

Supplementary material: Metric Learning for comparison of HMMs using Graph Neural Networks

Rajan Kumar Soni

RAJANSONI424@GMAIL.COM

Robert Bosch Centre for Data Science and AI, Indian Institute of Technology, Madras

Karthick Seshadri

KARTHICK.SESHADRI@NITANDHRA.AC.IN

Department of Computer Science and Engineering, National Institute of Technology, Andhra Pradesh

Balaraman Ravindran

RAVI@CSE.IITM.AC.IN

Robert Bosch Centre for Data Science and AI, Indian Institute of Technology, Madras

Editors: Vineeth N Balasubramanian and Ivor Tsang

1. Visualisations of the HMM embeddings learnt

1.1. Task agnostic embeddings learnt through Graph Variational Autoencoders

The Figure 1 shows the TSNE plot of the task agnostic HMM embeddings learnt using the Graph variational autoencoders. Each color in the image represents a digit in the FSDD dataset.

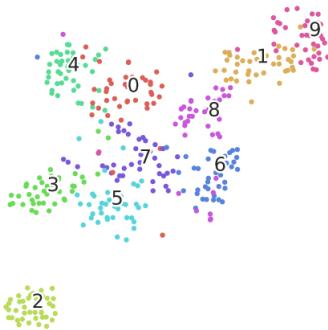


Figure 1: Visualisation of the GVAE based HMM embeddings

1.2. Diffpooling based class-aware HMM embeddings learnt through GCN

The Figure 2 shows the TSNE plot of the class-aware HMM embeddings learnt using the diffpooling based Graph convolutional neural nets. The effectiveness of the embedding is evident through the homogeneity of the clusters with respect to the colors.

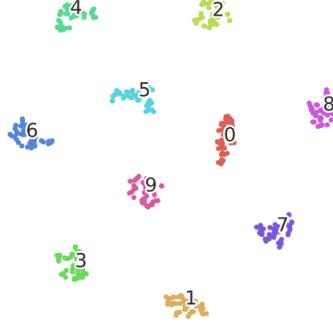


Figure 2: Visualisation of diffpooling based HMM embeddings

2. Mean and confidence interval for the performance indicators

Table 1 and Table 2 outline the mean values and the confidence intervals for the metrics computed across the experiments conducted to assess the six baselines and the two proposed models for the complete-linkage and single-linkage clustering tasks respectively. In the tables 1 and 2, $M1$ to $M8$ denote the following metrics: (i) $M1$: Cross Likelihood based metric, (ii) $M2$: State mapping based metric, (iii) $M3$: Unisequence Likelihood metric, (iv) $M4$: Matrix Factorization based metric (v) $M5$: Hybrid metric based on both structure and behavior, (vi) $M6$: Autoencoder based metric (vii) $M7$: Graph Autoencoder based metric, and (viii) $M8$: Diffpooling based metric.

Table 1: Mean and confidence intervals for complete-linkage clustering

Metrics →	Cluster Purity	Rand Index	Normalized Mutual Information
Models ↓	$\mu \pm \sigma$	$\mu \pm \sigma$	$\mu \pm \sigma$
M1	0.85 ± 0.12	0.96 ± 0.04	0.91 ± 0.11
M2	0.31 ± 0.06	0.79 ± 0.03	0.26 ± 0.10
M3	0.23 ± 0.03	0.78 ± 0.02	0.13 ± 0.05
M4	0.11 ± 0.00	0.75 ± 0.04	0.01 ± 0.00
M5	0.33 ± 0.07	0.79 ± 0.04	0.29 ± 0.11
M6	0.20 ± 0.03	0.64 ± 0.10	0.11 ± 0.03
M7	0.77 ± 0.10	0.93 ± 0.03	0.87 ± 0.11
M8	1.00 ± 0.00	1.00 ± 0.00	1.00 ± 0.00

Table 2: Mean and confidence intervals for single-linkage clustering

Metrics →	Cluster Purity	Rand Index	Normalized Mutual Information
Models ↓	$\mu \pm \sigma$	$\mu \pm \sigma$	$\mu \pm \sigma$
M1	0.39 ±0.20	0.54 ±0.28	0.50 ±0.28
M2	0.13 ±0.01	0.15 ±0.02	0.06 ±0.02
M3	0.16 ±0.02	0.27 ±0.07	0.10 ±0.03
M4	0.13 ±0.01	0.21 ±0.11	0.05 ±0.02
M5	0.13 ±0.01	0.15 ±0.02	0.06 ±0.02
M6	0.13 ±0.00	0.16 ±0.02	0.07 ±0.02
M7	0.50 ±0.18	0.68 ±0.24	0.64 ±0.26
M8	1.00 ±0.00	1.00 ±0.00	1.00 ±0.00