Hidden Markov Model

- It is a probabilistic model that captures the system's dynamics when the observations are the functions of the underlying hidden states.
- State transition is according to the first step Markov chain and its parameters are transition and emission probability matrices.

![Hidden Markov Model Diagram](image)

- Training is done according to the Baum Welch algorithm.

Dynamic Time Warping (DTW)

- Measure of the distance between the two time series.
- Constructs n x m matrix D where D_{i,j} = d(x_i,y_j) and d(x,y) is usually |x-y| or √(x-y)^2

Hierarchical Clustering

- Agglomerative: Bottom up approach.
- Divisive: Top down approach.

![Dynamic Time Warping Distance](image)

Summary

- Forward and Backward Algorithm
- Baum Welch Algorithm
- Hierarchical Clustering
- Simulation

Discussion and Conclusion

- According to the above plots the correct number of the hidden states are 2 or 4.
- Proportions of students in different clusters follow power law distribution.
- HMM considers the stationary distribution so it assumes different levels of the game to be the same difficulty levels. This might not necessary be true
- Confounding variables such as game mechanics can severally affect the game performance analysis.

Clustering Students Trajectories Using Hidden Markov Model (HMM)

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