PROJECT: CHARACTER RECOGNITION

EQ2341:PATTERN RECOGNITION AND MACHINE LEARNING

GROUP 15

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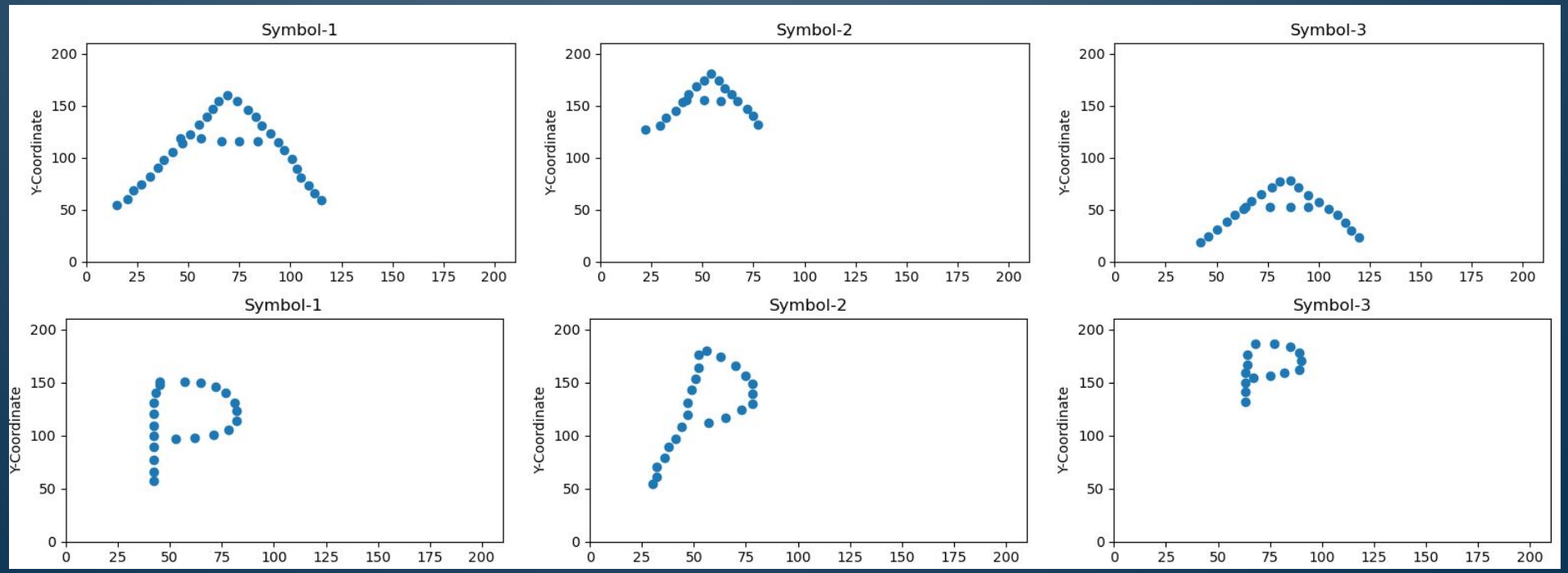
Application and Data

Characters that we have used in the project for training and classification:

[A, C, K, P, X, T, +, N, V, 4]

