Appendix

A Investigation of Embedding Dynamics

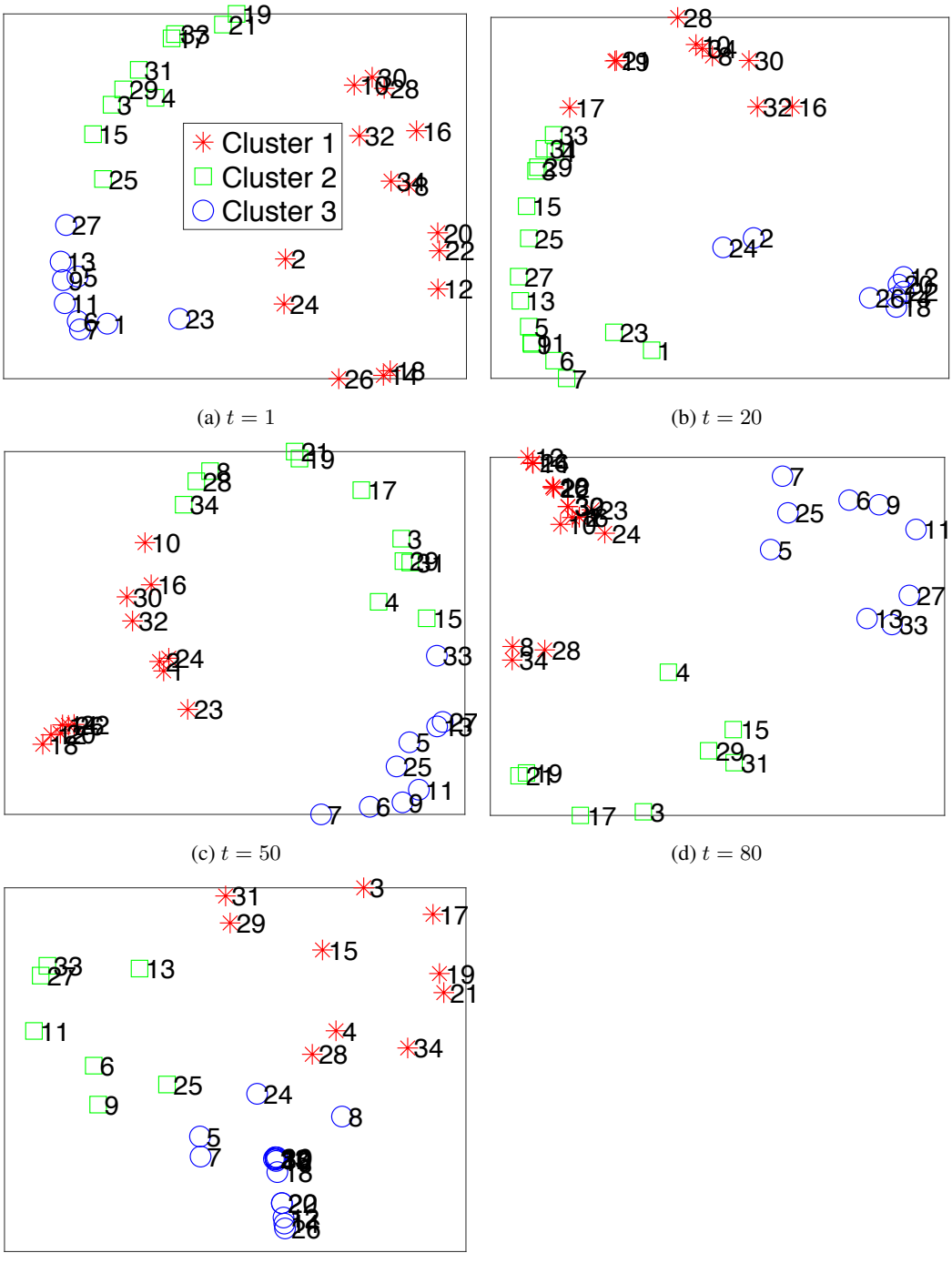
We investigated if there are underlying structures within the embeddings during their evolution. To this end, we looked into the embeddings of the 34 locations on *Server Room* dataset at five time points (t = 1, 20, 50, 80, 100). At each time point, we ran the k-means algorithm over the embeddings to extract the clustering structures. We used the elbow method (Ketchen and Shook, 1996) to select the number of clusters. We can see that at earlier time ($t \leq 50$), the clusters are more compact, while at the later stages, the clusters become more scattered. This reflects how the structure of those entities (*i.e.*, locations) evolves along with time. It is interesting to see that some locations are in the same cluster all the time, like location {5,7} and location {16, 32}. It implies that their underlying properties might have quite similar (or correlated) evolution patterns. Some locations are grouped in the cluster at the beginning, *e.g.*, location {32, 34} (at $t = 1$), but later moves to different clusters ($t > 1$). It implies their evolution patterns can vary significantly, leading to the change of the cluster memberships.

References

Ketchen, D. J. and Shook, C. L. (1996). The application of cluster analysis in strategic management research: an analysis and critique. Strategic management journal, 17(6):441–458.

	CA Weather	*CA Traffic*	*Server Room*
CP-DTLD	0.037	0.086	0.023
GP-DTLD	0.246	0.247	0.248
NN-DTLD	2.400	4.730	1.080
CP-DTND	0.038	0.087	0.025
GP-DTND	0.119	0.242	0.080
NN-DTND	2.360	4.701	1.060
CP-CT	0.025	0.052	0.018
GP-CT	0.068	0.216	0.105
NN-CT	2.310	3.885	1.030
NONFAT	0.952	1.925	0.571
THIS-ODE	58.710	136.100	7.190
DEMOTE	1.390	1.895	0.309
DEMOTE-NS	6.12	10.42	7.06

Table 1: Per-epoch/iteration running time (in seconds). DEMOTE-NS means running DEMOTE with naive sampling of min-batches rather than the stratified sampling.



(a) $t = 1$

(b) $t = 20$

(c) $t = 50$

(d) $t = 80$

(e) $t = 100$

Figure 1: Evolution of the clustering structure within the 34 locations on *Server Room* dataset.