PS Q:\LEARNNING-POSTGRADUATE\BaiduSyncdisk\LEARNNING-POSTGRADUATE\站点深化\ATP inferred\MGGDC\_1018> & C:/Users/zou/.conda/envs/conda/python.exe "q:/LEARNNING-POSTGRADUATE/BaiduSyncdisk/LEARNNING-POSTGRADUATE/站点深化/ATP inferred/MGGDC\_1018/train\_egae\_num.py"

2025-07-16 11:15:42,966 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=4, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-16 11:15:43,033 - INFO - CUDA available. Using device: cuda:0

2025-07-16 11:15:43,033 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-16 11:16:09,190 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-16 11:16:09,194 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-16 11:16:09,208 - INFO - Numerical features scaled.

2025-07-16 11:16:09,354 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-16 11:16:09,358 - INFO - Loading pre-built graphs from directory: ./data

2025-07-16 11:16:09,359 - ERROR - Error: Graph file not found: ./data\adaptive\_undir\_knn\_graph\_gz\_ptype0\_time\_k100.pt

2025-07-16 11:16:09,359 - ERROR - Please ensure you have run graph\_builder.py first to generate the .pt files,

2025-07-16 11:16:09,359 - ERROR - and that --graph\_dir ('./data'), --graph\_prefix ('adaptive\_undir\_knn\_graph\_gz\_ptype0'), and --knn\_k (100) match.

PS Q:\LEARNNING-POSTGRADUATE\BaiduSyncdisk\LEARNNING-POSTGRADUATE\站点深化\ATP inferred\MGGDC\_1018> & C:/Users/zou/.conda/envs/conda/python.exe "q:/LEARNNING-POSTGRADUATE/BaiduSyncdisk/LEARNNING-POSTGRADUATE/站点深化/ATP inferred/MGGDC\_1018/train\_egae\_num.py"

2025-07-16 11:17:32,040 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=4, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-16 11:17:32,058 - INFO - CUDA available. Using device: cuda:0

2025-07-16 11:17:32,058 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-16 11:17:57,016 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-16 11:17:57,019 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-16 11:17:57,030 - INFO - Numerical features scaled.

2025-07-16 11:17:57,151 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-16 11:17:57,155 - INFO - Loading pre-built graphs from directory: ./data

2025-07-16 11:17:57,251 - INFO - Loaded time graph: 807056 edges.

2025-07-16 11:17:57,260 - INFO - Loaded space graph: 890250 edges.

2025-07-16 11:17:57,271 - INFO - Loaded attr graph: 982548 edges.

2025-07-16 11:17:57,271 - INFO - Initializing model components...

2025-07-16 11:17:57,299 - INFO - Pretraining encoder...

2025-07-16 11:17:57,299 - WARNING - The main training loop might still encounter OutOfMemoryError due to the N x N matrix calculation

2025-07-16 11:17:57,299 - WARNING - in the clustering loss module (ZZ^T for SVD). This is inherent to the standard EGAE Jc loss formulation.

2025-07-16 11:17:57,299 - WARNING - If OOM occurs in the main loop, consider using a GPU with more memory or exploring approximations if available.

2025-07-16 11:19:57,933 - INFO - Pretrain Epoch 10/100 - Time: 11.63s: Recon Loss = 0.2130, Reg Loss = 0.1389, Total Loss = 0.3519

2025-07-16 11:22:06,926 - INFO - Pretrain Epoch 20/100 - Time: 13.72s: Recon Loss = 0.1893, Reg Loss = 0.1170, Total Loss = 0.3064

2025-07-16 11:24:11,101 - INFO - Pretrain Epoch 30/100 - Time: 11.93s: Recon Loss = 0.1630, Reg Loss = 0.0982, Total Loss = 0.2612

2025-07-16 11:26:16,511 - INFO - Pretrain Epoch 40/100 - Time: 13.76s: Recon Loss = 0.1618, Reg Loss = 0.0815, Total Loss = 0.2433

2025-07-16 11:28:42,677 - INFO - Pretrain Epoch 50/100 - Time: 14.78s: Recon Loss = 0.1623, Reg Loss = 0.0673, Total Loss = 0.2296

2025-07-16 11:30:57,882 - INFO - Pretrain Epoch 60/100 - Time: 13.46s: Recon Loss = 0.1619, Reg Loss = 0.0556, Total Loss = 0.2175

2025-07-16 11:33:13,254 - INFO - Pretrain Epoch 70/100 - Time: 14.10s: Recon Loss = 0.1620, Reg Loss = 0.0460, Total Loss = 0.2080

2025-07-16 11:35:34,097 - INFO - Pretrain Epoch 80/100 - Time: 13.34s: Recon Loss = 0.1621, Reg Loss = 0.0383, Total Loss = 0.2004

2025-07-16 11:37:46,319 - INFO - Pretrain Epoch 90/100 - Time: 12.06s: Recon Loss = 0.1620, Reg Loss = 0.0320, Total Loss = 0.1940

2025-07-16 11:40:05,039 - INFO - Pretrain Epoch 100/100 - Time: 14.64s: Recon Loss = 0.1620, Reg Loss = 0.0269, Total Loss = 0.1888

2025-07-16 11:40:05,039 - INFO -

Pretraining finished. Evaluating pretraining results with standard K-Means...

2025-07-16 11:40:08,871 - INFO - Running standard KMeans on pretrain embeddings ((7181, 64))...

2025-07-16 11:40:09,481 - INFO - Standard KMeans finished.

2025-07-16 11:40:10,302 - INFO - Pretraining Standard K-Means Clustering Evaluation:

2025-07-16 11:40:10,302 - INFO - silhouette: 0.29309433698654175

2025-07-16 11:40:10,302 - INFO - davies\_bouldin: 1.1585

2025-07-16 11:40:10,302 - INFO - calinski\_harabasz: 5154.8433

2025-07-16 11:40:10,302 - INFO - cohesion: -1.2125201225280762

2025-07-16 11:40:10,302 - INFO - separation: 2.5722

2025-07-16 11:40:10,302 - INFO - separation\_to\_cohesion: 2.1214

2025-07-16 11:40:10,302 - INFO - size\_balance: 0.4604

2025-07-16 11:40:10,302 - INFO - cluster\_count: 4.0000

2025-07-16 11:40:10,303 - INFO - avg\_cluster\_size: 1795.2500

2025-07-16 11:40:10,303 - INFO - cluster\_size\_std: 968.7782

2025-07-16 11:40:10,303 - INFO - cluster\_sizes: [2327, 1526, 367, 2961]

2025-07-16 11:40:14,859 - INFO - Pretraining standard KMeans++ results saved to ./results/n4\_pretrain\_standard\_kmeans\_clustering\_gz\_ptype0\_no\_cat.csv

2025-07-16 11:40:14,873 - INFO - Pretraining standard KMeans++ evaluation metrics saved to ./results/n4\_pretrain\_standard\_kmeans\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-16 11:40:14,956 - INFO - Pretraining encoder saved to ./results/n4\_pretrain\_encoder\_gz\_pytpe0\_no\_cat.pth

2025-07-16 11:40:14,956 - INFO -

Starting main training loop (Alternating Optimization)...

2025-07-16 11:40:14,956 - INFO - Initializing indicator matrix P for main training...

2025-07-16 11:40:18,989 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 11:40:18,989 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 11:40:20,630 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 11:40:20,630 - INFO - Evaluating initial main training clustering results (SVD + KMeans++ on P)...

2025-07-16 11:40:21,464 - INFO - Initial Main Training SVD + KMeans++ Clustering Evaluation:

2025-07-16 11:40:21,464 - INFO - silhouette: 0.1819533109664917

2025-07-16 11:40:21,464 - INFO - davies\_bouldin: 2.4113

2025-07-16 11:40:21,464 - INFO - calinski\_harabasz: 1061.3100

2025-07-16 11:40:21,464 - INFO - cohesion: -1.6833902597427368

2025-07-16 11:40:21,464 - INFO - separation: 1.4387

2025-07-16 11:40:21,464 - INFO - separation\_to\_cohesion: 0.8546

2025-07-16 11:40:21,464 - INFO - size\_balance: 0.2577

2025-07-16 11:40:21,465 - INFO - cluster\_count: 4.0000

2025-07-16 11:40:21,465 - INFO - avg\_cluster\_size: 1795.2500

2025-07-16 11:40:21,465 - INFO - cluster\_size\_std: 1332.6291

2025-07-16 11:40:21,465 - INFO - cluster\_sizes: [2421, 605, 475, 3680]

2025-07-16 11:41:05,670 - INFO - Epoch 1/80 - Time: 44.21s:Recon Loss=0.1677, Cluster Loss=9.9547,Reg Loss=0.0264,Last Inner Loss=10.1488

2025-07-16 11:41:40,991 - INFO - Epoch 2/80 - Time: 35.32s:Recon Loss=0.2124, Cluster Loss=4.4956,Reg Loss=0.0265,Last Inner Loss=4.7345

2025-07-16 11:42:23,976 - INFO - Epoch 3/80 - Time: 42.98s:Recon Loss=0.2342, Cluster Loss=1.8944,Reg Loss=0.0267,Last Inner Loss=2.1553

2025-07-16 11:43:06,009 - INFO - Epoch 4/80 - Time: 42.03s:Recon Loss=0.2565, Cluster Loss=1.2867,Reg Loss=0.0269,Last Inner Loss=1.5701

2025-07-16 11:43:45,510 - INFO - Epoch 5/80 - Time: 39.50s:Recon Loss=0.2672, Cluster Loss=0.7831,Reg Loss=0.0270,Last Inner Loss=1.0774

2025-07-16 11:44:24,760 - INFO - Epoch 6/80 - Time: 39.25s:Recon Loss=0.2720, Cluster Loss=0.6953,Reg Loss=0.0272,Last Inner Loss=0.9945

2025-07-16 11:45:08,278 - INFO - Epoch 7/80 - Time: 43.52s:Recon Loss=0.2715, Cluster Loss=0.4963,Reg Loss=0.0273,Last Inner Loss=0.7951

2025-07-16 11:45:53,054 - INFO - Epoch 8/80 - Time: 44.78s:Recon Loss=0.2630, Cluster Loss=0.4981,Reg Loss=0.0274,Last Inner Loss=0.7885

2025-07-16 11:46:36,406 - INFO - Epoch 9/80 - Time: 43.35s:Recon Loss=0.2481, Cluster Loss=0.4241,Reg Loss=0.0274,Last Inner Loss=0.6996

2025-07-16 11:47:25,036 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 11:47:25,036 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 11:47:26,724 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 11:47:27,554 - INFO - Epoch 10/80 (Eval) - Time: 51.15s (Eval Time: 6.09s):

2025-07-16 11:47:27,554 - INFO - Evaluation Metrics:

2025-07-16 11:47:27,554 - INFO - silhouette: 0.31540772318840027

2025-07-16 11:47:27,554 - INFO - davies\_bouldin: 0.8973

2025-07-16 11:47:27,554 - INFO - calinski\_harabasz: 1654.2336

2025-07-16 11:47:27,555 - INFO - cohesion: -0.2961004078388214

2025-07-16 11:47:27,555 - INFO - separation: 2.1042

2025-07-16 11:47:27,555 - INFO - separation\_to\_cohesion: 7.1062

2025-07-16 11:47:27,555 - INFO - size\_balance: 0.0000

2025-07-16 11:47:27,555 - INFO - cluster\_count: 4.0000

2025-07-16 11:47:27,555 - INFO - avg\_cluster\_size: 1795.2500

2025-07-16 11:47:27,555 - INFO - cluster\_size\_std: 2368.1901

2025-07-16 11:47:27,556 - INFO - cluster\_sizes: [5776, 1, 1401, 3]

2025-07-16 11:48:08,317 - INFO - Epoch 11/80 - Time: 40.76s:Recon Loss=0.2180, Cluster Loss=0.2165,Reg Loss=0.0275,Last Inner Loss=0.4620

2025-07-16 11:48:50,615 - INFO - Epoch 12/80 - Time: 42.30s:Recon Loss=0.2203, Cluster Loss=0.1849,Reg Loss=0.0275,Last Inner Loss=0.4327

2025-07-16 11:49:31,581 - INFO - Epoch 13/80 - Time: 40.97s:Recon Loss=0.2181, Cluster Loss=0.2427,Reg Loss=0.0276,Last Inner Loss=0.4884

2025-07-16 11:50:13,493 - INFO - Epoch 14/80 - Time: 41.91s:Recon Loss=0.2154, Cluster Loss=0.1871,Reg Loss=0.0276,Last Inner Loss=0.4301

2025-07-16 11:50:56,506 - INFO - Epoch 15/80 - Time: 43.01s:Recon Loss=0.2119, Cluster Loss=0.1518,Reg Loss=0.0276,Last Inner Loss=0.3913

2025-07-16 11:51:40,646 - INFO - Epoch 16/80 - Time: 44.14s:Recon Loss=0.2098, Cluster Loss=0.1173,Reg Loss=0.0276,Last Inner Loss=0.3547

2025-07-16 11:52:23,341 - INFO - Epoch 17/80 - Time: 42.70s:Recon Loss=0.2060, Cluster Loss=0.1224,Reg Loss=0.0276,Last Inner Loss=0.3560

2025-07-16 11:53:06,292 - INFO - Epoch 18/80 - Time: 42.95s:Recon Loss=0.2052, Cluster Loss=0.1099,Reg Loss=0.0276,Last Inner Loss=0.3427

2025-07-16 11:53:47,854 - INFO - Epoch 19/80 - Time: 41.56s:Recon Loss=0.1956, Cluster Loss=0.1371,Reg Loss=0.0276,Last Inner Loss=0.3603

2025-07-16 11:54:34,511 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 11:54:34,511 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 11:54:36,286 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 11:54:37,148 - INFO - Epoch 20/80 (Eval) - Time: 49.29s (Eval Time: 6.74s):

2025-07-16 11:54:37,148 - INFO - Evaluation Metrics:

2025-07-16 11:54:37,148 - INFO - silhouette: 0.3870447278022766

2025-07-16 11:54:37,148 - INFO - davies\_bouldin: 0.7532

2025-07-16 11:54:37,148 - INFO - calinski\_harabasz: 3662.5689

2025-07-16 11:54:37,148 - INFO - cohesion: -0.3030525743961334

2025-07-16 11:54:37,148 - INFO - separation: 1.8904

2025-07-16 11:54:37,149 - INFO - separation\_to\_cohesion: 6.2378

2025-07-16 11:54:37,149 - INFO - size\_balance: 0.0000

2025-07-16 11:54:37,149 - INFO - cluster\_count: 4.0000

2025-07-16 11:54:37,149 - INFO - avg\_cluster\_size: 1795.2500

2025-07-16 11:54:37,149 - INFO - cluster\_size\_std: 2394.5699

2025-07-16 11:54:37,149 - INFO - cluster\_sizes: [5833, 3, 2, 1343]

2025-07-16 11:55:19,677 - INFO - Epoch 21/80 - Time: 42.53s:Recon Loss=0.2008, Cluster Loss=0.0954,Reg Loss=0.0276,Last Inner Loss=0.3237

2025-07-16 11:55:59,961 - INFO - Epoch 22/80 - Time: 40.28s:Recon Loss=0.2056, Cluster Loss=0.1094,Reg Loss=0.0276,Last Inner Loss=0.3426

2025-07-16 11:56:43,886 - INFO - Epoch 23/80 - Time: 43.92s:Recon Loss=0.2061, Cluster Loss=0.1016,Reg Loss=0.0275,Last Inner Loss=0.3352

2025-07-16 11:57:25,229 - INFO - Epoch 24/80 - Time: 41.34s:Recon Loss=0.2013, Cluster Loss=0.0731,Reg Loss=0.0275,Last Inner Loss=0.3019

2025-07-16 11:58:08,686 - INFO - Epoch 25/80 - Time: 43.46s:Recon Loss=0.1931, Cluster Loss=0.0823,Reg Loss=0.0275,Last Inner Loss=0.3029

2025-07-16 11:58:52,548 - INFO - Epoch 26/80 - Time: 43.86s:Recon Loss=0.1914, Cluster Loss=0.0933,Reg Loss=0.0275,Last Inner Loss=0.3122

2025-07-16 11:59:32,837 - INFO - Epoch 27/80 - Time: 40.29s:Recon Loss=0.1941, Cluster Loss=0.0720,Reg Loss=0.0275,Last Inner Loss=0.2936

2025-07-16 12:00:15,282 - INFO - Epoch 28/80 - Time: 42.44s:Recon Loss=0.1977, Cluster Loss=0.0864,Reg Loss=0.0275,Last Inner Loss=0.3116

2025-07-16 12:00:56,633 - INFO - Epoch 29/80 - Time: 41.35s:Recon Loss=0.2018, Cluster Loss=0.0744,Reg Loss=0.0275,Last Inner Loss=0.3037

2025-07-16 12:01:38,961 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 12:01:38,961 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 12:01:40,659 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 12:01:41,542 - INFO - Epoch 30/80 (Eval) - Time: 44.91s (Eval Time: 5.71s):

2025-07-16 12:01:41,542 - INFO - Evaluation Metrics:

2025-07-16 12:01:41,542 - INFO - silhouette: 0.33903786540031433

2025-07-16 12:01:41,542 - INFO - davies\_bouldin: 0.9901

2025-07-16 12:01:41,542 - INFO - calinski\_harabasz: 3783.4755

2025-07-16 12:01:41,542 - INFO - cohesion: -0.4183053970336914

2025-07-16 12:01:41,543 - INFO - separation: 1.8113

2025-07-16 12:01:41,543 - INFO - separation\_to\_cohesion: 4.3302

2025-07-16 12:01:41,543 - INFO - size\_balance: 0.0000

2025-07-16 12:01:41,543 - INFO - cluster\_count: 4.0000

2025-07-16 12:01:41,543 - INFO - avg\_cluster\_size: 1795.2500

2025-07-16 12:01:41,543 - INFO - cluster\_size\_std: 2353.4762

2025-07-16 12:01:41,543 - INFO - cluster\_sizes: [5745, 3, 1429, 4]

2025-07-16 12:02:22,140 - INFO - Epoch 31/80 - Time: 40.60s:Recon Loss=0.1946, Cluster Loss=0.0983,Reg Loss=0.0276,Last Inner Loss=0.3205

2025-07-16 12:03:02,903 - INFO - Epoch 32/80 - Time: 40.76s:Recon Loss=0.1935, Cluster Loss=0.0750,Reg Loss=0.0276,Last Inner Loss=0.2960

2025-07-16 12:03:45,623 - INFO - Epoch 33/80 - Time: 42.72s:Recon Loss=0.1849, Cluster Loss=0.0778,Reg Loss=0.0276,Last Inner Loss=0.2903

2025-07-16 12:04:31,048 - INFO - Epoch 34/80 - Time: 45.42s:Recon Loss=0.1844, Cluster Loss=0.0695,Reg Loss=0.0276,Last Inner Loss=0.2816

2025-07-16 12:05:13,462 - INFO - Epoch 35/80 - Time: 42.41s:Recon Loss=0.1810, Cluster Loss=0.0798,Reg Loss=0.0277,Last Inner Loss=0.2885

2025-07-16 12:05:53,829 - INFO - Epoch 36/80 - Time: 40.37s:Recon Loss=0.1742, Cluster Loss=0.0654,Reg Loss=0.0277,Last Inner Loss=0.2672

2025-07-16 12:06:36,237 - INFO - Epoch 37/80 - Time: 42.41s:Recon Loss=0.1757, Cluster Loss=0.0708,Reg Loss=0.0277,Last Inner Loss=0.2742

2025-07-16 12:07:17,335 - INFO - Epoch 38/80 - Time: 41.10s:Recon Loss=0.1721, Cluster Loss=0.0554,Reg Loss=0.0277,Last Inner Loss=0.2551

2025-07-16 12:07:57,241 - INFO - Epoch 39/80 - Time: 39.90s:Recon Loss=0.1704, Cluster Loss=0.0829,Reg Loss=0.0277,Last Inner Loss=0.2809

2025-07-16 12:08:42,010 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 12:08:42,010 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 12:08:43,682 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 12:08:44,544 - INFO - Epoch 40/80 (Eval) - Time: 47.30s (Eval Time: 6.34s):

2025-07-16 12:08:44,544 - INFO - Evaluation Metrics:

2025-07-16 12:08:44,544 - INFO - silhouette: 0.36424317955970764

2025-07-16 12:08:44,544 - INFO - davies\_bouldin: 1.6243

2025-07-16 12:08:44,544 - INFO - calinski\_harabasz: 2456.9398

2025-07-16 12:08:44,545 - INFO - cohesion: -0.19282856583595276

2025-07-16 12:08:44,545 - INFO - separation: 1.3746

2025-07-16 12:08:44,545 - INFO - separation\_to\_cohesion: 7.1284

2025-07-16 12:08:44,545 - INFO - size\_balance: 0.0000

2025-07-16 12:08:44,545 - INFO - cluster\_count: 4.0000

2025-07-16 12:08:44,545 - INFO - avg\_cluster\_size: 1795.2500

2025-07-16 12:08:44,545 - INFO - cluster\_size\_std: 1913.8517

2025-07-16 12:08:44,545 - INFO - cluster\_sizes: [995, 3, 5020, 1163]

2025-07-16 12:09:26,073 - INFO - Epoch 41/80 - Time: 41.53s:Recon Loss=0.1708, Cluster Loss=0.0653,Reg Loss=0.0276,Last Inner Loss=0.2637

2025-07-16 12:10:10,533 - INFO - Epoch 42/80 - Time: 44.46s:Recon Loss=0.1723, Cluster Loss=0.0617,Reg Loss=0.0276,Last Inner Loss=0.2617

2025-07-16 12:10:53,635 - INFO - Epoch 43/80 - Time: 43.10s:Recon Loss=0.1783, Cluster Loss=0.1610,Reg Loss=0.0276,Last Inner Loss=0.3670

2025-07-16 12:11:35,402 - INFO - Epoch 44/80 - Time: 41.77s:Recon Loss=0.1761, Cluster Loss=0.2871,Reg Loss=0.0277,Last Inner Loss=0.4909

2025-07-16 12:12:14,818 - INFO - Epoch 45/80 - Time: 39.42s:Recon Loss=0.1777, Cluster Loss=0.2887,Reg Loss=0.0277,Last Inner Loss=0.4941

2025-07-16 12:12:56,590 - INFO - Epoch 46/80 - Time: 41.77s:Recon Loss=0.1823, Cluster Loss=0.3871,Reg Loss=0.0277,Last Inner Loss=0.5970

2025-07-16 12:13:36,452 - INFO - Epoch 47/80 - Time: 39.86s:Recon Loss=0.1859, Cluster Loss=0.5039,Reg Loss=0.0277,Last Inner Loss=0.7175

2025-07-16 12:14:15,693 - INFO - Epoch 48/80 - Time: 39.24s:Recon Loss=0.1951, Cluster Loss=0.5857,Reg Loss=0.0277,Last Inner Loss=0.8085

2025-07-16 12:14:57,858 - INFO - Epoch 49/80 - Time: 42.17s:Recon Loss=0.1954, Cluster Loss=0.5862,Reg Loss=0.0278,Last Inner Loss=0.8094

2025-07-16 12:15:42,016 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 12:15:42,017 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 12:15:43,586 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 12:15:44,550 - INFO - Epoch 50/80 (Eval) - Time: 46.69s (Eval Time: 6.07s):

2025-07-16 12:15:44,550 - INFO - Evaluation Metrics:

2025-07-16 12:15:44,550 - INFO - silhouette: 0.15510137379169464

2025-07-16 12:15:44,550 - INFO - davies\_bouldin: 1.2878

2025-07-16 12:15:44,551 - INFO - calinski\_harabasz: 857.8865

2025-07-16 12:15:44,551 - INFO - cohesion: -0.3616773188114166

2025-07-16 12:15:44,551 - INFO - separation: 1.0359

2025-07-16 12:15:44,551 - INFO - separation\_to\_cohesion: 2.8642

2025-07-16 12:15:44,551 - INFO - size\_balance: 0.0000

2025-07-16 12:15:44,551 - INFO - cluster\_count: 4.0000

2025-07-16 12:15:44,551 - INFO - avg\_cluster\_size: 1795.2500

2025-07-16 12:15:44,551 - INFO - cluster\_size\_std: 2196.2672

2025-07-16 12:15:44,551 - INFO - cluster\_sizes: [5552, 5, 666, 958]

2025-07-16 12:16:28,054 - INFO - Epoch 51/80 - Time: 43.50s:Recon Loss=0.1949, Cluster Loss=0.3504,Reg Loss=0.0278,Last Inner Loss=0.5731

2025-07-16 12:17:12,874 - INFO - Epoch 52/80 - Time: 44.82s:Recon Loss=0.1893, Cluster Loss=0.4453,Reg Loss=0.0279,Last Inner Loss=0.6625

2025-07-16 12:17:54,159 - INFO - Epoch 53/80 - Time: 41.28s:Recon Loss=0.1902, Cluster Loss=0.4104,Reg Loss=0.0279,Last Inner Loss=0.6285

2025-07-16 12:18:36,284 - INFO - Epoch 54/80 - Time: 42.13s:Recon Loss=0.1875, Cluster Loss=0.3516,Reg Loss=0.0279,Last Inner Loss=0.5670

2025-07-16 12:19:19,334 - INFO - Epoch 55/80 - Time: 43.05s:Recon Loss=0.1848, Cluster Loss=0.3127,Reg Loss=0.0279,Last Inner Loss=0.5254

2025-07-16 12:20:00,750 - INFO - Epoch 56/80 - Time: 41.42s:Recon Loss=0.1847, Cluster Loss=0.3492,Reg Loss=0.0279,Last Inner Loss=0.5618

2025-07-16 12:20:42,146 - INFO - Epoch 57/80 - Time: 41.39s:Recon Loss=0.2054, Cluster Loss=1.0218,Reg Loss=0.0281,Last Inner Loss=1.2552

2025-07-16 12:21:23,736 - INFO - Epoch 58/80 - Time: 41.59s:Recon Loss=0.2027, Cluster Loss=1.0705,Reg Loss=0.0282,Last Inner Loss=1.3014

2025-07-16 12:22:11,070 - INFO - Epoch 59/80 - Time: 47.33s:Recon Loss=0.2036, Cluster Loss=0.8294,Reg Loss=0.0283,Last Inner Loss=1.0613

2025-07-16 12:22:56,442 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 12:22:56,442 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 12:22:58,003 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 12:22:58,897 - INFO - Epoch 60/80 (Eval) - Time: 47.83s (Eval Time: 6.07s):

2025-07-16 12:22:58,897 - INFO - Evaluation Metrics:

2025-07-16 12:22:58,898 - INFO - silhouette: 0.14956572651863098

2025-07-16 12:22:58,898 - INFO - davies\_bouldin: 1.6018

2025-07-16 12:22:58,898 - INFO - calinski\_harabasz: 678.2445

2025-07-16 12:22:58,898 - INFO - cohesion: -0.3782731294631958

2025-07-16 12:22:58,898 - INFO - separation: 0.7928

2025-07-16 12:22:58,898 - INFO - separation\_to\_cohesion: 2.0958

2025-07-16 12:22:58,899 - INFO - size\_balance: 0.0321

2025-07-16 12:22:58,899 - INFO - cluster\_count: 4.0000

2025-07-16 12:22:58,899 - INFO - avg\_cluster\_size: 1795.2500

2025-07-16 12:22:58,899 - INFO - cluster\_size\_std: 1737.6670

2025-07-16 12:22:58,899 - INFO - cluster\_sizes: [1503, 4656, 1016, 6]

2025-07-16 12:23:40,323 - INFO - Epoch 61/80 - Time: 41.42s:Recon Loss=0.2019, Cluster Loss=0.2842,Reg Loss=0.0285,Last Inner Loss=0.5146

2025-07-16 12:24:21,706 - INFO - Epoch 62/80 - Time: 41.38s:Recon Loss=0.2045, Cluster Loss=0.2645,Reg Loss=0.0285,Last Inner Loss=0.4976

2025-07-16 12:25:07,718 - INFO - Epoch 63/80 - Time: 46.01s:Recon Loss=0.2054, Cluster Loss=0.2363,Reg Loss=0.0285,Last Inner Loss=0.4702

2025-07-16 12:25:50,457 - INFO - Epoch 64/80 - Time: 42.74s:Recon Loss=0.1977, Cluster Loss=0.1802,Reg Loss=0.0285,Last Inner Loss=0.4065

2025-07-16 12:26:31,731 - INFO - Epoch 65/80 - Time: 41.27s:Recon Loss=0.1905, Cluster Loss=0.1689,Reg Loss=0.0285,Last Inner Loss=0.3879

2025-07-16 12:27:12,128 - INFO - Epoch 66/80 - Time: 40.40s:Recon Loss=0.1881, Cluster Loss=0.1611,Reg Loss=0.0285,Last Inner Loss=0.3777

2025-07-16 12:27:55,327 - INFO - Epoch 67/80 - Time: 43.20s:Recon Loss=0.1860, Cluster Loss=0.1543,Reg Loss=0.0285,Last Inner Loss=0.3688

2025-07-16 12:28:41,508 - INFO - Epoch 68/80 - Time: 46.18s:Recon Loss=0.1822, Cluster Loss=0.1310,Reg Loss=0.0285,Last Inner Loss=0.3417

2025-07-16 12:29:24,293 - INFO - Epoch 69/80 - Time: 42.79s:Recon Loss=0.1810, Cluster Loss=0.1212,Reg Loss=0.0285,Last Inner Loss=0.3307

2025-07-16 12:30:08,737 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 12:30:08,737 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 12:30:10,343 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 12:30:11,111 - INFO - Epoch 70/80 (Eval) - Time: 46.82s (Eval Time: 5.68s):

2025-07-16 12:30:11,112 - INFO - Evaluation Metrics:

2025-07-16 12:30:11,112 - INFO - silhouette: 0.15893931686878204

2025-07-16 12:30:11,112 - INFO - davies\_bouldin: 1.5361

2025-07-16 12:30:11,112 - INFO - calinski\_harabasz: 616.6754

2025-07-16 12:30:11,112 - INFO - cohesion: -0.2663930654525757

2025-07-16 12:30:11,112 - INFO - separation: 0.4716

2025-07-16 12:30:11,113 - INFO - separation\_to\_cohesion: 1.7703

2025-07-16 12:30:11,113 - INFO - size\_balance: 0.0000

2025-07-16 12:30:11,113 - INFO - cluster\_count: 4.0000

2025-07-16 12:30:11,113 - INFO - avg\_cluster\_size: 1795.2500

2025-07-16 12:30:11,113 - INFO - cluster\_size\_std: 1803.6178

2025-07-16 12:30:11,113 - INFO - cluster\_sizes: [1410, 4793, 7, 971]

2025-07-16 12:30:54,904 - INFO - Epoch 71/80 - Time: 43.79s:Recon Loss=0.1821, Cluster Loss=0.1002,Reg Loss=0.0285,Last Inner Loss=0.3108

2025-07-16 12:31:37,493 - INFO - Epoch 72/80 - Time: 42.59s:Recon Loss=0.1833, Cluster Loss=0.1318,Reg Loss=0.0285,Last Inner Loss=0.3435

2025-07-16 12:32:17,118 - INFO - Epoch 73/80 - Time: 39.63s:Recon Loss=0.1838, Cluster Loss=0.1791,Reg Loss=0.0285,Last Inner Loss=0.3914

2025-07-16 12:32:56,489 - INFO - Epoch 74/80 - Time: 39.37s:Recon Loss=0.1815, Cluster Loss=0.1618,Reg Loss=0.0285,Last Inner Loss=0.3718

2025-07-16 12:33:36,906 - INFO - Epoch 75/80 - Time: 40.42s:Recon Loss=0.1825, Cluster Loss=0.1402,Reg Loss=0.0285,Last Inner Loss=0.3512

2025-07-16 12:34:18,943 - INFO - Epoch 76/80 - Time: 42.04s:Recon Loss=0.1856, Cluster Loss=0.1280,Reg Loss=0.0285,Last Inner Loss=0.3420

2025-07-16 12:35:04,874 - INFO - Epoch 77/80 - Time: 45.93s:Recon Loss=0.1858, Cluster Loss=0.1205,Reg Loss=0.0285,Last Inner Loss=0.3348

2025-07-16 12:35:46,097 - INFO - Epoch 78/80 - Time: 41.22s:Recon Loss=0.1838, Cluster Loss=0.1107,Reg Loss=0.0285,Last Inner Loss=0.3229

2025-07-16 12:36:28,078 - INFO - Epoch 79/80 - Time: 41.98s:Recon Loss=0.1795, Cluster Loss=0.1146,Reg Loss=0.0284,Last Inner Loss=0.3226

2025-07-16 12:37:12,164 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 12:37:12,164 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 12:37:13,759 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 12:37:14,625 - INFO - Epoch 80/80 (Eval) - Time: 46.55s (Eval Time: 5.75s):

2025-07-16 12:37:14,625 - INFO - Evaluation Metrics:

2025-07-16 12:37:14,626 - INFO - silhouette: 0.34212908148765564

2025-07-16 12:37:14,626 - INFO - davies\_bouldin: 0.9471

2025-07-16 12:37:14,626 - INFO - calinski\_harabasz: 3379.5820

2025-07-16 12:37:14,626 - INFO - cohesion: -0.12262611091136932

2025-07-16 12:37:14,626 - INFO - separation: 0.2269

2025-07-16 12:37:14,626 - INFO - separation\_to\_cohesion: 1.8503

2025-07-16 12:37:14,626 - INFO - size\_balance: 0.2349

2025-07-16 12:37:14,626 - INFO - cluster\_count: 4.0000

2025-07-16 12:37:14,626 - INFO - avg\_cluster\_size: 1795.2500

2025-07-16 12:37:14,626 - INFO - cluster\_size\_std: 1373.4767

2025-07-16 12:37:14,626 - INFO - cluster\_sizes: [1077, 4172, 913, 1019]

2025-07-16 12:37:14,627 - INFO -

Training completed!

2025-07-16 12:37:14,627 - INFO -

Saving final trained model...

2025-07-16 12:37:16,842 - INFO - Final trained model saved to ./results/n4\_final\_model\_gz\_ptype0\_no\_cat.pth

2025-07-16 12:37:16,842 - INFO -

Evaluating final trained model...

2025-07-16 12:37:20,468 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 12:37:20,468 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 12:37:22,105 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 12:37:22,943 - INFO -

Detailed Clustering Evaluation of Final Model:

2025-07-16 12:37:22,943 - INFO - silhouette: 0.34212908148765564

2025-07-16 12:37:22,943 - INFO - davies\_bouldin: 0.9471

2025-07-16 12:37:22,943 - INFO - calinski\_harabasz: 3379.5815

2025-07-16 12:37:22,943 - INFO - cohesion: -0.12262609601020813

2025-07-16 12:37:22,944 - INFO - separation: 0.2269

2025-07-16 12:37:22,944 - INFO - separation\_to\_cohesion: 1.8503

2025-07-16 12:37:22,944 - INFO - size\_balance: 0.2349

2025-07-16 12:37:22,944 - INFO - cluster\_count: 4.0000

2025-07-16 12:37:22,944 - INFO - avg\_cluster\_size: 1795.2500

2025-07-16 12:37:22,944 - INFO - cluster\_size\_std: 1373.4767

2025-07-16 12:37:22,944 - INFO - cluster\_sizes: [1077, 4172, 913, 1019]

2025-07-16 12:37:22,944 - INFO -

--- Detailed Clustering Evaluation of Final Model (based on P indicator matrix as embeddings) ---

2025-07-16 12:37:23,777 - INFO - P\_based\_silhouette: 0.39067667722702026

2025-07-16 12:37:23,777 - INFO - P\_based\_davies\_bouldin: 0.9592

2025-07-16 12:37:23,777 - INFO - P\_based\_calinski\_harabasz: 2817.7480

2025-07-16 12:37:23,777 - INFO - P\_based\_cohesion: -0.012100184336304665

2025-07-16 12:37:23,778 - INFO - P\_based\_separation: 0.0249

2025-07-16 12:37:23,778 - INFO - P\_based\_separation\_to\_cohesion: 2.0584

2025-07-16 12:37:23,778 - INFO - P\_based\_size\_balance: 0.2349

2025-07-16 12:37:23,778 - INFO - P\_based\_cluster\_count: 4.0000

2025-07-16 12:37:23,778 - INFO - P\_based\_avg\_cluster\_size: 1795.2500

2025-07-16 12:37:23,779 - INFO - P\_based\_cluster\_size\_std: 1373.4767

2025-07-16 12:37:23,779 - INFO - P\_based\_cluster\_sizes: [1077, 4172, 913, 1019]

2025-07-16 12:37:23,779 - INFO - Saving final results with embeddings and view weights...

2025-07-16 12:37:26,656 - INFO - Final results saved to ./results/n4\_final\_clustering\_gz\_pytpe0\_no\_cat.csv

2025-07-16 12:37:26,670 - INFO - Final evaluation metrics saved to ./results/n4\_final\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-16 15:08:29,153 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=5, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-16 15:08:29,171 - INFO - CUDA available. Using device: cuda:0

2025-07-16 15:08:29,172 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-16 15:08:56,703 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-16 15:08:56,707 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-16 15:08:56,720 - INFO - Numerical features scaled.

2025-07-16 15:08:56,799 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-16 15:08:56,805 - INFO - Loading pre-built graphs from directory: ./data

2025-07-16 15:08:56,858 - INFO - Loaded time graph: 807056 edges.

2025-07-16 15:08:56,871 - INFO - Loaded space graph: 890250 edges.

2025-07-16 15:08:56,884 - INFO - Loaded attr graph: 982548 edges.

2025-07-16 15:08:56,884 - INFO - Initializing model components...

2025-07-16 15:08:56,916 - INFO - Pretraining encoder...

2025-07-16 15:08:56,917 - WARNING - The main training loop might still encounter OutOfMemoryError due to the N x N matrix calculation

2025-07-16 15:08:56,917 - WARNING - in the clustering loss module (ZZ^T for SVD). This is inherent to the standard EGAE Jc loss formulation.

2025-07-16 15:08:56,917 - WARNING - If OOM occurs in the main loop, consider using a GPU with more memory or exploring approximations if available.

2025-07-16 15:11:24,062 - INFO - Pretrain Epoch 10/100 - Time: 13.04s: Recon Loss = 0.2130, Reg Loss = 0.1389, Total Loss = 0.3519

2025-07-16 15:13:43,172 - INFO - Pretrain Epoch 20/100 - Time: 12.77s: Recon Loss = 0.1896, Reg Loss = 0.1170, Total Loss = 0.3066

2025-07-16 15:16:06,982 - INFO - Pretrain Epoch 30/100 - Time: 14.62s: Recon Loss = 0.1631, Reg Loss = 0.0981, Total Loss = 0.2612

2025-07-16 15:18:32,554 - INFO - Pretrain Epoch 40/100 - Time: 14.20s: Recon Loss = 0.1618, Reg Loss = 0.0814, Total Loss = 0.2432

2025-07-16 15:20:57,619 - INFO - Pretrain Epoch 50/100 - Time: 14.95s: Recon Loss = 0.1619, Reg Loss = 0.0672, Total Loss = 0.2291

2025-07-16 15:23:24,729 - INFO - Pretrain Epoch 60/100 - Time: 13.55s: Recon Loss = 0.1620, Reg Loss = 0.0555, Total Loss = 0.2175

2025-07-16 15:25:47,065 - INFO - Pretrain Epoch 70/100 - Time: 15.09s: Recon Loss = 0.1619, Reg Loss = 0.0460, Total Loss = 0.2079

2025-07-16 15:28:16,160 - INFO - Pretrain Epoch 80/100 - Time: 13.58s: Recon Loss = 0.1621, Reg Loss = 0.0383, Total Loss = 0.2004

2025-07-16 15:30:33,961 - INFO - Pretrain Epoch 90/100 - Time: 13.35s: Recon Loss = 0.1619, Reg Loss = 0.0320, Total Loss = 0.1938

2025-07-16 15:32:52,675 - INFO - Pretrain Epoch 100/100 - Time: 13.56s: Recon Loss = 0.1621, Reg Loss = 0.0269, Total Loss = 0.1890

2025-07-16 15:32:52,675 - INFO -

Pretraining finished. Evaluating pretraining results with standard K-Means...