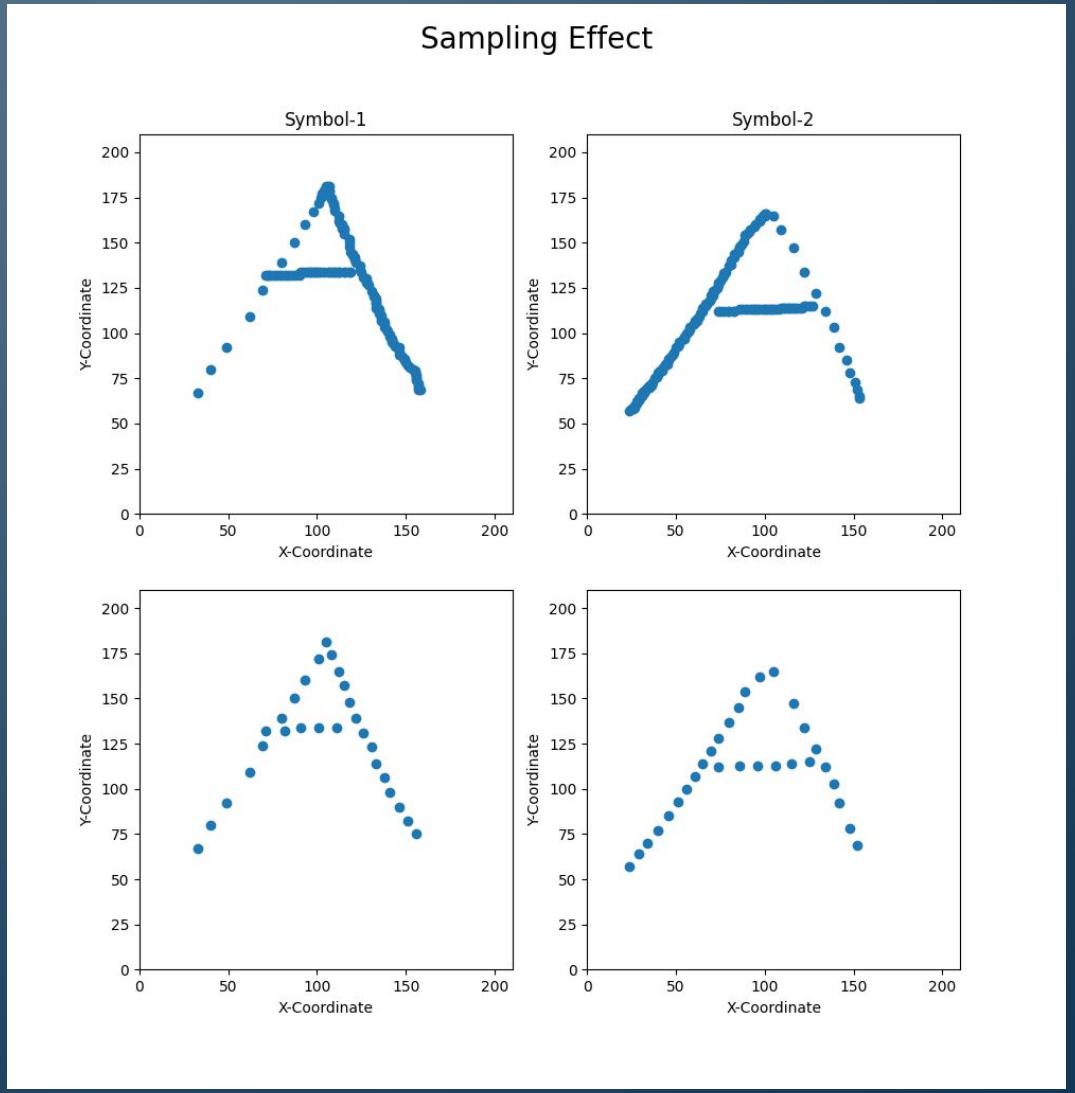
Examples:



