFrame(columns=['algorithm', 'minSup', 'patterns', 'runtime',␣
 ↪'memory'])
```

1.2.4 Step :- 4 Start Mining PAMI Apriori

[4]:
```
!pip install deprecated
```

```
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~bconvert
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~ami
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~cikit-learn
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~bconvert
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~ami
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~cikit-learn
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
Requirement already satisfied: deprecated in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (1.2.14)
Requirement already satisfied: wrapt<2,>=1.10 in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (from
deprecated) (1.14.1)
```

```
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~bconvert
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~ami
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~cikit-learn
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~bconvert
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~ami
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~cikit-learn
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
```

[5]:
```
# import PAMI.frequentPattern.basic.Apriori as alg
import Apriori as alg
```

```
for minSupCount in minimumSupportCountList:
  obj = alg.Apriori(inputFile, minSup=minSupCount, sep=seperator)
  obj.mine()
  result1.loc[result1.shape[0]] = ['PAMI-Apriori', minSupCount, len(obj.
 ↪getPatterns()), obj.getRuntime(), obj.getMemoryRSS()]
  del obj
```

```
Frequent patterns were generated successfully using Apriori algorithm
Frequent patterns were generated successfully using Apriori algorithm
Frequent patterns were generated successfully using Apriori algorithm
Frequent patterns were generated successfully using Apriori algorithm
Frequent patterns were generated successfully using Apriori algorithm
```

1.3 Comparing Apriori algorithm using mlxtend Library

1.3.1 Step :- 1 Start Mining mlxtend Apriori algorithm.

[6]:
```
from mlxtend.preprocessing import TransactionEncoder
from mlxtend.frequent_patterns import apriori
import time
import psutil
import warnings

for min_sup in minimumSupportCountList:
    start_time = time.time()

    df = pd.read_csv(inputFile, header=None)

    preprocessed_data = []
    for transaction in df[0]:
        items = transaction.split('\t')
        preprocessed_data.append(items)

    te = TransactionEncoder()
    te_ary = te.fit_transform(preprocessed_data)
    df_encoded = pd.DataFrame(te_ary, columns=te.columns_)
    frequent_itemsets = apriori(df_encoded, min_support=min_sup /␣
 ↪len(preprocessed_data), use_colnames=True, low_memory=True)
    end_time = time.time()

    runtime = end_time - start_time
    memory = psutil.Process().memory_info().rss
    print(f"Frequent patterns were generated successfully using Apriori␣
 ↪algorithm")

    result2.loc[result2.shape[0]] = ['mlxtend-Apriori', min_sup,␣
 ↪len(frequent_itemsets), runtime, memory]
```

```
Frequent patterns were generated successfully using Apriori algorithm
Frequent patterns were generated successfully using Apriori algorithm
Frequent patterns were generated successfully using Apriori algorithm
Frequent patterns were generated successfully using Apriori algorithm
Frequent patterns were generated successfully using Apriori algorithm
```

1.4 Comparing Apriori using efficient-Apriori Library

1.4.1 Step :- 1 Installing efficient_apriori package

[7]:
```
!pip install efficient_apriori
```

```
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~bconvert
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~ami
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~cikit-learn
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~bconvert
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~ami
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~cikit-learn
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
Requirement already satisfied: efficient_apriori in
/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages (2.0.3)
```

```
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~bconvert
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~ami
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~cikit-learn
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~bconvert
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~ami
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~cikit-learn
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~l-dtypes
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
WARNING: Ignoring invalid distribution ~etuptools
(/home/jupyter/anaconda3/envs/jupyterHub/lib/python3.11/site-packages)
```

1.4.2 Step :- 2 Start Mining efficient-Apriori algorithm.

[8]:
```
from efficient_apriori import apriori as apriori_efficient
import time
import os
import psutil

for minSupCount in minimumSupportCountList:
    start_time = time.time()
    fd = []
    with open(inputFile, 'r') as f:
        for line in f:
            fd.append(tuple(line.strip().split('\t')))
    itemsets, rules = apriori_efficient(fd, min_support=minSupCount / len(fd),␣
 ↪min_confidence=1, max_length=50)
    end_time = time.time()

    runtime = end_time - start_time
    memory = psutil.Process().memory_info().rss
    print(f"Frequent patterns were generated successfully using Efficient␣
 ↪Apriori algorithm")

    patterns = 0
    for itemset in itemsets:
        patterns += len(itemsets[itemset])

    result3.loc[result3.shape[0]] = ['EfficientApriori', minSupCount, patterns,␣
 ↪runtime, memory]
```