2025-07-16 15:32:56,144 - INFO - Running standard KMeans on pretrain embeddings ((7181, 64))...

2025-07-16 15:32:56,354 - INFO - Standard KMeans finished.

2025-07-16 15:32:57,147 - INFO - Pretraining Standard K-Means Clustering Evaluation:

2025-07-16 15:32:57,148 - INFO - silhouette: 0.30897098779678345

2025-07-16 15:32:57,148 - INFO - davies\_bouldin: 1.1742

2025-07-16 15:32:57,148 - INFO - calinski\_harabasz: 4706.7658

2025-07-16 15:32:57,148 - INFO - cohesion: -1.151278018951416

2025-07-16 15:32:57,148 - INFO - separation: 2.6118

2025-07-16 15:32:57,148 - INFO - separation\_to\_cohesion: 2.2686

2025-07-16 15:32:57,148 - INFO - size\_balance: 0.5728

2025-07-16 15:32:57,148 - INFO - cluster\_count: 5.0000

2025-07-16 15:32:57,148 - INFO - avg\_cluster\_size: 1436.2000

2025-07-16 15:32:57,148 - INFO - cluster\_size\_std: 613.5182

2025-07-16 15:32:57,149 - INFO - cluster\_sizes: [2215, 1640, 1385, 339, 1602]

2025-07-16 15:32:59,583 - INFO - Pretraining standard KMeans++ results saved to ./results/n5\_pretrain\_standard\_kmeans\_clustering\_gz\_ptype0\_no\_cat.csv

2025-07-16 15:32:59,607 - INFO - Pretraining standard KMeans++ evaluation metrics saved to ./results/n5\_pretrain\_standard\_kmeans\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-16 15:32:59,672 - INFO - Pretraining encoder saved to ./results/n5\_pretrain\_encoder\_gz\_pytpe0\_no\_cat.pth

2025-07-16 15:32:59,672 - INFO -

Starting main training loop (Alternating Optimization)...

2025-07-16 15:32:59,672 - INFO - Initializing indicator matrix P for main training...

2025-07-16 15:33:03,437 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 15:33:03,438 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 15:33:05,177 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 15:33:05,178 - INFO - Evaluating initial main training clustering results (SVD + KMeans++ on P)...

2025-07-16 15:33:06,016 - INFO - Initial Main Training SVD + KMeans++ Clustering Evaluation:

2025-07-16 15:33:06,016 - INFO - silhouette: 0.21238653361797333

2025-07-16 15:33:06,017 - INFO - davies\_bouldin: 2.4776

2025-07-16 15:33:06,017 - INFO - calinski\_harabasz: 1019.3433

2025-07-16 15:33:06,017 - INFO - cohesion: -1.7468640804290771

2025-07-16 15:33:06,017 - INFO - separation: 1.5713

2025-07-16 15:33:06,017 - INFO - separation\_to\_cohesion: 0.8995

2025-07-16 15:33:06,017 - INFO - size\_balance: 0.1365

2025-07-16 15:33:06,017 - INFO - cluster\_count: 5.0000

2025-07-16 15:33:06,017 - INFO - avg\_cluster\_size: 1436.2000

2025-07-16 15:33:06,017 - INFO - cluster\_size\_std: 1240.1209

2025-07-16 15:33:06,017 - INFO - cluster\_sizes: [3337, 667, 2484, 424, 269]

2025-07-16 15:33:49,844 - INFO - Epoch 1/80 - Time: 43.83s:Recon Loss=0.1675, Cluster Loss=9.9472,Reg Loss=0.0265,Last Inner Loss=10.1412

2025-07-16 15:34:31,370 - INFO - Epoch 2/80 - Time: 41.52s:Recon Loss=0.1955, Cluster Loss=3.8617,Reg Loss=0.0266,Last Inner Loss=4.0838

2025-07-16 15:35:15,530 - INFO - Epoch 3/80 - Time: 44.16s:Recon Loss=0.2271, Cluster Loss=1.7022,Reg Loss=0.0268,Last Inner Loss=1.9561

2025-07-16 15:36:01,493 - INFO - Epoch 4/80 - Time: 45.96s:Recon Loss=0.2512, Cluster Loss=1.0348,Reg Loss=0.0269,Last Inner Loss=1.3130

2025-07-16 15:36:50,258 - INFO - Epoch 5/80 - Time: 48.77s:Recon Loss=0.2607, Cluster Loss=0.6282,Reg Loss=0.0271,Last Inner Loss=0.9160

2025-07-16 15:37:29,742 - INFO - Epoch 6/80 - Time: 39.48s:Recon Loss=0.2615, Cluster Loss=0.5990,Reg Loss=0.0272,Last Inner Loss=0.8877

2025-07-16 15:38:09,450 - INFO - Epoch 7/80 - Time: 39.71s:Recon Loss=0.2574, Cluster Loss=0.4213,Reg Loss=0.0273,Last Inner Loss=0.7060

2025-07-16 15:38:52,321 - INFO - Epoch 8/80 - Time: 42.87s:Recon Loss=0.2509, Cluster Loss=0.4719,Reg Loss=0.0274,Last Inner Loss=0.7501

2025-07-16 15:39:34,751 - INFO - Epoch 9/80 - Time: 42.43s:Recon Loss=0.2394, Cluster Loss=0.3991,Reg Loss=0.0275,Last Inner Loss=0.6660

2025-07-16 15:40:23,213 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 15:40:23,213 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 15:40:24,971 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 15:40:25,822 - INFO - Epoch 10/80 (Eval) - Time: 51.07s (Eval Time: 6.72s):

2025-07-16 15:40:25,822 - INFO - Evaluation Metrics:

2025-07-16 15:40:25,822 - INFO - silhouette: 0.06253401190042496

2025-07-16 15:40:25,822 - INFO - davies\_bouldin: 1.7606

2025-07-16 15:40:25,822 - INFO - calinski\_harabasz: 2961.0927

2025-07-16 15:40:25,822 - INFO - cohesion: -0.5098048448562622

2025-07-16 15:40:25,822 - INFO - separation: 2.6125

2025-07-16 15:40:25,822 - INFO - separation\_to\_cohesion: 5.1246

2025-07-16 15:40:25,823 - INFO - size\_balance: 0.0000

2025-07-16 15:40:25,823 - INFO - cluster\_count: 5.0000

2025-07-16 15:40:25,823 - INFO - avg\_cluster\_size: 1436.2000

2025-07-16 15:40:25,823 - INFO - cluster\_size\_std: 1822.5938

2025-07-16 15:40:25,823 - INFO - cluster\_sizes: [4360, 2, 4, 2, 2813]

2025-07-16 15:41:09,409 - INFO - Epoch 11/80 - Time: 43.58s:Recon Loss=0.2127, Cluster Loss=0.2048,Reg Loss=0.0275,Last Inner Loss=0.4450

2025-07-16 15:41:48,480 - INFO - Epoch 12/80 - Time: 39.07s:Recon Loss=0.2061, Cluster Loss=0.2349,Reg Loss=0.0276,Last Inner Loss=0.4685

2025-07-16 15:42:26,321 - INFO - Epoch 13/80 - Time: 37.84s:Recon Loss=0.2009, Cluster Loss=0.1765,Reg Loss=0.0276,Last Inner Loss=0.4050

2025-07-16 15:43:07,197 - INFO - Epoch 14/80 - Time: 40.88s:Recon Loss=0.1957, Cluster Loss=0.2035,Reg Loss=0.0276,Last Inner Loss=0.4268

2025-07-16 15:43:45,995 - INFO - Epoch 15/80 - Time: 38.80s:Recon Loss=0.1955, Cluster Loss=0.1660,Reg Loss=0.0276,Last Inner Loss=0.3891

2025-07-16 15:44:25,432 - INFO - Epoch 16/80 - Time: 39.44s:Recon Loss=0.1952, Cluster Loss=0.1253,Reg Loss=0.0276,Last Inner Loss=0.3480

2025-07-16 15:45:06,631 - INFO - Epoch 17/80 - Time: 41.20s:Recon Loss=0.1942, Cluster Loss=0.1491,Reg Loss=0.0276,Last Inner Loss=0.3709

2025-07-16 15:45:51,256 - INFO - Epoch 18/80 - Time: 44.62s:Recon Loss=0.1927, Cluster Loss=0.1629,Reg Loss=0.0276,Last Inner Loss=0.3832

2025-07-16 15:46:37,362 - INFO - Epoch 19/80 - Time: 46.11s:Recon Loss=0.1863, Cluster Loss=0.1121,Reg Loss=0.0276,Last Inner Loss=0.3259

2025-07-16 15:47:22,267 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 15:47:22,268 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 15:47:23,882 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 15:47:24,748 - INFO - Epoch 20/80 (Eval) - Time: 47.38s (Eval Time: 5.91s):

2025-07-16 15:47:24,749 - INFO - Evaluation Metrics:

2025-07-16 15:47:24,749 - INFO - silhouette: 0.09514326602220535

2025-07-16 15:47:24,749 - INFO - davies\_bouldin: 1.3534

2025-07-16 15:47:24,749 - INFO - calinski\_harabasz: 2470.9174

2025-07-16 15:47:24,749 - INFO - cohesion: -0.4018130302429199

2025-07-16 15:47:24,749 - INFO - separation: 2.3555

2025-07-16 15:47:24,749 - INFO - separation\_to\_cohesion: 5.8623

2025-07-16 15:47:24,749 - INFO - size\_balance: 0.0000

2025-07-16 15:47:24,749 - INFO - cluster\_count: 5.0000

2025-07-16 15:47:24,749 - INFO - avg\_cluster\_size: 1436.2000

2025-07-16 15:47:24,750 - INFO - cluster\_size\_std: 2194.2018

2025-07-16 15:47:24,750 - INFO - cluster\_sizes: [5667, 2, 4, 1507, 1]

2025-07-16 15:48:04,273 - INFO - Epoch 21/80 - Time: 39.52s:Recon Loss=0.1844, Cluster Loss=0.1081,Reg Loss=0.0276,Last Inner Loss=0.3200

2025-07-16 15:48:46,428 - INFO - Epoch 22/80 - Time: 42.15s:Recon Loss=0.1803, Cluster Loss=0.0809,Reg Loss=0.0276,Last Inner Loss=0.2888

2025-07-16 15:49:27,408 - INFO - Epoch 23/80 - Time: 40.98s:Recon Loss=0.1791, Cluster Loss=0.0843,Reg Loss=0.0276,Last Inner Loss=0.2909

2025-07-16 15:50:07,618 - INFO - Epoch 24/80 - Time: 40.21s:Recon Loss=0.1766, Cluster Loss=0.0710,Reg Loss=0.0275,Last Inner Loss=0.2751

2025-07-16 15:50:51,960 - INFO - Epoch 25/80 - Time: 44.34s:Recon Loss=0.1784, Cluster Loss=0.0721,Reg Loss=0.0275,Last Inner Loss=0.2780

2025-07-16 15:51:33,780 - INFO - Epoch 26/80 - Time: 41.82s:Recon Loss=0.1763, Cluster Loss=0.0787,Reg Loss=0.0275,Last Inner Loss=0.2825

2025-07-16 15:52:20,029 - INFO - Epoch 27/80 - Time: 46.25s:Recon Loss=0.1774, Cluster Loss=0.0902,Reg Loss=0.0275,Last Inner Loss=0.2951

2025-07-16 15:53:02,849 - INFO - Epoch 28/80 - Time: 42.82s:Recon Loss=0.1753, Cluster Loss=0.0694,Reg Loss=0.0275,Last Inner Loss=0.2722

2025-07-16 15:53:41,224 - INFO - Epoch 29/80 - Time: 38.37s:Recon Loss=0.1761, Cluster Loss=0.0590,Reg Loss=0.0275,Last Inner Loss=0.2626

2025-07-16 15:54:26,305 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 15:54:26,305 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 15:54:27,996 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 15:54:28,774 - INFO - Epoch 30/80 (Eval) - Time: 47.55s (Eval Time: 6.15s):

2025-07-16 15:54:28,774 - INFO - Evaluation Metrics:

2025-07-16 15:54:28,774 - INFO - silhouette: 0.11258435249328613

2025-07-16 15:54:28,775 - INFO - davies\_bouldin: 1.6273

2025-07-16 15:54:28,775 - INFO - calinski\_harabasz: 3815.2130

2025-07-16 15:54:28,775 - INFO - cohesion: -0.5294056534767151

2025-07-16 15:54:28,775 - INFO - separation: 2.2201

2025-07-16 15:54:28,775 - INFO - separation\_to\_cohesion: 4.1937

2025-07-16 15:54:28,775 - INFO - size\_balance: 0.0000

2025-07-16 15:54:28,775 - INFO - cluster\_count: 5.0000

2025-07-16 15:54:28,775 - INFO - avg\_cluster\_size: 1436.2000

2025-07-16 15:54:28,775 - INFO - cluster\_size\_std: 2115.5666

2025-07-16 15:54:28,775 - INFO - cluster\_sizes: [5455, 2, 4, 7, 1713]

2025-07-16 15:55:09,238 - INFO - Epoch 31/80 - Time: 40.46s:Recon Loss=0.1796, Cluster Loss=0.1604,Reg Loss=0.0275,Last Inner Loss=0.3675

2025-07-16 15:55:48,634 - INFO - Epoch 32/80 - Time: 39.40s:Recon Loss=0.1791, Cluster Loss=0.3524,Reg Loss=0.0276,Last Inner Loss=0.5591

2025-07-16 15:56:27,972 - INFO - Epoch 33/80 - Time: 39.34s:Recon Loss=0.1780, Cluster Loss=0.4914,Reg Loss=0.0276,Last Inner Loss=0.6970

2025-07-16 15:57:10,619 - INFO - Epoch 34/80 - Time: 42.65s:Recon Loss=0.1797, Cluster Loss=0.4904,Reg Loss=0.0277,Last Inner Loss=0.6978

2025-07-16 15:57:56,428 - INFO - Epoch 35/80 - Time: 45.81s:Recon Loss=0.1854, Cluster Loss=0.4516,Reg Loss=0.0277,Last Inner Loss=0.6647

2025-07-16 15:58:41,399 - INFO - Epoch 36/80 - Time: 44.97s:Recon Loss=0.1815, Cluster Loss=0.3592,Reg Loss=0.0277,Last Inner Loss=0.5684

2025-07-16 15:59:21,960 - INFO - Epoch 37/80 - Time: 40.56s:Recon Loss=0.1830, Cluster Loss=0.3175,Reg Loss=0.0277,Last Inner Loss=0.5282

2025-07-16 16:00:00,453 - INFO - Epoch 38/80 - Time: 38.49s:Recon Loss=0.1747, Cluster Loss=0.2524,Reg Loss=0.0277,Last Inner Loss=0.4548

2025-07-16 16:00:41,773 - INFO - Epoch 39/80 - Time: 41.32s:Recon Loss=0.1740, Cluster Loss=0.2339,Reg Loss=0.0277,Last Inner Loss=0.4356

2025-07-16 16:01:26,178 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 16:01:26,179 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 16:01:27,835 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 16:01:28,691 - INFO - Epoch 40/80 (Eval) - Time: 46.92s (Eval Time: 5.89s):

2025-07-16 16:01:28,691 - INFO - Evaluation Metrics:

2025-07-16 16:01:28,691 - INFO - silhouette: 0.1923459768295288

2025-07-16 16:01:28,691 - INFO - davies\_bouldin: 1.3797

2025-07-16 16:01:28,691 - INFO - calinski\_harabasz: 2347.3618

2025-07-16 16:01:28,692 - INFO - cohesion: -0.4262491762638092

2025-07-16 16:01:28,692 - INFO - separation: 1.9093

2025-07-16 16:01:28,692 - INFO - separation\_to\_cohesion: 4.4794

2025-07-16 16:01:28,692 - INFO - size\_balance: 0.0000

2025-07-16 16:01:28,692 - INFO - cluster\_count: 5.0000

2025-07-16 16:01:28,692 - INFO - avg\_cluster\_size: 1436.2000

2025-07-16 16:01:28,692 - INFO - cluster\_size\_std: 2309.7767

2025-07-16 16:01:28,693 - INFO - cluster\_sizes: [6017, 2, 327, 12, 823]

2025-07-16 16:02:07,802 - INFO - Epoch 41/80 - Time: 39.11s:Recon Loss=0.1716, Cluster Loss=0.1185,Reg Loss=0.0277,Last Inner Loss=0.3177

2025-07-16 16:02:47,673 - INFO - Epoch 42/80 - Time: 39.87s:Recon Loss=0.1695, Cluster Loss=0.0810,Reg Loss=0.0276,Last Inner Loss=0.2782

2025-07-16 16:03:27,942 - INFO - Epoch 43/80 - Time: 40.27s:Recon Loss=0.1725, Cluster Loss=0.0778,Reg Loss=0.0276,Last Inner Loss=0.2780

2025-07-16 16:04:16,485 - INFO - Epoch 44/80 - Time: 48.54s:Recon Loss=0.1694, Cluster Loss=0.0736,Reg Loss=0.0276,Last Inner Loss=0.2706

2025-07-16 16:05:00,127 - INFO - Epoch 45/80 - Time: 43.64s:Recon Loss=0.1728, Cluster Loss=0.0896,Reg Loss=0.0276,Last Inner Loss=0.2899

2025-07-16 16:05:39,796 - INFO - Epoch 46/80 - Time: 39.67s:Recon Loss=0.1710, Cluster Loss=0.1304,Reg Loss=0.0276,Last Inner Loss=0.3290

2025-07-16 16:06:18,411 - INFO - Epoch 47/80 - Time: 38.62s:Recon Loss=0.1738, Cluster Loss=0.1711,Reg Loss=0.0276,Last Inner Loss=0.3726

2025-07-16 16:07:00,059 - INFO - Epoch 48/80 - Time: 41.65s:Recon Loss=0.1717, Cluster Loss=0.2089,Reg Loss=0.0276,Last Inner Loss=0.4082

2025-07-16 16:07:38,855 - INFO - Epoch 49/80 - Time: 38.80s:Recon Loss=0.1703, Cluster Loss=0.1606,Reg Loss=0.0276,Last Inner Loss=0.3585

2025-07-16 16:08:23,128 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 16:08:23,128 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 16:08:24,815 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 16:08:25,685 - INFO - Epoch 50/80 (Eval) - Time: 46.83s (Eval Time: 6.22s):

2025-07-16 16:08:25,685 - INFO - Evaluation Metrics:

2025-07-16 16:08:25,685 - INFO - silhouette: 0.33302223682403564

2025-07-16 16:08:25,685 - INFO - davies\_bouldin: 0.8834

2025-07-16 16:08:25,685 - INFO - calinski\_harabasz: 2141.3598

2025-07-16 16:08:25,686 - INFO - cohesion: -0.4042060971260071

2025-07-16 16:08:25,686 - INFO - separation: 2.1117

2025-07-16 16:08:25,686 - INFO - separation\_to\_cohesion: 5.2244

2025-07-16 16:08:25,686 - INFO - size\_balance: 0.0000

2025-07-16 16:08:25,686 - INFO - cluster\_count: 5.0000

2025-07-16 16:08:25,686 - INFO - avg\_cluster\_size: 1436.2000

2025-07-16 16:08:25,686 - INFO - cluster\_size\_std: 2612.5272

2025-07-16 16:08:25,686 - INFO - cluster\_sizes: [6646, 2, 520, 2, 11]

2025-07-16 16:09:10,639 - INFO - Epoch 51/80 - Time: 44.95s:Recon Loss=0.1685, Cluster Loss=0.1016,Reg Loss=0.0276,Last Inner Loss=0.2977

2025-07-16 16:09:57,070 - INFO - Epoch 52/80 - Time: 46.43s:Recon Loss=0.1685, Cluster Loss=0.1033,Reg Loss=0.0276,Last Inner Loss=0.2994

2025-07-16 16:10:39,535 - INFO - Epoch 53/80 - Time: 42.46s:Recon Loss=0.1691, Cluster Loss=0.0908,Reg Loss=0.0276,Last Inner Loss=0.2874

2025-07-16 16:11:22,198 - INFO - Epoch 54/80 - Time: 42.66s:Recon Loss=0.1701, Cluster Loss=0.1151,Reg Loss=0.0276,Last Inner Loss=0.3127

2025-07-16 16:12:03,434 - INFO - Epoch 55/80 - Time: 41.24s:Recon Loss=0.1673, Cluster Loss=0.1412,Reg Loss=0.0276,Last Inner Loss=0.3360

2025-07-16 16:12:48,419 - INFO - Epoch 56/80 - Time: 44.98s:Recon Loss=0.1667, Cluster Loss=0.1114,Reg Loss=0.0275,Last Inner Loss=0.3056

2025-07-16 16:13:30,217 - INFO - Epoch 57/80 - Time: 41.80s:Recon Loss=0.1668, Cluster Loss=0.0967,Reg Loss=0.0275,Last Inner Loss=0.2911

2025-07-16 16:14:11,249 - INFO - Epoch 58/80 - Time: 41.03s:Recon Loss=0.1662, Cluster Loss=0.0915,Reg Loss=0.0275,Last Inner Loss=0.2852

2025-07-16 16:14:53,794 - INFO - Epoch 59/80 - Time: 42.54s:Recon Loss=0.1702, Cluster Loss=0.1483,Reg Loss=0.0275,Last Inner Loss=0.3460

2025-07-16 16:15:37,911 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 16:15:37,911 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 16:15:39,500 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 16:15:40,291 - INFO - Epoch 60/80 (Eval) - Time: 46.50s (Eval Time: 6.49s):

2025-07-16 16:15:40,291 - INFO - Evaluation Metrics:

2025-07-16 16:15:40,292 - INFO - silhouette: 0.17195357382297516

2025-07-16 16:15:40,292 - INFO - davies\_bouldin: 1.2733

2025-07-16 16:15:40,292 - INFO - calinski\_harabasz: 1985.7101

2025-07-16 16:15:40,292 - INFO - cohesion: -0.4404621124267578

2025-07-16 16:15:40,292 - INFO - separation: 1.7419

2025-07-16 16:15:40,292 - INFO - separation\_to\_cohesion: 3.9548

2025-07-16 16:15:40,292 - INFO - size\_balance: 0.0000

2025-07-16 16:15:40,292 - INFO - cluster\_count: 5.0000

2025-07-16 16:15:40,293 - INFO - avg\_cluster\_size: 1436.2000

2025-07-16 16:15:40,293 - INFO - cluster\_size\_std: 1437.3082

2025-07-16 16:15:40,293 - INFO - cluster\_sizes: [3148, 3, 3159, 3, 868]

2025-07-16 16:16:23,327 - INFO - Epoch 61/80 - Time: 43.03s:Recon Loss=0.1761, Cluster Loss=0.1071,Reg Loss=0.0276,Last Inner Loss=0.3108

2025-07-16 16:17:06,408 - INFO - Epoch 62/80 - Time: 43.08s:Recon Loss=0.1722, Cluster Loss=0.1022,Reg Loss=0.0276,Last Inner Loss=0.3021

2025-07-16 16:17:46,566 - INFO - Epoch 63/80 - Time: 40.16s:Recon Loss=0.1686, Cluster Loss=0.1068,Reg Loss=0.0277,Last Inner Loss=0.3031

2025-07-16 16:18:25,458 - INFO - Epoch 64/80 - Time: 38.89s:Recon Loss=0.1671, Cluster Loss=0.0854,Reg Loss=0.0277,Last Inner Loss=0.2801

2025-07-16 16:19:06,019 - INFO - Epoch 65/80 - Time: 40.56s:Recon Loss=0.1663, Cluster Loss=0.0796,Reg Loss=0.0277,Last Inner Loss=0.2736

2025-07-16 16:19:45,992 - INFO - Epoch 66/80 - Time: 39.97s:Recon Loss=0.1665, Cluster Loss=0.0820,Reg Loss=0.0277,Last Inner Loss=0.2762

2025-07-16 16:20:25,627 - INFO - Epoch 67/80 - Time: 39.63s:Recon Loss=0.1656, Cluster Loss=0.0941,Reg Loss=0.0277,Last Inner Loss=0.2874

2025-07-16 16:21:08,608 - INFO - Epoch 68/80 - Time: 42.98s:Recon Loss=0.1731, Cluster Loss=0.1639,Reg Loss=0.0277,Last Inner Loss=0.3647

2025-07-16 16:21:52,202 - INFO - Epoch 69/80 - Time: 43.59s:Recon Loss=0.1689, Cluster Loss=0.2209,Reg Loss=0.0278,Last Inner Loss=0.4176

2025-07-16 16:22:39,307 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 16:22:39,308 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 16:22:40,892 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 16:22:41,728 - INFO - Epoch 70/80 (Eval) - Time: 49.53s (Eval Time: 6.99s):

2025-07-16 16:22:41,728 - INFO - Evaluation Metrics:

2025-07-16 16:22:41,729 - INFO - silhouette: 0.1966584026813507

2025-07-16 16:22:41,729 - INFO - davies\_bouldin: 1.2012

2025-07-16 16:22:41,729 - INFO - calinski\_harabasz: 814.3989

2025-07-16 16:22:41,729 - INFO - cohesion: -0.3571198582649231

2025-07-16 16:22:41,730 - INFO - separation: 1.9568

2025-07-16 16:22:41,730 - INFO - separation\_to\_cohesion: 5.4793

2025-07-16 16:22:41,730 - INFO - size\_balance: 0.0000

2025-07-16 16:22:41,730 - INFO - cluster\_count: 5.0000

2025-07-16 16:22:41,730 - INFO - avg\_cluster\_size: 1436.2000

2025-07-16 16:22:41,730 - INFO - cluster\_size\_std: 1815.2658

2025-07-16 16:22:41,731 - INFO - cluster\_sizes: [2814, 4344, 2, 2, 19]

2025-07-16 16:23:23,645 - INFO - Epoch 71/80 - Time: 41.91s:Recon Loss=0.1664, Cluster Loss=0.0967,Reg Loss=0.0278,Last Inner Loss=0.2909

2025-07-16 16:24:04,016 - INFO - Epoch 72/80 - Time: 40.37s:Recon Loss=0.1668, Cluster Loss=0.1104,Reg Loss=0.0278,Last Inner Loss=0.3050

2025-07-16 16:24:46,583 - INFO - Epoch 73/80 - Time: 42.57s:Recon Loss=0.1663, Cluster Loss=0.0973,Reg Loss=0.0278,Last Inner Loss=0.2914

2025-07-16 16:25:27,051 - INFO - Epoch 74/80 - Time: 40.47s:Recon Loss=0.1645, Cluster Loss=0.0812,Reg Loss=0.0278,Last Inner Loss=0.2734

2025-07-16 16:26:06,650 - INFO - Epoch 75/80 - Time: 39.60s:Recon Loss=0.1630, Cluster Loss=0.0713,Reg Loss=0.0278,Last Inner Loss=0.2621

2025-07-16 16:26:45,432 - INFO - Epoch 76/80 - Time: 38.78s:Recon Loss=0.1629, Cluster Loss=0.0656,Reg Loss=0.0278,Last Inner Loss=0.2563

2025-07-16 16:27:25,375 - INFO - Epoch 77/80 - Time: 39.94s:Recon Loss=0.1632, Cluster Loss=0.0651,Reg Loss=0.0278,Last Inner Loss=0.2560

2025-07-16 16:28:10,747 - INFO - Epoch 78/80 - Time: 45.37s:Recon Loss=0.1628, Cluster Loss=0.0581,Reg Loss=0.0277,Last Inner Loss=0.2487

2025-07-16 16:28:57,938 - INFO - Epoch 79/80 - Time: 47.19s:Recon Loss=0.1628, Cluster Loss=0.0592,Reg Loss=0.0277,Last Inner Loss=0.2497

2025-07-16 16:29:41,513 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 16:29:41,513 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 16:29:43,094 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 16:29:43,950 - INFO - Epoch 80/80 (Eval) - Time: 46.01s (Eval Time: 5.92s):

2025-07-16 16:29:43,951 - INFO - Evaluation Metrics:

2025-07-16 16:29:43,951 - INFO - silhouette: 0.334077388048172

2025-07-16 16:29:43,951 - INFO - davies\_bouldin: 0.8570

2025-07-16 16:29:43,951 - INFO - calinski\_harabasz: 1972.0457

2025-07-16 16:29:43,951 - INFO - cohesion: -0.3013472557067871

2025-07-16 16:29:43,951 - INFO - separation: 1.6962

2025-07-16 16:29:43,952 - INFO - separation\_to\_cohesion: 5.6288

2025-07-16 16:29:43,952 - INFO - size\_balance: 0.0000

2025-07-16 16:29:43,952 - INFO - cluster\_count: 5.0000

2025-07-16 16:29:43,952 - INFO - avg\_cluster\_size: 1436.2000

2025-07-16 16:29:43,952 - INFO - cluster\_size\_std: 1872.9416

2025-07-16 16:29:43,952 - INFO - cluster\_sizes: [869, 3, 1255, 2, 5052]

2025-07-16 16:29:43,952 - INFO -

Training completed!

2025-07-16 16:29:43,952 - INFO -

Saving final trained model...

2025-07-16 16:29:46,178 - INFO - Final trained model saved to ./results/n5\_final\_model\_gz\_ptype0\_no\_cat.pth

2025-07-16 16:29:46,178 - INFO -

Evaluating final trained model...

2025-07-16 16:29:49,943 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 16:29:49,943 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 16:29:51,522 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 16:29:52,362 - INFO -

Detailed Clustering Evaluation of Final Model:

2025-07-16 16:29:52,362 - INFO - silhouette: 0.334077388048172

2025-07-16 16:29:52,363 - INFO - davies\_bouldin: 0.8570

2025-07-16 16:29:52,363 - INFO - calinski\_harabasz: 1972.0464

2025-07-16 16:29:52,363 - INFO - cohesion: -0.3013473153114319

2025-07-16 16:29:52,363 - INFO - separation: 1.6962

2025-07-16 16:29:52,363 - INFO - separation\_to\_cohesion: 5.6288

2025-07-16 16:29:52,363 - INFO - size\_balance: 0.0000

2025-07-16 16:29:52,363 - INFO - cluster\_count: 5.0000

2025-07-16 16:29:52,363 - INFO - avg\_cluster\_size: 1436.2000

2025-07-16 16:29:52,363 - INFO - cluster\_size\_std: 1872.9416

2025-07-16 16:29:52,364 - INFO - cluster\_sizes: [869, 3, 1255, 2, 5052]

2025-07-16 16:29:52,364 - INFO -

--- Detailed Clustering Evaluation of Final Model (based on P indicator matrix as embeddings) ---

2025-07-16 16:29:53,211 - INFO - P\_based\_silhouette: 0.4264567196369171

2025-07-16 16:29:53,211 - INFO - P\_based\_davies\_bouldin: 0.6557

2025-07-16 16:29:53,212 - INFO - P\_based\_calinski\_harabasz: 3360.0321

2025-07-16 16:29:53,212 - INFO - P\_based\_cohesion: -0.04887611046433449

2025-07-16 16:29:53,212 - INFO - P\_based\_separation: 0.3245

2025-07-16 16:29:53,212 - INFO - P\_based\_separation\_to\_cohesion: 6.6385

2025-07-16 16:29:53,212 - INFO - P\_based\_size\_balance: 0.0000

2025-07-16 16:29:53,212 - INFO - P\_based\_cluster\_count: 5.0000

2025-07-16 16:29:53,212 - INFO - P\_based\_avg\_cluster\_size: 1436.2000

2025-07-16 16:29:53,212 - INFO - P\_based\_cluster\_size\_std: 1872.9416

2025-07-16 16:29:53,212 - INFO - P\_based\_cluster\_sizes: [869, 3, 1255, 2, 5052]

2025-07-16 16:29:53,213 - INFO - Saving final results with embeddings and view weights...

2025-07-16 16:29:56,006 - INFO - Final results saved to ./results/n5\_final\_clustering\_gz\_pytpe0\_no\_cat.csv

2025-07-16 16:29:56,031 - INFO - Final evaluation metrics saved to ./results/n5\_final\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-16 17:47:42,762 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=6, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-16 17:47:42,784 - INFO - CUDA available. Using device: cuda:0

2025-07-16 17:47:42,784 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-16 17:48:08,414 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-16 17:48:08,418 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-16 17:48:08,426 - INFO - Numerical features scaled.

2025-07-16 17:48:08,598 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-16 17:48:08,602 - INFO - Loading pre-built graphs from directory: ./data

2025-07-16 17:48:08,650 - INFO - Loaded time graph: 807056 edges.

2025-07-16 17:48:08,660 - INFO - Loaded space graph: 890250 edges.

2025-07-16 17:48:08,670 - INFO - Loaded attr graph: 982548 edges.

2025-07-16 17:48:08,670 - INFO - Initializing model components...

2025-07-16 17:48:08,696 - INFO - Pretraining encoder...

2025-07-16 17:48:08,696 - WARNING - The main training loop might still encounter OutOfMemoryError due to the N x N matrix calculation

2025-07-16 17:48:08,696 - WARNING - in the clustering loss module (ZZ^T for SVD). This is inherent to the standard EGAE Jc loss formulation.

2025-07-16 17:48:08,697 - WARNING - If OOM occurs in the main loop, consider using a GPU with more memory or exploring approximations if available.

2025-07-16 17:50:24,031 - INFO - Pretrain Epoch 10/100 - Time: 13.48s: Recon Loss = 0.2130, Reg Loss = 0.1389, Total Loss = 0.3519

2025-07-16 17:52:48,192 - INFO - Pretrain Epoch 20/100 - Time: 14.25s: Recon Loss = 0.1896, Reg Loss = 0.1171, Total Loss = 0.3067

2025-07-16 17:54:56,766 - INFO - Pretrain Epoch 30/100 - Time: 13.33s: Recon Loss = 0.1627, Reg Loss = 0.0991, Total Loss = 0.2618

2025-07-16 17:57:08,282 - INFO - Pretrain Epoch 40/100 - Time: 13.51s: Recon Loss = 0.1620, Reg Loss = 0.0833, Total Loss = 0.2453

2025-07-16 17:59:25,417 - INFO - Pretrain Epoch 50/100 - Time: 13.21s: Recon Loss = 0.1618, Reg Loss = 0.0697, Total Loss = 0.2315

2025-07-16 18:01:38,936 - INFO - Pretrain Epoch 60/100 - Time: 12.91s: Recon Loss = 0.1620, Reg Loss = 0.0584, Total Loss = 0.2203

2025-07-16 18:03:56,934 - INFO - Pretrain Epoch 70/100 - Time: 15.31s: Recon Loss = 0.1620, Reg Loss = 0.0490, Total Loss = 0.2110

2025-07-16 18:06:14,008 - INFO - Pretrain Epoch 80/100 - Time: 12.59s: Recon Loss = 0.1623, Reg Loss = 0.0413, Total Loss = 0.2036

2025-07-16 18:08:24,882 - INFO - Pretrain Epoch 90/100 - Time: 13.18s: Recon Loss = 0.1619, Reg Loss = 0.0349, Total Loss = 0.1969

2025-07-16 18:10:43,774 - INFO - Pretrain Epoch 100/100 - Time: 14.91s: Recon Loss = 0.1620, Reg Loss = 0.0297, Total Loss = 0.1917

2025-07-16 18:10:43,774 - INFO -

Pretraining finished. Evaluating pretraining results with standard K-Means...

2025-07-16 18:10:47,561 - INFO - Running standard KMeans on pretrain embeddings ((7181, 64))...

2025-07-16 18:10:47,781 - INFO - Standard KMeans finished.

2025-07-16 18:10:48,566 - INFO - Pretraining Standard K-Means Clustering Evaluation:

2025-07-16 18:10:48,566 - INFO - silhouette: 0.26254063844680786

2025-07-16 18:10:48,566 - INFO - davies\_bouldin: 1.2966

2025-07-16 18:10:48,566 - INFO - calinski\_harabasz: 4333.4229

2025-07-16 18:10:48,567 - INFO - cohesion: -1.413256049156189

2025-07-16 18:10:48,567 - INFO - separation: 3.5238

2025-07-16 18:10:48,567 - INFO - separation\_to\_cohesion: 2.4934

2025-07-16 18:10:48,567 - INFO - size\_balance: 0.6156

2025-07-16 18:10:48,567 - INFO - cluster\_count: 6.0000

2025-07-16 18:10:48,567 - INFO - avg\_cluster\_size: 1196.8333

2025-07-16 18:10:48,567 - INFO - cluster\_size\_std: 460.1139

2025-07-16 18:10:48,567 - INFO - cluster\_sizes: [1474, 1354, 1688, 308, 917, 1440]

2025-07-16 18:10:53,170 - INFO - Pretraining standard KMeans++ results saved to ./results/n6\_pretrain\_standard\_kmeans\_clustering\_gz\_ptype0\_no\_cat.csv

2025-07-16 18:10:53,195 - INFO - Pretraining standard KMeans++ evaluation metrics saved to ./results/n6\_pretrain\_standard\_kmeans\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-16 18:10:53,262 - INFO - Pretraining encoder saved to ./results/n6\_pretrain\_encoder\_gz\_pytpe0\_no\_cat.pth

2025-07-16 18:10:53,262 - INFO -

Starting main training loop (Alternating Optimization)...

2025-07-16 18:10:53,262 - INFO - Initializing indicator matrix P for main training...

2025-07-16 18:10:56,875 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 18:10:56,875 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 18:10:58,567 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 18:10:58,567 - INFO - Evaluating initial main training clustering results (SVD + KMeans++ on P)...