Feature Extraction

1) Sampling of Drawings

- Decreases Sensitivity against speed
- More consistent extraction



Feature Extraction

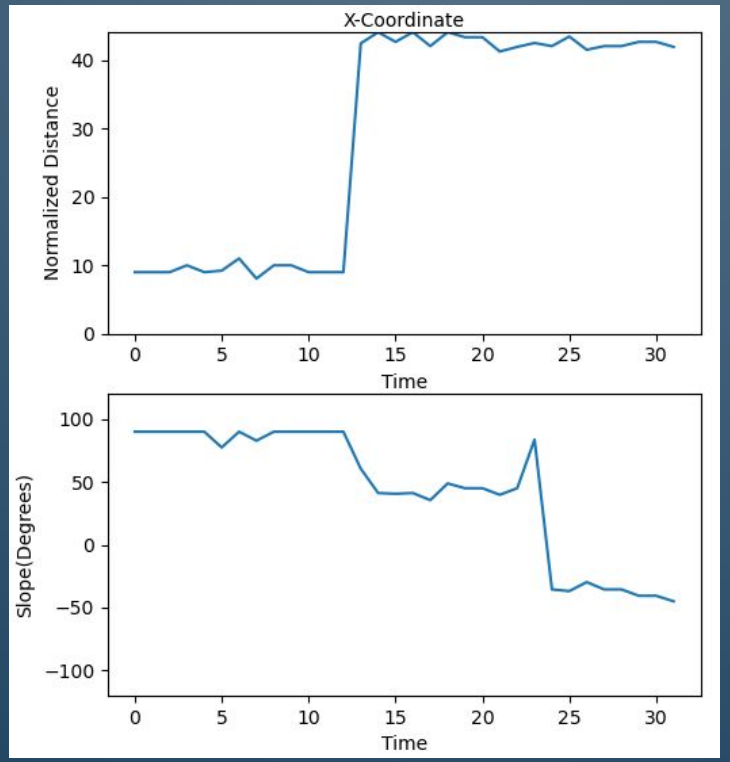
2) Feature Types

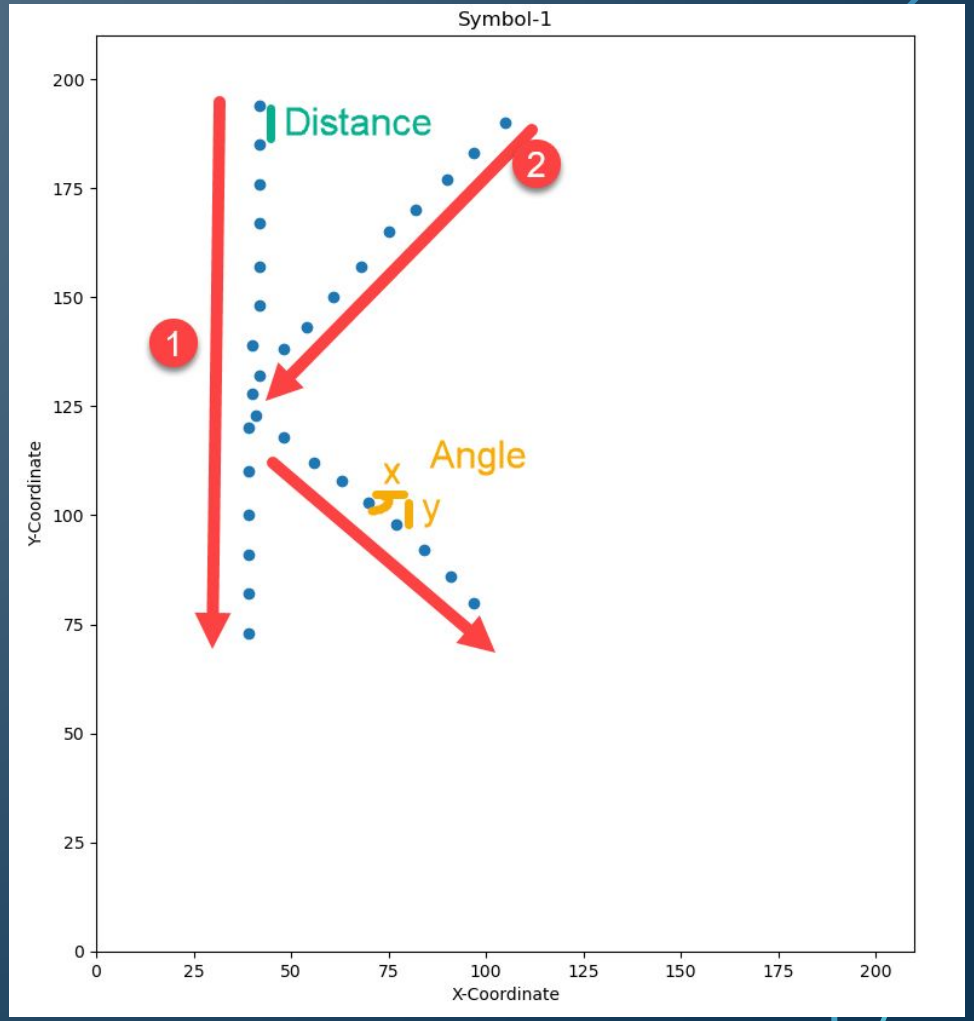
- Feature 1: Distances

-Continuous Vectors

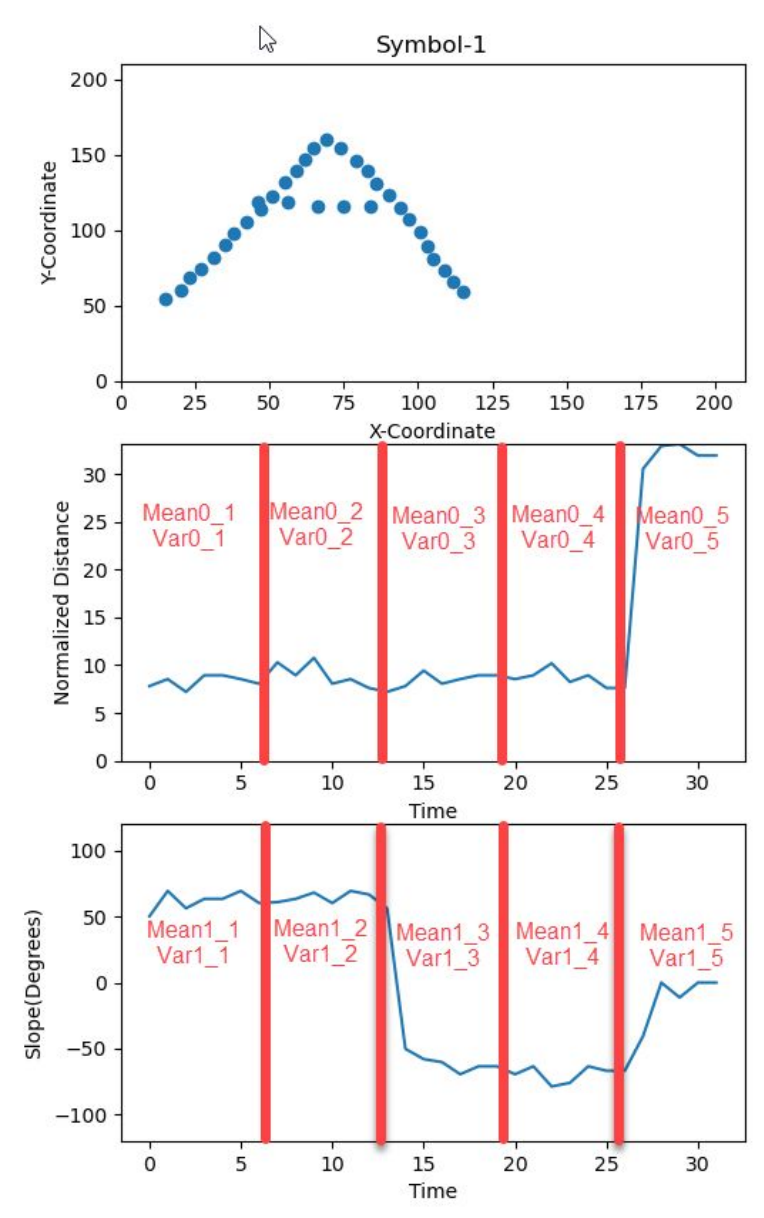
- Feature 2: Angle

-Continuous Vectors





HMM Design



Number of States = 5

x = 0.1 / (Number of States-1)

y = 0.1 / (Number of States-2)

$$q = \begin{bmatrix} 0.9 & x & x & x & x \end{bmatrix}$$

$$A = \begin{bmatrix} 0.8 & 0.1 & y & y & y \\ y & 0.8 & 0.1 & y & y \\ y & y & 0.8 & 0.1 & y \\ y & y & y & 0.8 & 0.1 \\ x & x & x & x & 0.9 \end{bmatrix}$$