```
Frequent patterns were generated successfully using Efficient Apriori algorithm
Frequent patterns were generated successfully using Efficient Apriori algorithm
Frequent patterns were generated successfully using Efficient Apriori algorithm
Frequent patterns were generated successfully using Efficient Apriori algorithm
Frequent patterns were generated successfully using Efficient Apriori algorithm
```

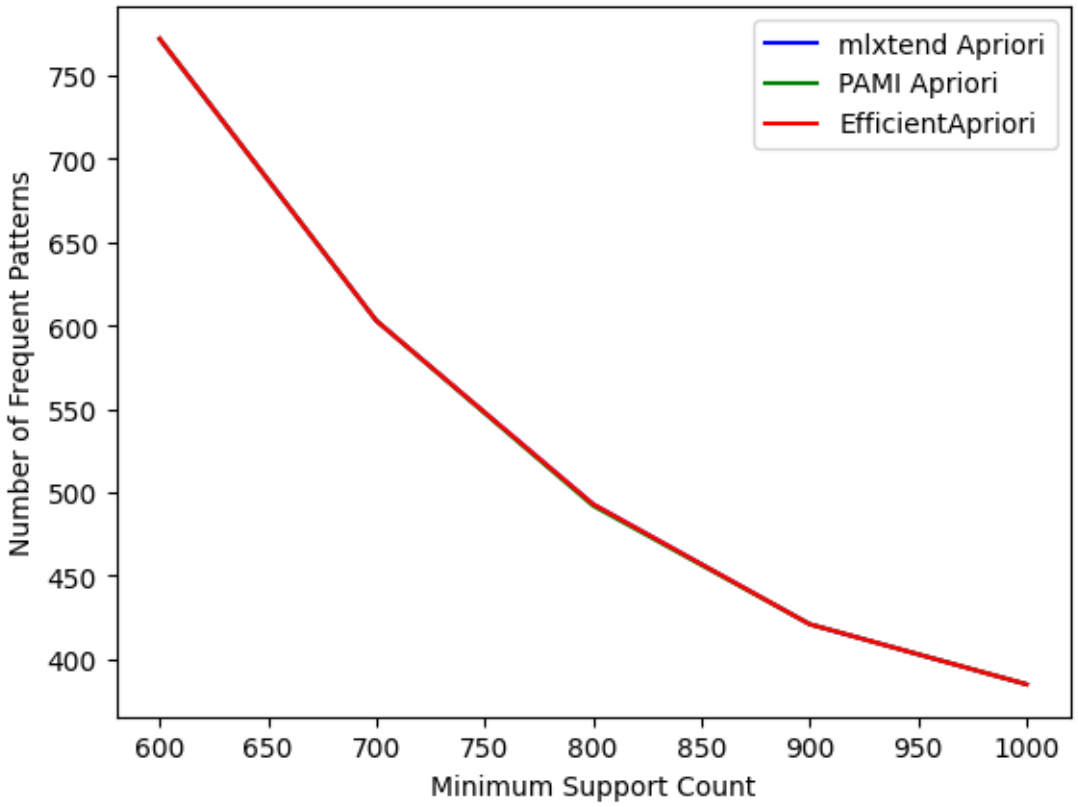
1.5 Visualizing the performance of the Apriori algorithm in three different graphs (patterns extracted, memory usage, and runtime) using different Python libraries.

1.5.1 Comparing the patterns generated by different Python libraries for the Apriori algorithm.

[9]:
```
import matplotlib.pyplot as plt

for result, color, label in zip([result1, result2, result3], ['blue', 'green',␣
 ↪'red'], ['mlxtend Apriori', 'PAMI Apriori', 'EfficientApriori']):
    plt.plot(result['minSup'], result['patterns'], label=label, color=color)
plt.xlabel('Minimum Support Count')
```