2025-07-16 18:10:59,391 - INFO - Initial Main Training SVD + KMeans++ Clustering Evaluation:

2025-07-16 18:10:59,392 - INFO - silhouette: 0.13147477805614471

2025-07-16 18:10:59,392 - INFO - davies\_bouldin: 2.9105

2025-07-16 18:10:59,392 - INFO - calinski\_harabasz: 829.2420

2025-07-16 18:10:59,392 - INFO - cohesion: -2.168962240219116

2025-07-16 18:10:59,392 - INFO - separation: 2.0595

2025-07-16 18:10:59,392 - INFO - separation\_to\_cohesion: 0.9495

2025-07-16 18:10:59,392 - INFO - size\_balance: 0.3627

2025-07-16 18:10:59,392 - INFO - cluster\_count: 6.0000

2025-07-16 18:10:59,392 - INFO - avg\_cluster\_size: 1196.8333

2025-07-16 18:10:59,392 - INFO - cluster\_size\_std: 762.7119

2025-07-16 18:10:59,392 - INFO - cluster\_sizes: [2312, 2004, 506, 354, 595, 1410]

2025-07-16 18:11:38,312 - INFO - Epoch 1/80 - Time: 38.92s:Recon Loss=0.1722, Cluster Loss=15.3523,Reg Loss=0.0293,Last Inner Loss=15.5538

2025-07-16 18:12:17,071 - INFO - Epoch 2/80 - Time: 38.76s:Recon Loss=0.2103, Cluster Loss=6.6757,Reg Loss=0.0294,Last Inner Loss=6.9154

2025-07-16 18:12:57,966 - INFO - Epoch 3/80 - Time: 40.89s:Recon Loss=0.2232, Cluster Loss=3.1696,Reg Loss=0.0296,Last Inner Loss=3.4224

2025-07-16 18:13:35,833 - INFO - Epoch 4/80 - Time: 37.87s:Recon Loss=0.2420, Cluster Loss=1.9668,Reg Loss=0.0297,Last Inner Loss=2.2385

2025-07-16 18:14:14,228 - INFO - Epoch 5/80 - Time: 38.40s:Recon Loss=0.2582, Cluster Loss=1.2329,Reg Loss=0.0299,Last Inner Loss=1.5210

2025-07-16 18:14:55,350 - INFO - Epoch 6/80 - Time: 41.12s:Recon Loss=0.2577, Cluster Loss=0.9426,Reg Loss=0.0300,Last Inner Loss=1.2303

2025-07-16 18:15:36,643 - INFO - Epoch 7/80 - Time: 41.29s:Recon Loss=0.2602, Cluster Loss=0.7043,Reg Loss=0.0302,Last Inner Loss=0.9947

2025-07-16 18:16:20,711 - INFO - Epoch 8/80 - Time: 44.07s:Recon Loss=0.2600, Cluster Loss=0.6881,Reg Loss=0.0302,Last Inner Loss=0.9784

2025-07-16 18:17:02,652 - INFO - Epoch 9/80 - Time: 41.94s:Recon Loss=0.2566, Cluster Loss=0.5756,Reg Loss=0.0303,Last Inner Loss=0.8624

2025-07-16 18:17:43,927 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 18:17:43,927 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 18:17:45,580 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 18:17:46,410 - INFO - Epoch 10/80 (Eval) - Time: 43.76s (Eval Time: 5.62s):

2025-07-16 18:17:46,410 - INFO - Evaluation Metrics:

2025-07-16 18:17:46,411 - INFO - silhouette: 0.4161674380302429

2025-07-16 18:17:46,411 - INFO - davies\_bouldin: 0.8779

2025-07-16 18:17:46,411 - INFO - calinski\_harabasz: 1679.3499

2025-07-16 18:17:46,411 - INFO - cohesion: -0.4194587767124176

2025-07-16 18:17:46,411 - INFO - separation: 1.6674

2025-07-16 18:17:46,411 - INFO - separation\_to\_cohesion: 3.9752

2025-07-16 18:17:46,411 - INFO - size\_balance: 0.0000

2025-07-16 18:17:46,411 - INFO - cluster\_count: 6.0000

2025-07-16 18:17:46,411 - INFO - avg\_cluster\_size: 1196.8333

2025-07-16 18:17:46,411 - INFO - cluster\_size\_std: 2236.1888

2025-07-16 18:17:46,411 - INFO - cluster\_sizes: [6141, 3, 74, 22, 3, 938]

2025-07-16 18:18:23,830 - INFO - Epoch 11/80 - Time: 37.42s:Recon Loss=0.2429, Cluster Loss=0.3011,Reg Loss=0.0304,Last Inner Loss=0.5744

2025-07-16 18:19:03,485 - INFO - Epoch 12/80 - Time: 39.65s:Recon Loss=0.2382, Cluster Loss=0.2686,Reg Loss=0.0304,Last Inner Loss=0.5372

2025-07-16 18:19:42,333 - INFO - Epoch 13/80 - Time: 38.85s:Recon Loss=0.2294, Cluster Loss=0.2588,Reg Loss=0.0304,Last Inner Loss=0.5186

2025-07-16 18:20:20,799 - INFO - Epoch 14/80 - Time: 38.47s:Recon Loss=0.2215, Cluster Loss=0.2806,Reg Loss=0.0304,Last Inner Loss=0.5325

2025-07-16 18:21:01,783 - INFO - Epoch 15/80 - Time: 40.98s:Recon Loss=0.2144, Cluster Loss=0.2352,Reg Loss=0.0304,Last Inner Loss=0.4800

2025-07-16 18:21:43,279 - INFO - Epoch 16/80 - Time: 41.49s:Recon Loss=0.2084, Cluster Loss=0.1938,Reg Loss=0.0304,Last Inner Loss=0.4326

2025-07-16 18:22:21,234 - INFO - Epoch 17/80 - Time: 37.96s:Recon Loss=0.2006, Cluster Loss=0.2105,Reg Loss=0.0304,Last Inner Loss=0.4415

2025-07-16 18:22:59,187 - INFO - Epoch 18/80 - Time: 37.95s:Recon Loss=0.1991, Cluster Loss=0.2337,Reg Loss=0.0304,Last Inner Loss=0.4632

2025-07-16 18:23:33,739 - INFO - Epoch 19/80 - Time: 34.55s:Recon Loss=0.1922, Cluster Loss=0.1781,Reg Loss=0.0304,Last Inner Loss=0.4007

2025-07-16 18:24:10,450 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 18:24:10,450 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 18:24:12,052 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 18:24:12,789 - INFO - Epoch 20/80 (Eval) - Time: 39.05s (Eval Time: 4.98s):

2025-07-16 18:24:12,789 - INFO - Evaluation Metrics:

2025-07-16 18:24:12,790 - INFO - silhouette: 0.13529497385025024

2025-07-16 18:24:12,790 - INFO - davies\_bouldin: 1.6644

2025-07-16 18:24:12,790 - INFO - calinski\_harabasz: 1184.7506

2025-07-16 18:24:12,790 - INFO - cohesion: -0.19167214632034302

2025-07-16 18:24:12,790 - INFO - separation: 0.4847

2025-07-16 18:24:12,790 - INFO - separation\_to\_cohesion: 2.5290

2025-07-16 18:24:12,790 - INFO - size\_balance: 0.0000

2025-07-16 18:24:12,790 - INFO - cluster\_count: 6.0000

2025-07-16 18:24:12,790 - INFO - avg\_cluster\_size: 1196.8333

2025-07-16 18:24:12,790 - INFO - cluster\_size\_std: 1366.0775

2025-07-16 18:24:12,790 - INFO - cluster\_sizes: [3792, 1123, 75, 18, 142, 2031]

2025-07-16 18:24:48,800 - INFO - Epoch 21/80 - Time: 36.01s:Recon Loss=0.1880, Cluster Loss=0.1764,Reg Loss=0.0304,Last Inner Loss=0.3948

2025-07-16 18:25:24,018 - INFO - Epoch 22/80 - Time: 35.22s:Recon Loss=0.1851, Cluster Loss=0.1463,Reg Loss=0.0304,Last Inner Loss=0.3618

2025-07-16 18:25:58,292 - INFO - Epoch 23/80 - Time: 34.27s:Recon Loss=0.1852, Cluster Loss=0.1388,Reg Loss=0.0304,Last Inner Loss=0.3544

2025-07-16 18:26:31,583 - INFO - Epoch 24/80 - Time: 33.29s:Recon Loss=0.1840, Cluster Loss=0.1192,Reg Loss=0.0304,Last Inner Loss=0.3337

2025-07-16 18:27:09,386 - INFO - Epoch 25/80 - Time: 37.80s:Recon Loss=0.1813, Cluster Loss=0.1175,Reg Loss=0.0304,Last Inner Loss=0.3292

2025-07-16 18:27:46,407 - INFO - Epoch 26/80 - Time: 37.02s:Recon Loss=0.1808, Cluster Loss=0.1344,Reg Loss=0.0304,Last Inner Loss=0.3456

2025-07-16 18:28:20,562 - INFO - Epoch 27/80 - Time: 34.15s:Recon Loss=0.1809, Cluster Loss=0.1570,Reg Loss=0.0304,Last Inner Loss=0.3683

2025-07-16 18:29:00,775 - INFO - Epoch 28/80 - Time: 40.21s:Recon Loss=0.1807, Cluster Loss=0.1288,Reg Loss=0.0304,Last Inner Loss=0.3400

2025-07-16 18:29:34,214 - INFO - Epoch 29/80 - Time: 33.44s:Recon Loss=0.1788, Cluster Loss=0.1057,Reg Loss=0.0304,Last Inner Loss=0.3148

2025-07-16 18:30:11,233 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 18:30:11,233 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 18:30:12,840 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 18:30:13,586 - INFO - Epoch 30/80 (Eval) - Time: 39.37s (Eval Time: 5.40s):

2025-07-16 18:30:13,586 - INFO - Evaluation Metrics:

2025-07-16 18:30:13,587 - INFO - silhouette: 0.12009328603744507

2025-07-16 18:30:13,587 - INFO - davies\_bouldin: 1.4519

2025-07-16 18:30:13,587 - INFO - calinski\_harabasz: 1376.9576

2025-07-16 18:30:13,587 - INFO - cohesion: -0.2114618420600891

2025-07-16 18:30:13,587 - INFO - separation: 1.4775

2025-07-16 18:30:13,587 - INFO - separation\_to\_cohesion: 6.9872

2025-07-16 18:30:13,587 - INFO - size\_balance: 0.0000

2025-07-16 18:30:13,587 - INFO - cluster\_count: 6.0000

2025-07-16 18:30:13,588 - INFO - avg\_cluster\_size: 1196.8333

2025-07-16 18:30:13,588 - INFO - cluster\_size\_std: 1829.1036

2025-07-16 18:30:13,588 - INFO - cluster\_sizes: [1972, 3, 4975, 81, 1, 149]

2025-07-16 18:30:51,206 - INFO - Epoch 31/80 - Time: 37.62s:Recon Loss=0.1763, Cluster Loss=0.0983,Reg Loss=0.0304,Last Inner Loss=0.3050

2025-07-16 18:31:25,604 - INFO - Epoch 32/80 - Time: 34.40s:Recon Loss=0.1781, Cluster Loss=0.0887,Reg Loss=0.0304,Last Inner Loss=0.2973

2025-07-16 18:31:59,343 - INFO - Epoch 33/80 - Time: 33.74s:Recon Loss=0.1769, Cluster Loss=0.0922,Reg Loss=0.0304,Last Inner Loss=0.2995

2025-07-16 18:32:33,964 - INFO - Epoch 34/80 - Time: 34.62s:Recon Loss=0.1783, Cluster Loss=0.0865,Reg Loss=0.0304,Last Inner Loss=0.2952

2025-07-16 18:33:08,961 - INFO - Epoch 35/80 - Time: 35.00s:Recon Loss=0.1776, Cluster Loss=0.1103,Reg Loss=0.0304,Last Inner Loss=0.3183

2025-07-16 18:33:44,189 - INFO - Epoch 36/80 - Time: 35.23s:Recon Loss=0.1748, Cluster Loss=0.0811,Reg Loss=0.0304,Last Inner Loss=0.2863

2025-07-16 18:34:19,576 - INFO - Epoch 37/80 - Time: 35.39s:Recon Loss=0.1746, Cluster Loss=0.1004,Reg Loss=0.0304,Last Inner Loss=0.3054

2025-07-16 18:34:58,616 - INFO - Epoch 38/80 - Time: 39.04s:Recon Loss=0.1776, Cluster Loss=0.1956,Reg Loss=0.0304,Last Inner Loss=0.4036

2025-07-16 18:35:33,185 - INFO - Epoch 39/80 - Time: 34.57s:Recon Loss=0.1808, Cluster Loss=0.3147,Reg Loss=0.0304,Last Inner Loss=0.5259

2025-07-16 18:36:11,754 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 18:36:11,754 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 18:36:13,424 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 18:36:14,196 - INFO - Epoch 40/80 (Eval) - Time: 41.01s (Eval Time: 5.45s):

2025-07-16 18:36:14,196 - INFO - Evaluation Metrics:

2025-07-16 18:36:14,196 - INFO - silhouette: 0.24470773339271545

2025-07-16 18:36:14,197 - INFO - davies\_bouldin: 1.1721

2025-07-16 18:36:14,197 - INFO - calinski\_harabasz: 1823.6765

2025-07-16 18:36:14,197 - INFO - cohesion: -0.3091275990009308

2025-07-16 18:36:14,197 - INFO - separation: 1.1633

2025-07-16 18:36:14,197 - INFO - separation\_to\_cohesion: 3.7632

2025-07-16 18:36:14,197 - INFO - size\_balance: 0.0000

2025-07-16 18:36:14,198 - INFO - cluster\_count: 6.0000

2025-07-16 18:36:14,198 - INFO - avg\_cluster\_size: 1196.8333

2025-07-16 18:36:14,198 - INFO - cluster\_size\_std: 1679.7106

2025-07-16 18:36:14,198 - INFO - cluster\_sizes: [4718, 3, 596, 146, 19, 1699]

2025-07-16 18:36:51,387 - INFO - Epoch 41/80 - Time: 37.19s:Recon Loss=0.1799, Cluster Loss=0.1539,Reg Loss=0.0305,Last Inner Loss=0.3643

2025-07-16 18:37:28,143 - INFO - Epoch 42/80 - Time: 36.76s:Recon Loss=0.1781, Cluster Loss=0.1122,Reg Loss=0.0305,Last Inner Loss=0.3208

2025-07-16 18:38:05,169 - INFO - Epoch 43/80 - Time: 37.03s:Recon Loss=0.1804, Cluster Loss=0.1375,Reg Loss=0.0305,Last Inner Loss=0.3485

2025-07-16 18:38:41,409 - INFO - Epoch 44/80 - Time: 36.24s:Recon Loss=0.1816, Cluster Loss=0.2483,Reg Loss=0.0305,Last Inner Loss=0.4604

2025-07-16 18:39:20,185 - INFO - Epoch 45/80 - Time: 38.78s:Recon Loss=0.1819, Cluster Loss=0.3820,Reg Loss=0.0306,Last Inner Loss=0.5945

2025-07-16 18:39:58,878 - INFO - Epoch 46/80 - Time: 38.69s:Recon Loss=0.1791, Cluster Loss=0.4667,Reg Loss=0.0306,Last Inner Loss=0.6764

2025-07-16 18:40:36,892 - INFO - Epoch 47/80 - Time: 38.01s:Recon Loss=0.1776, Cluster Loss=0.4349,Reg Loss=0.0306,Last Inner Loss=0.6432

2025-07-16 18:41:14,608 - INFO - Epoch 48/80 - Time: 37.72s:Recon Loss=0.1746, Cluster Loss=0.3921,Reg Loss=0.0307,Last Inner Loss=0.5974

2025-07-16 18:41:50,919 - INFO - Epoch 49/80 - Time: 36.31s:Recon Loss=0.1790, Cluster Loss=0.3127,Reg Loss=0.0307,Last Inner Loss=0.5223

2025-07-16 18:42:32,507 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 18:42:32,508 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 18:42:34,235 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 18:42:34,955 - INFO - Epoch 50/80 (Eval) - Time: 44.04s (Eval Time: 5.71s):

2025-07-16 18:42:34,956 - INFO - Evaluation Metrics:

2025-07-16 18:42:34,956 - INFO - silhouette: 0.21913866698741913

2025-07-16 18:42:34,956 - INFO - davies\_bouldin: 1.2179

2025-07-16 18:42:34,956 - INFO - calinski\_harabasz: 1334.6335

2025-07-16 18:42:34,956 - INFO - cohesion: -0.23781879246234894

2025-07-16 18:42:34,956 - INFO - separation: 0.5283

2025-07-16 18:42:34,956 - INFO - separation\_to\_cohesion: 2.2213

2025-07-16 18:42:34,956 - INFO - size\_balance: 0.0000

2025-07-16 18:42:34,956 - INFO - cluster\_count: 6.0000

2025-07-16 18:42:34,957 - INFO - avg\_cluster\_size: 1196.8333

2025-07-16 18:42:34,957 - INFO - cluster\_size\_std: 1624.4199

2025-07-16 18:42:34,957 - INFO - cluster\_sizes: [4726, 534, 518, 1231, 22, 150]

2025-07-16 18:43:13,185 - INFO - Epoch 51/80 - Time: 38.23s:Recon Loss=0.1796, Cluster Loss=0.1878,Reg Loss=0.0307,Last Inner Loss=0.3982

2025-07-16 18:43:49,408 - INFO - Epoch 52/80 - Time: 36.22s:Recon Loss=0.1816, Cluster Loss=0.2863,Reg Loss=0.0307,Last Inner Loss=0.4985

2025-07-16 18:44:25,726 - INFO - Epoch 53/80 - Time: 36.32s:Recon Loss=0.1856, Cluster Loss=0.4133,Reg Loss=0.0307,Last Inner Loss=0.6297

2025-07-16 18:45:04,804 - INFO - Epoch 54/80 - Time: 39.08s:Recon Loss=0.1879, Cluster Loss=0.7347,Reg Loss=0.0308,Last Inner Loss=0.9534

2025-07-16 18:45:42,741 - INFO - Epoch 55/80 - Time: 37.94s:Recon Loss=0.1831, Cluster Loss=0.9158,Reg Loss=0.0308,Last Inner Loss=1.1297

2025-07-16 18:46:20,342 - INFO - Epoch 56/80 - Time: 37.60s:Recon Loss=0.1801, Cluster Loss=0.8589,Reg Loss=0.0308,Last Inner Loss=1.0699

2025-07-16 18:46:57,773 - INFO - Epoch 57/80 - Time: 37.43s:Recon Loss=0.1833, Cluster Loss=0.9338,Reg Loss=0.0309,Last Inner Loss=1.1480

2025-07-16 18:47:31,406 - INFO - Epoch 58/80 - Time: 33.63s:Recon Loss=0.1842, Cluster Loss=0.8778,Reg Loss=0.0309,Last Inner Loss=1.0928

2025-07-16 18:48:04,995 - INFO - Epoch 59/80 - Time: 33.59s:Recon Loss=0.1842, Cluster Loss=0.8059,Reg Loss=0.0309,Last Inner Loss=1.0210

2025-07-16 18:48:44,189 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 18:48:44,190 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 18:48:45,831 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 18:48:46,550 - INFO - Epoch 60/80 (Eval) - Time: 41.55s (Eval Time: 5.41s):

2025-07-16 18:48:46,550 - INFO - Evaluation Metrics:

2025-07-16 18:48:46,550 - INFO - silhouette: 0.14643174409866333

2025-07-16 18:48:46,550 - INFO - davies\_bouldin: 1.5748

2025-07-16 18:48:46,550 - INFO - calinski\_harabasz: 827.7261

2025-07-16 18:48:46,550 - INFO - cohesion: -0.2549906075000763

2025-07-16 18:48:46,550 - INFO - separation: 0.5168

2025-07-16 18:48:46,551 - INFO - separation\_to\_cohesion: 2.0269

2025-07-16 18:48:46,551 - INFO - size\_balance: 0.0000

2025-07-16 18:48:46,551 - INFO - cluster\_count: 6.0000

2025-07-16 18:48:46,551 - INFO - avg\_cluster\_size: 1196.8333

2025-07-16 18:48:46,551 - INFO - cluster\_size\_std: 1456.5652

2025-07-16 18:48:46,551 - INFO - cluster\_sizes: [707, 4322, 687, 1283, 21, 161]

2025-07-16 18:49:22,379 - INFO - Epoch 61/80 - Time: 35.83s:Recon Loss=0.1864, Cluster Loss=0.3003,Reg Loss=0.0309,Last Inner Loss=0.5176

2025-07-16 18:49:56,761 - INFO - Epoch 62/80 - Time: 34.38s:Recon Loss=0.1854, Cluster Loss=0.2796,Reg Loss=0.0308,Last Inner Loss=0.4959

2025-07-16 18:50:30,141 - INFO - Epoch 63/80 - Time: 33.38s:Recon Loss=0.1832, Cluster Loss=0.2586,Reg Loss=0.0308,Last Inner Loss=0.4726

2025-07-16 18:51:06,713 - INFO - Epoch 64/80 - Time: 36.57s:Recon Loss=0.1800, Cluster Loss=0.2345,Reg Loss=0.0308,Last Inner Loss=0.4452

2025-07-16 18:51:43,409 - INFO - Epoch 65/80 - Time: 36.70s:Recon Loss=0.1767, Cluster Loss=0.1889,Reg Loss=0.0308,Last Inner Loss=0.3965

2025-07-16 18:52:19,966 - INFO - Epoch 66/80 - Time: 36.56s:Recon Loss=0.1755, Cluster Loss=0.1770,Reg Loss=0.0308,Last Inner Loss=0.3833

2025-07-16 18:52:57,365 - INFO - Epoch 67/80 - Time: 37.40s:Recon Loss=0.1727, Cluster Loss=0.1611,Reg Loss=0.0308,Last Inner Loss=0.3646

2025-07-16 18:53:31,183 - INFO - Epoch 68/80 - Time: 33.82s:Recon Loss=0.1689, Cluster Loss=0.1522,Reg Loss=0.0308,Last Inner Loss=0.3519

2025-07-16 18:54:07,042 - INFO - Epoch 69/80 - Time: 35.86s:Recon Loss=0.1691, Cluster Loss=0.1357,Reg Loss=0.0308,Last Inner Loss=0.3356

2025-07-16 18:54:45,845 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 18:54:45,845 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 18:54:47,452 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 18:54:48,183 - INFO - Epoch 70/80 (Eval) - Time: 41.14s (Eval Time: 5.44s):

2025-07-16 18:54:48,183 - INFO - Evaluation Metrics:

2025-07-16 18:54:48,183 - INFO - silhouette: 0.1960890144109726

2025-07-16 18:54:48,183 - INFO - davies\_bouldin: 1.5451

2025-07-16 18:54:48,183 - INFO - calinski\_harabasz: 1167.6977

2025-07-16 18:54:48,183 - INFO - cohesion: -0.1371455043554306

2025-07-16 18:54:48,183 - INFO - separation: 0.2307

2025-07-16 18:54:48,183 - INFO - separation\_to\_cohesion: 1.6824

2025-07-16 18:54:48,184 - INFO - size\_balance: 0.0415

2025-07-16 18:54:48,184 - INFO - cluster\_count: 6.0000

2025-07-16 18:54:48,184 - INFO - avg\_cluster\_size: 1196.8333

2025-07-16 18:54:48,184 - INFO - cluster\_size\_std: 1147.1391

2025-07-16 18:54:48,184 - INFO - cluster\_sizes: [678, 1188, 794, 167, 3674, 680]

2025-07-16 18:55:24,108 - INFO - Epoch 71/80 - Time: 35.92s:Recon Loss=0.1677, Cluster Loss=0.1116,Reg Loss=0.0307,Last Inner Loss=0.3101

2025-07-16 18:55:59,613 - INFO - Epoch 72/80 - Time: 35.50s:Recon Loss=0.1681, Cluster Loss=0.1931,Reg Loss=0.0307,Last Inner Loss=0.3919

2025-07-16 18:56:35,954 - INFO - Epoch 73/80 - Time: 36.34s:Recon Loss=0.1686, Cluster Loss=0.1113,Reg Loss=0.0307,Last Inner Loss=0.3106

2025-07-16 18:57:14,003 - INFO - Epoch 74/80 - Time: 38.05s:Recon Loss=0.1677, Cluster Loss=0.1069,Reg Loss=0.0307,Last Inner Loss=0.3053

2025-07-16 18:57:53,476 - INFO - Epoch 75/80 - Time: 39.47s:Recon Loss=0.1669, Cluster Loss=0.0915,Reg Loss=0.0307,Last Inner Loss=0.2891

2025-07-16 18:58:30,163 - INFO - Epoch 76/80 - Time: 36.69s:Recon Loss=0.1672, Cluster Loss=0.0863,Reg Loss=0.0307,Last Inner Loss=0.2842

2025-07-16 18:59:06,364 - INFO - Epoch 77/80 - Time: 36.20s:Recon Loss=0.1667, Cluster Loss=0.0909,Reg Loss=0.0307,Last Inner Loss=0.2882

2025-07-16 18:59:40,146 - INFO - Epoch 78/80 - Time: 33.78s:Recon Loss=0.1661, Cluster Loss=0.0988,Reg Loss=0.0307,Last Inner Loss=0.2956

2025-07-16 19:00:13,676 - INFO - Epoch 79/80 - Time: 33.53s:Recon Loss=0.1653, Cluster Loss=0.0853,Reg Loss=0.0307,Last Inner Loss=0.2812

2025-07-16 19:00:55,555 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 19:00:55,555 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 19:00:57,205 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 19:00:57,924 - INFO - Epoch 80/80 (Eval) - Time: 44.25s (Eval Time: 5.57s):

2025-07-16 19:00:57,924 - INFO - Evaluation Metrics:

2025-07-16 19:00:57,924 - INFO - silhouette: 0.12426774948835373

2025-07-16 19:00:57,924 - INFO - davies\_bouldin: 1.4507

2025-07-16 19:00:57,924 - INFO - calinski\_harabasz: 787.8175

2025-07-16 19:00:57,925 - INFO - cohesion: -0.17617224156856537

2025-07-16 19:00:57,925 - INFO - separation: 0.3799

2025-07-16 19:00:57,925 - INFO - separation\_to\_cohesion: 2.1562

2025-07-16 19:00:57,925 - INFO - size\_balance: 0.0000

2025-07-16 19:00:57,925 - INFO - cluster\_count: 6.0000

2025-07-16 19:00:57,925 - INFO - avg\_cluster\_size: 1196.8333

2025-07-16 19:00:57,925 - INFO - cluster\_size\_std: 1465.8569

2025-07-16 19:00:57,925 - INFO - cluster\_sizes: [710, 4355, 711, 165, 22, 1218]

2025-07-16 19:00:57,925 - INFO -

Training completed!

2025-07-16 19:00:57,925 - INFO -

Saving final trained model...

2025-07-16 19:01:00,148 - INFO - Final trained model saved to ./results/n6\_final\_model\_gz\_ptype0\_no\_cat.pth

2025-07-16 19:01:00,148 - INFO -

Evaluating final trained model...

2025-07-16 19:01:03,025 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 19:01:03,025 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 19:01:04,645 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 19:01:05,358 - INFO -

Detailed Clustering Evaluation of Final Model:

2025-07-16 19:01:05,359 - INFO - silhouette: 0.12426774948835373

2025-07-16 19:01:05,359 - INFO - davies\_bouldin: 1.4507

2025-07-16 19:01:05,359 - INFO - calinski\_harabasz: 787.8175

2025-07-16 19:01:05,359 - INFO - cohesion: -0.17617224156856537

2025-07-16 19:01:05,359 - INFO - separation: 0.3799

2025-07-16 19:01:05,359 - INFO - separation\_to\_cohesion: 2.1562

2025-07-16 19:01:05,359 - INFO - size\_balance: 0.0000

2025-07-16 19:01:05,360 - INFO - cluster\_count: 6.0000

2025-07-16 19:01:05,360 - INFO - avg\_cluster\_size: 1196.8333

2025-07-16 19:01:05,360 - INFO - cluster\_size\_std: 1465.8569

2025-07-16 19:01:05,360 - INFO - cluster\_sizes: [710, 4355, 711, 165, 22, 1218]

2025-07-16 19:01:05,360 - INFO -

--- Detailed Clustering Evaluation of Final Model (based on P indicator matrix as embeddings) ---

2025-07-16 19:01:06,048 - INFO - P\_based\_silhouette: 0.3426769971847534

2025-07-16 19:01:06,049 - INFO - P\_based\_davies\_bouldin: 0.8583

2025-07-16 19:01:06,049 - INFO - P\_based\_calinski\_harabasz: 2249.0586

2025-07-16 19:01:06,049 - INFO - P\_based\_cohesion: -0.02453370951116085

2025-07-16 19:01:06,049 - INFO - P\_based\_separation: 0.0739

2025-07-16 19:01:06,049 - INFO - P\_based\_separation\_to\_cohesion: 3.0134

2025-07-16 19:01:06,049 - INFO - P\_based\_size\_balance: 0.0000

2025-07-16 19:01:06,049 - INFO - P\_based\_cluster\_count: 6.0000

2025-07-16 19:01:06,049 - INFO - P\_based\_avg\_cluster\_size: 1196.8333

2025-07-16 19:01:06,050 - INFO - P\_based\_cluster\_size\_std: 1465.8569

2025-07-16 19:01:06,050 - INFO - P\_based\_cluster\_sizes: [710, 4355, 711, 165, 22, 1218]

2025-07-16 19:01:06,050 - INFO - Saving final results with embeddings and view weights...

2025-07-16 19:01:08,753 - INFO - Final results saved to ./results/n6\_final\_clustering\_gz\_pytpe0\_no\_cat.csv

2025-07-16 19:01:08,776 - INFO - Final evaluation metrics saved to ./results/n6\_final\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-16 19:04:24,592 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=7, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-16 19:04:24,610 - INFO - CUDA available. Using device: cuda:0

2025-07-16 19:04:24,610 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-16 19:04:49,640 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-16 19:04:49,644 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-16 19:04:49,656 - INFO - Numerical features scaled.

2025-07-16 19:04:49,778 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-16 19:04:49,782 - INFO - Loading pre-built graphs from directory: ./data

2025-07-16 19:04:49,830 - INFO - Loaded time graph: 807056 edges.

2025-07-16 19:04:49,841 - INFO - Loaded space graph: 890250 edges.

2025-07-16 19:04:49,853 - INFO - Loaded attr graph: 982548 edges.

2025-07-16 19:04:49,854 - INFO - Initializing model components...

2025-07-16 19:04:49,882 - INFO - Pretraining encoder...

2025-07-16 19:04:49,882 - WARNING - The main training loop might still encounter OutOfMemoryError due to the N x N matrix calculation

2025-07-16 19:04:49,882 - WARNING - in the clustering loss module (ZZ^T for SVD). This is inherent to the standard EGAE Jc loss formulation.

2025-07-16 19:04:49,882 - WARNING - If OOM occurs in the main loop, consider using a GPU with more memory or exploring approximations if available.

2025-07-16 19:06:49,344 - INFO - Pretrain Epoch 10/100 - Time: 13.68s: Recon Loss = 0.2130, Reg Loss = 0.1389, Total Loss = 0.3519

2025-07-16 19:08:46,648 - INFO - Pretrain Epoch 20/100 - Time: 14.19s: Recon Loss = 0.1912, Reg Loss = 0.1171, Total Loss = 0.3083

2025-07-16 19:10:47,335 - INFO - Pretrain Epoch 30/100 - Time: 14.03s: Recon Loss = 0.1625, Reg Loss = 0.0986, Total Loss = 0.2611

2025-07-16 19:12:47,627 - INFO - Pretrain Epoch 40/100 - Time: 12.95s: Recon Loss = 0.1617, Reg Loss = 0.0820, Total Loss = 0.2438

2025-07-16 19:14:42,320 - INFO - Pretrain Epoch 50/100 - Time: 14.09s: Recon Loss = 0.1619, Reg Loss = 0.0680, Total Loss = 0.2299

2025-07-16 19:16:45,352 - INFO - Pretrain Epoch 60/100 - Time: 14.07s: Recon Loss = 0.1618, Reg Loss = 0.0563, Total Loss = 0.2181

2025-07-16 19:18:40,931 - INFO - Pretrain Epoch 70/100 - Time: 13.24s: Recon Loss = 0.1620, Reg Loss = 0.0468, Total Loss = 0.2088

2025-07-16 19:20:41,526 - INFO - Pretrain Epoch 80/100 - Time: 13.92s: Recon Loss = 0.1627, Reg Loss = 0.0390, Total Loss = 0.2017

2025-07-16 19:22:45,510 - INFO - Pretrain Epoch 90/100 - Time: 14.35s: Recon Loss = 0.1639, Reg Loss = 0.0331, Total Loss = 0.1970

2025-07-16 19:24:40,115 - INFO - Pretrain Epoch 100/100 - Time: 11.52s: Recon Loss = 0.1622, Reg Loss = 0.0284, Total Loss = 0.1906

2025-07-16 19:24:40,116 - INFO -

Pretraining finished. Evaluating pretraining results with standard K-Means...

2025-07-16 19:24:42,770 - INFO - Running standard KMeans on pretrain embeddings ((7181, 64))...

2025-07-16 19:24:42,949 - INFO - Standard KMeans finished.

2025-07-16 19:24:43,581 - INFO - Pretraining Standard K-Means Clustering Evaluation:

2025-07-16 19:24:43,581 - INFO - silhouette: 0.26322829723358154

2025-07-16 19:24:43,581 - INFO - davies\_bouldin: 1.3738

2025-07-16 19:24:43,581 - INFO - calinski\_harabasz: 3150.8960

2025-07-16 19:24:43,581 - INFO - cohesion: -1.3610023260116577

2025-07-16 19:24:43,581 - INFO - separation: 2.9645

2025-07-16 19:24:43,582 - INFO - separation\_to\_cohesion: 2.1782

2025-07-16 19:24:43,582 - INFO - size\_balance: 0.7165

2025-07-16 19:24:43,582 - INFO - cluster\_count: 7.0000

2025-07-16 19:24:43,582 - INFO - avg\_cluster\_size: 1025.8571

2025-07-16 19:24:43,582 - INFO - cluster\_size\_std: 290.8414

2025-07-16 19:24:43,582 - INFO - cluster\_sizes: [1435, 809, 1212, 486, 955, 1043, 1241]

2025-07-16 19:24:47,690 - INFO - Pretraining standard KMeans++ results saved to ./results/n7\_pretrain\_standard\_kmeans\_clustering\_gz\_ptype0\_no\_cat.csv

2025-07-16 19:24:47,704 - INFO - Pretraining standard KMeans++ evaluation metrics saved to ./results/n7\_pretrain\_standard\_kmeans\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-16 19:24:47,774 - INFO - Pretraining encoder saved to ./results/n7\_pretrain\_encoder\_gz\_pytpe0\_no\_cat.pth

2025-07-16 19:24:47,774 - INFO -

Starting main training loop (Alternating Optimization)...

2025-07-16 19:24:47,774 - INFO - Initializing indicator matrix P for main training...

2025-07-16 19:24:50,988 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 19:24:50,988 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 19:24:52,705 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 19:24:52,706 - INFO - Evaluating initial main training clustering results (SVD + KMeans++ on P)...

2025-07-16 19:24:53,364 - INFO - Initial Main Training SVD + KMeans++ Clustering Evaluation:

2025-07-16 19:24:53,365 - INFO - silhouette: 0.10667943954467773

2025-07-16 19:24:53,365 - INFO - davies\_bouldin: 2.2150

2025-07-16 19:24:53,365 - INFO - calinski\_harabasz: 654.6252

2025-07-16 19:24:53,365 - INFO - cohesion: -1.9391419887542725

2025-07-16 19:24:53,366 - INFO - separation: 2.4265

2025-07-16 19:24:53,366 - INFO - separation\_to\_cohesion: 1.2513

2025-07-16 19:24:53,366 - INFO - size\_balance: 0.1505

2025-07-16 19:24:53,366 - INFO - cluster\_count: 7.0000

2025-07-16 19:24:53,366 - INFO - avg\_cluster\_size: 1025.8571

2025-07-16 19:24:53,366 - INFO - cluster\_size\_std: 871.4153

2025-07-16 19:24:53,366 - INFO - cluster\_sizes: [2275, 665, 2089, 156, 1613, 169, 214]

2025-07-16 19:25:27,240 - INFO - Epoch 1/80 - Time: 33.87s:Recon Loss=0.1851, Cluster Loss=33.9450,Reg Loss=0.0280,Last Inner Loss=34.1581

2025-07-16 19:26:00,783 - INFO - Epoch 2/80 - Time: 33.54s:Recon Loss=0.2261, Cluster Loss=15.1566,Reg Loss=0.0281,Last Inner Loss=15.4108

2025-07-16 19:26:34,980 - INFO - Epoch 3/80 - Time: 34.20s:Recon Loss=0.2571, Cluster Loss=8.3703,Reg Loss=0.0282,Last Inner Loss=8.6557

2025-07-16 19:27:13,770 - INFO - Epoch 4/80 - Time: 38.79s:Recon Loss=0.2588, Cluster Loss=6.0747,Reg Loss=0.0284,Last Inner Loss=6.3619

2025-07-16 19:27:49,755 - INFO - Epoch 5/80 - Time: 35.99s:Recon Loss=0.2523, Cluster Loss=4.3153,Reg Loss=0.0286,Last Inner Loss=4.5961

2025-07-16 19:28:25,680 - INFO - Epoch 6/80 - Time: 35.92s:Recon Loss=0.2431, Cluster Loss=2.8857,Reg Loss=0.0287,Last Inner Loss=3.1574

2025-07-16 19:29:02,197 - INFO - Epoch 7/80 - Time: 36.52s:Recon Loss=0.2474, Cluster Loss=2.3359,Reg Loss=0.0288,Last Inner Loss=2.6121

2025-07-16 19:29:36,128 - INFO - Epoch 8/80 - Time: 33.93s:Recon Loss=0.2503, Cluster Loss=1.4155,Reg Loss=0.0289,Last Inner Loss=1.6948

2025-07-16 19:30:08,833 - INFO - Epoch 9/80 - Time: 32.70s:Recon Loss=0.2439, Cluster Loss=1.2208,Reg Loss=0.0291,Last Inner Loss=1.4938

2025-07-16 19:30:47,313 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 19:30:47,313 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 19:30:49,052 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 19:30:49,728 - INFO - Epoch 10/80 (Eval) - Time: 40.89s (Eval Time: 6.01s):

2025-07-16 19:30:49,729 - INFO - Evaluation Metrics:

2025-07-16 19:30:49,729 - INFO - silhouette: 0.15104898810386658

2025-07-16 19:30:49,729 - INFO - davies\_bouldin: 1.5478

2025-07-16 19:30:49,729 - INFO - calinski\_harabasz: 3217.6020

2025-07-16 19:30:49,729 - INFO - cohesion: -0.2959865629673004

2025-07-16 19:30:49,729 - INFO - separation: 1.2162

2025-07-16 19:30:49,729 - INFO - separation\_to\_cohesion: 4.1088

2025-07-16 19:30:49,729 - INFO - size\_balance: 0.0000

2025-07-16 19:30:49,729 - INFO - cluster\_count: 7.0000

2025-07-16 19:30:49,729 - INFO - avg\_cluster\_size: 1025.8571

2025-07-16 19:30:49,730 - INFO - cluster\_size\_std: 1190.5133

2025-07-16 19:30:49,730 - INFO - cluster\_sizes: [2346, 356, 78, 27, 242, 830, 3302]

2025-07-16 19:31:24,383 - INFO - Epoch 11/80 - Time: 34.65s:Recon Loss=0.2368, Cluster Loss=0.7086,Reg Loss=0.0292,Last Inner Loss=0.9746

2025-07-16 19:31:57,927 - INFO - Epoch 12/80 - Time: 33.54s:Recon Loss=0.2342, Cluster Loss=0.7161,Reg Loss=0.0293,Last Inner Loss=0.9796

2025-07-16 19:32:32,795 - INFO - Epoch 13/80 - Time: 34.87s:Recon Loss=0.2336, Cluster Loss=0.6162,Reg Loss=0.0293,Last Inner Loss=0.8791

2025-07-16 19:33:12,425 - INFO - Epoch 14/80 - Time: 39.63s:Recon Loss=0.2202, Cluster Loss=0.5599,Reg Loss=0.0293,Last Inner Loss=0.8094

2025-07-16 19:33:48,774 - INFO - Epoch 15/80 - Time: 36.35s:Recon Loss=0.2136, Cluster Loss=0.4244,Reg Loss=0.0294,Last Inner Loss=0.6673

2025-07-16 19:34:22,934 - INFO - Epoch 16/80 - Time: 34.16s:Recon Loss=0.2122, Cluster Loss=0.4005,Reg Loss=0.0294,Last Inner Loss=0.6420

2025-07-16 19:35:00,968 - INFO - Epoch 17/80 - Time: 38.03s:Recon Loss=0.2004, Cluster Loss=0.3955,Reg Loss=0.0294,Last Inner Loss=0.6252

2025-07-16 19:35:34,538 - INFO - Epoch 18/80 - Time: 33.57s:Recon Loss=0.1979, Cluster Loss=0.4043,Reg Loss=0.0294,Last Inner Loss=0.6316

2025-07-16 19:36:08,408 - INFO - Epoch 19/80 - Time: 33.87s:Recon Loss=0.1894, Cluster Loss=0.3352,Reg Loss=0.0294,Last Inner Loss=0.5540

2025-07-16 19:36:47,641 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 19:36:47,642 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 19:36:49,317 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 19:36:49,987 - INFO - Epoch 20/80 (Eval) - Time: 41.58s (Eval Time: 5.91s):

2025-07-16 19:36:49,987 - INFO - Evaluation Metrics:

2025-07-16 19:36:49,987 - INFO - silhouette: 0.13365794718265533

2025-07-16 19:36:49,987 - INFO - davies\_bouldin: 1.2906

2025-07-16 19:36:49,987 - INFO - calinski\_harabasz: 3793.5408

2025-07-16 19:36:49,987 - INFO - cohesion: -0.20962384343147278

2025-07-16 19:36:49,988 - INFO - separation: 0.9940

2025-07-16 19:36:49,988 - INFO - separation\_to\_cohesion: 4.7420

2025-07-16 19:36:49,988 - INFO - size\_balance: 0.0000

2025-07-16 19:36:49,988 - INFO - cluster\_count: 7.0000

2025-07-16 19:36:49,988 - INFO - avg\_cluster\_size: 1025.8571

2025-07-16 19:36:49,988 - INFO - cluster\_size\_std: 1308.8955

2025-07-16 19:36:49,988 - INFO - cluster\_sizes: [2604, 962, 60, 52, 3412, 27, 64]

2025-07-16 19:37:24,352 - INFO - Epoch 21/80 - Time: 34.36s:Recon Loss=0.1825, Cluster Loss=0.3356,Reg Loss=0.0294,Last Inner Loss=0.5475

2025-07-16 19:37:58,019 - INFO - Epoch 22/80 - Time: 33.67s:Recon Loss=0.1763, Cluster Loss=0.3181,Reg Loss=0.0294,Last Inner Loss=0.5238

2025-07-16 19:38:31,259 - INFO - Epoch 23/80 - Time: 33.24s:Recon Loss=0.1777, Cluster Loss=0.2948,Reg Loss=0.0294,Last Inner Loss=0.5019

2025-07-16 19:39:06,916 - INFO - Epoch 24/80 - Time: 35.66s:Recon Loss=0.1761, Cluster Loss=0.2657,Reg Loss=0.0294,Last Inner Loss=0.4712

2025-07-16 19:39:46,066 - INFO - Epoch 25/80 - Time: 39.15s:Recon Loss=0.1745, Cluster Loss=0.2486,Reg Loss=0.0294,Last Inner Loss=0.4525

2025-07-16 19:40:30,549 - INFO - Epoch 26/80 - Time: 44.48s:Recon Loss=0.1750, Cluster Loss=0.2400,Reg Loss=0.0294,Last Inner Loss=0.4444

2025-07-16 19:41:08,854 - INFO - Epoch 27/80 - Time: 38.30s:Recon Loss=0.1745, Cluster Loss=0.2641,Reg Loss=0.0294,Last Inner Loss=0.4680

2025-07-16 19:41:42,222 - INFO - Epoch 28/80 - Time: 33.37s:Recon Loss=0.1769, Cluster Loss=0.3023,Reg Loss=0.0294,Last Inner Loss=0.5085

2025-07-16 19:42:15,229 - INFO - Epoch 29/80 - Time: 33.01s:Recon Loss=0.1780, Cluster Loss=0.2792,Reg Loss=0.0294,Last Inner Loss=0.4866

2025-07-16 19:42:54,163 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 19:42:54,163 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 19:42:55,879 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 19:42:56,556 - INFO - Epoch 30/80 (Eval) - Time: 41.33s (Eval Time: 5.62s):

2025-07-16 19:42:56,556 - INFO - Evaluation Metrics:

2025-07-16 19:42:56,556 - INFO - silhouette: 0.13767346739768982

2025-07-16 19:42:56,556 - INFO - davies\_bouldin: 1.4027

2025-07-16 19:42:56,556 - INFO - calinski\_harabasz: 2537.2561

2025-07-16 19:42:56,557 - INFO - cohesion: -0.1661156564950943

2025-07-16 19:42:56,557 - INFO - separation: 0.6656

2025-07-16 19:42:56,557 - INFO - separation\_to\_cohesion: 4.0071

2025-07-16 19:42:56,557 - INFO - size\_balance: 0.0000

2025-07-16 19:42:56,557 - INFO - cluster\_count: 7.0000

2025-07-16 19:42:56,557 - INFO - avg\_cluster\_size: 1025.8571

2025-07-16 19:42:56,557 - INFO - cluster\_size\_std: 1376.6155

2025-07-16 19:42:56,557 - INFO - cluster\_sizes: [733, 66, 65, 3964, 250, 2076, 27]

2025-07-16 19:43:30,119 - INFO - Epoch 31/80 - Time: 33.56s:Recon Loss=0.1787, Cluster Loss=0.2135,Reg Loss=0.0294,Last Inner Loss=0.4216

2025-07-16 19:44:04,090 - INFO - Epoch 32/80 - Time: 33.97s:Recon Loss=0.1816, Cluster Loss=0.1866,Reg Loss=0.0294,Last Inner Loss=0.3976

2025-07-16 19:44:39,310 - INFO - Epoch 33/80 - Time: 35.22s:Recon Loss=0.1782, Cluster Loss=0.1906,Reg Loss=0.0294,Last Inner Loss=0.3983

2025-07-16 19:45:14,550 - INFO - Epoch 34/80 - Time: 35.24s:Recon Loss=0.1846, Cluster Loss=0.1998,Reg Loss=0.0295,Last Inner Loss=0.4139

2025-07-16 19:45:54,697 - INFO - Epoch 35/80 - Time: 40.15s:Recon Loss=0.1887, Cluster Loss=0.3922,Reg Loss=0.0295,Last Inner Loss=0.6104

2025-07-16 19:46:30,195 - INFO - Epoch 36/80 - Time: 35.50s:Recon Loss=0.1912, Cluster Loss=0.6090,Reg Loss=0.0296,Last Inner Loss=0.8298

2025-07-16 19:47:06,364 - INFO - Epoch 37/80 - Time: 36.17s:Recon Loss=0.1877, Cluster Loss=0.6388,Reg Loss=0.0296,Last Inner Loss=0.8561

2025-07-16 19:47:39,701 - INFO - Epoch 38/80 - Time: 33.34s:Recon Loss=0.1819, Cluster Loss=0.5957,Reg Loss=0.0297,Last Inner Loss=0.8073

2025-07-16 19:48:12,760 - INFO - Epoch 39/80 - Time: 33.06s:Recon Loss=0.1800, Cluster Loss=0.5707,Reg Loss=0.0297,Last Inner Loss=0.7804

2025-07-16 19:48:50,848 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 19:48:50,848 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 19:48:52,518 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 19:48:53,208 - INFO - Epoch 40/80 (Eval) - Time: 40.45s (Eval Time: 5.00s):

2025-07-16 19:48:53,208 - INFO - Evaluation Metrics:

2025-07-16 19:48:53,208 - INFO - silhouette: 0.15664801001548767

2025-07-16 19:48:53,208 - INFO - davies\_bouldin: 1.1995

2025-07-16 19:48:53,208 - INFO - calinski\_harabasz: 1880.7428

2025-07-16 19:48:53,208 - INFO - cohesion: -0.19177497923374176

2025-07-16 19:48:53,208 - INFO - separation: 0.5528

2025-07-16 19:48:53,208 - INFO - separation\_to\_cohesion: 2.8828

2025-07-16 19:48:53,208 - INFO - size\_balance: 0.0000

2025-07-16 19:48:53,208 - INFO - cluster\_count: 7.0000

2025-07-16 19:48:53,208 - INFO - avg\_cluster\_size: 1025.8571

2025-07-16 19:48:53,208 - INFO - cluster\_size\_std: 1590.3559

2025-07-16 19:48:53,209 - INFO - cluster\_sizes: [423, 4884, 98, 541, 27, 548, 660]

2025-07-16 19:49:27,500 - INFO - Epoch 41/80 - Time: 34.29s:Recon Loss=0.1770, Cluster Loss=0.2781,Reg Loss=0.0298,Last Inner Loss=0.4849

2025-07-16 19:50:00,618 - INFO - Epoch 42/80 - Time: 33.12s:Recon Loss=0.1737, Cluster Loss=0.2345,Reg Loss=0.0298,Last Inner Loss=0.4379

2025-07-16 19:50:37,750 - INFO - Epoch 43/80 - Time: 37.13s:Recon Loss=0.1723, Cluster Loss=0.2260,Reg Loss=0.0298,Last Inner Loss=0.4280

2025-07-16 19:51:16,747 - INFO - Epoch 44/80 - Time: 39.00s:Recon Loss=0.1689, Cluster Loss=0.1972,Reg Loss=0.0298,Last Inner Loss=0.3959

2025-07-16 19:51:58,113 - INFO - Epoch 45/80 - Time: 41.37s:Recon Loss=0.1691, Cluster Loss=0.1954,Reg Loss=0.0298,Last Inner Loss=0.3942

2025-07-16 19:52:31,567 - INFO - Epoch 46/80 - Time: 33.45s:Recon Loss=0.1677, Cluster Loss=0.1740,Reg Loss=0.0298,Last Inner Loss=0.3715

2025-07-16 19:53:10,719 - INFO - Epoch 47/80 - Time: 39.15s:Recon Loss=0.1664, Cluster Loss=0.1999,Reg Loss=0.0298,Last Inner Loss=0.3960

2025-07-16 19:53:44,347 - INFO - Epoch 48/80 - Time: 33.63s:Recon Loss=0.1661, Cluster Loss=0.2327,Reg Loss=0.0298,Last Inner Loss=0.4285

2025-07-16 19:54:17,674 - INFO - Epoch 49/80 - Time: 33.33s:Recon Loss=0.1677, Cluster Loss=0.1971,Reg Loss=0.0298,Last Inner Loss=0.3945

2025-07-16 19:54:58,552 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 19:54:58,552 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 19:55:00,268 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 19:55:00,936 - INFO - Epoch 50/80 (Eval) - Time: 43.26s (Eval Time: 5.80s):

2025-07-16 19:55:00,936 - INFO - Evaluation Metrics:

2025-07-16 19:55:00,936 - INFO - silhouette: 0.15953977406024933

2025-07-16 19:55:00,936 - INFO - davies\_bouldin: 1.5074

2025-07-16 19:55:00,936 - INFO - calinski\_harabasz: 1868.1239

2025-07-16 19:55:00,936 - INFO - cohesion: -0.14507579803466797

2025-07-16 19:55:00,936 - INFO - separation: 0.4392

2025-07-16 19:55:00,936 - INFO - separation\_to\_cohesion: 3.0276

2025-07-16 19:55:00,937 - INFO - size\_balance: 0.0000

2025-07-16 19:55:00,937 - INFO - cluster\_count: 7.0000

2025-07-16 19:55:00,937 - INFO - avg\_cluster\_size: 1025.8571

2025-07-16 19:55:00,937 - INFO - cluster\_size\_std: 1172.6742

2025-07-16 19:55:00,937 - INFO - cluster\_sizes: [3667, 323, 1613, 18, 520, 401, 639]

2025-07-16 19:55:34,003 - INFO - Epoch 51/80 - Time: 33.06s:Recon Loss=0.1661, Cluster Loss=0.1479,Reg Loss=0.0297,Last Inner Loss=0.3438

2025-07-16 19:56:07,544 - INFO - Epoch 52/80 - Time: 33.54s:Recon Loss=0.1673, Cluster Loss=0.1341,Reg Loss=0.0297,Last Inner Loss=0.3311

2025-07-16 19:56:42,259 - INFO - Epoch 53/80 - Time: 34.72s:Recon Loss=0.1678, Cluster Loss=0.1448,Reg Loss=0.0297,Last Inner Loss=0.3424

2025-07-16 19:57:20,016 - INFO - Epoch 54/80 - Time: 37.76s:Recon Loss=0.1699, Cluster Loss=0.1394,Reg Loss=0.0297,Last Inner Loss=0.3390

2025-07-16 19:58:02,707 - INFO - Epoch 55/80 - Time: 42.69s:Recon Loss=0.1762, Cluster Loss=0.1969,Reg Loss=0.0297,Last Inner Loss=0.4029

2025-07-16 19:58:47,286 - INFO - Epoch 56/80 - Time: 44.58s:Recon Loss=0.1748, Cluster Loss=0.1753,Reg Loss=0.0298,Last Inner Loss=0.3799

2025-07-16 19:59:22,664 - INFO - Epoch 57/80 - Time: 35.38s:Recon Loss=0.1734, Cluster Loss=0.1789,Reg Loss=0.0298,Last Inner Loss=0.3821

2025-07-16 19:59:56,184 - INFO - Epoch 58/80 - Time: 33.52s:Recon Loss=0.1734, Cluster Loss=0.2045,Reg Loss=0.0298,Last Inner Loss=0.4076

2025-07-16 20:00:28,814 - INFO - Epoch 59/80 - Time: 32.63s:Recon Loss=0.1691, Cluster Loss=0.1950,Reg Loss=0.0298,Last Inner Loss=0.3939

2025-07-16 20:01:07,948 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 20:01:07,948 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 20:01:09,668 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 20:01:10,354 - INFO - Epoch 60/80 (Eval) - Time: 41.54s (Eval Time: 5.15s):

2025-07-16 20:01:10,354 - INFO - Evaluation Metrics:

2025-07-16 20:01:10,354 - INFO - silhouette: 0.1757470816373825

2025-07-16 20:01:10,354 - INFO - davies\_bouldin: 1.6205

2025-07-16 20:01:10,354 - INFO - calinski\_harabasz: 1113.4094

2025-07-16 20:01:10,354 - INFO - cohesion: -0.1559685319662094

2025-07-16 20:01:10,354 - INFO - separation: 0.7327

2025-07-16 20:01:10,354 - INFO - separation\_to\_cohesion: 4.6976

2025-07-16 20:01:10,355 - INFO - size\_balance: 0.0000

2025-07-16 20:01:10,355 - INFO - cluster\_count: 7.0000

2025-07-16 20:01:10,355 - INFO - avg\_cluster\_size: 1025.8571

2025-07-16 20:01:10,355 - INFO - cluster\_size\_std: 1651.9710

2025-07-16 20:01:10,355 - INFO - cluster\_sizes: [867, 158, 1, 588, 17, 5005, 545]

2025-07-16 20:01:43,538 - INFO - Epoch 61/80 - Time: 33.18s:Recon Loss=0.1697, Cluster Loss=0.1680,Reg Loss=0.0298,Last Inner Loss=0.3675

2025-07-16 20:02:16,298 - INFO - Epoch 62/80 - Time: 32.76s:Recon Loss=0.1694, Cluster Loss=0.2567,Reg Loss=0.0298,Last Inner Loss=0.4559

2025-07-16 20:02:56,551 - INFO - Epoch 63/80 - Time: 40.25s:Recon Loss=0.1693, Cluster Loss=0.2210,Reg Loss=0.0298,Last Inner Loss=0.4201

2025-07-16 20:03:33,106 - INFO - Epoch 64/80 - Time: 36.56s:Recon Loss=0.1700, Cluster Loss=0.2025,Reg Loss=0.0298,Last Inner Loss=0.4023

2025-07-16 20:04:12,331 - INFO - Epoch 65/80 - Time: 39.22s:Recon Loss=0.1690, Cluster Loss=0.1733,Reg Loss=0.0298,Last Inner Loss=0.3720

2025-07-16 20:04:48,520 - INFO - Epoch 66/80 - Time: 36.19s:Recon Loss=0.1680, Cluster Loss=0.1787,Reg Loss=0.0298,Last Inner Loss=0.3765

2025-07-16 20:05:22,641 - INFO - Epoch 67/80 - Time: 34.12s:Recon Loss=0.1695, Cluster Loss=0.1559,Reg Loss=0.0298,Last Inner Loss=0.3552

2025-07-16 20:05:56,431 - INFO - Epoch 68/80 - Time: 33.79s:Recon Loss=0.1678, Cluster Loss=0.1391,Reg Loss=0.0298,Last Inner Loss=0.3367

2025-07-16 20:06:30,484 - INFO - Epoch 69/80 - Time: 34.05s:Recon Loss=0.1715, Cluster Loss=0.1950,Reg Loss=0.0298,Last Inner Loss=0.3963

2025-07-16 20:07:10,059 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 20:07:10,060 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 20:07:11,721 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 20:07:12,376 - INFO - Epoch 70/80 (Eval) - Time: 41.89s (Eval Time: 5.07s):

2025-07-16 20:07:12,376 - INFO - Evaluation Metrics:

2025-07-16 20:07:12,376 - INFO - silhouette: 0.1489035189151764

2025-07-16 20:07:12,376 - INFO - davies\_bouldin: 1.7860

2025-07-16 20:07:12,376 - INFO - calinski\_harabasz: 2075.1799

2025-07-16 20:07:12,377 - INFO - cohesion: -0.12640546262264252

2025-07-16 20:07:12,377 - INFO - separation: 0.2691

2025-07-16 20:07:12,377 - INFO - separation\_to\_cohesion: 2.1291

2025-07-16 20:07:12,377 - INFO - size\_balance: 0.1580

2025-07-16 20:07:12,377 - INFO - cluster\_count: 7.0000

2025-07-16 20:07:12,377 - INFO - avg\_cluster\_size: 1025.8571

2025-07-16 20:07:12,377 - INFO - cluster\_size\_std: 863.8003

2025-07-16 20:07:12,377 - INFO - cluster\_sizes: [500, 1600, 493, 528, 676, 452, 2932]

2025-07-16 20:07:46,414 - INFO - Epoch 71/80 - Time: 34.04s:Recon Loss=0.1706, Cluster Loss=0.1424,Reg Loss=0.0298,Last Inner Loss=0.3428

2025-07-16 20:08:21,022 - INFO - Epoch 72/80 - Time: 34.61s:Recon Loss=0.1690, Cluster Loss=0.2441,Reg Loss=0.0298,Last Inner Loss=0.4429

2025-07-16 20:08:56,974 - INFO - Epoch 73/80 - Time: 35.95s:Recon Loss=0.1705, Cluster Loss=0.1456,Reg Loss=0.0298,Last Inner Loss=0.3459

2025-07-16 20:09:32,197 - INFO - Epoch 74/80 - Time: 35.22s:Recon Loss=0.1699, Cluster Loss=0.1774,Reg Loss=0.0298,Last Inner Loss=0.3771

2025-07-16 20:10:08,571 - INFO - Epoch 75/80 - Time: 36.37s:Recon Loss=0.1696, Cluster Loss=0.1296,Reg Loss=0.0298,Last Inner Loss=0.3290

2025-07-16 20:10:47,529 - INFO - Epoch 76/80 - Time: 38.96s:Recon Loss=0.1681, Cluster Loss=0.1705,Reg Loss=0.0298,Last Inner Loss=0.3684

2025-07-16 20:11:23,833 - INFO - Epoch 77/80 - Time: 36.30s:Recon Loss=0.1697, Cluster Loss=0.1280,Reg Loss=0.0298,Last Inner Loss=0.3276

2025-07-16 20:11:56,995 - INFO - Epoch 78/80 - Time: 33.16s:Recon Loss=0.1661, Cluster Loss=0.1547,Reg Loss=0.0298,Last Inner Loss=0.3506

2025-07-16 20:12:30,246 - INFO - Epoch 79/80 - Time: 33.25s:Recon Loss=0.1681, Cluster Loss=0.1353,Reg Loss=0.0298,Last Inner Loss=0.3332

2025-07-16 20:13:09,130 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 20:13:09,130 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 20:13:10,849 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 20:13:11,518 - INFO - Epoch 80/80 (Eval) - Time: 41.27s (Eval Time: 5.21s):

2025-07-16 20:13:11,518 - INFO - Evaluation Metrics:

2025-07-16 20:13:11,518 - INFO - silhouette: 0.2075147032737732

2025-07-16 20:13:11,518 - INFO - davies\_bouldin: 1.3922

2025-07-16 20:13:11,518 - INFO - calinski\_harabasz: 2004.2560

2025-07-16 20:13:11,518 - INFO - cohesion: -0.14432425796985626

2025-07-16 20:13:11,518 - INFO - separation: 0.3760

2025-07-16 20:13:11,518 - INFO - separation\_to\_cohesion: 2.6050

2025-07-16 20:13:11,518 - INFO - size\_balance: 0.0000

2025-07-16 20:13:11,518 - INFO - cluster\_count: 7.0000

2025-07-16 20:13:11,519 - INFO - avg\_cluster\_size: 1025.8571

2025-07-16 20:13:11,519 - INFO - cluster\_size\_std: 1267.5089

2025-07-16 20:13:11,519 - INFO - cluster\_sizes: [502, 1094, 484, 549, 4047, 5, 500]

2025-07-16 20:13:11,519 - INFO -

Training completed!

2025-07-16 20:13:11,519 - INFO -

Saving final trained model...

2025-07-16 20:13:13,755 - INFO - Final trained model saved to ./results/n7\_final\_model\_gz\_ptype0\_no\_cat.pth

2025-07-16 20:13:13,756 - INFO -

Evaluating final trained model...

2025-07-16 20:13:16,462 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 20:13:16,462 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 20:13:18,124 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 20:13:18,783 - INFO -

Detailed Clustering Evaluation of Final Model:

2025-07-16 20:13:18,784 - INFO - silhouette: 0.207514688372612

2025-07-16 20:13:18,784 - INFO - davies\_bouldin: 1.3922

2025-07-16 20:13:18,784 - INFO - calinski\_harabasz: 2004.2558

2025-07-16 20:13:18,784 - INFO - cohesion: -0.14432425796985626

2025-07-16 20:13:18,784 - INFO - separation: 0.3760

2025-07-16 20:13:18,784 - INFO - separation\_to\_cohesion: 2.6050

2025-07-16 20:13:18,784 - INFO - size\_balance: 0.0000

2025-07-16 20:13:18,784 - INFO - cluster\_count: 7.0000

2025-07-16 20:13:18,784 - INFO - avg\_cluster\_size: 1025.8571

2025-07-16 20:13:18,784 - INFO - cluster\_size\_std: 1267.5089

2025-07-16 20:13:18,784 - INFO - cluster\_sizes: [502, 1094, 484, 549, 4047, 5, 500]

2025-07-16 20:13:18,784 - INFO -

--- Detailed Clustering Evaluation of Final Model (based on P indicator matrix as embeddings) ---

2025-07-16 20:13:19,422 - INFO - P\_based\_silhouette: 0.30058056116104126

2025-07-16 20:13:19,422 - INFO - P\_based\_davies\_bouldin: 1.0504

2025-07-16 20:13:19,422 - INFO - P\_based\_calinski\_harabasz: 1402.3766

2025-07-16 20:13:19,422 - INFO - P\_based\_cohesion: -0.0290223341435194

2025-07-16 20:13:19,422 - INFO - P\_based\_separation: 0.0925

2025-07-16 20:13:19,422 - INFO - P\_based\_separation\_to\_cohesion: 3.1855

2025-07-16 20:13:19,422 - INFO - P\_based\_size\_balance: 0.0000

2025-07-16 20:13:19,422 - INFO - P\_based\_cluster\_count: 7.0000

2025-07-16 20:13:19,423 - INFO - P\_based\_avg\_cluster\_size: 1025.8571

2025-07-16 20:13:19,423 - INFO - P\_based\_cluster\_size\_std: 1267.5089

2025-07-16 20:13:19,423 - INFO - P\_based\_cluster\_sizes: [502, 1094, 484, 549, 4047, 5, 500]

2025-07-16 20:13:19,423 - INFO - Saving final results with embeddings and view weights...

2025-07-16 20:13:22,043 - INFO - Final results saved to ./results/n7\_final\_clustering\_gz\_pytpe0\_no\_cat.csv

2025-07-16 20:13:22,058 - INFO - Final evaluation metrics saved to ./results/n7\_final\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-16 22:52:16,209 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=8, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-16 22:52:16,226 - INFO - CUDA available. Using device: cuda:0

2025-07-16 22:52:16,227 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-16 22:52:41,885 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-16 22:52:41,889 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-16 22:52:41,902 - INFO - Numerical features scaled.

2025-07-16 22:52:42,000 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-16 22:52:42,005 - INFO - Loading pre-built graphs from directory: ./data

2025-07-16 22:52:42,056 - INFO - Loaded time graph: 807056 edges.

2025-07-16 22:52:42,066 - INFO - Loaded space graph: 890250 edges.

2025-07-16 22:52:42,077 - INFO - Loaded attr graph: 982548 edges.

2025-07-16 22:52:42,077 - INFO - Initializing model components...

2025-07-16 22:52:42,105 - INFO - Pretraining encoder...

2025-07-16 22:52:42,105 - WARNING - The main training loop might still encounter OutOfMemoryError due to the N x N matrix calculation

2025-07-16 22:52:42,105 - WARNING - in the clustering loss module (ZZ^T for SVD). This is inherent to the standard EGAE Jc loss formulation.

2025-07-16 22:52:42,105 - WARNING - If OOM occurs in the main loop, consider using a GPU with more memory or exploring approximations if available.

2025-07-16 22:54:58,633 - INFO - Pretrain Epoch 10/100 - Time: 13.51s: Recon Loss = 0.2130, Reg Loss = 0.1389, Total Loss = 0.3519

2025-07-16 22:57:18,087 - INFO - Pretrain Epoch 20/100 - Time: 14.25s: Recon Loss = 0.1889, Reg Loss = 0.1170, Total Loss = 0.3060

2025-07-16 22:59:36,446 - INFO - Pretrain Epoch 30/100 - Time: 12.97s: Recon Loss = 0.1621, Reg Loss = 0.0980, Total Loss = 0.2601

2025-07-16 23:01:49,117 - INFO - Pretrain Epoch 40/100 - Time: 12.67s: Recon Loss = 0.1618, Reg Loss = 0.0812, Total Loss = 0.2430

2025-07-16 23:04:07,151 - INFO - Pretrain Epoch 50/100 - Time: 13.39s: Recon Loss = 0.1618, Reg Loss = 0.0669, Total Loss = 0.2287

2025-07-16 23:06:19,630 - INFO - Pretrain Epoch 60/100 - Time: 13.31s: Recon Loss = 0.1619, Reg Loss = 0.0552, Total Loss = 0.2171

2025-07-16 23:08:31,773 - INFO - Pretrain Epoch 70/100 - Time: 13.63s: Recon Loss = 0.1618, Reg Loss = 0.0456, Total Loss = 0.2074

2025-07-16 23:10:51,578 - INFO - Pretrain Epoch 80/100 - Time: 13.83s: Recon Loss = 0.1620, Reg Loss = 0.0378, Total Loss = 0.1998

2025-07-16 23:13:03,460 - INFO - Pretrain Epoch 90/100 - Time: 13.13s: Recon Loss = 0.1619, Reg Loss = 0.0315, Total Loss = 0.1934

2025-07-16 23:15:15,284 - INFO - Pretrain Epoch 100/100 - Time: 13.87s: Recon Loss = 0.1619, Reg Loss = 0.0264, Total Loss = 0.1883

2025-07-16 23:15:15,285 - INFO -

Pretraining finished. Evaluating pretraining results with standard K-Means...

2025-07-16 23:15:18,734 - INFO - Running standard KMeans on pretrain embeddings ((7181, 64))...

2025-07-16 23:15:18,961 - INFO - Standard KMeans finished.

2025-07-16 23:15:19,775 - INFO - Pretraining Standard K-Means Clustering Evaluation:

2025-07-16 23:15:19,775 - INFO - silhouette: 0.32687121629714966

2025-07-16 23:15:19,775 - INFO - davies\_bouldin: 1.3079

2025-07-16 23:15:19,776 - INFO - calinski\_harabasz: 3630.1812

2025-07-16 23:15:19,776 - INFO - cohesion: -1.303952693939209

2025-07-16 23:15:19,776 - INFO - separation: 3.6829

2025-07-16 23:15:19,776 - INFO - separation\_to\_cohesion: 2.8244

2025-07-16 23:15:19,776 - INFO - size\_balance: 0.3306

2025-07-16 23:15:19,776 - INFO - cluster\_count: 8.0000

2025-07-16 23:15:19,776 - INFO - avg\_cluster\_size: 897.6250

2025-07-16 23:15:19,776 - INFO - cluster\_size\_std: 600.8839

2025-07-16 23:15:19,776 - INFO - cluster\_sizes: [1690, 556, 1681, 44, 1363, 1073, 259, 515]

2025-07-16 23:15:24,433 - INFO - Pretraining standard KMeans++ results saved to ./results/n8\_pretrain\_standard\_kmeans\_clustering\_gz\_ptype0\_no\_cat.csv

2025-07-16 23:15:24,458 - INFO - Pretraining standard KMeans++ evaluation metrics saved to ./results/n8\_pretrain\_standard\_kmeans\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-16 23:15:24,524 - INFO - Pretraining encoder saved to ./results/n8\_pretrain\_encoder\_gz\_pytpe0\_no\_cat.pth

2025-07-16 23:15:24,524 - INFO -

Starting main training loop (Alternating Optimization)...

2025-07-16 23:15:24,524 - INFO - Initializing indicator matrix P for main training...

2025-07-16 23:15:28,430 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 23:15:28,430 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 23:15:30,087 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 23:15:30,087 - INFO - Evaluating initial main training clustering results (SVD + KMeans++ on P)...

2025-07-16 23:15:30,916 - INFO - Initial Main Training SVD + KMeans++ Clustering Evaluation:

2025-07-16 23:15:30,917 - INFO - silhouette: 0.18412677943706512

2025-07-16 23:15:30,917 - INFO - davies\_bouldin: 2.1036

2025-07-16 23:15:30,917 - INFO - calinski\_harabasz: 913.9203

2025-07-16 23:15:30,917 - INFO - cohesion: -1.7073445320129395

2025-07-16 23:15:30,918 - INFO - separation: 2.3054

2025-07-16 23:15:30,918 - INFO - separation\_to\_cohesion: 1.3503

2025-07-16 23:15:30,918 - INFO - size\_balance: 0.1417

2025-07-16 23:15:30,918 - INFO - cluster\_count: 8.0000

2025-07-16 23:15:30,918 - INFO - avg\_cluster\_size: 897.6250

2025-07-16 23:15:30,918 - INFO - cluster\_size\_std: 770.3887

2025-07-16 23:15:30,918 - INFO - cluster\_sizes: [1690, 2163, 1755, 224, 216, 327, 562, 244]

2025-07-16 23:16:15,180 - INFO - Epoch 1/80 - Time: 44.26s:Recon Loss=0.1729, Cluster Loss=12.5418,Reg Loss=0.0260,Last Inner Loss=12.7407

2025-07-16 23:16:56,880 - INFO - Epoch 2/80 - Time: 41.70s:Recon Loss=0.2076, Cluster Loss=5.2580,Reg Loss=0.0261,Last Inner Loss=5.4916

2025-07-16 23:17:35,790 - INFO - Epoch 3/80 - Time: 38.91s:Recon Loss=0.2293, Cluster Loss=2.3139,Reg Loss=0.0262,Last Inner Loss=2.5695

2025-07-16 23:18:15,123 - INFO - Epoch 4/80 - Time: 39.33s:Recon Loss=0.2425, Cluster Loss=1.6739,Reg Loss=0.0264,Last Inner Loss=1.9428

2025-07-16 23:18:56,338 - INFO - Epoch 5/80 - Time: 41.21s:Recon Loss=0.2526, Cluster Loss=1.2102,Reg Loss=0.0266,Last Inner Loss=1.4893

2025-07-16 23:19:35,471 - INFO - Epoch 6/80 - Time: 39.13s:Recon Loss=0.2574, Cluster Loss=1.0034,Reg Loss=0.0267,Last Inner Loss=1.2875

2025-07-16 23:20:16,261 - INFO - Epoch 7/80 - Time: 40.79s:Recon Loss=0.2510, Cluster Loss=1.5618,Reg Loss=0.0268,Last Inner Loss=1.8396

2025-07-16 23:20:59,598 - INFO - Epoch 8/80 - Time: 43.34s:Recon Loss=0.2619, Cluster Loss=0.7544,Reg Loss=0.0269,Last Inner Loss=1.0432

2025-07-16 23:21:42,204 - INFO - Epoch 9/80 - Time: 42.61s:Recon Loss=0.2620, Cluster Loss=0.6121,Reg Loss=0.0269,Last Inner Loss=0.9010

2025-07-16 23:22:28,636 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 23:22:28,636 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 23:22:30,274 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 23:22:31,093 - INFO - Epoch 10/80 (Eval) - Time: 48.89s (Eval Time: 6.12s):

2025-07-16 23:22:31,094 - INFO - Evaluation Metrics:

2025-07-16 23:22:31,094 - INFO - silhouette: 0.1154303178191185

2025-07-16 23:22:31,094 - INFO - davies\_bouldin: 2.2943

2025-07-16 23:22:31,094 - INFO - calinski\_harabasz: 1888.0215

2025-07-16 23:22:31,094 - INFO - cohesion: -0.13697919249534607

2025-07-16 23:22:31,094 - INFO - separation: 0.4134

2025-07-16 23:22:31,094 - INFO - separation\_to\_cohesion: 3.0178

2025-07-16 23:22:31,094 - INFO - size\_balance: 0.0105

2025-07-16 23:22:31,094 - INFO - cluster\_count: 8.0000

2025-07-16 23:22:31,094 - INFO - avg\_cluster\_size: 897.6250

2025-07-16 23:22:31,094 - INFO - cluster\_size\_std: 888.2035

2025-07-16 23:22:31,094 - INFO - cluster\_sizes: [2279, 31, 2377, 180, 817, 100, 362, 1035]

2025-07-16 23:23:12,044 - INFO - Epoch 11/80 - Time: 40.95s:Recon Loss=0.2564, Cluster Loss=0.2551,Reg Loss=0.0270,Last Inner Loss=0.5385

2025-07-16 23:23:51,603 - INFO - Epoch 12/80 - Time: 39.56s:Recon Loss=0.2499, Cluster Loss=0.2438,Reg Loss=0.0270,Last Inner Loss=0.5207

2025-07-16 23:24:31,571 - INFO - Epoch 13/80 - Time: 39.97s:Recon Loss=0.2404, Cluster Loss=0.2209,Reg Loss=0.0270,Last Inner Loss=0.4883

2025-07-16 23:25:12,378 - INFO - Epoch 14/80 - Time: 40.81s:Recon Loss=0.2286, Cluster Loss=0.2108,Reg Loss=0.0270,Last Inner Loss=0.4664

2025-07-16 23:25:51,960 - INFO - Epoch 15/80 - Time: 39.58s:Recon Loss=0.2145, Cluster Loss=0.1870,Reg Loss=0.0270,Last Inner Loss=0.4285

2025-07-16 23:26:33,983 - INFO - Epoch 16/80 - Time: 42.02s:Recon Loss=0.2207, Cluster Loss=0.1555,Reg Loss=0.0270,Last Inner Loss=0.4032

2025-07-16 23:27:16,976 - INFO - Epoch 17/80 - Time: 42.99s:Recon Loss=0.2067, Cluster Loss=0.1692,Reg Loss=0.0270,Last Inner Loss=0.4029

2025-07-16 23:28:00,250 - INFO - Epoch 18/80 - Time: 43.27s:Recon Loss=0.2066, Cluster Loss=0.1659,Reg Loss=0.0270,Last Inner Loss=0.3995

2025-07-16 23:28:43,030 - INFO - Epoch 19/80 - Time: 42.78s:Recon Loss=0.2056, Cluster Loss=0.1238,Reg Loss=0.0270,Last Inner Loss=0.3564

2025-07-16 23:29:26,859 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 23:29:26,859 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 23:29:28,499 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 23:29:29,329 - INFO - Epoch 20/80 (Eval) - Time: 46.30s (Eval Time: 5.76s):

2025-07-16 23:29:29,330 - INFO - Evaluation Metrics:

2025-07-16 23:29:29,330 - INFO - silhouette: 0.10374832153320312

2025-07-16 23:29:29,330 - INFO - davies\_bouldin: 2.1398

2025-07-16 23:29:29,330 - INFO - calinski\_harabasz: 1309.6649

2025-07-16 23:29:29,330 - INFO - cohesion: -0.08147592842578888

2025-07-16 23:29:29,330 - INFO - separation: 0.1845

2025-07-16 23:29:29,330 - INFO - separation\_to\_cohesion: 2.2646

2025-07-16 23:29:29,330 - INFO - size\_balance: 0.2370

2025-07-16 23:29:29,330 - INFO - cluster\_count: 8.0000

2025-07-16 23:29:29,331 - INFO - avg\_cluster\_size: 897.6250

2025-07-16 23:29:29,331 - INFO - cluster\_size\_std: 684.8772

2025-07-16 23:29:29,331 - INFO - cluster\_sizes: [1994, 730, 1903, 175, 514, 707, 1128, 30]

2025-07-16 23:30:08,545 - INFO - Epoch 21/80 - Time: 39.21s:Recon Loss=0.1886, Cluster Loss=0.1098,Reg Loss=0.0270,Last Inner Loss=0.3254

2025-07-16 23:30:49,533 - INFO - Epoch 22/80 - Time: 40.99s:Recon Loss=0.1843, Cluster Loss=0.1218,Reg Loss=0.0270,Last Inner Loss=0.3331

2025-07-16 23:31:29,034 - INFO - Epoch 23/80 - Time: 39.50s:Recon Loss=0.1809, Cluster Loss=0.0899,Reg Loss=0.0269,Last Inner Loss=0.2978

2025-07-16 23:32:07,971 - INFO - Epoch 24/80 - Time: 38.94s:Recon Loss=0.1817, Cluster Loss=0.1483,Reg Loss=0.0270,Last Inner Loss=0.3569

2025-07-16 23:32:47,481 - INFO - Epoch 25/80 - Time: 39.51s:Recon Loss=0.1809, Cluster Loss=0.2114,Reg Loss=0.0270,Last Inner Loss=0.4193

2025-07-16 23:33:29,465 - INFO - Epoch 26/80 - Time: 41.98s:Recon Loss=0.1787, Cluster Loss=0.2414,Reg Loss=0.0270,Last Inner Loss=0.4471

2025-07-16 23:34:12,366 - INFO - Epoch 27/80 - Time: 42.90s:Recon Loss=0.1760, Cluster Loss=0.2462,Reg Loss=0.0270,Last Inner Loss=0.4492

2025-07-16 23:34:54,021 - INFO - Epoch 28/80 - Time: 41.65s:Recon Loss=0.1748, Cluster Loss=0.1978,Reg Loss=0.0270,Last Inner Loss=0.3996

2025-07-16 23:35:32,638 - INFO - Epoch 29/80 - Time: 38.62s:Recon Loss=0.1743, Cluster Loss=0.1695,Reg Loss=0.0270,Last Inner Loss=0.3708

2025-07-16 23:36:14,805 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 23:36:14,806 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 23:36:16,455 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 23:36:17,319 - INFO - Epoch 30/80 (Eval) - Time: 44.68s (Eval Time: 5.61s):

2025-07-16 23:36:17,319 - INFO - Evaluation Metrics:

2025-07-16 23:36:17,319 - INFO - silhouette: 0.13481341302394867

2025-07-16 23:36:17,319 - INFO - davies\_bouldin: 1.7581

2025-07-16 23:36:17,319 - INFO - calinski\_harabasz: 1239.3359

2025-07-16 23:36:17,319 - INFO - cohesion: -0.0751076191663742

2025-07-16 23:36:17,319 - INFO - separation: 0.1961

2025-07-16 23:36:17,319 - INFO - separation\_to\_cohesion: 2.6108

2025-07-16 23:36:17,319 - INFO - size\_balance: 0.0466

2025-07-16 23:36:17,319 - INFO - cluster\_count: 8.0000

2025-07-16 23:36:17,319 - INFO - avg\_cluster\_size: 897.6250

2025-07-16 23:36:17,319 - INFO - cluster\_size\_std: 855.8047

2025-07-16 23:36:17,319 - INFO - cluster\_sizes: [1174, 920, 118, 2432, 331, 32, 2003, 171]

2025-07-16 23:36:57,371 - INFO - Epoch 31/80 - Time: 40.05s:Recon Loss=0.1723, Cluster Loss=0.0698,Reg Loss=0.0270,Last Inner Loss=0.2691

2025-07-16 23:37:35,709 - INFO - Epoch 32/80 - Time: 38.34s:Recon Loss=0.1714, Cluster Loss=0.0611,Reg Loss=0.0269,Last Inner Loss=0.2595

2025-07-16 23:38:14,090 - INFO - Epoch 33/80 - Time: 38.38s:Recon Loss=0.1695, Cluster Loss=0.0621,Reg Loss=0.0269,Last Inner Loss=0.2585

2025-07-16 23:38:56,136 - INFO - Epoch 34/80 - Time: 42.05s:Recon Loss=0.1700, Cluster Loss=0.0638,Reg Loss=0.0269,Last Inner Loss=0.2607

2025-07-16 23:39:39,987 - INFO - Epoch 35/80 - Time: 43.85s:Recon Loss=0.2150, Cluster Loss=0.1016,Reg Loss=0.0269,Last Inner Loss=0.3436

2025-07-16 23:40:22,197 - INFO - Epoch 36/80 - Time: 42.21s:Recon Loss=0.2301, Cluster Loss=0.1136,Reg Loss=0.0269,Last Inner Loss=0.3706

2025-07-16 23:41:03,384 - INFO - Epoch 37/80 - Time: 41.19s:Recon Loss=0.2193, Cluster Loss=0.1260,Reg Loss=0.0269,Last Inner Loss=0.3722

2025-07-16 23:41:42,894 - INFO - Epoch 38/80 - Time: 39.51s:Recon Loss=0.1949, Cluster Loss=0.1166,Reg Loss=0.0269,Last Inner Loss=0.3385

2025-07-16 23:42:21,946 - INFO - Epoch 39/80 - Time: 39.05s:Recon Loss=0.1845, Cluster Loss=0.1046,Reg Loss=0.0269,Last Inner Loss=0.3159

2025-07-16 23:43:05,787 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 23:43:05,788 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 23:43:07,423 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 23:43:08,270 - INFO - Epoch 40/80 (Eval) - Time: 46.32s (Eval Time: 5.81s):

2025-07-16 23:43:08,270 - INFO - Evaluation Metrics:

2025-07-16 23:43:08,270 - INFO - silhouette: 0.09454894810914993

2025-07-16 23:43:08,271 - INFO - davies\_bouldin: 1.8568

2025-07-16 23:43:08,271 - INFO - calinski\_harabasz: 896.7161

2025-07-16 23:43:08,271 - INFO - cohesion: -0.07018467783927917

2025-07-16 23:43:08,271 - INFO - separation: 0.1661

2025-07-16 23:43:08,271 - INFO - separation\_to\_cohesion: 2.3661

2025-07-16 23:43:08,271 - INFO - size\_balance: 0.1434

2025-07-16 23:43:08,271 - INFO - cluster\_count: 8.0000

2025-07-16 23:43:08,271 - INFO - avg\_cluster\_size: 897.6250

2025-07-16 23:43:08,271 - INFO - cluster\_size\_std: 768.8929

2025-07-16 23:43:08,271 - INFO - cluster\_sizes: [542, 1881, 32, 120, 165, 2100, 896, 1445]

2025-07-16 23:43:46,947 - INFO - Epoch 41/80 - Time: 38.67s:Recon Loss=0.1731, Cluster Loss=0.0950,Reg Loss=0.0269,Last Inner Loss=0.2950

2025-07-16 23:44:26,427 - INFO - Epoch 42/80 - Time: 39.48s:Recon Loss=0.1698, Cluster Loss=0.0528,Reg Loss=0.0268,Last Inner Loss=0.2494

2025-07-16 23:45:04,029 - INFO - Epoch 43/80 - Time: 37.60s:Recon Loss=0.1690, Cluster Loss=0.0611,Reg Loss=0.0268,Last Inner Loss=0.2569

2025-07-16 23:45:41,451 - INFO - Epoch 44/80 - Time: 37.42s:Recon Loss=0.1664, Cluster Loss=0.0488,Reg Loss=0.0268,Last Inner Loss=0.2420

2025-07-16 23:46:18,557 - INFO - Epoch 45/80 - Time: 37.11s:Recon Loss=0.1670, Cluster Loss=0.0494,Reg Loss=0.0268,Last Inner Loss=0.2432

2025-07-16 23:46:56,748 - INFO - Epoch 46/80 - Time: 38.19s:Recon Loss=0.1686, Cluster Loss=0.1043,Reg Loss=0.0268,Last Inner Loss=0.2997

2025-07-16 23:47:31,536 - INFO - Epoch 47/80 - Time: 34.79s:Recon Loss=0.1723, Cluster Loss=0.1920,Reg Loss=0.0268,Last Inner Loss=0.3911

2025-07-16 23:48:10,963 - INFO - Epoch 48/80 - Time: 39.43s:Recon Loss=0.1776, Cluster Loss=0.2094,Reg Loss=0.0269,Last Inner Loss=0.4139

2025-07-16 23:48:51,096 - INFO - Epoch 49/80 - Time: 40.13s:Recon Loss=0.1745, Cluster Loss=0.2255,Reg Loss=0.0269,Last Inner Loss=0.4270

2025-07-16 23:49:33,109 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 23:49:33,109 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 23:49:34,761 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 23:49:35,517 - INFO - Epoch 50/80 (Eval) - Time: 44.42s (Eval Time: 5.59s):

2025-07-16 23:49:35,517 - INFO - Evaluation Metrics:

2025-07-16 23:49:35,517 - INFO - silhouette: 0.03615305945277214

2025-07-16 23:49:35,517 - INFO - davies\_bouldin: 2.8955

2025-07-16 23:49:35,517 - INFO - calinski\_harabasz: 1753.6835

2025-07-16 23:49:35,518 - INFO - cohesion: -0.09847111999988556

2025-07-16 23:49:35,518 - INFO - separation: 0.2476

2025-07-16 23:49:35,518 - INFO - separation\_to\_cohesion: 2.5142

2025-07-16 23:49:35,518 - INFO - size\_balance: 0.3320

2025-07-16 23:49:35,518 - INFO - cluster\_count: 8.0000

2025-07-16 23:49:35,518 - INFO - avg\_cluster\_size: 897.6250

2025-07-16 23:49:35,518 - INFO - cluster\_size\_std: 599.6451

2025-07-16 23:49:35,518 - INFO - cluster\_sizes: [1501, 153, 850, 720, 1958, 585, 1268, 146]

2025-07-16 23:50:14,838 - INFO - Epoch 51/80 - Time: 39.32s:Recon Loss=0.1743, Cluster Loss=0.0799,Reg Loss=0.0270,Last Inner Loss=0.2812

2025-07-16 23:50:57,453 - INFO - Epoch 52/80 - Time: 42.61s:Recon Loss=0.1733, Cluster Loss=0.1144,Reg Loss=0.0270,Last Inner Loss=0.3147

2025-07-16 23:51:40,005 - INFO - Epoch 53/80 - Time: 42.55s:Recon Loss=0.1711, Cluster Loss=0.1304,Reg Loss=0.0270,Last Inner Loss=0.3285

2025-07-16 23:52:21,931 - INFO - Epoch 54/80 - Time: 41.93s:Recon Loss=0.1698, Cluster Loss=0.1215,Reg Loss=0.0270,Last Inner Loss=0.3183

2025-07-16 23:53:02,278 - INFO - Epoch 55/80 - Time: 40.35s:Recon Loss=0.1692, Cluster Loss=0.1943,Reg Loss=0.0270,Last Inner Loss=0.3906

2025-07-16 23:53:40,712 - INFO - Epoch 56/80 - Time: 38.43s:Recon Loss=0.1712, Cluster Loss=0.2213,Reg Loss=0.0271,Last Inner Loss=0.4195

2025-07-16 23:54:19,237 - INFO - Epoch 57/80 - Time: 38.52s:Recon Loss=0.1686, Cluster Loss=0.2058,Reg Loss=0.0271,Last Inner Loss=0.4015

2025-07-16 23:54:58,140 - INFO - Epoch 58/80 - Time: 38.90s:Recon Loss=0.1671, Cluster Loss=0.1684,Reg Loss=0.0271,Last Inner Loss=0.3626

2025-07-16 23:55:37,699 - INFO - Epoch 59/80 - Time: 39.56s:Recon Loss=0.1641, Cluster Loss=0.1975,Reg Loss=0.0271,Last Inner Loss=0.3886

2025-07-16 23:56:20,390 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-16 23:56:20,390 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-16 23:56:22,023 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-16 23:56:22,951 - INFO - Epoch 60/80 (Eval) - Time: 45.25s (Eval Time: 6.02s):

2025-07-16 23:56:22,951 - INFO - Evaluation Metrics:

2025-07-16 23:56:22,951 - INFO - silhouette: 0.08514852076768875

2025-07-16 23:56:22,952 - INFO - davies\_bouldin: 2.1334

2025-07-16 23:56:22,952 - INFO - calinski\_harabasz: 1161.5363

2025-07-16 23:56:22,952 - INFO - cohesion: -0.09341716766357422

2025-07-16 23:56:22,952 - INFO - separation: 0.1691

2025-07-16 23:56:22,952 - INFO - separation\_to\_cohesion: 1.8100

2025-07-16 23:56:22,952 - INFO - size\_balance: 0.3696

2025-07-16 23:56:22,952 - INFO - cluster\_count: 8.0000

2025-07-16 23:56:22,952 - INFO - avg\_cluster\_size: 897.6250

2025-07-16 23:56:22,952 - INFO - cluster\_size\_std: 565.8933

2025-07-16 23:56:22,952 - INFO - cluster\_sizes: [1837, 1000, 780, 258, 640, 241, 1737, 688]

2025-07-16 23:57:05,624 - INFO - Epoch 61/80 - Time: 42.67s:Recon Loss=0.1691, Cluster Loss=0.0932,Reg Loss=0.0270,Last Inner Loss=0.2893

2025-07-16 23:57:49,415 - INFO - Epoch 62/80 - Time: 43.79s:Recon Loss=0.1728, Cluster Loss=0.1550,Reg Loss=0.0270,Last Inner Loss=0.3548

2025-07-16 23:58:30,250 - INFO - Epoch 63/80 - Time: 40.83s:Recon Loss=0.1704, Cluster Loss=0.2083,Reg Loss=0.0271,Last Inner Loss=0.4058

2025-07-16 23:59:10,805 - INFO - Epoch 64/80 - Time: 40.55s:Recon Loss=0.1704, Cluster Loss=0.2332,Reg Loss=0.0271,Last Inner Loss=0.4307

2025-07-16 23:59:49,656 - INFO - Epoch 65/80 - Time: 38.85s:Recon Loss=0.1699, Cluster Loss=0.1971,Reg Loss=0.0271,Last Inner Loss=0.3941

2025-07-17 00:00:30,586 - INFO - Epoch 66/80 - Time: 40.93s:Recon Loss=0.1663, Cluster Loss=0.2020,Reg Loss=0.0271,Last Inner Loss=0.3954

2025-07-17 00:01:10,918 - INFO - Epoch 67/80 - Time: 40.33s:Recon Loss=0.1671, Cluster Loss=0.1466,Reg Loss=0.0271,Last Inner Loss=0.3408

2025-07-17 00:01:49,238 - INFO - Epoch 68/80 - Time: 38.32s:Recon Loss=0.1665, Cluster Loss=0.1582,Reg Loss=0.0271,Last Inner Loss=0.3518

2025-07-17 00:02:29,069 - INFO - Epoch 69/80 - Time: 39.83s:Recon Loss=0.1645, Cluster Loss=0.1193,Reg Loss=0.0271,Last Inner Loss=0.3109

2025-07-17 00:03:13,517 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 00:03:13,517 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 00:03:15,170 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 00:03:15,876 - INFO - Epoch 70/80 (Eval) - Time: 46.81s (Eval Time: 5.37s):

2025-07-17 00:03:15,876 - INFO - Evaluation Metrics:

2025-07-17 00:03:15,876 - INFO - silhouette: 0.09797098487615585

2025-07-17 00:03:15,876 - INFO - davies\_bouldin: 2.3277

2025-07-17 00:03:15,876 - INFO - calinski\_harabasz: 825.1958

2025-07-17 00:03:15,877 - INFO - cohesion: -0.10594809055328369

2025-07-17 00:03:15,877 - INFO - separation: 0.1857

2025-07-17 00:03:15,877 - INFO - separation\_to\_cohesion: 1.7527

2025-07-17 00:03:15,877 - INFO - size\_balance: 0.2702

2025-07-17 00:03:15,877 - INFO - cluster\_count: 8.0000

2025-07-17 00:03:15,877 - INFO - avg\_cluster\_size: 897.6250

2025-07-17 00:03:15,877 - INFO - cluster\_size\_std: 655.0588

2025-07-17 00:03:15,877 - INFO - cluster\_sizes: [266, 472, 438, 1654, 2170, 1031, 240, 910]

2025-07-17 00:03:53,913 - INFO - Epoch 71/80 - Time: 38.04s:Recon Loss=0.1639, Cluster Loss=0.0599,Reg Loss=0.0271,Last Inner Loss=0.2509

2025-07-17 00:04:31,233 - INFO - Epoch 72/80 - Time: 37.32s:Recon Loss=0.1638, Cluster Loss=0.1126,Reg Loss=0.0271,Last Inner Loss=0.3034

2025-07-17 00:05:06,859 - INFO - Epoch 73/80 - Time: 35.63s:Recon Loss=0.1645, Cluster Loss=0.0975,Reg Loss=0.0271,Last Inner Loss=0.2890

2025-07-17 00:05:40,911 - INFO - Epoch 74/80 - Time: 34.05s:Recon Loss=0.1626, Cluster Loss=0.1338,Reg Loss=0.0270,Last Inner Loss=0.3235

2025-07-17 00:06:14,874 - INFO - Epoch 75/80 - Time: 33.96s:Recon Loss=0.1633, Cluster Loss=0.0904,Reg Loss=0.0270,Last Inner Loss=0.2807

2025-07-17 00:06:50,594 - INFO - Epoch 76/80 - Time: 35.72s:Recon Loss=0.1637, Cluster Loss=0.0793,Reg Loss=0.0270,Last Inner Loss=0.2700

2025-07-17 00:07:25,576 - INFO - Epoch 77/80 - Time: 34.98s:Recon Loss=0.1638, Cluster Loss=0.0729,Reg Loss=0.0270,Last Inner Loss=0.2637

2025-07-17 00:07:59,889 - INFO - Epoch 78/80 - Time: 34.31s:Recon Loss=0.1624, Cluster Loss=0.0967,Reg Loss=0.0270,Last Inner Loss=0.2861

2025-07-17 00:08:36,959 - INFO - Epoch 79/80 - Time: 37.07s:Recon Loss=0.1641, Cluster Loss=0.0767,Reg Loss=0.0270,Last Inner Loss=0.2677

2025-07-17 00:09:15,877 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 00:09:15,877 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 00:09:17,513 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 00:09:18,205 - INFO - Epoch 80/80 (Eval) - Time: 41.25s (Eval Time: 5.21s):

2025-07-17 00:09:18,205 - INFO - Evaluation Metrics:

2025-07-17 00:09:18,206 - INFO - silhouette: 0.09532102197408676

2025-07-17 00:09:18,206 - INFO - davies\_bouldin: 2.2579

2025-07-17 00:09:18,206 - INFO - calinski\_harabasz: 991.2116

2025-07-17 00:09:18,206 - INFO - cohesion: -0.09721037745475769

2025-07-17 00:09:18,206 - INFO - separation: 0.1678

2025-07-17 00:09:18,206 - INFO - separation\_to\_cohesion: 1.7259

2025-07-17 00:09:18,206 - INFO - size\_balance: 0.3796

2025-07-17 00:09:18,206 - INFO - cluster\_count: 8.0000

2025-07-17 00:09:18,206 - INFO - avg\_cluster\_size: 897.6250

2025-07-17 00:09:18,206 - INFO - cluster\_size\_std: 556.8563

2025-07-17 00:09:18,206 - INFO - cluster\_sizes: [1051, 928, 507, 277, 1463, 1975, 720, 260]

2025-07-17 00:09:18,207 - INFO -

Training completed!

2025-07-17 00:09:18,207 - INFO -

Saving final trained model...

2025-07-17 00:09:18,563 - INFO - Final trained model saved to ./results/n8\_final\_model\_gz\_ptype0\_no\_cat.pth

2025-07-17 00:09:18,563 - INFO -

Evaluating final trained model...

2025-07-17 00:09:21,602 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 00:09:21,602 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 00:09:23,266 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 00:09:23,970 - INFO -

Detailed Clustering Evaluation of Final Model:

2025-07-17 00:09:23,970 - INFO - silhouette: 0.09532102197408676

2025-07-17 00:09:23,970 - INFO - davies\_bouldin: 2.2579

2025-07-17 00:09:23,970 - INFO - calinski\_harabasz: 991.2117

2025-07-17 00:09:23,970 - INFO - cohesion: -0.09721037745475769

2025-07-17 00:09:23,970 - INFO - separation: 0.1678

2025-07-17 00:09:23,970 - INFO - separation\_to\_cohesion: 1.7259

2025-07-17 00:09:23,970 - INFO - size\_balance: 0.3796

2025-07-17 00:09:23,970 - INFO - cluster\_count: 8.0000

2025-07-17 00:09:23,970 - INFO - avg\_cluster\_size: 897.6250

2025-07-17 00:09:23,971 - INFO - cluster\_size\_std: 556.8563

2025-07-17 00:09:23,971 - INFO - cluster\_sizes: [1051, 928, 507, 277, 1463, 1975, 720, 260]

2025-07-17 00:09:23,971 - INFO -

--- Detailed Clustering Evaluation of Final Model (based on P indicator matrix as embeddings) ---

2025-07-17 00:09:24,620 - INFO - P\_based\_silhouette: 0.19363191723823547

2025-07-17 00:09:24,620 - INFO - P\_based\_davies\_bouldin: 1.3522

2025-07-17 00:09:24,620 - INFO - P\_based\_calinski\_harabasz: 1020.9138

2025-07-17 00:09:24,620 - INFO - P\_based\_cohesion: -0.02271864376962185

2025-07-17 00:09:24,620 - INFO - P\_based\_separation: 0.0367

2025-07-17 00:09:24,620 - INFO - P\_based\_separation\_to\_cohesion: 1.6150

2025-07-17 00:09:24,620 - INFO - P\_based\_size\_balance: 0.3796

2025-07-17 00:09:24,620 - INFO - P\_based\_cluster\_count: 8.0000

2025-07-17 00:09:24,620 - INFO - P\_based\_avg\_cluster\_size: 897.6250

2025-07-17 00:09:24,621 - INFO - P\_based\_cluster\_size\_std: 556.8563

2025-07-17 00:09:24,621 - INFO - P\_based\_cluster\_sizes: [1051, 928, 507, 277, 1463, 1975, 720, 260]

2025-07-17 00:09:24,621 - INFO - Saving final results with embeddings and view weights...

2025-07-17 00:09:38,931 - INFO - Final results saved to ./results/n8\_final\_clustering\_gz\_pytpe0\_no\_cat.csv

2025-07-17 00:09:38,944 - INFO - Final evaluation metrics saved to ./results/n8\_final\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 00:12:52,334 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=9, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-17 00:12:52,351 - INFO - CUDA available. Using device: cuda:0

2025-07-17 00:12:52,351 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-17 00:13:19,246 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-17 00:13:19,249 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-17 00:13:19,260 - INFO - Numerical features scaled.

2025-07-17 00:13:19,381 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-17 00:13:19,386 - INFO - Loading pre-built graphs from directory: ./data

2025-07-17 00:13:19,433 - INFO - Loaded time graph: 807056 edges.

2025-07-17 00:13:19,443 - INFO - Loaded space graph: 890250 edges.

2025-07-17 00:13:19,453 - INFO - Loaded attr graph: 982548 edges.

2025-07-17 00:13:19,453 - INFO - Initializing model components...

2025-07-17 00:13:19,476 - INFO - Pretraining encoder...

2025-07-17 00:13:19,476 - WARNING - The main training loop might still encounter OutOfMemoryError due to the N x N matrix calculation

2025-07-17 00:13:19,477 - WARNING - in the clustering loss module (ZZ^T for SVD). This is inherent to the standard EGAE Jc loss formulation.

2025-07-17 00:13:19,477 - WARNING - If OOM occurs in the main loop, consider using a GPU with more memory or exploring approximations if available.

2025-07-17 00:15:40,448 - INFO - Pretrain Epoch 10/100 - Time: 17.28s: Recon Loss = 0.2130, Reg Loss = 0.1389, Total Loss = 0.3519

2025-07-17 00:18:07,213 - INFO - Pretrain Epoch 20/100 - Time: 12.98s: Recon Loss = 0.1884, Reg Loss = 0.1171, Total Loss = 0.3055

2025-07-17 00:20:19,410 - INFO - Pretrain Epoch 30/100 - Time: 12.30s: Recon Loss = 0.1632, Reg Loss = 0.0983, Total Loss = 0.2615

2025-07-17 00:22:49,640 - INFO - Pretrain Epoch 40/100 - Time: 15.74s: Recon Loss = 0.1619, Reg Loss = 0.0817, Total Loss = 0.2436

2025-07-17 00:25:04,255 - INFO - Pretrain Epoch 50/100 - Time: 13.10s: Recon Loss = 0.1621, Reg Loss = 0.0675, Total Loss = 0.2296

2025-07-17 00:27:22,749 - INFO - Pretrain Epoch 60/100 - Time: 13.19s: Recon Loss = 0.1620, Reg Loss = 0.0558, Total Loss = 0.2177

2025-07-17 00:29:42,638 - INFO - Pretrain Epoch 70/100 - Time: 14.52s: Recon Loss = 0.1619, Reg Loss = 0.0463, Total Loss = 0.2082

2025-07-17 00:32:00,962 - INFO - Pretrain Epoch 80/100 - Time: 13.67s: Recon Loss = 0.1621, Reg Loss = 0.0386, Total Loss = 0.2006

2025-07-17 00:34:28,148 - INFO - Pretrain Epoch 90/100 - Time: 14.83s: Recon Loss = 0.1619, Reg Loss = 0.0323, Total Loss = 0.1942

2025-07-17 00:36:47,589 - INFO - Pretrain Epoch 100/100 - Time: 14.75s: Recon Loss = 0.1620, Reg Loss = 0.0272, Total Loss = 0.1891

2025-07-17 00:36:47,589 - INFO -

Pretraining finished. Evaluating pretraining results with standard K-Means...

2025-07-17 00:36:51,144 - INFO - Running standard KMeans on pretrain embeddings ((7181, 64))...

2025-07-17 00:36:51,355 - INFO - Standard KMeans finished.

2025-07-17 00:36:52,176 - INFO - Pretraining Standard K-Means Clustering Evaluation:

2025-07-17 00:36:52,176 - INFO - silhouette: 0.29808729887008667

2025-07-17 00:36:52,176 - INFO - davies\_bouldin: 1.2657

2025-07-17 00:36:52,176 - INFO - calinski\_harabasz: 3421.3575

2025-07-17 00:36:52,177 - INFO - cohesion: -0.9633212685585022

2025-07-17 00:36:52,177 - INFO - separation: 2.5292

2025-07-17 00:36:52,177 - INFO - separation\_to\_cohesion: 2.6255

2025-07-17 00:36:52,177 - INFO - size\_balance: 0.4668

2025-07-17 00:36:52,177 - INFO - cluster\_count: 9.0000

2025-07-17 00:36:52,177 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 00:36:52,177 - INFO - cluster\_size\_std: 425.4243

2025-07-17 00:36:52,177 - INFO - cluster\_sizes: [1091, 270, 1639, 581, 1172, 490, 786, 279, 873]

2025-07-17 00:36:56,519 - INFO - Pretraining standard KMeans++ results saved to ./results/n9\_pretrain\_standard\_kmeans\_clustering\_gz\_ptype0\_no\_cat.csv

2025-07-17 00:36:56,537 - INFO - Pretraining standard KMeans++ evaluation metrics saved to ./results/n9\_pretrain\_standard\_kmeans\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 00:36:56,614 - INFO - Pretraining encoder saved to ./results/n9\_pretrain\_encoder\_gz\_pytpe0\_no\_cat.pth

2025-07-17 00:36:56,614 - INFO -

Starting main training loop (Alternating Optimization)...

2025-07-17 00:36:56,614 - INFO - Initializing indicator matrix P for main training...

2025-07-17 00:37:00,310 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 00:37:00,310 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 00:37:01,893 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 00:37:01,893 - INFO - Evaluating initial main training clustering results (SVD + KMeans++ on P)...

2025-07-17 00:37:02,682 - INFO - Initial Main Training SVD + KMeans++ Clustering Evaluation:

2025-07-17 00:37:02,682 - INFO - silhouette: 0.1589023917913437

2025-07-17 00:37:02,682 - INFO - davies\_bouldin: 2.2057

2025-07-17 00:37:02,682 - INFO - calinski\_harabasz: 674.3557

2025-07-17 00:37:02,682 - INFO - cohesion: -1.511688232421875

2025-07-17 00:37:02,682 - INFO - separation: 1.9092

2025-07-17 00:37:02,682 - INFO - separation\_to\_cohesion: 1.2629

2025-07-17 00:37:02,682 - INFO - size\_balance: 0.1583

2025-07-17 00:37:02,683 - INFO - cluster\_count: 9.0000

2025-07-17 00:37:02,683 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 00:37:02,683 - INFO - cluster\_size\_std: 671.6150

2025-07-17 00:37:02,683 - INFO - cluster\_sizes: [1667, 1958, 118, 374, 579, 335, 211, 399, 1540]

2025-07-17 00:37:42,059 - INFO - Epoch 1/80 - Time: 39.38s:Recon Loss=0.1710, Cluster Loss=13.6301,Reg Loss=0.0267,Last Inner Loss=13.8278

2025-07-17 00:38:20,542 - INFO - Epoch 2/80 - Time: 38.48s:Recon Loss=0.2153, Cluster Loss=5.1742,Reg Loss=0.0268,Last Inner Loss=5.4163

2025-07-17 00:39:03,989 - INFO - Epoch 3/80 - Time: 43.45s:Recon Loss=0.2200, Cluster Loss=2.7696,Reg Loss=0.0270,Last Inner Loss=3.0165

2025-07-17 00:39:49,797 - INFO - Epoch 4/80 - Time: 45.81s:Recon Loss=0.2381, Cluster Loss=1.5891,Reg Loss=0.0271,Last Inner Loss=1.8544

2025-07-17 00:40:37,248 - INFO - Epoch 5/80 - Time: 47.45s:Recon Loss=0.2435, Cluster Loss=1.1851,Reg Loss=0.0273,Last Inner Loss=1.4559

2025-07-17 00:41:19,147 - INFO - Epoch 6/80 - Time: 41.90s:Recon Loss=0.2463, Cluster Loss=0.9583,Reg Loss=0.0274,Last Inner Loss=1.2319

2025-07-17 00:42:00,344 - INFO - Epoch 7/80 - Time: 41.20s:Recon Loss=0.2434, Cluster Loss=1.4085,Reg Loss=0.0275,Last Inner Loss=1.6794

2025-07-17 00:42:40,824 - INFO - Epoch 8/80 - Time: 40.48s:Recon Loss=0.2494, Cluster Loss=0.5742,Reg Loss=0.0276,Last Inner Loss=0.8512

2025-07-17 00:43:20,046 - INFO - Epoch 9/80 - Time: 39.22s:Recon Loss=0.2461, Cluster Loss=0.4424,Reg Loss=0.0276,Last Inner Loss=0.7162

2025-07-17 00:44:03,499 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 00:44:03,499 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 00:44:05,071 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 00:44:05,846 - INFO - Epoch 10/80 (Eval) - Time: 45.80s (Eval Time: 5.60s):

2025-07-17 00:44:05,846 - INFO - Evaluation Metrics:

2025-07-17 00:44:05,846 - INFO - silhouette: 0.08730888366699219

2025-07-17 00:44:05,846 - INFO - davies\_bouldin: 2.5165

2025-07-17 00:44:05,846 - INFO - calinski\_harabasz: 1121.7188

2025-07-17 00:44:05,846 - INFO - cohesion: -0.10243311524391174

2025-07-17 00:44:05,846 - INFO - separation: 0.1591

2025-07-17 00:44:05,846 - INFO - separation\_to\_cohesion: 1.5529

2025-07-17 00:44:05,847 - INFO - size\_balance: 0.2829

2025-07-17 00:44:05,847 - INFO - cluster\_count: 9.0000

2025-07-17 00:44:05,847 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 00:44:05,847 - INFO - cluster\_size\_std: 572.2032

2025-07-17 00:44:05,847 - INFO - cluster\_sizes: [1868, 1682, 200, 467, 654, 1076, 478, 380, 376]

2025-07-17 00:44:45,729 - INFO - Epoch 11/80 - Time: 39.88s:Recon Loss=0.2314, Cluster Loss=0.2621,Reg Loss=0.0277,Last Inner Loss=0.5211

2025-07-17 00:45:25,940 - INFO - Epoch 12/80 - Time: 40.21s:Recon Loss=0.2238, Cluster Loss=0.2613,Reg Loss=0.0277,Last Inner Loss=0.5128

2025-07-17 00:46:13,999 - INFO - Epoch 13/80 - Time: 48.06s:Recon Loss=0.2166, Cluster Loss=0.2009,Reg Loss=0.0277,Last Inner Loss=0.4452

2025-07-17 00:46:59,444 - INFO - Epoch 14/80 - Time: 45.44s:Recon Loss=0.2081, Cluster Loss=0.2339,Reg Loss=0.0277,Last Inner Loss=0.4697

2025-07-17 00:47:39,629 - INFO - Epoch 15/80 - Time: 40.18s:Recon Loss=0.2001, Cluster Loss=0.2207,Reg Loss=0.0277,Last Inner Loss=0.4485

2025-07-17 00:48:19,973 - INFO - Epoch 16/80 - Time: 40.34s:Recon Loss=0.2068, Cluster Loss=0.1477,Reg Loss=0.0277,Last Inner Loss=0.3821

2025-07-17 00:49:04,972 - INFO - Epoch 17/80 - Time: 45.00s:Recon Loss=0.1954, Cluster Loss=0.2212,Reg Loss=0.0277,Last Inner Loss=0.4443

2025-07-17 00:49:45,016 - INFO - Epoch 18/80 - Time: 40.04s:Recon Loss=0.1947, Cluster Loss=0.1920,Reg Loss=0.0277,Last Inner Loss=0.4143

2025-07-17 00:50:24,450 - INFO - Epoch 19/80 - Time: 39.43s:Recon Loss=0.1948, Cluster Loss=0.1280,Reg Loss=0.0277,Last Inner Loss=0.3504

2025-07-17 00:51:12,093 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 00:51:12,093 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 00:51:13,667 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 00:51:14,504 - INFO - Epoch 20/80 (Eval) - Time: 50.05s (Eval Time: 5.88s):

2025-07-17 00:51:14,505 - INFO - Evaluation Metrics:

2025-07-17 00:51:14,505 - INFO - silhouette: 0.10472622513771057

2025-07-17 00:51:14,505 - INFO - davies\_bouldin: 2.0226

2025-07-17 00:51:14,505 - INFO - calinski\_harabasz: 1017.2786

2025-07-17 00:51:14,505 - INFO - cohesion: -0.0730682983994484

2025-07-17 00:51:14,505 - INFO - separation: 0.1159

2025-07-17 00:51:14,505 - INFO - separation\_to\_cohesion: 1.5859

2025-07-17 00:51:14,505 - INFO - size\_balance: 0.1908

2025-07-17 00:51:14,505 - INFO - cluster\_count: 9.0000

2025-07-17 00:51:14,505 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 00:51:14,505 - INFO - cluster\_size\_std: 645.6193

2025-07-17 00:51:14,505 - INFO - cluster\_sizes: [2037, 1182, 1704, 371, 653, 142, 436, 472, 184]

2025-07-17 00:52:03,247 - INFO - Epoch 21/80 - Time: 48.74s:Recon Loss=0.1835, Cluster Loss=0.1309,Reg Loss=0.0277,Last Inner Loss=0.3420

2025-07-17 00:52:45,783 - INFO - Epoch 22/80 - Time: 42.54s:Recon Loss=0.1795, Cluster Loss=0.1594,Reg Loss=0.0277,Last Inner Loss=0.3666

2025-07-17 00:53:24,405 - INFO - Epoch 23/80 - Time: 38.62s:Recon Loss=0.1782, Cluster Loss=0.0941,Reg Loss=0.0277,Last Inner Loss=0.3000

2025-07-17 00:54:05,159 - INFO - Epoch 24/80 - Time: 40.75s:Recon Loss=0.1745, Cluster Loss=0.1069,Reg Loss=0.0277,Last Inner Loss=0.3091

2025-07-17 00:54:45,412 - INFO - Epoch 25/80 - Time: 40.25s:Recon Loss=0.1710, Cluster Loss=0.0901,Reg Loss=0.0276,Last Inner Loss=0.2888

2025-07-17 00:55:24,441 - INFO - Epoch 26/80 - Time: 39.03s:Recon Loss=0.1696, Cluster Loss=0.0956,Reg Loss=0.0276,Last Inner Loss=0.2929

2025-07-17 00:56:03,966 - INFO - Epoch 27/80 - Time: 39.52s:Recon Loss=0.1688, Cluster Loss=0.1150,Reg Loss=0.0276,Last Inner Loss=0.3115

2025-07-17 00:56:44,393 - INFO - Epoch 28/80 - Time: 40.43s:Recon Loss=0.1682, Cluster Loss=0.0832,Reg Loss=0.0276,Last Inner Loss=0.2791

2025-07-17 00:57:23,764 - INFO - Epoch 29/80 - Time: 39.37s:Recon Loss=0.1693, Cluster Loss=0.0815,Reg Loss=0.0276,Last Inner Loss=0.2785

2025-07-17 00:58:16,897 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 00:58:16,898 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 00:58:18,475 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 00:58:19,298 - INFO - Epoch 30/80 (Eval) - Time: 55.53s (Eval Time: 7.09s):

2025-07-17 00:58:19,298 - INFO - Evaluation Metrics:

2025-07-17 00:58:19,299 - INFO - silhouette: 0.11188299208879471

2025-07-17 00:58:19,299 - INFO - davies\_bouldin: 1.8533

2025-07-17 00:58:19,299 - INFO - calinski\_harabasz: 987.2899

2025-07-17 00:58:19,299 - INFO - cohesion: -0.05830758810043335

2025-07-17 00:58:19,299 - INFO - separation: 0.1009

2025-07-17 00:58:19,299 - INFO - separation\_to\_cohesion: 1.7303

2025-07-17 00:58:19,299 - INFO - size\_balance: 0.1258

2025-07-17 00:58:19,299 - INFO - cluster\_count: 9.0000

2025-07-17 00:58:19,300 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 00:58:19,300 - INFO - cluster\_size\_std: 697.5225

2025-07-17 00:58:19,300 - INFO - cluster\_sizes: [2172, 1004, 219, 1832, 518, 578, 38, 271, 549]

2025-07-17 00:59:03,594 - INFO - Epoch 31/80 - Time: 44.29s:Recon Loss=0.1669, Cluster Loss=0.0681,Reg Loss=0.0276,Last Inner Loss=0.2627

2025-07-17 00:59:42,830 - INFO - Epoch 32/80 - Time: 39.24s:Recon Loss=0.1681, Cluster Loss=0.0573,Reg Loss=0.0276,Last Inner Loss=0.2530

2025-07-17 01:00:20,774 - INFO - Epoch 33/80 - Time: 37.94s:Recon Loss=0.1667, Cluster Loss=0.0679,Reg Loss=0.0276,Last Inner Loss=0.2621

2025-07-17 01:01:02,710 - INFO - Epoch 34/80 - Time: 41.93s:Recon Loss=0.1669, Cluster Loss=0.0620,Reg Loss=0.0276,Last Inner Loss=0.2564

2025-07-17 01:01:43,047 - INFO - Epoch 35/80 - Time: 40.34s:Recon Loss=0.1670, Cluster Loss=0.0721,Reg Loss=0.0276,Last Inner Loss=0.2666

2025-07-17 01:02:22,614 - INFO - Epoch 36/80 - Time: 39.57s:Recon Loss=0.1657, Cluster Loss=0.0583,Reg Loss=0.0276,Last Inner Loss=0.2515

2025-07-17 01:03:06,400 - INFO - Epoch 37/80 - Time: 43.79s:Recon Loss=0.1651, Cluster Loss=0.0736,Reg Loss=0.0275,Last Inner Loss=0.2662

2025-07-17 01:03:51,234 - INFO - Epoch 38/80 - Time: 44.83s:Recon Loss=0.1644, Cluster Loss=0.0620,Reg Loss=0.0275,Last Inner Loss=0.2540

2025-07-17 01:04:35,377 - INFO - Epoch 39/80 - Time: 44.14s:Recon Loss=0.1643, Cluster Loss=0.0645,Reg Loss=0.0275,Last Inner Loss=0.2563

2025-07-17 01:05:20,559 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 01:05:20,559 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 01:05:22,191 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 01:05:22,952 - INFO - Epoch 40/80 (Eval) - Time: 47.57s (Eval Time: 5.57s):

2025-07-17 01:05:22,952 - INFO - Evaluation Metrics:

2025-07-17 01:05:22,952 - INFO - silhouette: 0.10037638992071152

2025-07-17 01:05:22,952 - INFO - davies\_bouldin: 2.0371

2025-07-17 01:05:22,952 - INFO - calinski\_harabasz: 1019.0522

2025-07-17 01:05:22,953 - INFO - cohesion: -0.05814828351140022

2025-07-17 01:05:22,953 - INFO - separation: 0.0853

2025-07-17 01:05:22,953 - INFO - separation\_to\_cohesion: 1.4677

2025-07-17 01:05:22,953 - INFO - size\_balance: 0.1494

2025-07-17 01:05:22,953 - INFO - cluster\_count: 9.0000

2025-07-17 01:05:22,953 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 01:05:22,953 - INFO - cluster\_size\_std: 678.6507

2025-07-17 01:05:22,953 - INFO - cluster\_sizes: [2055, 1980, 317, 242, 281, 512, 394, 919, 481]

2025-07-17 01:06:04,756 - INFO - Epoch 41/80 - Time: 41.80s:Recon Loss=0.1649, Cluster Loss=0.0646,Reg Loss=0.0275,Last Inner Loss=0.2570

2025-07-17 01:06:44,133 - INFO - Epoch 42/80 - Time: 39.38s:Recon Loss=0.1653, Cluster Loss=0.0535,Reg Loss=0.0275,Last Inner Loss=0.2463

2025-07-17 01:07:25,329 - INFO - Epoch 43/80 - Time: 41.20s:Recon Loss=0.1659, Cluster Loss=0.0574,Reg Loss=0.0275,Last Inner Loss=0.2508

2025-07-17 01:08:07,030 - INFO - Epoch 44/80 - Time: 41.70s:Recon Loss=0.1651, Cluster Loss=0.0463,Reg Loss=0.0275,Last Inner Loss=0.2389

2025-07-17 01:08:52,109 - INFO - Epoch 45/80 - Time: 45.08s:Recon Loss=0.1644, Cluster Loss=0.0714,Reg Loss=0.0275,Last Inner Loss=0.2633

2025-07-17 01:09:34,617 - INFO - Epoch 46/80 - Time: 42.51s:Recon Loss=0.1642, Cluster Loss=0.0454,Reg Loss=0.0274,Last Inner Loss=0.2370

2025-07-17 01:10:19,584 - INFO - Epoch 47/80 - Time: 44.97s:Recon Loss=0.1640, Cluster Loss=0.0566,Reg Loss=0.0274,Last Inner Loss=0.2480

2025-07-17 01:11:02,615 - INFO - Epoch 48/80 - Time: 43.03s:Recon Loss=0.1638, Cluster Loss=0.0526,Reg Loss=0.0274,Last Inner Loss=0.2438

2025-07-17 01:11:43,405 - INFO - Epoch 49/80 - Time: 40.79s:Recon Loss=0.1646, Cluster Loss=0.0582,Reg Loss=0.0274,Last Inner Loss=0.2502

2025-07-17 01:12:26,862 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 01:12:26,862 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 01:12:28,453 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 01:12:29,242 - INFO - Epoch 50/80 (Eval) - Time: 45.84s (Eval Time: 5.91s):

2025-07-17 01:12:29,243 - INFO - Evaluation Metrics:

2025-07-17 01:12:29,243 - INFO - silhouette: 0.10200542956590652

2025-07-17 01:12:29,243 - INFO - davies\_bouldin: 2.1558

2025-07-17 01:12:29,243 - INFO - calinski\_harabasz: 1038.2294

2025-07-17 01:12:29,243 - INFO - cohesion: -0.05292283743619919

2025-07-17 01:12:29,243 - INFO - separation: 0.0805

2025-07-17 01:12:29,243 - INFO - separation\_to\_cohesion: 1.5202

2025-07-17 01:12:29,243 - INFO - size\_balance: 0.2952

2025-07-17 01:12:29,243 - INFO - cluster\_count: 9.0000

2025-07-17 01:12:29,243 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 01:12:29,244 - INFO - cluster\_size\_std: 562.3227

2025-07-17 01:12:29,244 - INFO - cluster\_sizes: [1041, 419, 1978, 142, 298, 567, 446, 869, 1421]

2025-07-17 01:13:12,220 - INFO - Epoch 51/80 - Time: 42.98s:Recon Loss=0.1641, Cluster Loss=0.0633,Reg Loss=0.0274,Last Inner Loss=0.2547

2025-07-17 01:13:52,607 - INFO - Epoch 52/80 - Time: 40.39s:Recon Loss=0.1664, Cluster Loss=0.0591,Reg Loss=0.0274,Last Inner Loss=0.2529

2025-07-17 01:14:32,434 - INFO - Epoch 53/80 - Time: 39.83s:Recon Loss=0.1709, Cluster Loss=0.1328,Reg Loss=0.0274,Last Inner Loss=0.3311

2025-07-17 01:15:15,181 - INFO - Epoch 54/80 - Time: 42.75s:Recon Loss=0.1894, Cluster Loss=0.3761,Reg Loss=0.0274,Last Inner Loss=0.5929

2025-07-17 01:16:02,823 - INFO - Epoch 55/80 - Time: 47.64s:Recon Loss=0.1847, Cluster Loss=0.6103,Reg Loss=0.0275,Last Inner Loss=0.8225

2025-07-17 01:16:49,007 - INFO - Epoch 56/80 - Time: 46.18s:Recon Loss=0.1821, Cluster Loss=0.5784,Reg Loss=0.0276,Last Inner Loss=0.7881

2025-07-17 01:17:29,821 - INFO - Epoch 57/80 - Time: 40.81s:Recon Loss=0.1774, Cluster Loss=0.4981,Reg Loss=0.0277,Last Inner Loss=0.7032

2025-07-17 01:18:10,910 - INFO - Epoch 58/80 - Time: 41.09s:Recon Loss=0.1738, Cluster Loss=0.4205,Reg Loss=0.0277,Last Inner Loss=0.6219

2025-07-17 01:18:56,100 - INFO - Epoch 59/80 - Time: 45.19s:Recon Loss=0.1675, Cluster Loss=0.3465,Reg Loss=0.0277,Last Inner Loss=0.5417

2025-07-17 01:19:38,153 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 01:19:38,154 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 01:19:39,786 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 01:19:40,604 - INFO - Epoch 60/80 (Eval) - Time: 44.50s (Eval Time: 5.60s):

2025-07-17 01:19:40,604 - INFO - Evaluation Metrics:

2025-07-17 01:19:40,604 - INFO - silhouette: 0.06928551197052002

2025-07-17 01:19:40,604 - INFO - davies\_bouldin: 2.0278

2025-07-17 01:19:40,604 - INFO - calinski\_harabasz: 758.4637

2025-07-17 01:19:40,604 - INFO - cohesion: -0.07697994261980057

2025-07-17 01:19:40,605 - INFO - separation: 0.1117

2025-07-17 01:19:40,605 - INFO - separation\_to\_cohesion: 1.4515

2025-07-17 01:19:40,605 - INFO - size\_balance: 0.4130

2025-07-17 01:19:40,605 - INFO - cluster\_count: 9.0000

2025-07-17 01:19:40,605 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 01:19:40,605 - INFO - cluster\_size\_std: 468.3779

2025-07-17 01:19:40,605 - INFO - cluster\_sizes: [800, 634, 432, 930, 645, 174, 1424, 1720, 422]

2025-07-17 01:20:20,703 - INFO - Epoch 61/80 - Time: 40.10s:Recon Loss=0.1702, Cluster Loss=0.0784,Reg Loss=0.0277,Last Inner Loss=0.2764

2025-07-17 01:21:03,591 - INFO - Epoch 62/80 - Time: 42.89s:Recon Loss=0.1727, Cluster Loss=0.1119,Reg Loss=0.0278,Last Inner Loss=0.3124

2025-07-17 01:21:47,299 - INFO - Epoch 63/80 - Time: 43.71s:Recon Loss=0.1691, Cluster Loss=0.1868,Reg Loss=0.0278,Last Inner Loss=0.3837

2025-07-17 01:22:32,928 - INFO - Epoch 64/80 - Time: 45.63s:Recon Loss=0.1694, Cluster Loss=0.1432,Reg Loss=0.0278,Last Inner Loss=0.3404

2025-07-17 01:23:15,436 - INFO - Epoch 65/80 - Time: 42.51s:Recon Loss=0.1708, Cluster Loss=0.1881,Reg Loss=0.0278,Last Inner Loss=0.3867

2025-07-17 01:23:55,201 - INFO - Epoch 66/80 - Time: 39.77s:Recon Loss=0.1690, Cluster Loss=0.2940,Reg Loss=0.0279,Last Inner Loss=0.4908

2025-07-17 01:24:34,774 - INFO - Epoch 67/80 - Time: 39.57s:Recon Loss=0.1733, Cluster Loss=0.3321,Reg Loss=0.0279,Last Inner Loss=0.5333

2025-07-17 01:25:14,098 - INFO - Epoch 68/80 - Time: 39.32s:Recon Loss=0.1715, Cluster Loss=0.3579,Reg Loss=0.0279,Last Inner Loss=0.5573

2025-07-17 01:25:55,107 - INFO - Epoch 69/80 - Time: 41.01s:Recon Loss=0.1671, Cluster Loss=0.3428,Reg Loss=0.0280,Last Inner Loss=0.5379

2025-07-17 01:26:38,148 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 01:26:38,149 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 01:26:39,787 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 01:26:40,565 - INFO - Epoch 70/80 (Eval) - Time: 45.46s (Eval Time: 6.33s):

2025-07-17 01:26:40,565 - INFO - Evaluation Metrics:

2025-07-17 01:26:40,565 - INFO - silhouette: 0.10229580849409103

2025-07-17 01:26:40,565 - INFO - davies\_bouldin: 2.2095

2025-07-17 01:26:40,565 - INFO - calinski\_harabasz: 773.5542

2025-07-17 01:26:40,565 - INFO - cohesion: -0.0984404981136322

2025-07-17 01:26:40,565 - INFO - separation: 0.1661

2025-07-17 01:26:40,565 - INFO - separation\_to\_cohesion: 1.6873

2025-07-17 01:26:40,565 - INFO - size\_balance: 0.4013

2025-07-17 01:26:40,566 - INFO - cluster\_count: 9.0000

2025-07-17 01:26:40,566 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 01:26:40,566 - INFO - cluster\_size\_std: 477.7050

2025-07-17 01:26:40,566 - INFO - cluster\_sizes: [1380, 157, 929, 1420, 500, 579, 188, 1400, 628]

2025-07-17 01:27:22,304 - INFO - Epoch 71/80 - Time: 41.74s:Recon Loss=0.1669, Cluster Loss=0.0964,Reg Loss=0.0280,Last Inner Loss=0.2913

2025-07-17 01:28:09,002 - INFO - Epoch 72/80 - Time: 46.70s:Recon Loss=0.1658, Cluster Loss=0.1406,Reg Loss=0.0280,Last Inner Loss=0.3344

2025-07-17 01:28:50,777 - INFO - Epoch 73/80 - Time: 41.77s:Recon Loss=0.1658, Cluster Loss=0.0815,Reg Loss=0.0280,Last Inner Loss=0.2753

2025-07-17 01:29:29,783 - INFO - Epoch 74/80 - Time: 39.01s:Recon Loss=0.1642, Cluster Loss=0.1134,Reg Loss=0.0280,Last Inner Loss=0.3056

2025-07-17 01:30:10,999 - INFO - Epoch 75/80 - Time: 41.22s:Recon Loss=0.1643, Cluster Loss=0.0735,Reg Loss=0.0280,Last Inner Loss=0.2658

2025-07-17 01:30:53,956 - INFO - Epoch 76/80 - Time: 42.96s:Recon Loss=0.1641, Cluster Loss=0.0750,Reg Loss=0.0280,Last Inner Loss=0.2671

2025-07-17 01:31:34,562 - INFO - Epoch 77/80 - Time: 40.61s:Recon Loss=0.1653, Cluster Loss=0.0875,Reg Loss=0.0280,Last Inner Loss=0.2807

2025-07-17 01:32:13,978 - INFO - Epoch 78/80 - Time: 39.42s:Recon Loss=0.1634, Cluster Loss=0.1222,Reg Loss=0.0280,Last Inner Loss=0.3135

2025-07-17 01:32:57,591 - INFO - Epoch 79/80 - Time: 43.61s:Recon Loss=0.1638, Cluster Loss=0.0786,Reg Loss=0.0280,Last Inner Loss=0.2704

2025-07-17 01:33:44,043 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 01:33:44,043 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 01:33:45,634 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 01:33:46,374 - INFO - Epoch 80/80 (Eval) - Time: 48.78s (Eval Time: 6.28s):

2025-07-17 01:33:46,374 - INFO - Evaluation Metrics:

2025-07-17 01:33:46,374 - INFO - silhouette: 0.11490841954946518

2025-07-17 01:33:46,374 - INFO - davies\_bouldin: 2.1779

2025-07-17 01:33:46,374 - INFO - calinski\_harabasz: 840.9761

2025-07-17 01:33:46,374 - INFO - cohesion: -0.09255935251712799

2025-07-17 01:33:46,374 - INFO - separation: 0.1530

2025-07-17 01:33:46,374 - INFO - separation\_to\_cohesion: 1.6533

2025-07-17 01:33:46,374 - INFO - size\_balance: 0.2702

2025-07-17 01:33:46,374 - INFO - cluster\_count: 9.0000

2025-07-17 01:33:46,375 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 01:33:46,375 - INFO - cluster\_size\_std: 582.2621

2025-07-17 01:33:46,375 - INFO - cluster\_sizes: [2002, 596, 1656, 245, 715, 504, 191, 588, 684]

2025-07-17 01:33:46,375 - INFO -

Training completed!

2025-07-17 01:33:46,375 - INFO -

Saving final trained model...

2025-07-17 01:33:48,598 - INFO - Final trained model saved to ./results/n9\_final\_model\_gz\_ptype0\_no\_cat.pth

2025-07-17 01:33:48,598 - INFO -

Evaluating final trained model...

2025-07-17 01:33:53,134 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 01:33:53,134 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 01:33:54,773 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 01:33:55,585 - INFO -

Detailed Clustering Evaluation of Final Model:

2025-07-17 01:33:55,585 - INFO - silhouette: 0.11488445103168488

2025-07-17 01:33:55,585 - INFO - davies\_bouldin: 2.1779

2025-07-17 01:33:55,585 - INFO - calinski\_harabasz: 841.0620

2025-07-17 01:33:55,585 - INFO - cohesion: -0.09255658090114594

2025-07-17 01:33:55,586 - INFO - separation: 0.1530

2025-07-17 01:33:55,586 - INFO - separation\_to\_cohesion: 1.6534

2025-07-17 01:33:55,586 - INFO - size\_balance: 0.2702

2025-07-17 01:33:55,586 - INFO - cluster\_count: 9.0000

2025-07-17 01:33:55,586 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 01:33:55,586 - INFO - cluster\_size\_std: 582.3055

2025-07-17 01:33:55,586 - INFO - cluster\_sizes: [2000, 596, 1659, 245, 713, 504, 191, 588, 685]

2025-07-17 01:33:55,586 - INFO -

--- Detailed Clustering Evaluation of Final Model (based on P indicator matrix as embeddings) ---

2025-07-17 01:33:56,321 - INFO - P\_based\_silhouette: 0.18929342925548553

2025-07-17 01:33:56,322 - INFO - P\_based\_davies\_bouldin: 1.3666

2025-07-17 01:33:56,322 - INFO - P\_based\_calinski\_harabasz: 964.6255

2025-07-17 01:33:56,322 - INFO - P\_based\_cohesion: -0.023617155849933624

2025-07-17 01:33:56,322 - INFO - P\_based\_separation: 0.0408

2025-07-17 01:33:56,322 - INFO - P\_based\_separation\_to\_cohesion: 1.7256

2025-07-17 01:33:56,322 - INFO - P\_based\_size\_balance: 0.2702

2025-07-17 01:33:56,322 - INFO - P\_based\_cluster\_count: 9.0000

2025-07-17 01:33:56,322 - INFO - P\_based\_avg\_cluster\_size: 797.8889

2025-07-17 01:33:56,322 - INFO - P\_based\_cluster\_size\_std: 582.3055

2025-07-17 01:33:56,322 - INFO - P\_based\_cluster\_sizes: [2000, 596, 1659, 245, 713, 504, 191, 588, 685]

2025-07-17 01:33:56,323 - INFO - Saving final results with embeddings and view weights...

2025-07-17 01:33:59,268 - INFO - Final results saved to ./results/n9\_final\_clustering\_gz\_pytpe0\_no\_cat.csv

2025-07-17 01:33:59,283 - INFO - Final evaluation metrics saved to ./results/n9\_final\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

PS Q:\LEARNNING-POSTGRADUATE\BaiduSyncdisk\LEARNNING-POSTGRADUATE\站点深化\ATP inferred\MGGDC\_1018> C:/Users/zou/.conda/envs/conda/python.exe "q:/LEARNNING-POSTGRADUATE/BaiduSyncdisk/LEARNNING-POSTGRADUATE/站点深化/ATP inferred/MGGDC\_1018/train\_egae\_num.py"

2025-07-17 01:34:05,010 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=9, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-17 01:34:05,030 - INFO - CUDA available. Using device: cuda:0

2025-07-17 01:34:05,030 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-17 01:34:32,683 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-17 01:34:32,688 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-17 01:34:32,696 - INFO - Numerical features scaled.

2025-07-17 01:34:32,824 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-17 01:34:32,830 - INFO - Loading pre-built graphs from directory: ./data

2025-07-17 01:34:32,872 - INFO - Loaded time graph: 807056 edges.

2025-07-17 01:34:32,885 - INFO - Loaded space graph: 890250 edges.

2025-07-17 01:34:32,895 - INFO - Loaded attr graph: 982548 edges.

2025-07-17 01:34:32,895 - INFO - Initializing model components...

2025-07-17 01:34:32,918 - INFO - Pretraining encoder...

2025-07-17 01:34:32,919 - WARNING - The main training loop might still encounter OutOfMemoryError due to the N x N matrix calculation

2025-07-17 01:34:32,919 - WARNING - in the clustering loss module (ZZ^T for SVD). This is inherent to the standard EGAE Jc loss formulation.

2025-07-17 01:34:32,919 - WARNING - If OOM occurs in the main loop, consider using a GPU with more memory or exploring approximations if available.

2025-07-17 01:36:33,760 - INFO - Pretrain Epoch 10/100 - Time: 12.95s: Recon Loss = 0.2130, Reg Loss = 0.1389, Total Loss = 0.3519

2025-07-17 01:38:29,820 - INFO - Pretrain Epoch 20/100 - Time: 11.83s: Recon Loss = 0.1895, Reg Loss = 0.1171, Total Loss = 0.3066

2025-07-17 01:40:37,433 - INFO - Pretrain Epoch 30/100 - Time: 13.45s: Recon Loss = 0.1626, Reg Loss = 0.0982, Total Loss = 0.2608

2025-07-17 01:42:37,818 - INFO - Pretrain Epoch 40/100 - Time: 12.20s: Recon Loss = 0.1618, Reg Loss = 0.0815, Total Loss = 0.2433

2025-07-17 01:44:31,987 - INFO - Pretrain Epoch 50/100 - Time: 13.03s: Recon Loss = 0.1626, Reg Loss = 0.0672, Total Loss = 0.2298

2025-07-17 01:46:47,967 - INFO - Pretrain Epoch 60/100 - Time: 14.95s: Recon Loss = 0.1620, Reg Loss = 0.0555, Total Loss = 0.2175

2025-07-17 01:48:43,996 - INFO - Pretrain Epoch 70/100 - Time: 12.00s: Recon Loss = 0.1620, Reg Loss = 0.0459, Total Loss = 0.2080

2025-07-17 01:50:38,142 - INFO - Pretrain Epoch 80/100 - Time: 13.74s: Recon Loss = 0.1628, Reg Loss = 0.0382, Total Loss = 0.2010

2025-07-17 01:52:55,180 - INFO - Pretrain Epoch 90/100 - Time: 14.34s: Recon Loss = 0.1621, Reg Loss = 0.0319, Total Loss = 0.1940

2025-07-17 01:54:50,373 - INFO - Pretrain Epoch 100/100 - Time: 12.39s: Recon Loss = 0.1620, Reg Loss = 0.0268, Total Loss = 0.1888

2025-07-17 01:54:50,374 - INFO -

Pretraining finished. Evaluating pretraining results with standard K-Means...

2025-07-17 01:54:53,931 - INFO - Running standard KMeans on pretrain embeddings ((7181, 64))...

2025-07-17 01:54:54,112 - INFO - Standard KMeans finished.

2025-07-17 01:54:54,847 - INFO - Pretraining Standard K-Means Clustering Evaluation:

2025-07-17 01:54:54,848 - INFO - silhouette: 0.2537623345851898

2025-07-17 01:54:54,848 - INFO - davies\_bouldin: 1.5088

2025-07-17 01:54:54,848 - INFO - calinski\_harabasz: 3156.7891

2025-07-17 01:54:54,848 - INFO - cohesion: -1.1385483741760254

2025-07-17 01:54:54,848 - INFO - separation: 2.8834

2025-07-17 01:54:54,848 - INFO - separation\_to\_cohesion: 2.5325

2025-07-17 01:54:54,848 - INFO - size\_balance: 0.3536

2025-07-17 01:54:54,848 - INFO - cluster\_count: 9.0000

2025-07-17 01:54:54,848 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 01:54:54,848 - INFO - cluster\_size\_std: 515.7423

2025-07-17 01:54:54,849 - INFO - cluster\_sizes: [1449, 1000, 1442, 108, 564, 718, 1395, 366, 139]

2025-07-17 01:54:59,271 - INFO - Pretraining standard KMeans++ results saved to ./results/n9\_pretrain\_standard\_kmeans\_clustering\_gz\_ptype0\_no\_cat.csv

2025-07-17 01:54:59,286 - INFO - Pretraining standard KMeans++ evaluation metrics saved to ./results/n9\_pretrain\_standard\_kmeans\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 01:54:59,359 - INFO - Pretraining encoder saved to ./results/n9\_pretrain\_encoder\_gz\_pytpe0\_no\_cat.pth

2025-07-17 01:54:59,360 - INFO -

Starting main training loop (Alternating Optimization)...

2025-07-17 01:54:59,360 - INFO - Initializing indicator matrix P for main training...

2025-07-17 01:55:02,332 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 01:55:02,332 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 01:55:03,980 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 01:55:03,980 - INFO - Evaluating initial main training clustering results (SVD + KMeans++ on P)...

2025-07-17 01:55:04,748 - INFO - Initial Main Training SVD + KMeans++ Clustering Evaluation:

2025-07-17 01:55:04,748 - INFO - silhouette: 0.16058672964572906

2025-07-17 01:55:04,748 - INFO - davies\_bouldin: 2.6672

2025-07-17 01:55:04,748 - INFO - calinski\_harabasz: 693.9779

2025-07-17 01:55:04,748 - INFO - cohesion: -1.7245484590530396

2025-07-17 01:55:04,748 - INFO - separation: 1.7476

2025-07-17 01:55:04,749 - INFO - separation\_to\_cohesion: 1.0133

2025-07-17 01:55:04,749 - INFO - size\_balance: 0.0000

2025-07-17 01:55:04,749 - INFO - cluster\_count: 9.0000

2025-07-17 01:55:04,749 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 01:55:04,749 - INFO - cluster\_size\_std: 866.0382

2025-07-17 01:55:04,749 - INFO - cluster\_sizes: [2385, 266, 2423, 401, 573, 243, 225, 210, 455]

2025-07-17 01:55:39,323 - INFO - Epoch 1/80 - Time: 34.57s:Recon Loss=0.1720, Cluster Loss=9.9757,Reg Loss=0.0264,Last Inner Loss=10.1741

2025-07-17 01:56:15,889 - INFO - Epoch 2/80 - Time: 36.57s:Recon Loss=0.2020, Cluster Loss=3.6137,Reg Loss=0.0265,Last Inner Loss=3.8422

2025-07-17 01:56:54,699 - INFO - Epoch 3/80 - Time: 38.81s:Recon Loss=0.2258, Cluster Loss=1.7741,Reg Loss=0.0266,Last Inner Loss=2.0265

2025-07-17 01:57:30,703 - INFO - Epoch 4/80 - Time: 36.00s:Recon Loss=0.2406, Cluster Loss=1.0606,Reg Loss=0.0268,Last Inner Loss=1.3280

2025-07-17 01:58:14,014 - INFO - Epoch 5/80 - Time: 43.31s:Recon Loss=0.2559, Cluster Loss=0.7720,Reg Loss=0.0270,Last Inner Loss=1.0549

2025-07-17 01:58:50,741 - INFO - Epoch 6/80 - Time: 36.73s:Recon Loss=0.2594, Cluster Loss=0.6711,Reg Loss=0.0271,Last Inner Loss=0.9576

2025-07-17 01:59:24,249 - INFO - Epoch 7/80 - Time: 33.51s:Recon Loss=0.2587, Cluster Loss=0.4933,Reg Loss=0.0272,Last Inner Loss=0.7791

2025-07-17 02:00:01,504 - INFO - Epoch 8/80 - Time: 37.25s:Recon Loss=0.2520, Cluster Loss=0.4071,Reg Loss=0.0273,Last Inner Loss=0.6864

2025-07-17 02:00:37,558 - INFO - Epoch 9/80 - Time: 36.05s:Recon Loss=0.2425, Cluster Loss=0.3391,Reg Loss=0.0273,Last Inner Loss=0.6089

2025-07-17 02:01:17,113 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 02:01:17,113 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 02:01:18,667 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 02:01:19,486 - INFO - Epoch 10/80 (Eval) - Time: 41.93s (Eval Time: 5.15s):

2025-07-17 02:01:19,486 - INFO - Evaluation Metrics:

2025-07-17 02:01:19,486 - INFO - silhouette: 0.09375476092100143

2025-07-17 02:01:19,487 - INFO - davies\_bouldin: 1.8805

2025-07-17 02:01:19,487 - INFO - calinski\_harabasz: 902.7035

2025-07-17 02:01:19,487 - INFO - cohesion: -0.09654118120670319

2025-07-17 02:01:19,487 - INFO - separation: 0.7427

2025-07-17 02:01:19,487 - INFO - separation\_to\_cohesion: 7.6932

2025-07-17 02:01:19,487 - INFO - size\_balance: 0.0000

2025-07-17 02:01:19,487 - INFO - cluster\_count: 9.0000

2025-07-17 02:01:19,487 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 02:01:19,487 - INFO - cluster\_size\_std: 900.6805

2025-07-17 02:01:19,487 - INFO - cluster\_sizes: [565, 602, 948, 1, 20, 871, 3137, 914, 123]

2025-07-17 02:01:55,405 - INFO - Epoch 11/80 - Time: 35.92s:Recon Loss=0.2229, Cluster Loss=0.1680,Reg Loss=0.0274,Last Inner Loss=0.4183

2025-07-17 02:02:28,941 - INFO - Epoch 12/80 - Time: 33.54s:Recon Loss=0.2186, Cluster Loss=0.1402,Reg Loss=0.0274,Last Inner Loss=0.3862

2025-07-17 02:03:08,422 - INFO - Epoch 13/80 - Time: 39.48s:Recon Loss=0.2053, Cluster Loss=0.1186,Reg Loss=0.0274,Last Inner Loss=0.3513

2025-07-17 02:03:47,411 - INFO - Epoch 14/80 - Time: 38.99s:Recon Loss=0.1999, Cluster Loss=0.1258,Reg Loss=0.0274,Last Inner Loss=0.3532

2025-07-17 02:04:28,820 - INFO - Epoch 15/80 - Time: 41.41s:Recon Loss=0.1903, Cluster Loss=0.1344,Reg Loss=0.0274,Last Inner Loss=0.3522

2025-07-17 02:05:08,905 - INFO - Epoch 16/80 - Time: 40.08s:Recon Loss=0.1856, Cluster Loss=0.0956,Reg Loss=0.0274,Last Inner Loss=0.3086

2025-07-17 02:05:44,497 - INFO - Epoch 17/80 - Time: 35.59s:Recon Loss=0.1814, Cluster Loss=0.1395,Reg Loss=0.0274,Last Inner Loss=0.3484

2025-07-17 02:06:18,117 - INFO - Epoch 18/80 - Time: 33.62s:Recon Loss=0.1797, Cluster Loss=0.1001,Reg Loss=0.0274,Last Inner Loss=0.3073

2025-07-17 02:06:56,128 - INFO - Epoch 19/80 - Time: 38.01s:Recon Loss=0.1763, Cluster Loss=0.0800,Reg Loss=0.0274,Last Inner Loss=0.2838

2025-07-17 02:07:33,582 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 02:07:33,582 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 02:07:35,191 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 02:07:35,954 - INFO - Epoch 20/80 (Eval) - Time: 39.83s (Eval Time: 5.44s):

2025-07-17 02:07:35,954 - INFO - Evaluation Metrics:

2025-07-17 02:07:35,954 - INFO - silhouette: 0.06645514816045761

2025-07-17 02:07:35,955 - INFO - davies\_bouldin: 1.9643

2025-07-17 02:07:35,955 - INFO - calinski\_harabasz: 1068.9755

2025-07-17 02:07:35,955 - INFO - cohesion: -0.07314324378967285

2025-07-17 02:07:35,955 - INFO - separation: 0.6518

2025-07-17 02:07:35,955 - INFO - separation\_to\_cohesion: 8.9106

2025-07-17 02:07:35,955 - INFO - size\_balance: 0.1201

2025-07-17 02:07:35,955 - INFO - cluster\_count: 9.0000

2025-07-17 02:07:35,955 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 02:07:35,955 - INFO - cluster\_size\_std: 702.0279

2025-07-17 02:07:35,955 - INFO - cluster\_sizes: [2144, 854, 736, 1, 125, 707, 846, 17, 1751]

2025-07-17 02:08:11,093 - INFO - Epoch 21/80 - Time: 35.14s:Recon Loss=0.1777, Cluster Loss=0.0873,Reg Loss=0.0274,Last Inner Loss=0.2923

2025-07-17 02:08:48,964 - INFO - Epoch 22/80 - Time: 37.87s:Recon Loss=0.1736, Cluster Loss=0.0618,Reg Loss=0.0274,Last Inner Loss=0.2628

2025-07-17 02:09:23,207 - INFO - Epoch 23/80 - Time: 34.24s:Recon Loss=0.1723, Cluster Loss=0.0625,Reg Loss=0.0274,Last Inner Loss=0.2623

2025-07-17 02:10:08,813 - INFO - Epoch 24/80 - Time: 45.60s:Recon Loss=0.1690, Cluster Loss=0.0595,Reg Loss=0.0274,Last Inner Loss=0.2559

2025-07-17 02:10:49,748 - INFO - Epoch 25/80 - Time: 40.94s:Recon Loss=0.1682, Cluster Loss=0.0535,Reg Loss=0.0274,Last Inner Loss=0.2491

2025-07-17 02:11:23,926 - INFO - Epoch 26/80 - Time: 34.18s:Recon Loss=0.1684, Cluster Loss=0.0590,Reg Loss=0.0274,Last Inner Loss=0.2547

2025-07-17 02:12:00,405 - INFO - Epoch 27/80 - Time: 36.48s:Recon Loss=0.1689, Cluster Loss=0.0694,Reg Loss=0.0274,Last Inner Loss=0.2656

2025-07-17 02:12:34,286 - INFO - Epoch 28/80 - Time: 33.88s:Recon Loss=0.1676, Cluster Loss=0.0480,Reg Loss=0.0274,Last Inner Loss=0.2430

2025-07-17 02:13:11,355 - INFO - Epoch 29/80 - Time: 37.07s:Recon Loss=0.1686, Cluster Loss=0.0467,Reg Loss=0.0273,Last Inner Loss=0.2426

2025-07-17 02:13:49,154 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 02:13:49,154 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 02:13:50,780 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 02:13:51,553 - INFO - Epoch 30/80 (Eval) - Time: 40.20s (Eval Time: 5.14s):

2025-07-17 02:13:51,554 - INFO - Evaluation Metrics:

2025-07-17 02:13:51,554 - INFO - silhouette: 0.11168501526117325

2025-07-17 02:13:51,554 - INFO - davies\_bouldin: 1.3636

2025-07-17 02:13:51,554 - INFO - calinski\_harabasz: 1123.9612

2025-07-17 02:13:51,554 - INFO - cohesion: -0.06587576121091843

2025-07-17 02:13:51,554 - INFO - separation: 0.8429

2025-07-17 02:13:51,554 - INFO - separation\_to\_cohesion: 12.7959

2025-07-17 02:13:51,554 - INFO - size\_balance: 0.0000

2025-07-17 02:13:51,554 - INFO - cluster\_count: 9.0000

2025-07-17 02:13:51,554 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 02:13:51,555 - INFO - cluster\_size\_std: 1042.9290

2025-07-17 02:13:51,555 - INFO - cluster\_sizes: [3522, 913, 865, 1, 965, 132, 764, 1, 18]

2025-07-17 02:14:27,760 - INFO - Epoch 31/80 - Time: 36.20s:Recon Loss=0.1664, Cluster Loss=0.0469,Reg Loss=0.0273,Last Inner Loss=0.2407

2025-07-17 02:15:02,782 - INFO - Epoch 32/80 - Time: 35.02s:Recon Loss=0.1671, Cluster Loss=0.0436,Reg Loss=0.0273,Last Inner Loss=0.2380

2025-07-17 02:15:42,313 - INFO - Epoch 33/80 - Time: 39.53s:Recon Loss=0.1668, Cluster Loss=0.0408,Reg Loss=0.0273,Last Inner Loss=0.2349

2025-07-17 02:16:23,300 - INFO - Epoch 34/80 - Time: 40.99s:Recon Loss=0.1672, Cluster Loss=0.0413,Reg Loss=0.0273,Last Inner Loss=0.2358

2025-07-17 02:17:01,982 - INFO - Epoch 35/80 - Time: 38.68s:Recon Loss=0.1664, Cluster Loss=0.0583,Reg Loss=0.0273,Last Inner Loss=0.2520

2025-07-17 02:17:37,500 - INFO - Epoch 36/80 - Time: 35.52s:Recon Loss=0.1728, Cluster Loss=0.1186,Reg Loss=0.0273,Last Inner Loss=0.3187

2025-07-17 02:18:10,740 - INFO - Epoch 37/80 - Time: 33.24s:Recon Loss=0.1784, Cluster Loss=0.2188,Reg Loss=0.0273,Last Inner Loss=0.4245

2025-07-17 02:18:45,010 - INFO - Epoch 38/80 - Time: 34.27s:Recon Loss=0.1747, Cluster Loss=0.2508,Reg Loss=0.0274,Last Inner Loss=0.4528

2025-07-17 02:19:18,797 - INFO - Epoch 39/80 - Time: 33.79s:Recon Loss=0.1714, Cluster Loss=0.2375,Reg Loss=0.0274,Last Inner Loss=0.4363

2025-07-17 02:19:56,522 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 02:19:56,522 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 02:19:58,159 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 02:19:58,977 - INFO - Epoch 40/80 (Eval) - Time: 40.18s (Eval Time: 5.58s):

2025-07-17 02:19:58,978 - INFO - Evaluation Metrics:

2025-07-17 02:19:58,978 - INFO - silhouette: 0.22251300513744354

2025-07-17 02:19:58,978 - INFO - davies\_bouldin: 1.2319

2025-07-17 02:19:58,978 - INFO - calinski\_harabasz: 1023.4039

2025-07-17 02:19:58,978 - INFO - cohesion: -0.0990862101316452

2025-07-17 02:19:58,978 - INFO - separation: 0.8669

2025-07-17 02:19:58,978 - INFO - separation\_to\_cohesion: 8.7487

2025-07-17 02:19:58,978 - INFO - size\_balance: 0.0000

2025-07-17 02:19:58,978 - INFO - cluster\_count: 9.0000

2025-07-17 02:19:58,978 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 02:19:58,979 - INFO - cluster\_size\_std: 1121.3498

2025-07-17 02:19:58,979 - INFO - cluster\_sizes: [3830, 1, 935, 692, 17, 684, 643, 378, 1]

2025-07-17 02:20:33,376 - INFO - Epoch 41/80 - Time: 34.40s:Recon Loss=0.1777, Cluster Loss=0.1118,Reg Loss=0.0274,Last Inner Loss=0.3169

2025-07-17 02:21:11,090 - INFO - Epoch 42/80 - Time: 37.71s:Recon Loss=0.1742, Cluster Loss=0.0796,Reg Loss=0.0274,Last Inner Loss=0.2812

2025-07-17 02:21:54,718 - INFO - Epoch 43/80 - Time: 43.63s:Recon Loss=0.1742, Cluster Loss=0.0797,Reg Loss=0.0275,Last Inner Loss=0.2814

2025-07-17 02:22:34,612 - INFO - Epoch 44/80 - Time: 39.89s:Recon Loss=0.1704, Cluster Loss=0.0709,Reg Loss=0.0275,Last Inner Loss=0.2688

2025-07-17 02:23:09,330 - INFO - Epoch 45/80 - Time: 34.72s:Recon Loss=0.1701, Cluster Loss=0.0838,Reg Loss=0.0275,Last Inner Loss=0.2813

2025-07-17 02:23:44,740 - INFO - Epoch 46/80 - Time: 35.41s:Recon Loss=0.1690, Cluster Loss=0.0979,Reg Loss=0.0275,Last Inner Loss=0.2943

2025-07-17 02:24:16,845 - INFO - Epoch 47/80 - Time: 32.10s:Recon Loss=0.1664, Cluster Loss=0.1027,Reg Loss=0.0275,Last Inner Loss=0.2966

2025-07-17 02:24:52,340 - INFO - Epoch 48/80 - Time: 35.49s:Recon Loss=0.1671, Cluster Loss=0.1025,Reg Loss=0.0275,Last Inner Loss=0.2971

2025-07-17 02:25:26,276 - INFO - Epoch 49/80 - Time: 33.94s:Recon Loss=0.1646, Cluster Loss=0.0684,Reg Loss=0.0275,Last Inner Loss=0.2605

2025-07-17 02:26:03,298 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 02:26:03,298 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 02:26:04,859 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 02:26:05,622 - INFO - Epoch 50/80 (Eval) - Time: 39.35s (Eval Time: 4.88s):

2025-07-17 02:26:05,622 - INFO - Evaluation Metrics:

2025-07-17 02:26:05,622 - INFO - silhouette: 0.2609495222568512

2025-07-17 02:26:05,622 - INFO - davies\_bouldin: 0.9665

2025-07-17 02:26:05,622 - INFO - calinski\_harabasz: 2182.8415

2025-07-17 02:26:05,623 - INFO - cohesion: -0.09166894108057022

2025-07-17 02:26:05,623 - INFO - separation: 0.9248

2025-07-17 02:26:05,623 - INFO - separation\_to\_cohesion: 10.0889

2025-07-17 02:26:05,623 - INFO - size\_balance: 0.0000

2025-07-17 02:26:05,623 - INFO - cluster\_count: 9.0000

2025-07-17 02:26:05,623 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 02:26:05,623 - INFO - cluster\_size\_std: 1141.6276

2025-07-17 02:26:05,623 - INFO - cluster\_sizes: [3794, 1122, 18, 1, 1114, 644, 369, 1, 118]

2025-07-17 02:26:40,365 - INFO - Epoch 51/80 - Time: 34.74s:Recon Loss=0.1641, Cluster Loss=0.0543,Reg Loss=0.0275,Last Inner Loss=0.2458

2025-07-17 02:27:17,986 - INFO - Epoch 52/80 - Time: 37.62s:Recon Loss=0.1640, Cluster Loss=0.0565,Reg Loss=0.0275,Last Inner Loss=0.2480

2025-07-17 02:27:57,530 - INFO - Epoch 53/80 - Time: 39.54s:Recon Loss=0.1664, Cluster Loss=0.0490,Reg Loss=0.0274,Last Inner Loss=0.2428

2025-07-17 02:28:37,183 - INFO - Epoch 54/80 - Time: 39.65s:Recon Loss=0.1647, Cluster Loss=0.0520,Reg Loss=0.0274,Last Inner Loss=0.2441

2025-07-17 02:29:15,190 - INFO - Epoch 55/80 - Time: 38.01s:Recon Loss=0.1637, Cluster Loss=0.0764,Reg Loss=0.0274,Last Inner Loss=0.2676

2025-07-17 02:29:52,131 - INFO - Epoch 56/80 - Time: 36.94s:Recon Loss=0.1638, Cluster Loss=0.0427,Reg Loss=0.0274,Last Inner Loss=0.2339

2025-07-17 02:30:28,946 - INFO - Epoch 57/80 - Time: 36.81s:Recon Loss=0.1636, Cluster Loss=0.0415,Reg Loss=0.0274,Last Inner Loss=0.2325

2025-07-17 02:31:06,697 - INFO - Epoch 58/80 - Time: 37.75s:Recon Loss=0.1633, Cluster Loss=0.0443,Reg Loss=0.0274,Last Inner Loss=0.2349

2025-07-17 02:31:41,560 - INFO - Epoch 59/80 - Time: 34.86s:Recon Loss=0.1690, Cluster Loss=0.1442,Reg Loss=0.0274,Last Inner Loss=0.3406

2025-07-17 02:32:19,792 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 02:32:19,792 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 02:32:21,392 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 02:32:22,167 - INFO - Epoch 60/80 (Eval) - Time: 40.61s (Eval Time: 5.62s):

2025-07-17 02:32:22,167 - INFO - Evaluation Metrics:

2025-07-17 02:32:22,167 - INFO - silhouette: 0.21954838931560516

2025-07-17 02:32:22,167 - INFO - davies\_bouldin: 1.3769

2025-07-17 02:32:22,167 - INFO - calinski\_harabasz: 1789.3506

2025-07-17 02:32:22,167 - INFO - cohesion: -0.11683154106140137

2025-07-17 02:32:22,167 - INFO - separation: 0.6907

2025-07-17 02:32:22,168 - INFO - separation\_to\_cohesion: 5.9117

2025-07-17 02:32:22,168 - INFO - size\_balance: 0.0000

2025-07-17 02:32:22,168 - INFO - cluster\_count: 9.0000

2025-07-17 02:32:22,168 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 02:32:22,168 - INFO - cluster\_size\_std: 850.4143

2025-07-17 02:32:22,168 - INFO - cluster\_sizes: [734, 1, 387, 776, 633, 867, 3046, 18, 719]

2025-07-17 02:32:57,492 - INFO - Epoch 61/80 - Time: 35.32s:Recon Loss=0.1655, Cluster Loss=0.0566,Reg Loss=0.0274,Last Inner Loss=0.2495

2025-07-17 02:33:36,581 - INFO - Epoch 62/80 - Time: 39.09s:Recon Loss=0.1643, Cluster Loss=0.0554,Reg Loss=0.0274,Last Inner Loss=0.2472

2025-07-17 02:34:17,555 - INFO - Epoch 63/80 - Time: 40.97s:Recon Loss=0.1662, Cluster Loss=0.0986,Reg Loss=0.0275,Last Inner Loss=0.2923

2025-07-17 02:34:55,534 - INFO - Epoch 64/80 - Time: 37.98s:Recon Loss=0.1681, Cluster Loss=0.1099,Reg Loss=0.0275,Last Inner Loss=0.3054

2025-07-17 02:35:30,190 - INFO - Epoch 65/80 - Time: 34.66s:Recon Loss=0.1932, Cluster Loss=0.2728,Reg Loss=0.0276,Last Inner Loss=0.4936

2025-07-17 02:36:05,166 - INFO - Epoch 66/80 - Time: 34.98s:Recon Loss=0.1869, Cluster Loss=0.4587,Reg Loss=0.0277,Last Inner Loss=0.6733

2025-07-17 02:36:41,186 - INFO - Epoch 67/80 - Time: 36.02s:Recon Loss=0.1832, Cluster Loss=0.4982,Reg Loss=0.0278,Last Inner Loss=0.7092

2025-07-17 02:37:17,376 - INFO - Epoch 68/80 - Time: 36.19s:Recon Loss=0.1756, Cluster Loss=0.4863,Reg Loss=0.0280,Last Inner Loss=0.6898

2025-07-17 02:37:52,528 - INFO - Epoch 69/80 - Time: 35.15s:Recon Loss=0.1744, Cluster Loss=0.4230,Reg Loss=0.0280,Last Inner Loss=0.6255

2025-07-17 02:38:31,926 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 02:38:31,926 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 02:38:33,562 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 02:38:34,312 - INFO - Epoch 70/80 (Eval) - Time: 41.78s (Eval Time: 5.75s):

2025-07-17 02:38:34,313 - INFO - Evaluation Metrics:

2025-07-17 02:38:34,313 - INFO - silhouette: 0.17652837932109833

2025-07-17 02:38:34,313 - INFO - davies\_bouldin: 1.6381

2025-07-17 02:38:34,313 - INFO - calinski\_harabasz: 1934.4507

2025-07-17 02:38:34,313 - INFO - cohesion: -0.12126967310905457

2025-07-17 02:38:34,313 - INFO - separation: 0.7795

2025-07-17 02:38:34,313 - INFO - separation\_to\_cohesion: 6.4279

2025-07-17 02:38:34,313 - INFO - size\_balance: 0.2425

2025-07-17 02:38:34,313 - INFO - cluster\_count: 9.0000

2025-07-17 02:38:34,313 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 02:38:34,314 - INFO - cluster\_size\_std: 604.3741

2025-07-17 02:38:34,314 - INFO - cluster\_sizes: [1752, 918, 654, 1, 459, 479, 433, 1936, 549]

2025-07-17 02:39:10,594 - INFO - Epoch 71/80 - Time: 36.28s:Recon Loss=0.1677, Cluster Loss=0.1216,Reg Loss=0.0281,Last Inner Loss=0.3174

2025-07-17 02:39:54,494 - INFO - Epoch 72/80 - Time: 43.90s:Recon Loss=0.1684, Cluster Loss=0.2125,Reg Loss=0.0282,Last Inner Loss=0.4091

2025-07-17 02:40:32,163 - INFO - Epoch 73/80 - Time: 37.67s:Recon Loss=0.1671, Cluster Loss=0.1789,Reg Loss=0.0282,Last Inner Loss=0.3742

2025-07-17 02:41:10,119 - INFO - Epoch 74/80 - Time: 37.96s:Recon Loss=0.1670, Cluster Loss=0.1830,Reg Loss=0.0282,Last Inner Loss=0.3782

2025-07-17 02:41:45,912 - INFO - Epoch 75/80 - Time: 35.79s:Recon Loss=0.1661, Cluster Loss=0.1559,Reg Loss=0.0282,Last Inner Loss=0.3502

2025-07-17 02:42:20,678 - INFO - Epoch 76/80 - Time: 34.76s:Recon Loss=0.1661, Cluster Loss=0.1330,Reg Loss=0.0282,Last Inner Loss=0.3273

2025-07-17 02:42:59,342 - INFO - Epoch 77/80 - Time: 38.66s:Recon Loss=0.1696, Cluster Loss=0.1289,Reg Loss=0.0282,Last Inner Loss=0.3268

2025-07-17 02:43:33,593 - INFO - Epoch 78/80 - Time: 34.25s:Recon Loss=0.1686, Cluster Loss=0.1551,Reg Loss=0.0282,Last Inner Loss=0.3519

2025-07-17 02:44:11,287 - INFO - Epoch 79/80 - Time: 37.69s:Recon Loss=0.1743, Cluster Loss=0.2254,Reg Loss=0.0282,Last Inner Loss=0.4279

2025-07-17 02:44:55,590 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 02:44:55,590 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 02:44:57,189 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 02:44:58,017 - INFO - Epoch 80/80 (Eval) - Time: 46.73s (Eval Time: 6.08s):

2025-07-17 02:44:58,017 - INFO - Evaluation Metrics:

2025-07-17 02:44:58,018 - INFO - silhouette: 0.17987939715385437

2025-07-17 02:44:58,018 - INFO - davies\_bouldin: 1.7095

2025-07-17 02:44:58,018 - INFO - calinski\_harabasz: 1724.4214

2025-07-17 02:44:58,018 - INFO - cohesion: -0.13598041236400604

2025-07-17 02:44:58,018 - INFO - separation: 0.3333

2025-07-17 02:44:58,018 - INFO - separation\_to\_cohesion: 2.4507

2025-07-17 02:44:58,018 - INFO - size\_balance: 0.4201

2025-07-17 02:44:58,018 - INFO - cluster\_count: 9.0000

2025-07-17 02:44:58,018 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 02:44:58,019 - INFO - cluster\_size\_std: 462.7215

2025-07-17 02:44:58,019 - INFO - cluster\_sizes: [1384, 616, 1505, 756, 561, 393, 1331, 521, 114]

2025-07-17 02:44:58,019 - INFO -

Training completed!

