Clustering Assignments

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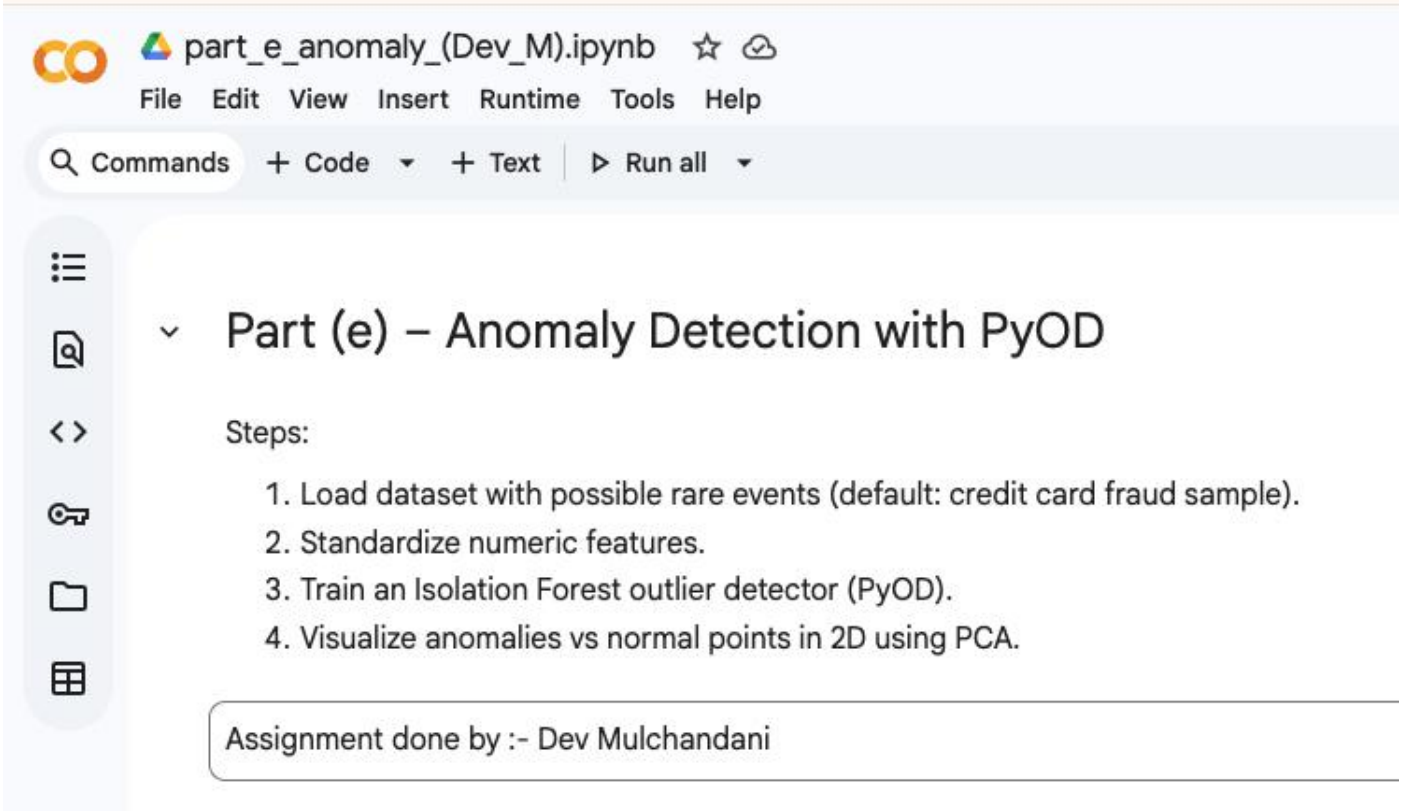
❖ Part-E :– Anomaly Detection Using PyOD

In Part E, I applied anomaly detection techniques using the PyOD library to identify unusual or rare observations in the dataset. After selecting and scaling the numerical variables, I used an Isolation Forest model to detect anomalies based on how easily each point could be isolated in a tree structure. I then visualized the results by projecting the data into two PCA components and plotting normal points versus anomalies. This task highlighted how anomaly detection differs from standard clustering and is particularly useful for fraud detection, quality control, and rare-event analysis.