```
plt.ylabel('Number of Frequent Patterns')
plt.legend()
plt.show()
```



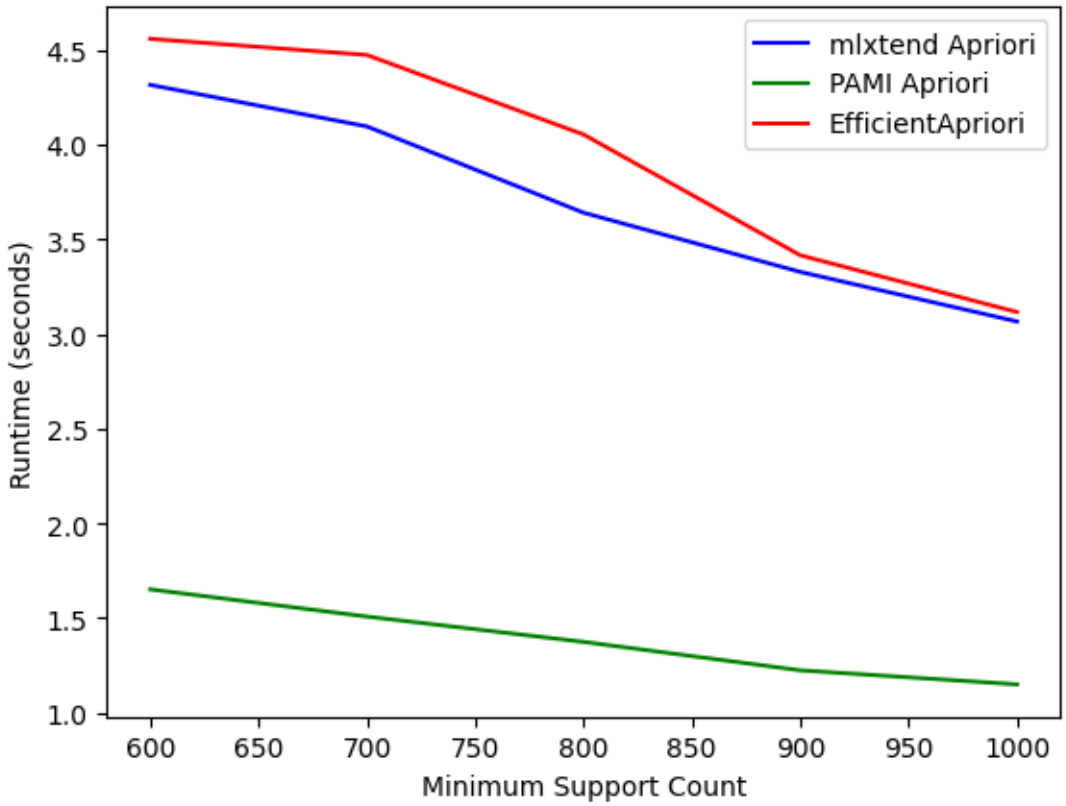
Observations 1. The extraction of interesting patterns decreases as the minimum support (minSup) value increases. When minSup is high, the number of generated patterns is low because satisfying a high threshold would be challenging. 2. The count of generated patterns is the same for different Python libraries implementing the Apriori algorithm. This proves the correctness of the PAMI Apriori Algorithm.

1.5.2 Comparing the runtime of the Apriori algorithm across different Python libraries.

[10]:
```
import matplotlib.pyplot as plt

for result, color, label in zip([result1, result2, result3], ['blue', 'green',␣
 ↪'red'], ['mlxtend Apriori', 'PAMI Apriori', 'EfficientApriori']):
    plt.plot(result['minSup'], result['runtime'], label=label, color=color)
plt.xlabel('Minimum Support Count')
plt.ylabel('Runtime (seconds)')
plt.legend()
```