Mean

Covariance

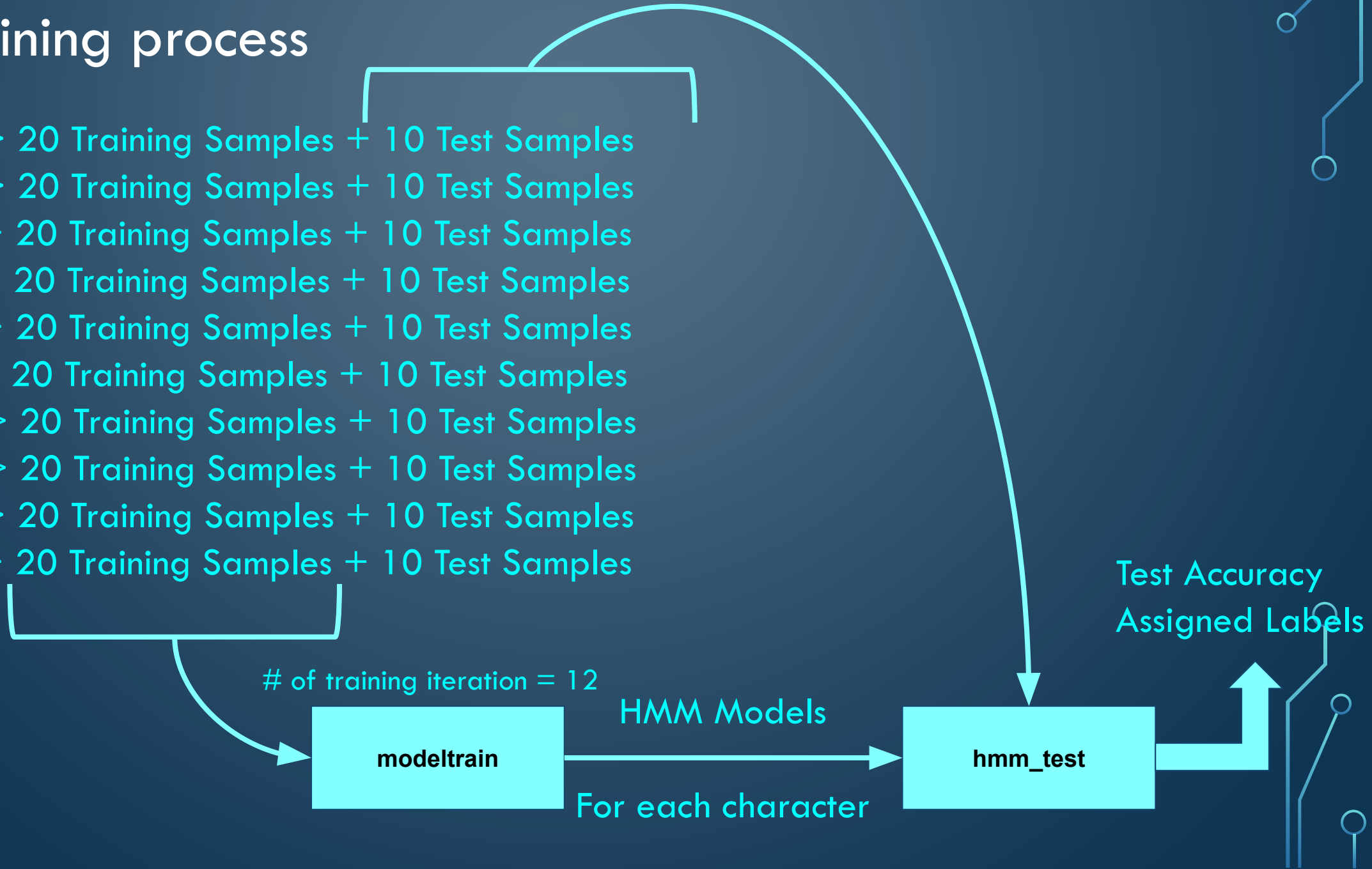
multigaussD

B

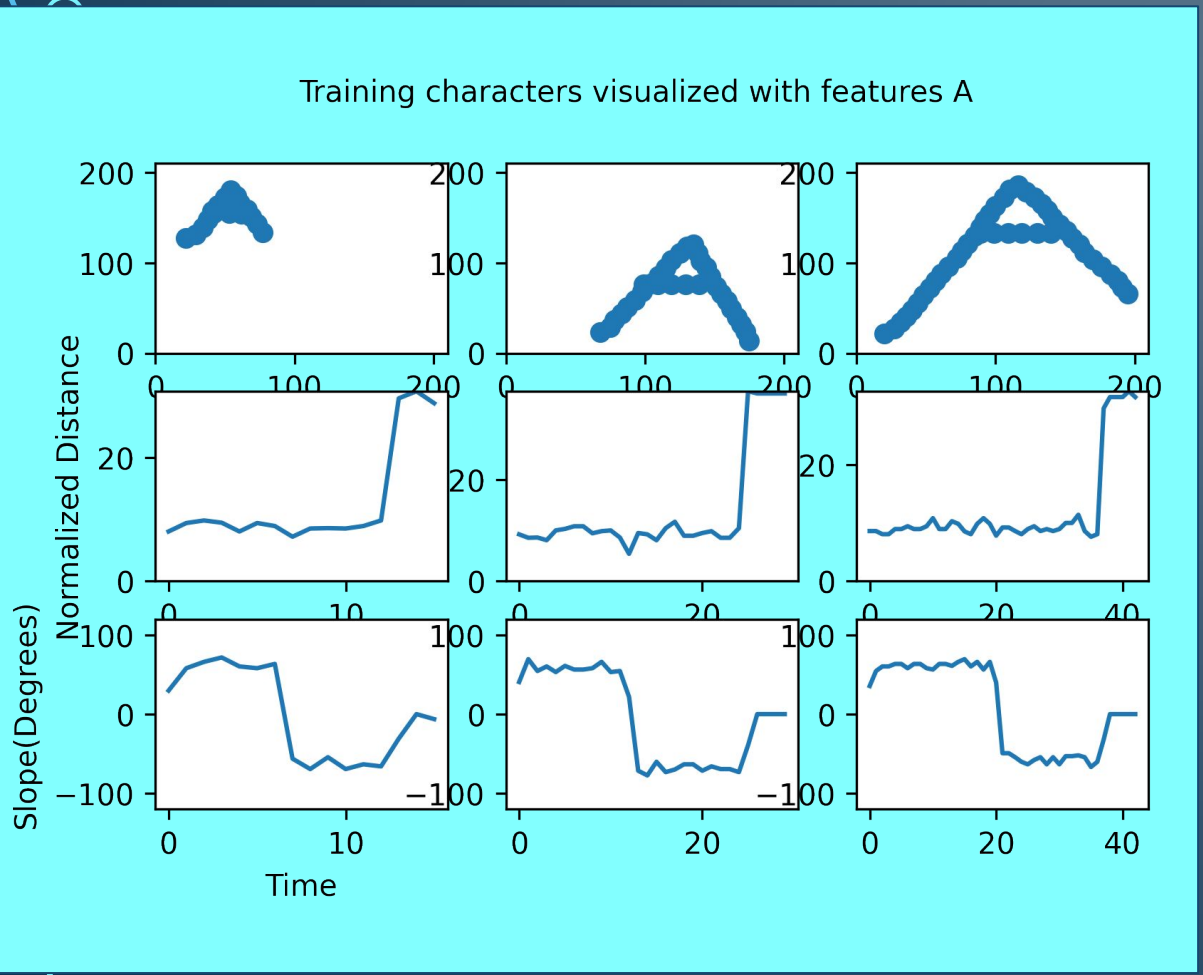
HMM Model

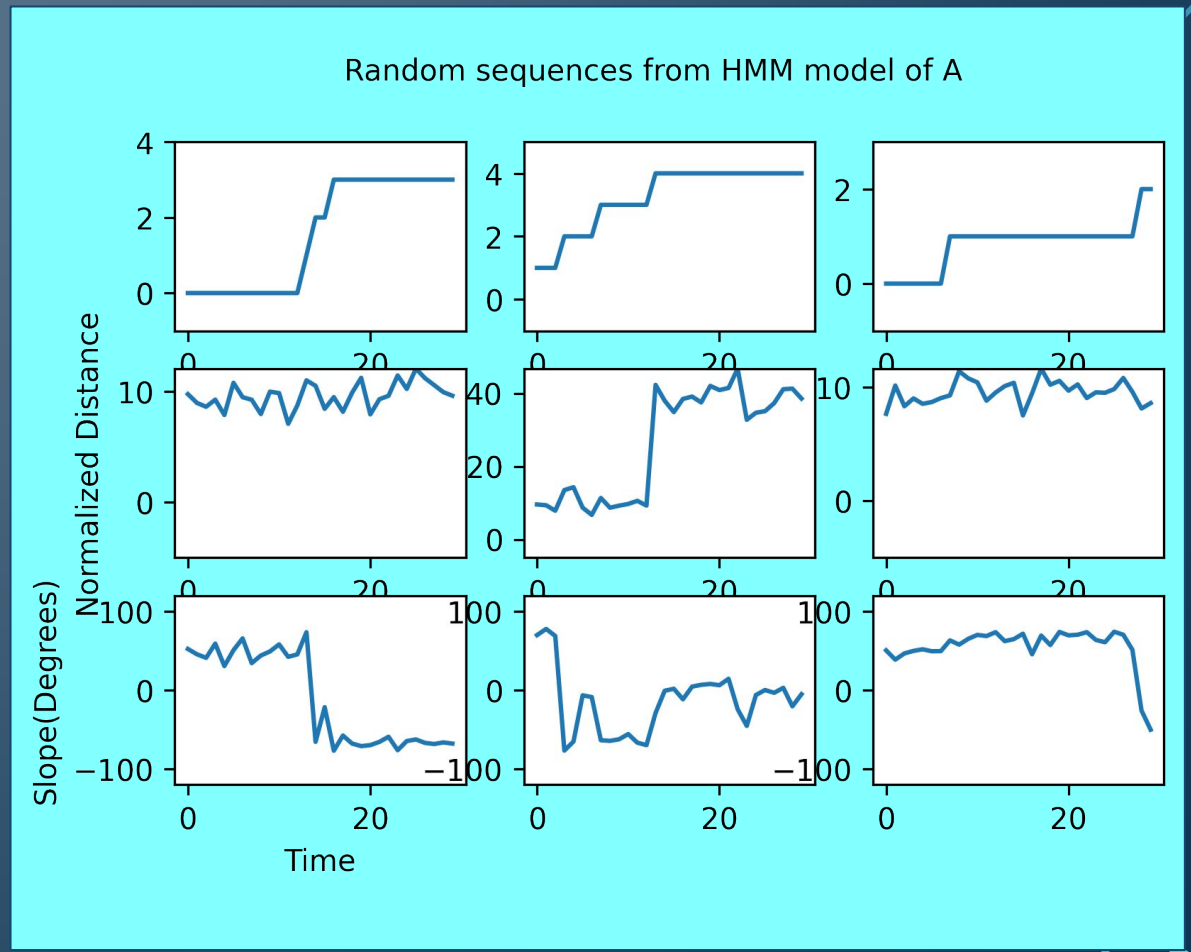
Training process

A > 20 Training Samples + 10 Test Samples
C > 20 Training Samples + 10 Test Samples
K > 20 Training Samples + 10 Test Samples
P > 20 Training Samples + 10 Test Samples
X > 20 Training Samples + 10 Test Samples
T > 20 Training Samples + 10 Test Samples
+ > 20 Training Samples + 10 Test Samples
N > 20 Training Samples + 10 Test Samples
V > 20 Training Samples + 10 Test Samples
4 > 20 Training Samples + 10 Test Samples



Training sequences



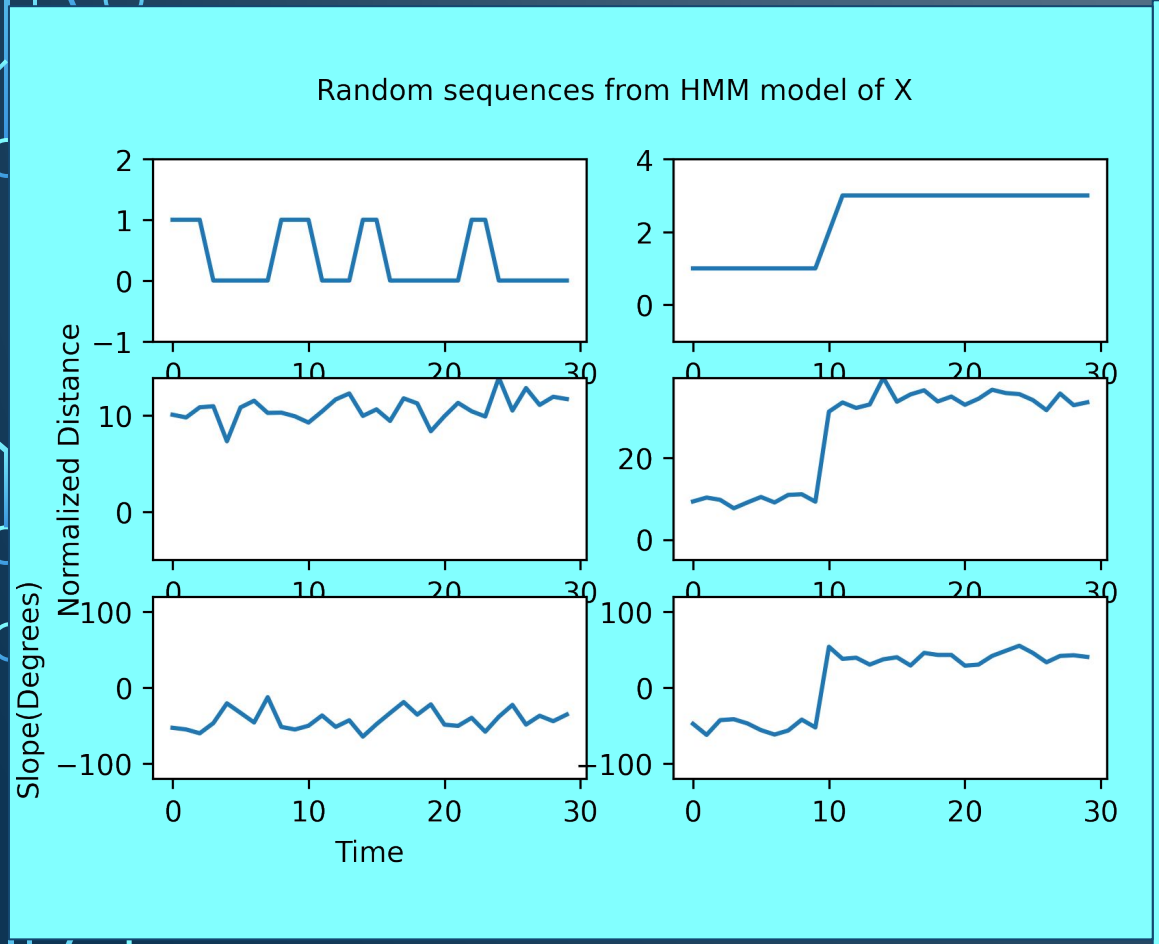


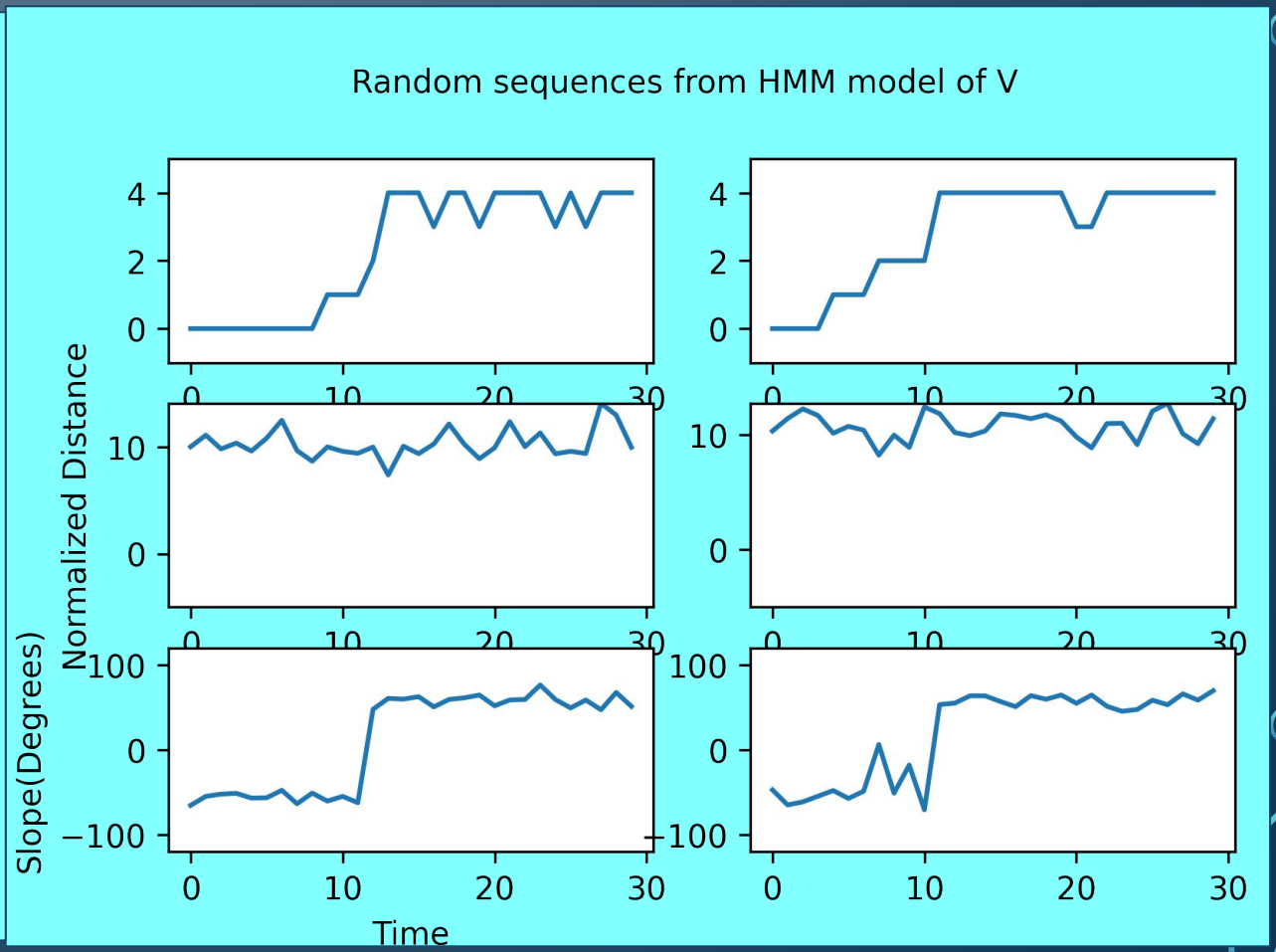
Classification results

Classification Accuracy of Test Samples of Character A: 100%
Classification Accuracy of Test Samples of Character C: 100%
Classification Accuracy of Test Samples of Character K: 90%
Classification Accuracy of Test Samples of Character P: 50%
Classification Accuracy of Test Samples of Character X: 70%
Classification Accuracy of Test Samples of Character T: 0%
Classification Accuracy of Test Samples of Character +: 30%
Classification Accuracy of Test Samples of Character N: 90%
Classification Accuracy of Test Samples of Character V: 10%
Classification Accuracy of Test Samples of Character 4: 80%

Common misclassifications

V: ['X', 'X', 'X', 'X', 'X', 'X', 'X', 'X', 'X', 'V']
T: ['P', 'N', 'P', 'P', 'P', 'V', 'P', 'P', 'P', 'V']
+: ['V', '+', 'P', 'P', '+', 'P', '+', 'N', 'V', 'P']





Conclusions

Strengths and weaknesses

- Half of the character classifications have accuracy higher than 80 %
- Robust against character scalings and positions
- Features are not unique enough
- Number of states is not adaptive for each class

Improvables

- More features can be extracted (Centroid of character)
- Angle feature can be stabilized
- Adaptive number of states can be implemented

Lessons

- Classification
- Start with less class to get rid of problems earlier
- Be sure about quality of features