🧠 PitchDNA: PCA & UMAP Dimensionality Reduction

This notebook loads your `pitcher_long_format.csv` and runs both **PCA** and **UMAP** to visualize pitch similarities.

```
# Install UMAP if needed
!pip install umap-learn
```

```
Requirement already satisfied: umap-learn in /usr/local/lib/python3.11/dist-packages (0.5.9.post2)
Requirement already satisfied: numpy>=1.23 in /usr/local/lib/python3.11/dist-packages (from umap-learn) (2.0.2)
Requirement already satisfied: scipy>=1.3.1 in /usr/local/lib/python3.11/dist-packages (from umap-learn) (1.15.3)
Requirement already satisfied: scikit-learn>=1.6 in /usr/local/lib/python3.11/dist-packages (from umap-learn) (1.6.
Requirement already satisfied: numba>=0.51.2 in /usr/local/lib/python3.11/dist-packages (from umap-learn) (0.60.0)
Requirement already satisfied: pynndescent>=0.5 in /usr/local/lib/python3.11/dist-packages (from umap-learn) (0.5.
Requirement already satisfied: tqdm in /usr/local/lib/python3.11/dist-packages (from umap-learn) (4.67.1)
Requirement already satisfied: llvmlite<0.44,>=0.43.0dev0 in /usr/local/lib/python3.11/dist-packages (from numba>=
Requirement already satisfied: joblib>=0.11 in /usr/local/lib/python3.11/dist-packages (from pynndescent>=0.5->umap
Requirement already satisfied: threadpoolctl>=3.1.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn>=
```

```
import os
print("Files in directory:", os.listdir())
```

```
Files in directory: ['.config', 'sample_data']
```

```
import os
print("Current working directory:", os.getcwd())
```

```
Current working directory: /content
```

```
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.preprocessing import StandardScaler
from sklearn.decomposition import PCA
import umap.umap_ as umap

# Load your dataset
df = pd.read_csv("pitcher_long_format.csv")
```

```
# Select numeric features for dimensionality reduction
features = ['avg_speed', 'avg_spin', 'avg_break_x', 'avg_break_z',
            'avg_break_z_induced', 'avg_break', 'range_speed', 'usage_pct']
df_filtered = df.dropna(subset=features)

# Standardize the features
X = df_filtered[features]
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
```