2025-07-17 02:44:58,019 - INFO -

Saving final trained model...

2025-07-17 02:45:00,243 - INFO - Final trained model saved to ./results/n9\_final\_model\_gz\_ptype0\_no\_cat.pth

2025-07-17 02:45:00,244 - INFO -

Evaluating final trained model...

2025-07-17 02:45:03,335 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 02:45:03,335 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 02:45:04,961 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 02:45:05,695 - INFO -

Detailed Clustering Evaluation of Final Model:

2025-07-17 02:45:05,695 - INFO - silhouette: 0.17987941205501556

2025-07-17 02:45:05,695 - INFO - davies\_bouldin: 1.7095

2025-07-17 02:45:05,695 - INFO - calinski\_harabasz: 1724.4217

2025-07-17 02:45:05,695 - INFO - cohesion: -0.13598041236400604

2025-07-17 02:45:05,696 - INFO - separation: 0.3333

2025-07-17 02:45:05,696 - INFO - separation\_to\_cohesion: 2.4507

2025-07-17 02:45:05,696 - INFO - size\_balance: 0.4201

2025-07-17 02:45:05,696 - INFO - cluster\_count: 9.0000

2025-07-17 02:45:05,696 - INFO - avg\_cluster\_size: 797.8889

2025-07-17 02:45:05,696 - INFO - cluster\_size\_std: 462.7215

2025-07-17 02:45:05,696 - INFO - cluster\_sizes: [1384, 616, 1505, 756, 561, 393, 1331, 521, 114]

2025-07-17 02:45:05,696 - INFO -

--- Detailed Clustering Evaluation of Final Model (based on P indicator matrix as embeddings) ---

2025-07-17 02:45:06,440 - INFO - P\_based\_silhouette: 0.2338980734348297

2025-07-17 02:45:06,440 - INFO - P\_based\_davies\_bouldin: 1.2782

2025-07-17 02:45:06,440 - INFO - P\_based\_calinski\_harabasz: 918.4220

2025-07-17 02:45:06,440 - INFO - P\_based\_cohesion: -0.019413813948631287

2025-07-17 02:45:06,441 - INFO - P\_based\_separation: 0.0393

2025-07-17 02:45:06,441 - INFO - P\_based\_separation\_to\_cohesion: 2.0267

2025-07-17 02:45:06,441 - INFO - P\_based\_size\_balance: 0.4201

2025-07-17 02:45:06,441 - INFO - P\_based\_cluster\_count: 9.0000

2025-07-17 02:45:06,441 - INFO - P\_based\_avg\_cluster\_size: 797.8889

2025-07-17 02:45:06,442 - INFO - P\_based\_cluster\_size\_std: 462.7215

2025-07-17 02:45:06,442 - INFO - P\_based\_cluster\_sizes: [1384, 616, 1505, 756, 561, 393, 1331, 521, 114]

2025-07-17 02:45:06,442 - INFO - Saving final results with embeddings and view weights...

2025-07-17 02:45:09,208 - INFO - Final results saved to ./results/n9\_final\_clustering\_gz\_pytpe0\_no\_cat.csv

2025-07-17 02:45:09,223 - INFO - Final evaluation metrics saved to ./results/n9\_final\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 09:16:38,529 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=10, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-17 09:16:38,551 - INFO - CUDA available. Using device: cuda:0

2025-07-17 09:16:38,551 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-17 09:17:04,915 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-17 09:17:04,919 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-17 09:17:04,929 - INFO - Numerical features scaled.

2025-07-17 09:17:05,093 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-17 09:17:05,099 - INFO - Loading pre-built graphs from directory: ./data

2025-07-17 09:17:05,145 - INFO - Loaded time graph: 807056 edges.

2025-07-17 09:17:05,156 - INFO - Loaded space graph: 890250 edges.

2025-07-17 09:17:05,167 - INFO - Loaded attr graph: 982548 edges.

2025-07-17 09:17:05,191 - INFO - Pretraining encoder...

2025-07-17 09:17:05,191 - WARNING - The main training loop might still encounter OutOfMemoryError due to the N x N matrix calculation

2025-07-17 09:17:05,191 - WARNING - in the clustering loss module (ZZ^T for SVD). This is inherent to the standard EGAE Jc loss formulation.

2025-07-17 09:17:05,191 - WARNING - If OOM occurs in the main loop, consider using a GPU with more memory or exploring approximations if available.

2025-07-17 09:19:18,386 - INFO - Pretrain Epoch 10/100 - Time: 13.09s: Recon Loss = 0.2130, Reg Loss = 0.1389, Total Loss = 0.3519

2025-07-17 09:21:36,421 - INFO - Pretrain Epoch 20/100 - Time: 15.17s: Recon Loss = 0.1900, Reg Loss = 0.1171, Total Loss = 0.3071

2025-07-17 09:23:59,803 - INFO - Pretrain Epoch 30/100 - Time: 12.90s: Recon Loss = 0.1623, Reg Loss = 0.0982, Total Loss = 0.2606

2025-07-17 09:26:12,924 - INFO - Pretrain Epoch 40/100 - Time: 13.17s: Recon Loss = 0.1618, Reg Loss = 0.0815, Total Loss = 0.2433

2025-07-17 09:28:41,570 - INFO - Pretrain Epoch 50/100 - Time: 16.46s: Recon Loss = 0.1618, Reg Loss = 0.0673, Total Loss = 0.2291

2025-07-17 09:30:55,948 - INFO - Pretrain Epoch 60/100 - Time: 15.04s: Recon Loss = 0.1620, Reg Loss = 0.0556, Total Loss = 0.2175

2025-07-17 09:33:09,370 - INFO - Pretrain Epoch 70/100 - Time: 12.99s: Recon Loss = 0.1620, Reg Loss = 0.0460, Total Loss = 0.2079

2025-07-17 09:35:23,370 - INFO - Pretrain Epoch 80/100 - Time: 10.98s: Recon Loss = 0.1623, Reg Loss = 0.0382, Total Loss = 0.2005

2025-07-17 09:37:20,237 - INFO - Pretrain Epoch 90/100 - Time: 11.03s: Recon Loss = 0.1620, Reg Loss = 0.0319, Total Loss = 0.1939

2025-07-17 09:39:19,317 - INFO - Pretrain Epoch 100/100 - Time: 11.54s: Recon Loss = 0.1620, Reg Loss = 0.0268, Total Loss = 0.1888

2025-07-17 09:39:19,317 - INFO -

Pretraining finished. Evaluating pretraining results with standard K-Means...

2025-07-17 09:39:22,278 - INFO - Running standard KMeans on pretrain embeddings ((7181, 64))...

2025-07-17 09:39:22,462 - INFO - Standard KMeans finished.

2025-07-17 09:39:23,105 - INFO - Pretraining Standard K-Means Clustering Evaluation:

2025-07-17 09:39:23,106 - INFO - silhouette: 0.29705944657325745

2025-07-17 09:39:23,106 - INFO - davies\_bouldin: 1.3348

2025-07-17 09:39:23,106 - INFO - calinski\_harabasz: 3799.4032

2025-07-17 09:39:23,106 - INFO - cohesion: -1.0482876300811768

2025-07-17 09:39:23,106 - INFO - separation: 3.1698

2025-07-17 09:39:23,106 - INFO - separation\_to\_cohesion: 3.0238

2025-07-17 09:39:23,106 - INFO - size\_balance: 0.3728

2025-07-17 09:39:23,106 - INFO - cluster\_count: 10.0000

2025-07-17 09:39:23,106 - INFO - avg\_cluster\_size: 718.1000

2025-07-17 09:39:23,106 - INFO - cluster\_size\_std: 450.3890

2025-07-17 09:39:23,107 - INFO - cluster\_sizes: [1147, 846, 304, 430, 1630, 762, 106, 306, 531, 1119]

2025-07-17 09:39:27,425 - INFO - Pretraining standard KMeans++ results saved to ./results/n10\_pretrain\_standard\_kmeans\_clustering\_gz\_ptype0\_no\_cat.csv

2025-07-17 09:39:27,440 - INFO - Pretraining standard KMeans++ evaluation metrics saved to ./results/n10\_pretrain\_standard\_kmeans\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 09:39:27,504 - INFO - Pretraining encoder saved to ./results/n10\_pretrain\_encoder\_gz\_pytpe0\_no\_cat.pth

2025-07-17 09:39:27,505 - INFO -

Starting main training loop (Alternating Optimization)...

2025-07-17 09:39:27,505 - INFO - Initializing indicator matrix P for main training...

2025-07-17 09:39:31,543 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 09:39:31,543 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 09:39:33,253 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 09:39:33,253 - INFO - Evaluating initial main training clustering results (SVD + KMeans++ on P)...

2025-07-17 09:39:33,917 - INFO - Initial Main Training SVD + KMeans++ Clustering Evaluation:

2025-07-17 09:39:33,917 - INFO - silhouette: 0.2123599797487259

2025-07-17 09:39:33,917 - INFO - davies\_bouldin: 2.2237

2025-07-17 09:39:33,917 - INFO - calinski\_harabasz: 739.6679

2025-07-17 09:39:33,917 - INFO - cohesion: -1.799261450767517

2025-07-17 09:39:33,919 - INFO - separation: 2.1994

2025-07-17 09:39:33,919 - INFO - separation\_to\_cohesion: 1.2224

2025-07-17 09:39:33,919 - INFO - size\_balance: 0.0000

2025-07-17 09:39:33,919 - INFO - cluster\_count: 10.0000

2025-07-17 09:39:33,919 - INFO - avg\_cluster\_size: 718.1000

2025-07-17 09:39:33,919 - INFO - cluster\_size\_std: 742.9367

2025-07-17 09:39:33,919 - INFO - cluster\_sizes: [1864, 219, 229, 627, 2084, 1495, 160, 218, 233, 52]

2025-07-17 09:40:19,422 - INFO - Epoch 1/80 - Time: 45.50s:Recon Loss=0.1744, Cluster Loss=11.2850,Reg Loss=0.0264,Last Inner Loss=11.4857

2025-07-17 09:41:03,199 - INFO - Epoch 2/80 - Time: 43.78s:Recon Loss=0.2068, Cluster Loss=4.6489,Reg Loss=0.0265,Last Inner Loss=4.8822

2025-07-17 09:41:44,522 - INFO - Epoch 3/80 - Time: 41.32s:Recon Loss=0.2123, Cluster Loss=2.1901,Reg Loss=0.0267,Last Inner Loss=2.4290

2025-07-17 09:42:25,674 - INFO - Epoch 4/80 - Time: 41.15s:Recon Loss=0.2402, Cluster Loss=1.4476,Reg Loss=0.0268,Last Inner Loss=1.7147

2025-07-17 09:43:06,535 - INFO - Epoch 5/80 - Time: 40.86s:Recon Loss=0.2462, Cluster Loss=1.0818,Reg Loss=0.0270,Last Inner Loss=1.3550

2025-07-17 09:43:45,619 - INFO - Epoch 6/80 - Time: 39.08s:Recon Loss=0.2479, Cluster Loss=0.8729,Reg Loss=0.0271,Last Inner Loss=1.1479

2025-07-17 09:44:26,012 - INFO - Epoch 7/80 - Time: 40.39s:Recon Loss=0.2433, Cluster Loss=1.3163,Reg Loss=0.0272,Last Inner Loss=1.5869

2025-07-17 09:45:10,579 - INFO - Epoch 8/80 - Time: 44.57s:Recon Loss=0.2496, Cluster Loss=0.5486,Reg Loss=0.0273,Last Inner Loss=0.8256

2025-07-17 09:45:55,368 - INFO - Epoch 9/80 - Time: 44.79s:Recon Loss=0.2461, Cluster Loss=0.4311,Reg Loss=0.0274,Last Inner Loss=0.7046

2025-07-17 09:46:39,426 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 09:46:39,426 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 09:46:41,058 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 09:46:41,796 - INFO - Epoch 10/80 (Eval) - Time: 46.43s (Eval Time: 5.99s):

2025-07-17 09:46:41,796 - INFO - Evaluation Metrics:

2025-07-17 09:46:41,796 - INFO - silhouette: 0.06249972805380821

2025-07-17 09:46:41,797 - INFO - davies\_bouldin: 2.6751

2025-07-17 09:46:41,797 - INFO - calinski\_harabasz: 1073.5254

2025-07-17 09:46:41,797 - INFO - cohesion: -0.08612917363643646

2025-07-17 09:46:41,797 - INFO - separation: 0.1581

2025-07-17 09:46:41,797 - INFO - separation\_to\_cohesion: 1.8360

2025-07-17 09:46:41,797 - INFO - size\_balance: 0.5460

2025-07-17 09:46:41,797 - INFO - cluster\_count: 10.0000

2025-07-17 09:46:41,797 - INFO - avg\_cluster\_size: 718.1000

2025-07-17 09:46:41,797 - INFO - cluster\_size\_std: 326.0235

2025-07-17 09:46:41,797 - INFO - cluster\_sizes: [368, 585, 511, 176, 827, 1030, 846, 1151, 496, 1191]

2025-07-17 09:47:22,990 - INFO - Epoch 11/80 - Time: 41.19s:Recon Loss=0.2340, Cluster Loss=0.2274,Reg Loss=0.0274,Last Inner Loss=0.4888

2025-07-17 09:48:01,322 - INFO - Epoch 12/80 - Time: 38.33s:Recon Loss=0.2281, Cluster Loss=0.2426,Reg Loss=0.0275,Last Inner Loss=0.4982

2025-07-17 09:48:41,836 - INFO - Epoch 13/80 - Time: 40.51s:Recon Loss=0.2173, Cluster Loss=0.1726,Reg Loss=0.0275,Last Inner Loss=0.4174

2025-07-17 09:49:22,616 - INFO - Epoch 14/80 - Time: 40.78s:Recon Loss=0.2061, Cluster Loss=0.2185,Reg Loss=0.0275,Last Inner Loss=0.4521

2025-07-17 09:50:01,580 - INFO - Epoch 15/80 - Time: 38.96s:Recon Loss=0.1973, Cluster Loss=0.1595,Reg Loss=0.0275,Last Inner Loss=0.3842

2025-07-17 09:50:42,591 - INFO - Epoch 16/80 - Time: 41.01s:Recon Loss=0.2044, Cluster Loss=0.1402,Reg Loss=0.0275,Last Inner Loss=0.3721

2025-07-17 09:51:24,003 - INFO - Epoch 17/80 - Time: 41.41s:Recon Loss=0.1924, Cluster Loss=0.1507,Reg Loss=0.0275,Last Inner Loss=0.3706

2025-07-17 09:52:07,378 - INFO - Epoch 18/80 - Time: 43.37s:Recon Loss=0.1913, Cluster Loss=0.1417,Reg Loss=0.0275,Last Inner Loss=0.3605

2025-07-17 09:52:49,595 - INFO - Epoch 19/80 - Time: 42.22s:Recon Loss=0.1890, Cluster Loss=0.1214,Reg Loss=0.0275,Last Inner Loss=0.3379

2025-07-17 09:53:32,619 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 09:53:32,620 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 09:53:34,261 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 09:53:35,027 - INFO - Epoch 20/80 (Eval) - Time: 45.43s (Eval Time: 5.77s):

2025-07-17 09:53:35,027 - INFO - Evaluation Metrics:

2025-07-17 09:53:35,027 - INFO - silhouette: 0.07217863202095032

2025-07-17 09:53:35,027 - INFO - davies\_bouldin: 2.4363

2025-07-17 09:53:35,027 - INFO - calinski\_harabasz: 1003.7180

2025-07-17 09:53:35,027 - INFO - cohesion: -0.05801957845687866

2025-07-17 09:53:35,028 - INFO - separation: 0.1142

2025-07-17 09:53:35,028 - INFO - separation\_to\_cohesion: 1.9689

2025-07-17 09:53:35,028 - INFO - size\_balance: 0.4378

2025-07-17 09:53:35,028 - INFO - cluster\_count: 10.0000

2025-07-17 09:53:35,028 - INFO - avg\_cluster\_size: 718.1000

2025-07-17 09:53:35,028 - INFO - cluster\_size\_std: 403.7255

2025-07-17 09:53:35,028 - INFO - cluster\_sizes: [1155, 1104, 110, 980, 1054, 356, 522, 1201, 170, 529]

2025-07-17 09:54:14,240 - INFO - Epoch 21/80 - Time: 39.21s:Recon Loss=0.1792, Cluster Loss=0.0960,Reg Loss=0.0275,Last Inner Loss=0.3026

2025-07-17 09:54:55,713 - INFO - Epoch 22/80 - Time: 41.47s:Recon Loss=0.1771, Cluster Loss=0.1666,Reg Loss=0.0274,Last Inner Loss=0.3711

2025-07-17 09:55:34,826 - INFO - Epoch 23/80 - Time: 39.11s:Recon Loss=0.1776, Cluster Loss=0.1049,Reg Loss=0.0274,Last Inner Loss=0.3099

2025-07-17 09:56:15,371 - INFO - Epoch 24/80 - Time: 40.54s:Recon Loss=0.1736, Cluster Loss=0.1242,Reg Loss=0.0274,Last Inner Loss=0.3253

2025-07-17 09:56:58,680 - INFO - Epoch 25/80 - Time: 43.31s:Recon Loss=0.1706, Cluster Loss=0.1090,Reg Loss=0.0274,Last Inner Loss=0.3071

2025-07-17 09:57:43,640 - INFO - Epoch 26/80 - Time: 44.96s:Recon Loss=0.1705, Cluster Loss=0.1249,Reg Loss=0.0274,Last Inner Loss=0.3228

2025-07-17 09:58:28,276 - INFO - Epoch 27/80 - Time: 44.64s:Recon Loss=0.1687, Cluster Loss=0.0972,Reg Loss=0.0274,Last Inner Loss=0.2933

2025-07-17 09:59:10,955 - INFO - Epoch 28/80 - Time: 42.68s:Recon Loss=0.1717, Cluster Loss=0.1155,Reg Loss=0.0274,Last Inner Loss=0.3146

2025-07-17 09:59:50,897 - INFO - Epoch 29/80 - Time: 39.94s:Recon Loss=0.1735, Cluster Loss=0.1696,Reg Loss=0.0274,Last Inner Loss=0.3705

2025-07-17 10:00:31,359 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 10:00:31,359 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 10:00:33,042 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 10:00:33,875 - INFO - Epoch 30/80 (Eval) - Time: 42.98s (Eval Time: 5.70s):

2025-07-17 10:00:33,875 - INFO - Evaluation Metrics:

2025-07-17 10:00:33,875 - INFO - silhouette: 0.12808887660503387

2025-07-17 10:00:33,875 - INFO - davies\_bouldin: 1.7264

2025-07-17 10:00:33,875 - INFO - calinski\_harabasz: 1016.0487

2025-07-17 10:00:33,875 - INFO - cohesion: -0.05810391157865524

2025-07-17 10:00:33,875 - INFO - separation: 0.1127

2025-07-17 10:00:33,875 - INFO - separation\_to\_cohesion: 1.9400

2025-07-17 10:00:33,875 - INFO - size\_balance: 0.3360

2025-07-17 10:00:33,875 - INFO - cluster\_count: 10.0000

2025-07-17 10:00:33,876 - INFO - avg\_cluster\_size: 718.1000

2025-07-17 10:00:33,876 - INFO - cluster\_size\_std: 476.8223

2025-07-17 10:00:33,876 - INFO - cluster\_sizes: [514, 887, 596, 1661, 1394, 377, 895, 163, 111, 583]

2025-07-17 10:01:16,308 - INFO - Epoch 31/80 - Time: 42.43s:Recon Loss=0.1706, Cluster Loss=0.0965,Reg Loss=0.0274,Last Inner Loss=0.2945

2025-07-17 10:01:55,221 - INFO - Epoch 32/80 - Time: 38.91s:Recon Loss=0.1712, Cluster Loss=0.0667,Reg Loss=0.0274,Last Inner Loss=0.2653

2025-07-17 10:02:35,178 - INFO - Epoch 33/80 - Time: 39.96s:Recon Loss=0.1687, Cluster Loss=0.0665,Reg Loss=0.0274,Last Inner Loss=0.2626

2025-07-17 10:03:19,139 - INFO - Epoch 34/80 - Time: 43.96s:Recon Loss=0.1683, Cluster Loss=0.0665,Reg Loss=0.0274,Last Inner Loss=0.2622

2025-07-17 10:04:03,581 - INFO - Epoch 35/80 - Time: 44.44s:Recon Loss=0.1688, Cluster Loss=0.1029,Reg Loss=0.0274,Last Inner Loss=0.2991

2025-07-17 10:04:44,424 - INFO - Epoch 36/80 - Time: 40.84s:Recon Loss=0.1703, Cluster Loss=0.1395,Reg Loss=0.0274,Last Inner Loss=0.3372

2025-07-17 10:05:24,788 - INFO - Epoch 37/80 - Time: 40.36s:Recon Loss=0.1767, Cluster Loss=0.2570,Reg Loss=0.0274,Last Inner Loss=0.4612

2025-07-17 10:06:04,415 - INFO - Epoch 38/80 - Time: 39.63s:Recon Loss=0.1760, Cluster Loss=0.3217,Reg Loss=0.0274,Last Inner Loss=0.5251

2025-07-17 10:06:44,788 - INFO - Epoch 39/80 - Time: 40.37s:Recon Loss=0.1726, Cluster Loss=0.3060,Reg Loss=0.0275,Last Inner Loss=0.5061

2025-07-17 10:07:28,539 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 10:07:28,539 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 10:07:30,189 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 10:07:31,060 - INFO - Epoch 40/80 (Eval) - Time: 46.27s (Eval Time: 5.84s):

2025-07-17 10:07:31,060 - INFO - Evaluation Metrics:

2025-07-17 10:07:31,060 - INFO - silhouette: 0.1643017679452896

2025-07-17 10:07:31,060 - INFO - davies\_bouldin: 1.6422

2025-07-17 10:07:31,060 - INFO - calinski\_harabasz: 1103.0313

2025-07-17 10:07:31,060 - INFO - cohesion: -0.07830078899860382

2025-07-17 10:07:31,060 - INFO - separation: 0.1575

2025-07-17 10:07:31,062 - INFO - separation\_to\_cohesion: 2.0111

2025-07-17 10:07:31,062 - INFO - size\_balance: 0.3717

2025-07-17 10:07:31,062 - INFO - cluster\_count: 10.0000

2025-07-17 10:07:31,062 - INFO - avg\_cluster\_size: 718.1000

2025-07-17 10:07:31,062 - INFO - cluster\_size\_std: 451.2134

2025-07-17 10:07:31,062 - INFO - cluster\_sizes: [504, 589, 1133, 110, 678, 474, 158, 1664, 1119, 752]

2025-07-17 10:08:10,949 - INFO - Epoch 41/80 - Time: 39.89s:Recon Loss=0.1666, Cluster Loss=0.1289,Reg Loss=0.0275,Last Inner Loss=0.3230

2025-07-17 10:08:55,167 - INFO - Epoch 42/80 - Time: 44.22s:Recon Loss=0.1679, Cluster Loss=0.0687,Reg Loss=0.0275,Last Inner Loss=0.2640

2025-07-17 10:09:40,565 - INFO - Epoch 43/80 - Time: 45.40s:Recon Loss=0.1685, Cluster Loss=0.0686,Reg Loss=0.0275,Last Inner Loss=0.2646

2025-07-17 10:10:26,390 - INFO - Epoch 44/80 - Time: 45.82s:Recon Loss=0.1672, Cluster Loss=0.0632,Reg Loss=0.0275,Last Inner Loss=0.2579

2025-07-17 10:11:08,410 - INFO - Epoch 45/80 - Time: 42.02s:Recon Loss=0.1672, Cluster Loss=0.0808,Reg Loss=0.0275,Last Inner Loss=0.2755

2025-07-17 10:11:48,140 - INFO - Epoch 46/80 - Time: 39.73s:Recon Loss=0.1670, Cluster Loss=0.0628,Reg Loss=0.0275,Last Inner Loss=0.2573

2025-07-17 10:12:28,019 - INFO - Epoch 47/80 - Time: 39.88s:Recon Loss=0.1639, Cluster Loss=0.0889,Reg Loss=0.0274,Last Inner Loss=0.2802

2025-07-17 10:13:08,350 - INFO - Epoch 48/80 - Time: 40.33s:Recon Loss=0.1632, Cluster Loss=0.0887,Reg Loss=0.0274,Last Inner Loss=0.2793

2025-07-17 10:13:47,632 - INFO - Epoch 49/80 - Time: 39.28s:Recon Loss=0.1658, Cluster Loss=0.0706,Reg Loss=0.0274,Last Inner Loss=0.2638

2025-07-17 10:14:33,565 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 10:14:33,565 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 10:14:35,132 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 10:14:35,968 - INFO - Epoch 50/80 (Eval) - Time: 48.34s (Eval Time: 6.87s):

2025-07-17 10:14:35,968 - INFO - Evaluation Metrics:

2025-07-17 10:14:35,968 - INFO - silhouette: 0.15562467277050018

2025-07-17 10:14:35,968 - INFO - davies\_bouldin: 1.8427

2025-07-17 10:14:35,968 - INFO - calinski\_harabasz: 1142.9528

2025-07-17 10:14:35,968 - INFO - cohesion: -0.07470452040433884

2025-07-17 10:14:35,969 - INFO - separation: 0.1445

2025-07-17 10:14:35,969 - INFO - separation\_to\_cohesion: 1.9346

2025-07-17 10:14:35,969 - INFO - size\_balance: 0.4223

2025-07-17 10:14:35,969 - INFO - cluster\_count: 10.0000

2025-07-17 10:14:35,969 - INFO - avg\_cluster\_size: 718.1000

2025-07-17 10:14:35,969 - INFO - cluster\_size\_std: 414.8300

2025-07-17 10:14:35,969 - INFO - cluster\_sizes: [519, 1169, 410, 446, 1026, 343, 1383, 543, 125, 1217]

2025-07-17 10:15:17,581 - INFO - Epoch 51/80 - Time: 41.61s:Recon Loss=0.1652, Cluster Loss=0.0637,Reg Loss=0.0274,Last Inner Loss=0.2563

2025-07-17 10:16:02,531 - INFO - Epoch 52/80 - Time: 44.95s:Recon Loss=0.1653, Cluster Loss=0.0449,Reg Loss=0.0274,Last Inner Loss=0.2377

2025-07-17 10:16:45,187 - INFO - Epoch 53/80 - Time: 42.66s:Recon Loss=0.1671, Cluster Loss=0.0523,Reg Loss=0.0274,Last Inner Loss=0.2468

2025-07-17 10:17:24,776 - INFO - Epoch 54/80 - Time: 39.59s:Recon Loss=0.1677, Cluster Loss=0.0854,Reg Loss=0.0274,Last Inner Loss=0.2804

2025-07-17 10:18:03,005 - INFO - Epoch 55/80 - Time: 38.23s:Recon Loss=0.1656, Cluster Loss=0.1502,Reg Loss=0.0274,Last Inner Loss=0.3432

2025-07-17 10:18:41,621 - INFO - Epoch 56/80 - Time: 38.62s:Recon Loss=0.1662, Cluster Loss=0.0960,Reg Loss=0.0274,Last Inner Loss=0.2896

2025-07-17 10:19:19,949 - INFO - Epoch 57/80 - Time: 38.33s:Recon Loss=0.1657, Cluster Loss=0.0837,Reg Loss=0.0274,Last Inner Loss=0.2768

2025-07-17 10:19:57,926 - INFO - Epoch 58/80 - Time: 37.98s:Recon Loss=0.1651, Cluster Loss=0.0683,Reg Loss=0.0273,Last Inner Loss=0.2607

2025-07-17 10:20:39,347 - INFO - Epoch 59/80 - Time: 41.42s:Recon Loss=0.1642, Cluster Loss=0.1085,Reg Loss=0.0273,Last Inner Loss=0.3000

2025-07-17 10:21:28,436 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 10:21:28,436 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 10:21:30,036 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 10:21:30,886 - INFO - Epoch 60/80 (Eval) - Time: 51.54s (Eval Time: 6.15s):

2025-07-17 10:21:30,886 - INFO - Evaluation Metrics:

2025-07-17 10:21:30,886 - INFO - silhouette: 0.12552447617053986

2025-07-17 10:21:30,886 - INFO - davies\_bouldin: 1.7021

2025-07-17 10:21:30,886 - INFO - calinski\_harabasz: 1024.1859

2025-07-17 10:21:30,887 - INFO - cohesion: -0.07585453242063522

2025-07-17 10:21:30,887 - INFO - separation: 0.1506

2025-07-17 10:21:30,887 - INFO - separation\_to\_cohesion: 1.9850

2025-07-17 10:21:30,887 - INFO - size\_balance: 0.3241

2025-07-17 10:21:30,887 - INFO - cluster\_count: 10.0000

2025-07-17 10:21:30,887 - INFO - avg\_cluster\_size: 718.1000

2025-07-17 10:21:30,887 - INFO - cluster\_size\_std: 485.3746

2025-07-17 10:21:30,887 - INFO - cluster\_sizes: [533, 475, 154, 1394, 346, 1789, 443, 935, 672, 440]

2025-07-17 10:22:14,026 - INFO - Epoch 61/80 - Time: 43.14s:Recon Loss=0.1664, Cluster Loss=0.0486,Reg Loss=0.0273,Last Inner Loss=0.2423

2025-07-17 10:22:56,704 - INFO - Epoch 62/80 - Time: 42.68s:Recon Loss=0.1660, Cluster Loss=0.0406,Reg Loss=0.0273,Last Inner Loss=0.2339

2025-07-17 10:23:41,422 - INFO - Epoch 63/80 - Time: 44.72s:Recon Loss=0.1649, Cluster Loss=0.0515,Reg Loss=0.0273,Last Inner Loss=0.2437

2025-07-17 10:24:21,826 - INFO - Epoch 64/80 - Time: 40.40s:Recon Loss=0.1651, Cluster Loss=0.0392,Reg Loss=0.0273,Last Inner Loss=0.2316

2025-07-17 10:25:02,218 - INFO - Epoch 65/80 - Time: 40.39s:Recon Loss=0.1656, Cluster Loss=0.0366,Reg Loss=0.0272,Last Inner Loss=0.2294

2025-07-17 10:25:40,985 - INFO - Epoch 66/80 - Time: 38.77s:Recon Loss=0.1632, Cluster Loss=0.0534,Reg Loss=0.0272,Last Inner Loss=0.2439

2025-07-17 10:26:19,504 - INFO - Epoch 67/80 - Time: 38.52s:Recon Loss=0.1664, Cluster Loss=0.0705,Reg Loss=0.0272,Last Inner Loss=0.2641

2025-07-17 10:27:02,020 - INFO - Epoch 68/80 - Time: 42.52s:Recon Loss=0.1702, Cluster Loss=0.1725,Reg Loss=0.0272,Last Inner Loss=0.3699

2025-07-17 10:27:49,561 - INFO - Epoch 69/80 - Time: 47.54s:Recon Loss=0.1684, Cluster Loss=0.2220,Reg Loss=0.0273,Last Inner Loss=0.4176

2025-07-17 10:28:37,036 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 10:28:37,036 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 10:28:38,686 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 10:28:39,491 - INFO - Epoch 70/80 (Eval) - Time: 49.93s (Eval Time: 6.49s):

2025-07-17 10:28:39,492 - INFO - Evaluation Metrics:

2025-07-17 10:28:39,492 - INFO - silhouette: 0.16969944536685944

2025-07-17 10:28:39,492 - INFO - davies\_bouldin: 1.7221

2025-07-17 10:28:39,492 - INFO - calinski\_harabasz: 1352.5579

2025-07-17 10:28:39,492 - INFO - cohesion: -0.08005575835704803

2025-07-17 10:28:39,492 - INFO - separation: 0.1603

2025-07-17 10:28:39,492 - INFO - separation\_to\_cohesion: 2.0026

2025-07-17 10:28:39,493 - INFO - size\_balance: 0.4473

2025-07-17 10:28:39,493 - INFO - cluster\_count: 10.0000

2025-07-17 10:28:39,493 - INFO - avg\_cluster\_size: 718.1000

2025-07-17 10:28:39,493 - INFO - cluster\_size\_std: 396.8588

2025-07-17 10:28:39,493 - INFO - cluster\_sizes: [224, 1273, 1091, 356, 702, 1475, 430, 528, 503, 599]

2025-07-17 10:29:25,527 - INFO - Epoch 71/80 - Time: 46.03s:Recon Loss=0.1669, Cluster Loss=0.0594,Reg Loss=0.0273,Last Inner Loss=0.2536

2025-07-17 10:30:10,754 - INFO - Epoch 72/80 - Time: 45.23s:Recon Loss=0.1660, Cluster Loss=0.0682,Reg Loss=0.0273,Last Inner Loss=0.2615

2025-07-17 10:30:56,139 - INFO - Epoch 73/80 - Time: 45.38s:Recon Loss=0.1653, Cluster Loss=0.0570,Reg Loss=0.0273,Last Inner Loss=0.2496

2025-07-17 10:31:38,399 - INFO - Epoch 74/80 - Time: 42.26s:Recon Loss=0.1636, Cluster Loss=0.1012,Reg Loss=0.0273,Last Inner Loss=0.2921

2025-07-17 10:32:24,417 - INFO - Epoch 75/80 - Time: 46.02s:Recon Loss=0.1671, Cluster Loss=0.1144,Reg Loss=0.0273,Last Inner Loss=0.3088

2025-07-17 10:33:10,164 - INFO - Epoch 76/80 - Time: 45.75s:Recon Loss=0.1716, Cluster Loss=0.1771,Reg Loss=0.0273,Last Inner Loss=0.3760

2025-07-17 10:33:55,894 - INFO - Epoch 77/80 - Time: 45.73s:Recon Loss=0.1692, Cluster Loss=0.1851,Reg Loss=0.0273,Last Inner Loss=0.3817

2025-07-17 10:34:41,129 - INFO - Epoch 78/80 - Time: 45.23s:Recon Loss=0.1647, Cluster Loss=0.1821,Reg Loss=0.0274,Last Inner Loss=0.3741

2025-07-17 10:35:27,519 - INFO - Epoch 79/80 - Time: 46.39s:Recon Loss=0.1691, Cluster Loss=0.2276,Reg Loss=0.0274,Last Inner Loss=0.4241

2025-07-17 10:36:19,262 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 10:36:19,262 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 10:36:20,807 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 10:36:21,576 - INFO - Epoch 80/80 (Eval) - Time: 54.06s (Eval Time: 6.38s):

2025-07-17 10:36:21,576 - INFO - Evaluation Metrics:

2025-07-17 10:36:21,577 - INFO - silhouette: 0.17370471358299255

2025-07-17 10:36:21,577 - INFO - davies\_bouldin: 1.6860

2025-07-17 10:36:21,577 - INFO - calinski\_harabasz: 1266.7820

2025-07-17 10:36:21,577 - INFO - cohesion: -0.09861300885677338

2025-07-17 10:36:21,577 - INFO - separation: 0.1939

2025-07-17 10:36:21,577 - INFO - separation\_to\_cohesion: 1.9659

2025-07-17 10:36:21,577 - INFO - size\_balance: 0.5257

2025-07-17 10:36:21,577 - INFO - cluster\_count: 10.0000

2025-07-17 10:36:21,577 - INFO - avg\_cluster\_size: 718.1000

2025-07-17 10:36:21,577 - INFO - cluster\_size\_std: 340.5808

2025-07-17 10:36:21,578 - INFO - cluster\_sizes: [478, 1105, 459, 933, 546, 639, 361, 1514, 586, 560]

2025-07-17 10:36:21,578 - INFO -

Training completed!