❖ Screenshots:-



Load dataset (upload / URL / Kaggle)

[1] ✓ 17s

```python
# @title Load dataset (upload / URL / Kaggle)
import pandas as pd
import zipfile
from pathlib import Path

try:
    from google.colab import files  # type: ignore
    IN_COLAB = True
except Exception:
    IN_COLAB = False

DEFAULT_URL = "https://raw.githubusercontent.com/curiousily/credit-card-fraud-detection/master/data/creditcard.csv"

print("How do you want to load the dataset?")
print("1 = upload CSV file manually")
print("2 = download from URL (uses DEFAULT_URL above)")
print("3 = download from Kaggle (you must provide kaggle.json & dataset name)")
choice = input("Enter 1, 2, or 3: ").strip()

if choice == "1":
    if not IN_COLAB:
        raise RuntimeError("Manual upload only works in Google Colab.")
    uploaded = files.upload()
    fname = list(uploaded.keys())[0]
    df = pd.read_csv(fname)
    print("Loaded:", fname, "shape:", df.shape)
elif choice == "2":
    if not DEFAULT_URL:
        raise ValueError("DEFAULT_URL is empty. Please set it to a valid CSV URL or choose another option.")
    df = pd.read_csv(DEFAULT_URL)
    print("Loaded from URL. Shape:", df.shape)
elif choice == "3":
    import os, subprocess

    if IN_COLAB:
        from google.colab import files  # type: ignore
        print("Please upload your kaggle.json file (from your Kaggle account).")
        uploaded = files.upload()
        kaggle_path = Path("~/.kaggle").expanduser()
        uploaded = files.upload()
        kaggle_path = Path("~/.kaggle").expanduser()
        kaggle_path.mkdir(parents=True, exist_ok=True)
        for fn in uploaded:
            Path(fn).replace(kaggle_path / "kaggle.json")
        os.chmod(kaggle_path / "kaggle.json", 0o600)

    # Install kaggle CLI
    import sys
    !pip -q install kaggle

    DATASET_SLUG = input("Enter Kaggle dataset slug (e.g. 'uciml/iris'): ").strip()

    # Download entire dataset (may contain multiple files)
    !kaggle datasets download -d $DATASET_SLUG -p kaggle_data

    # Unzip everything
    kaggle_dir = Path("kaggle_data")
    kaggle_dir.mkdir(exist_ok=True)
    for zpath in kaggle_dir.glob("*.zip"):
        with zipfile.ZipFile(zpath, "r") as zf:
            zf.extractall(kaggle_dir)

    csv_files = list(kaggle_dir.rglob("*.csv"))
    if not csv_files:
        raise FileNotFoundError("No CSV files found in Kaggle dataset; please inspect kaggle_data/ manually.")
    csv_path = csv_files[0]
    print("Using CSV:", csv_path)
    df = pd.read_csv(csv_path)
    print("Loaded from Kaggle. Shape:", df.shape)
else:
    raise ValueError("Invalid choice. Please run this cell again.")

df.head()
```

```
How do you want to load the dataset?
1 = upload CSV file manually
2 = download from URL (uses DEFAULT_URL above)
3 = download from Kaggle (you must provide kaggle.json & dataset name)
Enter 1, 2, or 3: 1
```

Choose files fraud.csv

fraud.csv(text/csv) - 28511 bytes, last modified: 02/12/2025 - 100% done

```
Saving fraud.csv to fraud.csv
Loaded: fraud.csv shape: (500, 4)
```

	amount	oldbalanceOrg	newbalanceOrig	isFraud
0	542.624494	1412.956342	4799.566207	0
1	151.543587	240.370429	1024.043911	0
2	621.324466	1222.363101	1347.520028	1
3	734.610400	4114.057273	1885.415104	0
4	827.153278	2858.084672	1728.699835	1

Next steps: Generate code with df | New interactive sheet

Install PyOD and preprocess

[2] ✓ 6s

```python
# @title Install PyOD and preprocess
!pip -q install pyod

import numpy as np
from sklearn.preprocessing import StandardScaler

df_sample = df.sample(n=min(10000, len(df)), random_state=42)
X = df_sample.select_dtypes(include=["float64", "int64"]).values

scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
```

```
...     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 46.3/46.3 kB 2.0 MB/s eta 0:00:00
        ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 204.7/204.7 kB 7.9 MB/s eta 0:00:00
```

Fit an Isolation Forest anomaly detector

[3] ✓ 8s

```python
# @title Fit an Isolation Forest anomaly detector
from pyod.models.iforest import IForest
from sklearn.decomposition import PCA
import matplotlib.pyplot as plt

clf = IForest(random_state=42, contamination=0.02)
clf.fit(X_scaled)

scores = clf.decision_function(X_scaled)
y_pred = clf.predict(X_scaled)  # 0 = inlier, 1 = outlier

print("Number of anomalies detected:", int(y_pred.sum()))

pca = PCA(n_components=2)
X_2d = pca.fit_transform(X_scaled)

plt.figure()
plt.scatter(X_2d[:, 0], X_2d[:, 1], c=y_pred, cmap="coolwarm", alpha=0.5)
plt.title("Detected anomalies (red) vs normal points (blue)")
plt.xlabel("PC1")
plt.ylabel("PC2")
plt.show()
```

```
Number of anomalies detected: 10
```