```
plt.show()
```

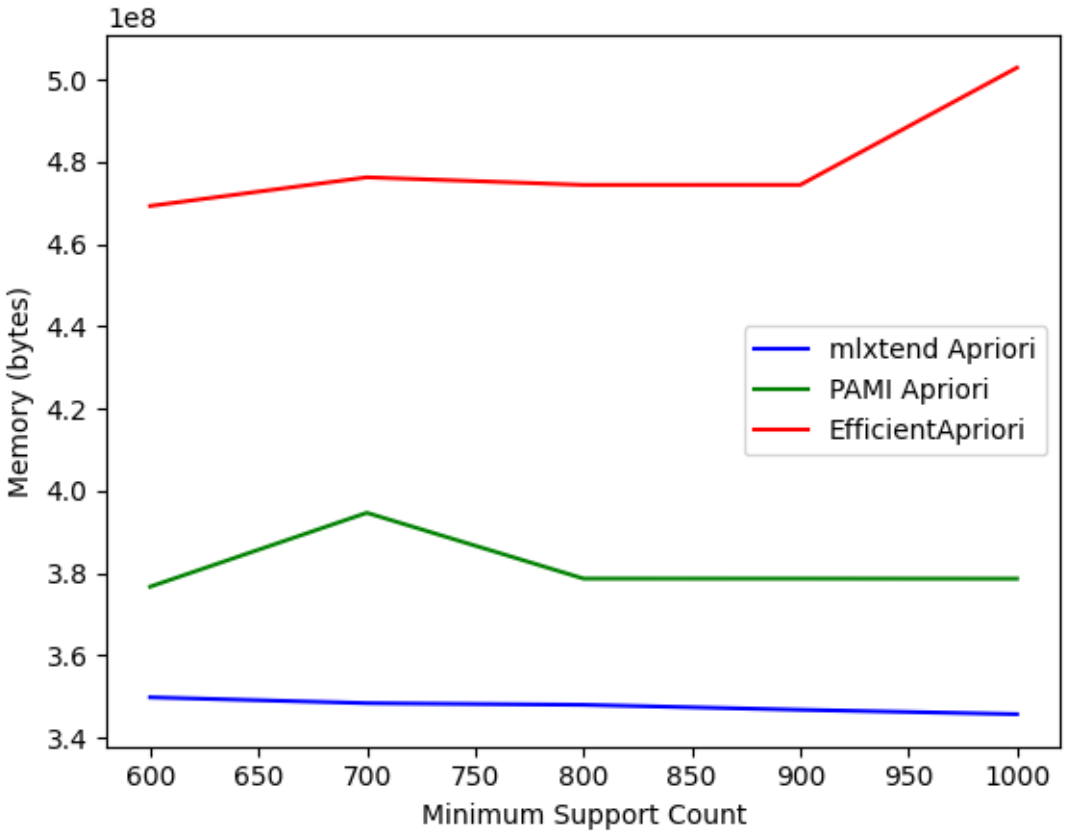


Observations 1. The runtime taken by the generated patterns decreases as the minSup value increases. 2. The runtime of PAMI Apriori yields the best results when compared to mlxtend and efficient_apriori.

1.5.3 Comparing the memory consumption of the Apriori algorithm across different Python libraries.

[11]:
```
import matplotlib.pyplot as plt

for result, color, label in zip([result1, result2, result3], ['blue', 'green',␣
 ↪'red'], ['mlxtend Apriori', 'PAMI Apriori', 'EfficientApriori']):
    plt.plot(result['minSup'], result['memory'], label=label, color=color)
plt.xlabel('Minimum Support Count')
plt.ylabel('Memory (bytes)')
plt.legend()
plt.show()
```



Observations 1. The memory consumption varies among three different libraries for the Apriori algorithm. The following observations are made - The memory usage in EfficientApriori initially sees a slight increase between minSup values of 600 to 900, followed by a steep increase beyond 900. - In mlxtend, the graph shows a slight decrease in memory consumption with an increase in the minSup value. - In the PAMI version of Apriori, the graph shows a slight increase from minSup values of 600 to 700, followed by a steep decrease for the remaining minSup values.

[ ]: