Using AI and Machine Learning for Time Series medical signal analysis

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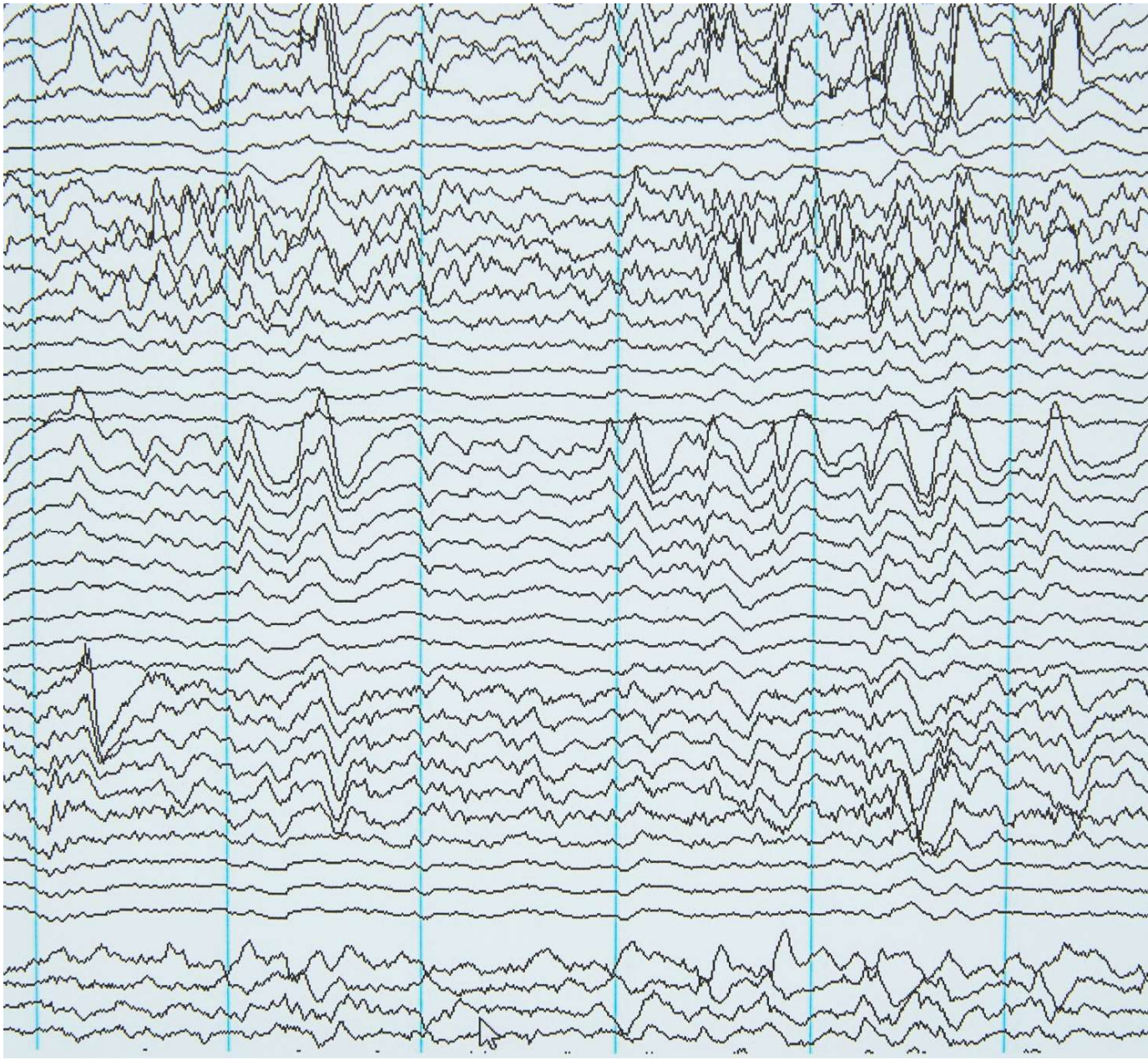
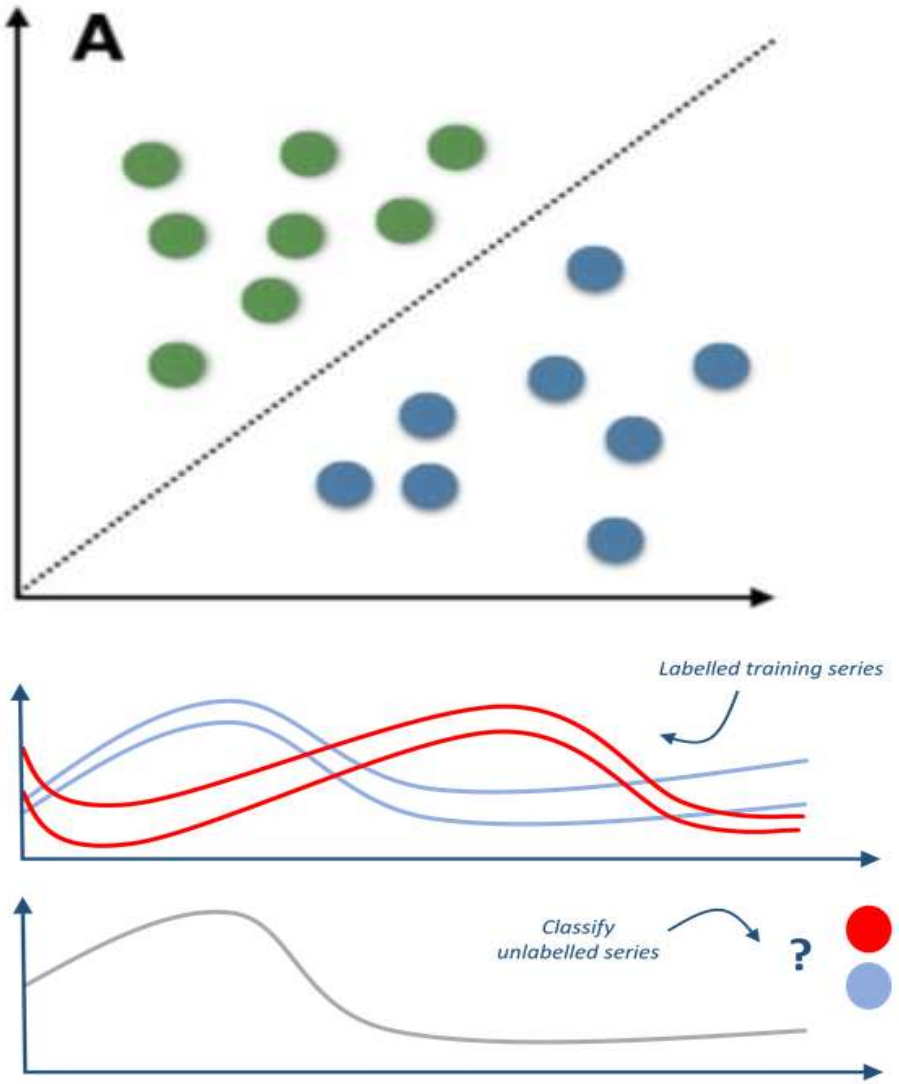
Time Series