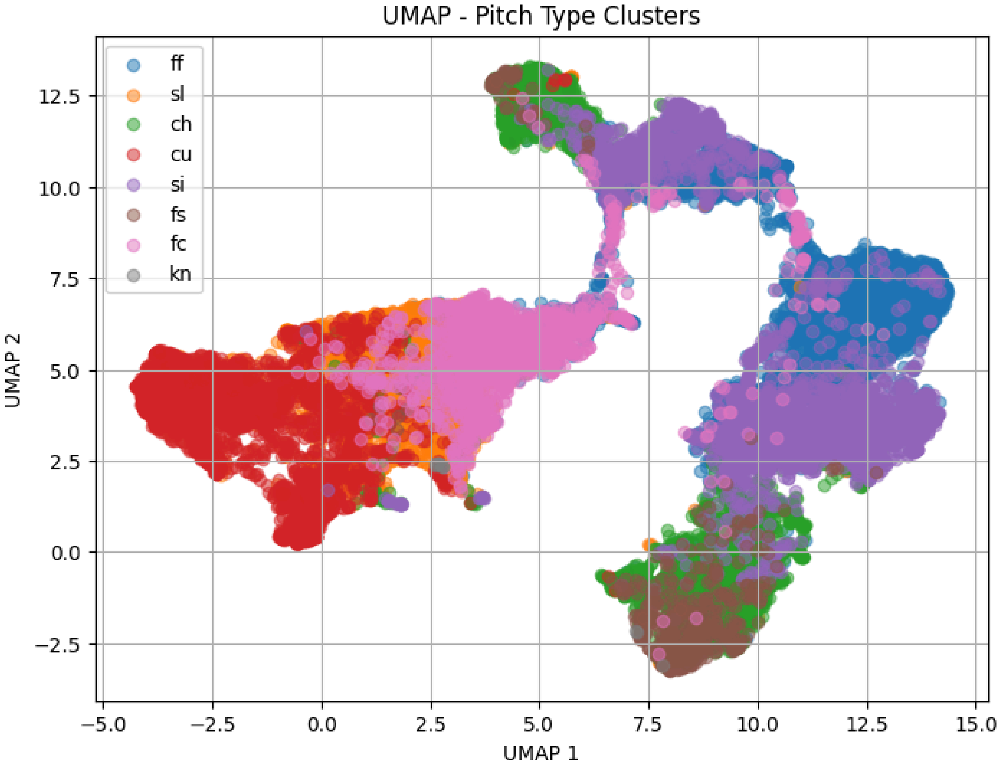
```
# UMAP
reducer = umap.UMAP(n_neighbors=15, min_dist=0.1, random_state=42)
umap_result = reducer.fit_transform(X_scaled)
df_filtered['umap_1'] = umap_result[:, 0]
df_filtered['umap_2'] = umap_result[:, 1]
```

```
# UMAP Plot
plt.figure(figsize=(8,6))
for pitch in df_filtered['pitch_type'].unique():
    subset = df_filtered[df_filtered['pitch_type'] == pitch]
    plt.scatter(subset['umap_1'], subset['umap_2'], label=pitch, alpha=0.5)
plt.title('UMAP - Pitch Type Clusters')
plt.xlabel('UMAP 1')
plt.ylabel('UMAP 2')
plt.legend()
plt.grid(True)
plt.show()
plt.show()
```

```
/usr/local/lib/python3.11/dist-packages/umap/umap_.py:1952: UserWarning: n_jobs value 1 overridden to 1 by setting
  warn(
/tmp/ipython-input-12-1755159842.py:25: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#return
  df_filtered['umap_1'] = umap_result[:, 0]
/tmp/ipython-input-12-1755159842.py:26: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#return
  df_filtered['umap_2'] = umap_result[:, 1]
```



```
import pandas as pd

try:
    df = pd.read_csv("pitcher_long_format.csv")
    print("File loaded successfully.")
except FileNotFoundError:
    print("Error: pitcher_long_format.csv not found. Please upload the file.")
```

```
File loaded successfully.
```

```
import pandas as pd
# ✚ Example: Matching a Pitch from Input
# Define a sample input pitch vector
input_vector = {
    'avg_speed': 94.5,
    'avg_spin': 2300,
    'avg_break_x': 1.1,
    'avg_break_z': -9.3
}

# Create a DataFrame from the input
import numpy as np
input_df = pd.DataFrame([input_vector])

# Ensure the relevant columns exist in the dataset
```

```
    required_columns = ["avg_speed", "avg_spin", "avg_break_x", "avg_break_z"]
    if not all(col in df.columns for col in required_columns):
        raise ValueError("One or more required columns are missing from the dataset.")

    # Compute Euclidean distance
    from scipy.spatial.distance import euclidean

    def get_distance(row):
        return euclidean(
            row[required_columns].values,
            input_df.iloc[0][required_columns].values
        )

    # Calculate distances and sort
    df["distance"] = df.apply(get_distance, axis=1)
    closest_matches = df.sort_values("distance").head(5)
    closest_matches[required_columns + ["distance"]]
```

	avg_speed	avg_spin	avg_break_x	avg_break_z	distance
16339	92.8	2298.0	3.2	-12.3	4.505552
13382	94.3	2298.0	-3.9	-10.3	5.480876
22236	93.7	2296.0	-1.9	-11.6	5.561475
2811	95.3	2302.0	0.7	-14.7	5.827521
5640	93.4	2296.0	-1.0	-14.0	6.611354