- Data recorded over time
- Evenly spaced time points
- One series (univariate) or multiple (multivariate) per recording
- Examples
  - Earthquake monitoring
  - Financial records
  - GPS trackers
  - Medical Signals (EEG, heart rate, blood pressure)



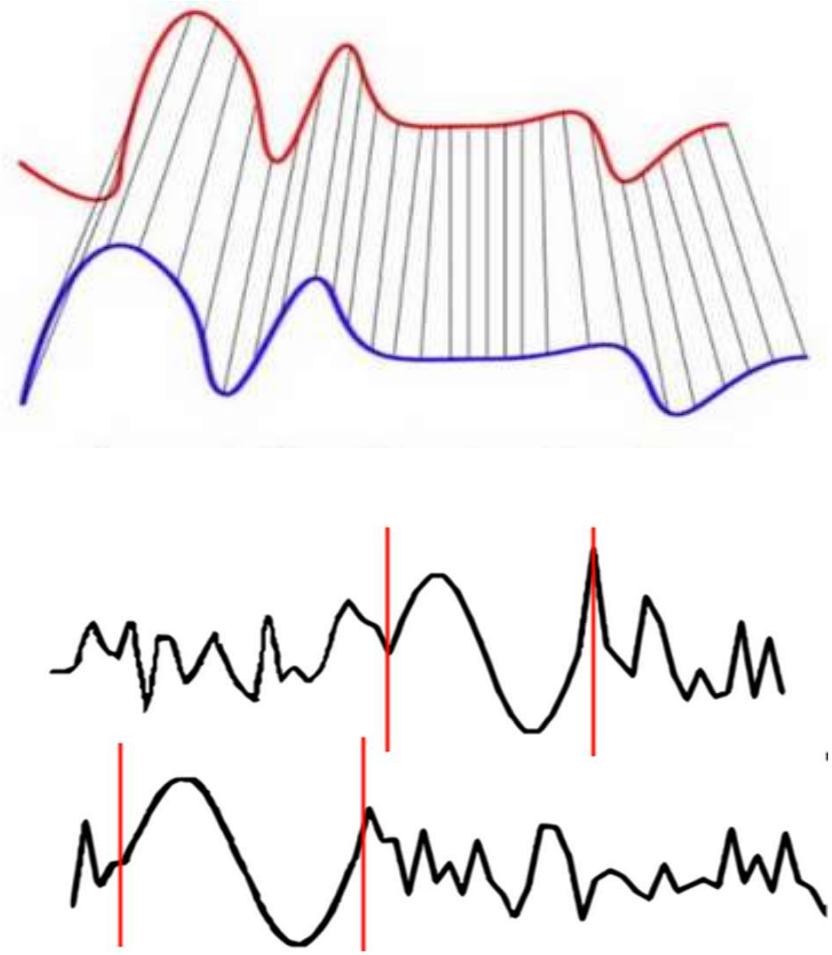
Classification

- Assign labels, or classes, to data
- Learn from known data
- Predict for unknown data
- Compare to true values to evaluate performance
- Look for discriminatory features between the classes
- Most commonly binary (2 classes) but can be more
- Used for detection of disorders and conditions
  - Epileptic seizure detection
  - Arrythmia
  - Sleep Disorders



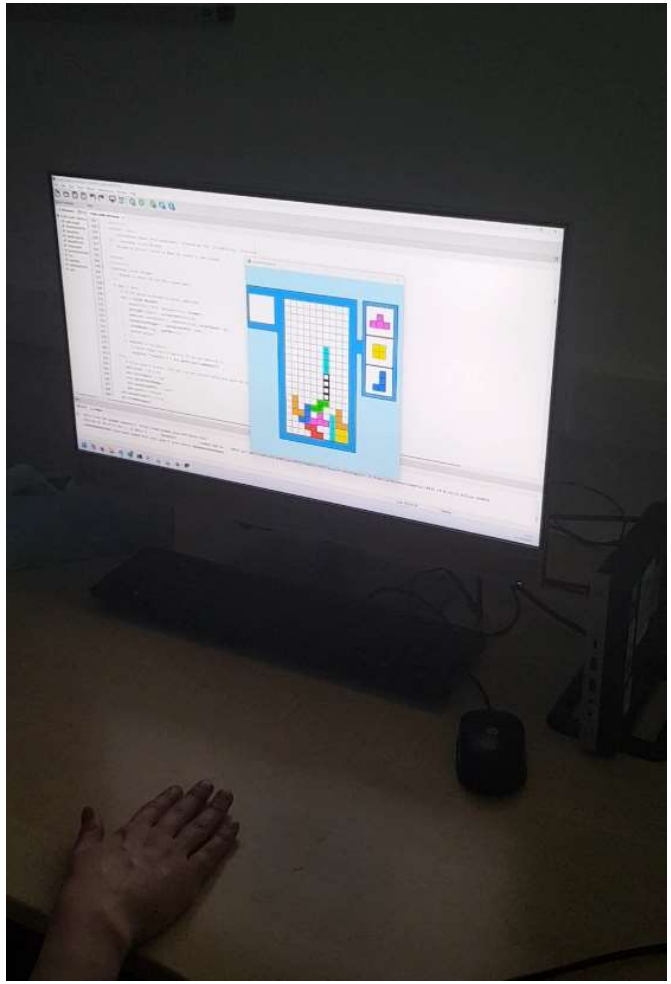
Time Series Classification

- Utilise time-based information to improve accuracy
- Different approaches available
  - Distance based
  - Shape based
  - Feature based (data trends, means, outliers)
  - Sub-series based
  - Filter(convolution) based
  - Hybrid approaches



Advantages

- High accuracy
- Robust for small or noisy data
- More potential for interpretability
- Fast allowing for real time classification
- Implemented in the Python Aeon Toolkit



Brain Computer Interfacing Example

- EEG Dataset with 32 channels
- 2 class classification problem
- Pressing a button and idle
- 70% accuracy

```
from aeon.datasets import load_from_ts_file
from sklearn.model_selection import train_test_split
from aeon.classification.distance_based import KNeighborsTimeSeriesClassifier

path = "./ButtonPress.ts"
X,y = load_from_ts_file(path)

X_train,X_test,y_train,y_test = train_test_split(X,y)

cls = KNeighborsTimeSeriesClassifier()
cls.fit(X_train,y_train)
print(cls.score(X_test,y_test))
```

Why It Matters in Clinical Practice

- Assistance with detection and diagnosis
- Earlier detection
- Larger amounts of data to be used
- Real time alerts
- Improved understanding of medical signals