2025-07-17 10:36:21,578 - INFO -

Saving final trained model...

2025-07-17 10:36:23,792 - INFO - Final trained model saved to ./results/n10\_final\_model\_gz\_ptype0\_no\_cat.pth

2025-07-17 10:36:23,792 - INFO -

Evaluating final trained model...

2025-07-17 10:36:27,921 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 10:36:27,921 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 10:36:29,714 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 10:36:30,582 - INFO -

Detailed Clustering Evaluation of Final Model:

2025-07-17 10:36:30,583 - INFO - silhouette: 0.17370471358299255

2025-07-17 10:36:30,583 - INFO - davies\_bouldin: 1.6860

2025-07-17 10:36:30,583 - INFO - calinski\_harabasz: 1266.7819

2025-07-17 10:36:30,583 - INFO - cohesion: -0.09861300885677338

2025-07-17 10:36:30,583 - INFO - separation: 0.1939

2025-07-17 10:36:30,583 - INFO - separation\_to\_cohesion: 1.9659

2025-07-17 10:36:30,583 - INFO - size\_balance: 0.5257

2025-07-17 10:36:30,583 - INFO - cluster\_count: 10.0000

2025-07-17 10:36:30,583 - INFO - avg\_cluster\_size: 718.1000

2025-07-17 10:36:30,583 - INFO - cluster\_size\_std: 340.5808

2025-07-17 10:36:30,583 - INFO - cluster\_sizes: [478, 1105, 459, 933, 546, 639, 361, 1514, 586, 560]

2025-07-17 10:36:30,583 - INFO -

--- Detailed Clustering Evaluation of Final Model (based on P indicator matrix as embeddings) ---

2025-07-17 10:36:31,419 - INFO - P\_based\_silhouette: 0.2164946049451828

2025-07-17 10:36:31,419 - INFO - P\_based\_davies\_bouldin: 1.4016

2025-07-17 10:36:31,419 - INFO - P\_based\_calinski\_harabasz: 1044.2647

2025-07-17 10:36:31,420 - INFO - P\_based\_cohesion: -0.02238667756319046

2025-07-17 10:36:31,420 - INFO - P\_based\_separation: 0.0396

2025-07-17 10:36:31,420 - INFO - P\_based\_separation\_to\_cohesion: 1.7702

2025-07-17 10:36:31,420 - INFO - P\_based\_size\_balance: 0.5257

2025-07-17 10:36:31,420 - INFO - P\_based\_cluster\_count: 10.0000

2025-07-17 10:36:31,420 - INFO - P\_based\_avg\_cluster\_size: 718.1000

2025-07-17 10:36:31,420 - INFO - P\_based\_cluster\_size\_std: 340.5808

2025-07-17 10:36:31,420 - INFO - P\_based\_cluster\_sizes: [478, 1105, 459, 933, 546, 639, 361, 1514, 586, 560]

2025-07-17 10:36:31,420 - INFO - Saving final results with embeddings and view weights...

2025-07-17 10:36:34,531 - INFO - Final results saved to ./results/n10\_final\_clustering\_gz\_pytpe0\_no\_cat.csv

2025-07-17 10:36:34,546 - INFO - Final evaluation metrics saved to ./results/n10\_final\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 10:39:03,771 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=11, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-17 10:39:03,791 - INFO - CUDA available. Using device: cuda:0

2025-07-17 10:39:03,791 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-17 10:39:29,124 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-17 10:39:29,128 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-17 10:39:29,137 - INFO - Numerical features scaled.

2025-07-17 10:39:29,265 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-17 10:39:29,270 - INFO - Loading pre-built graphs from directory: ./data

2025-07-17 10:39:29,314 - INFO - Loaded time graph: 807056 edges.

2025-07-17 10:39:29,324 - INFO - Loaded space graph: 890250 edges.

2025-07-17 10:39:29,335 - INFO - Loaded attr graph: 982548 edges.

2025-07-17 10:39:29,336 - INFO - Initializing model components...

2025-07-17 10:39:29,360 - INFO - Pretraining encoder...

2025-07-17 10:39:29,360 - WARNING - The main training loop might still encounter OutOfMemoryError due to the N x N matrix calculation

2025-07-17 10:39:29,360 - WARNING - in the clustering loss module (ZZ^T for SVD). This is inherent to the standard EGAE Jc loss formulation.

2025-07-17 10:39:29,360 - WARNING - If OOM occurs in the main loop, consider using a GPU with more memory or exploring approximations if available.

2025-07-17 10:41:39,351 - INFO - Pretrain Epoch 10/100 - Time: 12.67s: Recon Loss = 0.2130, Reg Loss = 0.1389, Total Loss = 0.3519

2025-07-17 10:43:54,800 - INFO - Pretrain Epoch 20/100 - Time: 15.91s: Recon Loss = 0.1896, Reg Loss = 0.1171, Total Loss = 0.3067

2025-07-17 10:46:27,167 - INFO - Pretrain Epoch 30/100 - Time: 14.48s: Recon Loss = 0.1628, Reg Loss = 0.0983, Total Loss = 0.2611

2025-07-17 10:48:58,189 - INFO - Pretrain Epoch 40/100 - Time: 15.36s: Recon Loss = 0.1618, Reg Loss = 0.0816, Total Loss = 0.2434

2025-07-17 10:51:33,145 - INFO - Pretrain Epoch 50/100 - Time: 14.83s: Recon Loss = 0.1618, Reg Loss = 0.0674, Total Loss = 0.2292

2025-07-17 10:54:07,964 - INFO - Pretrain Epoch 60/100 - Time: 15.24s: Recon Loss = 0.1620, Reg Loss = 0.0557, Total Loss = 0.2176

2025-07-17 10:56:51,712 - INFO - Pretrain Epoch 70/100 - Time: 15.08s: Recon Loss = 0.1622, Reg Loss = 0.0461, Total Loss = 0.2083

2025-07-17 10:59:24,808 - INFO - Pretrain Epoch 80/100 - Time: 14.93s: Recon Loss = 0.1629, Reg Loss = 0.0384, Total Loss = 0.2013

2025-07-17 11:02:00,898 - INFO - Pretrain Epoch 90/100 - Time: 16.25s: Recon Loss = 0.1621, Reg Loss = 0.0321, Total Loss = 0.1942

2025-07-17 11:04:35,177 - INFO - Pretrain Epoch 100/100 - Time: 15.35s: Recon Loss = 0.1620, Reg Loss = 0.0270, Total Loss = 0.1890

2025-07-17 11:04:35,177 - INFO -

Pretraining finished. Evaluating pretraining results with standard K-Means...

2025-07-17 11:04:39,097 - INFO - Running standard KMeans on pretrain embeddings ((7181, 64))...

2025-07-17 11:04:39,329 - INFO - Standard KMeans finished.

2025-07-17 11:04:40,172 - INFO - Pretraining Standard K-Means Clustering Evaluation:

2025-07-17 11:04:40,172 - INFO - silhouette: 0.20251697301864624

2025-07-17 11:04:40,172 - INFO - davies\_bouldin: 1.5572

2025-07-17 11:04:40,172 - INFO - calinski\_harabasz: 2297.2563

2025-07-17 11:04:40,173 - INFO - cohesion: -1.3767584562301636

2025-07-17 11:04:40,173 - INFO - separation: 3.7798

2025-07-17 11:04:40,174 - INFO - separation\_to\_cohesion: 2.7454

2025-07-17 11:04:40,174 - INFO - size\_balance: 0.3607

2025-07-17 11:04:40,174 - INFO - cluster\_count: 11.0000

2025-07-17 11:04:40,174 - INFO - avg\_cluster\_size: 652.8182

2025-07-17 11:04:40,174 - INFO - cluster\_size\_std: 417.3651

2025-07-17 11:04:40,175 - INFO - cluster\_sizes: [917, 403, 751, 186, 910, 989, 1568, 668, 30, 412, 347]

2025-07-17 11:04:42,710 - INFO - Pretraining standard KMeans++ results saved to ./results/n11\_pretrain\_standard\_kmeans\_clustering\_gz\_ptype0\_no\_cat.csv

2025-07-17 11:04:42,725 - INFO - Pretraining standard KMeans++ evaluation metrics saved to ./results/n11\_pretrain\_standard\_kmeans\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 11:04:42,791 - INFO - Pretraining encoder saved to ./results/n11\_pretrain\_encoder\_gz\_pytpe0\_no\_cat.pth

2025-07-17 11:04:42,791 - INFO -

Starting main training loop (Alternating Optimization)...

2025-07-17 11:04:42,791 - INFO - Initializing indicator matrix P for main training...

2025-07-17 11:04:46,665 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 11:04:46,666 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 11:04:48,354 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 11:04:48,354 - INFO - Evaluating initial main training clustering results (SVD + KMeans++ on P)...

2025-07-17 11:04:49,175 - INFO - Initial Main Training SVD + KMeans++ Clustering Evaluation:

2025-07-17 11:04:49,175 - INFO - silhouette: 0.0887269601225853

2025-07-17 11:04:49,175 - INFO - davies\_bouldin: 2.5749

2025-07-17 11:04:49,175 - INFO - calinski\_harabasz: 604.7600

2025-07-17 11:04:49,175 - INFO - cohesion: -1.6466476917266846

2025-07-17 11:04:49,175 - INFO - separation: 2.1742

2025-07-17 11:04:49,175 - INFO - separation\_to\_cohesion: 1.3204

2025-07-17 11:04:49,176 - INFO - size\_balance: 0.2966

2025-07-17 11:04:49,176 - INFO - cluster\_count: 11.0000

2025-07-17 11:04:49,176 - INFO - avg\_cluster\_size: 652.8182

2025-07-17 11:04:49,176 - INFO - cluster\_size\_std: 459.1787

2025-07-17 11:04:49,176 - INFO - cluster\_sizes: [1214, 584, 549, 1725, 191, 325, 828, 911, 242, 383, 229]

2025-07-17 11:05:35,206 - INFO - Epoch 1/80 - Time: 46.03s:Recon Loss=0.1718, Cluster Loss=18.6947,Reg Loss=0.0266,Last Inner Loss=18.8931

2025-07-17 11:06:20,791 - INFO - Epoch 2/80 - Time: 45.58s:Recon Loss=0.2180, Cluster Loss=6.0801,Reg Loss=0.0267,Last Inner Loss=6.3248

2025-07-17 11:07:06,890 - INFO - Epoch 3/80 - Time: 46.10s:Recon Loss=0.2242, Cluster Loss=2.9172,Reg Loss=0.0268,Last Inner Loss=3.1683

2025-07-17 11:07:53,781 - INFO - Epoch 4/80 - Time: 46.89s:Recon Loss=0.2385, Cluster Loss=2.3123,Reg Loss=0.0270,Last Inner Loss=2.5778

2025-07-17 11:08:41,294 - INFO - Epoch 5/80 - Time: 47.51s:Recon Loss=0.2514, Cluster Loss=1.3856,Reg Loss=0.0272,Last Inner Loss=1.6642

2025-07-17 11:09:27,308 - INFO - Epoch 6/80 - Time: 46.01s:Recon Loss=0.2507, Cluster Loss=1.1611,Reg Loss=0.0273,Last Inner Loss=1.4391

2025-07-17 11:10:12,947 - INFO - Epoch 7/80 - Time: 45.64s:Recon Loss=0.2473, Cluster Loss=1.1588,Reg Loss=0.0274,Last Inner Loss=1.4335

2025-07-17 11:10:59,347 - INFO - Epoch 8/80 - Time: 46.40s:Recon Loss=0.2536, Cluster Loss=0.7949,Reg Loss=0.0275,Last Inner Loss=1.0761

2025-07-17 11:11:44,301 - INFO - Epoch 9/80 - Time: 44.95s:Recon Loss=0.2521, Cluster Loss=0.6741,Reg Loss=0.0276,Last Inner Loss=0.9538

2025-07-17 11:12:33,533 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 11:12:33,534 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 11:12:35,271 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 11:12:36,077 - INFO - Epoch 10/80 (Eval) - Time: 51.78s (Eval Time: 6.57s):

2025-07-17 11:12:36,078 - INFO - Evaluation Metrics:

2025-07-17 11:12:36,078 - INFO - silhouette: 0.051070600748062134

2025-07-17 11:12:36,078 - INFO - davies\_bouldin: 2.5784

2025-07-17 11:12:36,078 - INFO - calinski\_harabasz: 820.3464

2025-07-17 11:12:36,078 - INFO - cohesion: -0.14627642929553986

2025-07-17 11:12:36,078 - INFO - separation: 0.2865

2025-07-17 11:12:36,078 - INFO - separation\_to\_cohesion: 1.9583

2025-07-17 11:12:36,078 - INFO - size\_balance: 0.1434

2025-07-17 11:12:36,079 - INFO - cluster\_count: 11.0000

2025-07-17 11:12:36,079 - INFO - avg\_cluster\_size: 652.8182

2025-07-17 11:12:36,079 - INFO - cluster\_size\_std: 559.1784

2025-07-17 11:12:36,079 - INFO - cluster\_sizes: [1780, 1393, 234, 60, 222, 884, 1119, 503, 776, 101, 109]

2025-07-17 11:13:21,666 - INFO - Epoch 11/80 - Time: 45.59s:Recon Loss=0.2406, Cluster Loss=0.2843,Reg Loss=0.0277,Last Inner Loss=0.5525

2025-07-17 11:14:09,914 - INFO - Epoch 12/80 - Time: 48.25s:Recon Loss=0.2284, Cluster Loss=0.6263,Reg Loss=0.0277,Last Inner Loss=0.8824

2025-07-17 11:14:56,063 - INFO - Epoch 13/80 - Time: 46.15s:Recon Loss=0.2236, Cluster Loss=0.2545,Reg Loss=0.0278,Last Inner Loss=0.5058

2025-07-17 11:15:41,556 - INFO - Epoch 14/80 - Time: 45.49s:Recon Loss=0.2098, Cluster Loss=0.2772,Reg Loss=0.0278,Last Inner Loss=0.5148

2025-07-17 11:16:27,592 - INFO - Epoch 15/80 - Time: 46.04s:Recon Loss=0.1955, Cluster Loss=0.2405,Reg Loss=0.0278,Last Inner Loss=0.4638

2025-07-17 11:17:14,210 - INFO - Epoch 16/80 - Time: 46.62s:Recon Loss=0.2024, Cluster Loss=0.1896,Reg Loss=0.0278,Last Inner Loss=0.4198

2025-07-17 11:18:00,004 - INFO - Epoch 17/80 - Time: 45.79s:Recon Loss=0.1908, Cluster Loss=0.2226,Reg Loss=0.0278,Last Inner Loss=0.4412

2025-07-17 11:18:47,404 - INFO - Epoch 18/80 - Time: 47.40s:Recon Loss=0.1906, Cluster Loss=0.2598,Reg Loss=0.0278,Last Inner Loss=0.4782

2025-07-17 11:19:33,527 - INFO - Epoch 19/80 - Time: 46.12s:Recon Loss=0.1879, Cluster Loss=0.1732,Reg Loss=0.0278,Last Inner Loss=0.3889

2025-07-17 11:20:25,675 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 11:20:25,675 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 11:20:27,343 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 11:20:28,328 - INFO - Epoch 20/80 (Eval) - Time: 54.80s (Eval Time: 6.81s):

2025-07-17 11:20:28,328 - INFO - Evaluation Metrics:

2025-07-17 11:20:28,329 - INFO - silhouette: 0.0641091838479042

2025-07-17 11:20:28,329 - INFO - davies\_bouldin: 2.1019

2025-07-17 11:20:28,329 - INFO - calinski\_harabasz: 923.7143

2025-07-17 11:20:28,329 - INFO - cohesion: -0.12233822792768478

2025-07-17 11:20:28,329 - INFO - separation: 0.2596

2025-07-17 11:20:28,329 - INFO - separation\_to\_cohesion: 2.1218

2025-07-17 11:20:28,329 - INFO - size\_balance: 0.0243

2025-07-17 11:20:28,329 - INFO - cluster\_count: 11.0000

2025-07-17 11:20:28,329 - INFO - avg\_cluster\_size: 652.8182

2025-07-17 11:20:28,330 - INFO - cluster\_size\_std: 636.9254

2025-07-17 11:20:28,330 - INFO - cluster\_sizes: [2113, 1507, 561, 209, 611, 1066, 47, 121, 692, 31, 223]

2025-07-17 11:21:13,110 - INFO - Epoch 21/80 - Time: 44.78s:Recon Loss=0.1812, Cluster Loss=0.1723,Reg Loss=0.0278,Last Inner Loss=0.3812

2025-07-17 11:21:58,374 - INFO - Epoch 22/80 - Time: 45.26s:Recon Loss=0.1782, Cluster Loss=0.1759,Reg Loss=0.0278,Last Inner Loss=0.3818

2025-07-17 11:22:43,514 - INFO - Epoch 23/80 - Time: 45.14s:Recon Loss=0.1804, Cluster Loss=0.1318,Reg Loss=0.0277,Last Inner Loss=0.3399

2025-07-17 11:23:29,283 - INFO - Epoch 24/80 - Time: 45.77s:Recon Loss=0.1756, Cluster Loss=0.1328,Reg Loss=0.0277,Last Inner Loss=0.3362

2025-07-17 11:24:14,370 - INFO - Epoch 25/80 - Time: 45.08s:Recon Loss=0.1742, Cluster Loss=0.1186,Reg Loss=0.0277,Last Inner Loss=0.3205

2025-07-17 11:25:00,577 - INFO - Epoch 26/80 - Time: 46.21s:Recon Loss=0.1732, Cluster Loss=0.1471,Reg Loss=0.0277,Last Inner Loss=0.3480

2025-07-17 11:25:46,795 - INFO - Epoch 27/80 - Time: 46.22s:Recon Loss=0.1722, Cluster Loss=0.1725,Reg Loss=0.0277,Last Inner Loss=0.3724

2025-07-17 11:26:34,467 - INFO - Epoch 28/80 - Time: 47.67s:Recon Loss=0.1733, Cluster Loss=0.1300,Reg Loss=0.0277,Last Inner Loss=0.3310

2025-07-17 11:27:19,034 - INFO - Epoch 29/80 - Time: 44.57s:Recon Loss=0.1737, Cluster Loss=0.1105,Reg Loss=0.0277,Last Inner Loss=0.3119

2025-07-17 11:28:07,907 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 11:28:07,907 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 11:28:09,560 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 11:28:10,412 - INFO - Epoch 30/80 (Eval) - Time: 51.38s (Eval Time: 6.29s):

2025-07-17 11:28:10,412 - INFO - Evaluation Metrics:

2025-07-17 11:28:10,412 - INFO - silhouette: 0.09541541337966919

2025-07-17 11:28:10,413 - INFO - davies\_bouldin: 1.5576

2025-07-17 11:28:10,413 - INFO - calinski\_harabasz: 1386.7150

2025-07-17 11:28:10,413 - INFO - cohesion: -0.14484268426895142

2025-07-17 11:28:10,413 - INFO - separation: 0.5913

2025-07-17 11:28:10,413 - INFO - separation\_to\_cohesion: 4.0821

2025-07-17 11:28:10,413 - INFO - size\_balance: 0.0000

2025-07-17 11:28:10,413 - INFO - cluster\_count: 11.0000

2025-07-17 11:28:10,413 - INFO - avg\_cluster\_size: 652.8182

2025-07-17 11:28:10,413 - INFO - cluster\_size\_std: 706.0295

2025-07-17 11:28:10,413 - INFO - cluster\_sizes: [2134, 833, 695, 1534, 145, 238, 1411, 6, 62, 121, 2]

2025-07-17 11:28:56,003 - INFO - Epoch 31/80 - Time: 45.59s:Recon Loss=0.1754, Cluster Loss=0.1314,Reg Loss=0.0277,Last Inner Loss=0.3345

2025-07-17 11:29:41,703 - INFO - Epoch 32/80 - Time: 45.70s:Recon Loss=0.1931, Cluster Loss=0.3005,Reg Loss=0.0277,Last Inner Loss=0.5213

2025-07-17 11:30:27,399 - INFO - Epoch 33/80 - Time: 45.70s:Recon Loss=0.1862, Cluster Loss=0.4275,Reg Loss=0.0278,Last Inner Loss=0.6415

2025-07-17 11:31:14,233 - INFO - Epoch 34/80 - Time: 46.83s:Recon Loss=0.1766, Cluster Loss=0.4547,Reg Loss=0.0278,Last Inner Loss=0.6591

2025-07-17 11:32:01,389 - INFO - Epoch 35/80 - Time: 47.15s:Recon Loss=0.1751, Cluster Loss=0.4385,Reg Loss=0.0278,Last Inner Loss=0.6415

2025-07-17 11:32:47,752 - INFO - Epoch 36/80 - Time: 46.36s:Recon Loss=0.1737, Cluster Loss=0.3652,Reg Loss=0.0278,Last Inner Loss=0.5667

2025-07-17 11:33:32,372 - INFO - Epoch 37/80 - Time: 44.62s:Recon Loss=0.1768, Cluster Loss=0.3312,Reg Loss=0.0278,Last Inner Loss=0.5358

2025-07-17 11:34:17,435 - INFO - Epoch 38/80 - Time: 45.06s:Recon Loss=0.1742, Cluster Loss=0.2670,Reg Loss=0.0278,Last Inner Loss=0.4690

2025-07-17 11:35:03,272 - INFO - Epoch 39/80 - Time: 45.84s:Recon Loss=0.1691, Cluster Loss=0.2265,Reg Loss=0.0278,Last Inner Loss=0.4234

2025-07-17 11:35:54,712 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 11:35:54,713 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 11:35:56,455 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 11:35:57,360 - INFO - Epoch 40/80 (Eval) - Time: 54.09s (Eval Time: 6.64s):

2025-07-17 11:35:57,362 - INFO - Evaluation Metrics:

2025-07-17 11:35:57,362 - INFO - silhouette: 0.07817188650369644

2025-07-17 11:35:57,362 - INFO - davies\_bouldin: 1.8502

2025-07-17 11:35:57,362 - INFO - calinski\_harabasz: 991.7633

2025-07-17 11:35:57,362 - INFO - cohesion: -0.13914543390274048

2025-07-17 11:35:57,362 - INFO - separation: 0.4935

2025-07-17 11:35:57,362 - INFO - separation\_to\_cohesion: 3.5466

2025-07-17 11:35:57,363 - INFO - size\_balance: 0.0151

2025-07-17 11:35:57,363 - INFO - cluster\_count: 11.0000

2025-07-17 11:35:57,363 - INFO - avg\_cluster\_size: 652.8182

2025-07-17 11:35:57,363 - INFO - cluster\_size\_std: 642.9791

2025-07-17 11:35:57,363 - INFO - cluster\_sizes: [1684, 1022, 262, 1264, 298, 331, 255, 1843, 62, 158, 2]

2025-07-17 11:36:43,959 - INFO - Epoch 41/80 - Time: 46.60s:Recon Loss=0.1674, Cluster Loss=0.1686,Reg Loss=0.0278,Last Inner Loss=0.3638

2025-07-17 11:37:30,557 - INFO - Epoch 42/80 - Time: 46.60s:Recon Loss=0.1701, Cluster Loss=0.1121,Reg Loss=0.0277,Last Inner Loss=0.3099

2025-07-17 11:38:19,303 - INFO - Epoch 43/80 - Time: 48.75s:Recon Loss=0.1725, Cluster Loss=0.1742,Reg Loss=0.0277,Last Inner Loss=0.3744

2025-07-17 11:39:07,460 - INFO - Epoch 44/80 - Time: 48.16s:Recon Loss=0.1688, Cluster Loss=0.1461,Reg Loss=0.0277,Last Inner Loss=0.3426

2025-07-17 11:39:55,744 - INFO - Epoch 45/80 - Time: 48.28s:Recon Loss=0.1700, Cluster Loss=0.1385,Reg Loss=0.0277,Last Inner Loss=0.3362

2025-07-17 11:40:42,355 - INFO - Epoch 46/80 - Time: 46.61s:Recon Loss=0.1701, Cluster Loss=0.1525,Reg Loss=0.0277,Last Inner Loss=0.3504

2025-07-17 11:41:28,074 - INFO - Epoch 47/80 - Time: 45.72s:Recon Loss=0.1666, Cluster Loss=0.1458,Reg Loss=0.0277,Last Inner Loss=0.3401

2025-07-17 11:42:13,307 - INFO - Epoch 48/80 - Time: 45.23s:Recon Loss=0.1671, Cluster Loss=0.1767,Reg Loss=0.0277,Last Inner Loss=0.3715

2025-07-17 11:42:59,565 - INFO - Epoch 49/80 - Time: 46.26s:Recon Loss=0.1683, Cluster Loss=0.1106,Reg Loss=0.0277,Last Inner Loss=0.3066

2025-07-17 11:43:51,253 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 11:43:51,253 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 11:43:52,846 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 11:43:53,706 - INFO - Epoch 50/80 (Eval) - Time: 54.14s (Eval Time: 6.33s):

2025-07-17 11:43:53,706 - INFO - Evaluation Metrics:

2025-07-17 11:43:53,706 - INFO - silhouette: 0.09399546682834625

2025-07-17 11:43:53,706 - INFO - davies\_bouldin: 1.7432

2025-07-17 11:43:53,706 - INFO - calinski\_harabasz: 753.3216

2025-07-17 11:43:53,707 - INFO - cohesion: -0.0849463939666748

2025-07-17 11:43:53,707 - INFO - separation: 0.1770

2025-07-17 11:43:53,707 - INFO - separation\_to\_cohesion: 2.0836

2025-07-17 11:43:53,707 - INFO - size\_balance: 0.0000

2025-07-17 11:43:53,707 - INFO - cluster\_count: 11.0000

2025-07-17 11:43:53,707 - INFO - avg\_cluster\_size: 652.8182

2025-07-17 11:43:53,707 - INFO - cluster\_size\_std: 686.0372

2025-07-17 11:43:53,708 - INFO - cluster\_sizes: [1870, 335, 2152, 951, 271, 158, 238, 654, 260, 29, 263]

2025-07-17 11:44:41,969 - INFO - Epoch 51/80 - Time: 48.26s:Recon Loss=0.1684, Cluster Loss=0.0802,Reg Loss=0.0277,Last Inner Loss=0.2762

2025-07-17 11:45:27,963 - INFO - Epoch 52/80 - Time: 45.99s:Recon Loss=0.1665, Cluster Loss=0.0693,Reg Loss=0.0277,Last Inner Loss=0.2634

2025-07-17 11:46:15,392 - INFO - Epoch 53/80 - Time: 47.43s:Recon Loss=0.1674, Cluster Loss=0.0668,Reg Loss=0.0276,Last Inner Loss=0.2619

2025-07-17 11:47:02,102 - INFO - Epoch 54/80 - Time: 46.71s:Recon Loss=0.1667, Cluster Loss=0.0617,Reg Loss=0.0276,Last Inner Loss=0.2560

2025-07-17 11:47:47,344 - INFO - Epoch 55/80 - Time: 45.24s:Recon Loss=0.1679, Cluster Loss=0.1134,Reg Loss=0.0276,Last Inner Loss=0.3089

2025-07-17 11:48:33,317 - INFO - Epoch 56/80 - Time: 45.97s:Recon Loss=0.1702, Cluster Loss=0.1565,Reg Loss=0.0276,Last Inner Loss=0.3543

2025-07-17 11:49:20,139 - INFO - Epoch 57/80 - Time: 46.82s:Recon Loss=0.1675, Cluster Loss=0.1833,Reg Loss=0.0276,Last Inner Loss=0.3784

2025-07-17 11:50:09,112 - INFO - Epoch 58/80 - Time: 48.97s:Recon Loss=0.1675, Cluster Loss=0.1483,Reg Loss=0.0276,Last Inner Loss=0.3435

2025-07-17 11:50:53,761 - INFO - Epoch 59/80 - Time: 44.65s:Recon Loss=0.1652, Cluster Loss=0.1523,Reg Loss=0.0276,Last Inner Loss=0.3451

2025-07-17 11:51:40,935 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 11:51:40,935 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 11:51:42,572 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 11:51:43,395 - INFO - Epoch 60/80 (Eval) - Time: 49.63s (Eval Time: 6.24s):

2025-07-17 11:51:43,395 - INFO - Evaluation Metrics:

2025-07-17 11:51:43,395 - INFO - silhouette: 0.08741165697574615

2025-07-17 11:51:43,396 - INFO - davies\_bouldin: 1.9200

2025-07-17 11:51:43,396 - INFO - calinski\_harabasz: 645.9026

2025-07-17 11:51:43,396 - INFO - cohesion: -0.08908241242170334

2025-07-17 11:51:43,396 - INFO - separation: 0.1757

2025-07-17 11:51:43,396 - INFO - separation\_to\_cohesion: 1.9723

2025-07-17 11:51:43,396 - INFO - size\_balance: 0.0250

2025-07-17 11:51:43,396 - INFO - cluster\_count: 11.0000

2025-07-17 11:51:43,396 - INFO - avg\_cluster\_size: 652.8182

2025-07-17 11:51:43,397 - INFO - cluster\_size\_std: 636.4671

2025-07-17 11:51:43,397 - INFO - cluster\_sizes: [1447, 240, 279, 994, 297, 1549, 1823, 30, 76, 292, 154]

2025-07-17 11:52:31,570 - INFO - Epoch 61/80 - Time: 48.17s:Recon Loss=0.1649, Cluster Loss=0.0861,Reg Loss=0.0276,Last Inner Loss=0.2786

2025-07-17 11:53:17,918 - INFO - Epoch 62/80 - Time: 46.35s:Recon Loss=0.1663, Cluster Loss=0.0724,Reg Loss=0.0276,Last Inner Loss=0.2663

2025-07-17 11:54:04,541 - INFO - Epoch 63/80 - Time: 46.62s:Recon Loss=0.1653, Cluster Loss=0.0963,Reg Loss=0.0276,Last Inner Loss=0.2892

2025-07-17 11:54:50,671 - INFO - Epoch 64/80 - Time: 46.13s:Recon Loss=0.1663, Cluster Loss=0.1210,Reg Loss=0.0276,Last Inner Loss=0.3149

2025-07-17 11:55:36,105 - INFO - Epoch 65/80 - Time: 45.43s:Recon Loss=0.1656, Cluster Loss=0.1023,Reg Loss=0.0276,Last Inner Loss=0.2955

2025-07-17 11:56:23,676 - INFO - Epoch 66/80 - Time: 47.57s:Recon Loss=0.1650, Cluster Loss=0.1028,Reg Loss=0.0276,Last Inner Loss=0.2954

2025-07-17 11:57:07,539 - INFO - Epoch 67/80 - Time: 43.86s:Recon Loss=0.1648, Cluster Loss=0.0744,Reg Loss=0.0276,Last Inner Loss=0.2668

2025-07-17 11:57:55,326 - INFO - Epoch 68/80 - Time: 47.79s:Recon Loss=0.1656, Cluster Loss=0.1053,Reg Loss=0.0276,Last Inner Loss=0.2985

2025-07-17 11:58:40,746 - INFO - Epoch 69/80 - Time: 45.42s:Recon Loss=0.1645, Cluster Loss=0.0830,Reg Loss=0.0276,Last Inner Loss=0.2751

2025-07-17 11:59:32,521 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 11:59:32,522 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 11:59:34,164 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 11:59:35,192 - INFO - Epoch 70/80 (Eval) - Time: 54.45s (Eval Time: 6.43s):

2025-07-17 11:59:35,192 - INFO - Evaluation Metrics:

2025-07-17 11:59:35,192 - INFO - silhouette: 0.07893435657024384

2025-07-17 11:59:35,192 - INFO - davies\_bouldin: 1.8811

2025-07-17 11:59:35,192 - INFO - calinski\_harabasz: 570.3773

2025-07-17 11:59:35,192 - INFO - cohesion: -0.11922401934862137

2025-07-17 11:59:35,192 - INFO - separation: 0.3297

2025-07-17 11:59:35,192 - INFO - separation\_to\_cohesion: 2.7651

2025-07-17 11:59:35,193 - INFO - size\_balance: 0.0000

2025-07-17 11:59:35,193 - INFO - cluster\_count: 11.0000

2025-07-17 11:59:35,193 - INFO - avg\_cluster\_size: 652.8182

2025-07-17 11:59:35,193 - INFO - cluster\_size\_std: 665.0039

2025-07-17 11:59:35,193 - INFO - cluster\_sizes: [1593, 290, 1811, 1140, 162, 115, 293, 281, 1465, 29, 2]

2025-07-17 12:00:22,188 - INFO - Epoch 71/80 - Time: 46.99s:Recon Loss=0.1644, Cluster Loss=0.0515,Reg Loss=0.0275,Last Inner Loss=0.2434

2025-07-17 12:01:10,322 - INFO - Epoch 72/80 - Time: 48.13s:Recon Loss=0.1642, Cluster Loss=0.0853,Reg Loss=0.0275,Last Inner Loss=0.2771

2025-07-17 12:01:56,177 - INFO - Epoch 73/80 - Time: 45.85s:Recon Loss=0.1642, Cluster Loss=0.0522,Reg Loss=0.0275,Last Inner Loss=0.2439

2025-07-17 12:02:43,189 - INFO - Epoch 74/80 - Time: 47.01s:Recon Loss=0.1638, Cluster Loss=0.0747,Reg Loss=0.0275,Last Inner Loss=0.2660

2025-07-17 12:03:27,115 - INFO - Epoch 75/80 - Time: 43.93s:Recon Loss=0.1638, Cluster Loss=0.0454,Reg Loss=0.0275,Last Inner Loss=0.2367

2025-07-17 12:04:12,094 - INFO - Epoch 76/80 - Time: 44.98s:Recon Loss=0.1642, Cluster Loss=0.0486,Reg Loss=0.0275,Last Inner Loss=0.2402

2025-07-17 12:04:57,743 - INFO - Epoch 77/80 - Time: 45.65s:Recon Loss=0.1643, Cluster Loss=0.0616,Reg Loss=0.0275,Last Inner Loss=0.2534

2025-07-17 12:05:45,941 - INFO - Epoch 78/80 - Time: 48.20s:Recon Loss=0.1652, Cluster Loss=0.1713,Reg Loss=0.0275,Last Inner Loss=0.3639

2025-07-17 12:06:30,331 - INFO - Epoch 79/80 - Time: 44.39s:Recon Loss=0.1838, Cluster Loss=0.4789,Reg Loss=0.0276,Last Inner Loss=0.6902

2025-07-17 12:07:18,084 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 12:07:18,084 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 12:07:19,653 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 12:07:20,508 - INFO - Epoch 80/80 (Eval) - Time: 50.18s (Eval Time: 6.35s):

2025-07-17 12:07:20,508 - INFO - Evaluation Metrics:

2025-07-17 12:07:20,508 - INFO - silhouette: 0.15818822383880615

2025-07-17 12:07:20,509 - INFO - davies\_bouldin: 1.9533

2025-07-17 12:07:20,509 - INFO - calinski\_harabasz: 961.8464

2025-07-17 12:07:20,509 - INFO - cohesion: -0.1118680015206337

2025-07-17 12:07:20,509 - INFO - separation: 0.1827

2025-07-17 12:07:20,509 - INFO - separation\_to\_cohesion: 1.6332

2025-07-17 12:07:20,509 - INFO - size\_balance: 0.0939

2025-07-17 12:07:20,509 - INFO - cluster\_count: 11.0000

2025-07-17 12:07:20,509 - INFO - avg\_cluster\_size: 652.8182

2025-07-17 12:07:20,509 - INFO - cluster\_size\_std: 591.5459

2025-07-17 12:07:20,509 - INFO - cluster\_sizes: [2121, 256, 351, 1395, 520, 650, 145, 963, 291, 415, 74]

2025-07-17 12:07:20,509 - INFO -

Training completed!

2025-07-17 12:07:20,509 - INFO -

Saving final trained model...

2025-07-17 12:07:20,578 - INFO - Final trained model saved to ./results/n11\_final\_model\_gz\_ptype0\_no\_cat.pth

2025-07-17 12:07:20,579 - INFO -

Evaluating final trained model...

2025-07-17 12:07:24,587 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 12:07:24,588 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 12:07:26,197 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 12:07:27,014 - INFO -

Detailed Clustering Evaluation of Final Model:

2025-07-17 12:07:27,015 - INFO - silhouette: 0.15818823873996735

2025-07-17 12:07:27,015 - INFO - davies\_bouldin: 1.9533

2025-07-17 12:07:27,015 - INFO - calinski\_harabasz: 961.8464

2025-07-17 12:07:27,015 - INFO - cohesion: -0.1118680015206337

2025-07-17 12:07:27,015 - INFO - separation: 0.1827

2025-07-17 12:07:27,015 - INFO - separation\_to\_cohesion: 1.6332

2025-07-17 12:07:27,015 - INFO - size\_balance: 0.0939

2025-07-17 12:07:27,015 - INFO - cluster\_count: 11.0000

2025-07-17 12:07:27,015 - INFO - avg\_cluster\_size: 652.8182

2025-07-17 12:07:27,016 - INFO - cluster\_size\_std: 591.5459

2025-07-17 12:07:27,016 - INFO - cluster\_sizes: [2121, 256, 351, 1395, 520, 650, 145, 963, 291, 415, 74]

2025-07-17 12:07:27,016 - INFO -

--- Detailed Clustering Evaluation of Final Model (based on P indicator matrix as embeddings) ---

2025-07-17 12:07:27,871 - INFO - P\_based\_silhouette: 0.20083992183208466

2025-07-17 12:07:27,872 - INFO - P\_based\_davies\_bouldin: 1.3033

2025-07-17 12:07:27,872 - INFO - P\_based\_calinski\_harabasz: 800.3777

2025-07-17 12:07:27,872 - INFO - P\_based\_cohesion: -0.028864024206995964

2025-07-17 12:07:27,872 - INFO - P\_based\_separation: 0.0517

2025-07-17 12:07:27,872 - INFO - P\_based\_separation\_to\_cohesion: 1.7910

2025-07-17 12:07:27,872 - INFO - P\_based\_size\_balance: 0.0939

2025-07-17 12:07:27,872 - INFO - P\_based\_cluster\_count: 11.0000

2025-07-17 12:07:27,873 - INFO - P\_based\_avg\_cluster\_size: 652.8182

2025-07-17 12:07:27,873 - INFO - P\_based\_cluster\_size\_std: 591.5459

2025-07-17 12:07:27,873 - INFO - P\_based\_cluster\_sizes: [2121, 256, 351, 1395, 520, 650, 145, 963, 291, 415, 74]

2025-07-17 12:07:27,873 - INFO - Saving final results with embeddings and view weights...

2025-07-17 12:07:31,043 - INFO - Final results saved to ./results/n11\_final\_clustering\_gz\_pytpe0\_no\_cat.csv

2025-07-17 12:07:31,068 - INFO - Final evaluation metrics saved to ./results/n11\_final\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 12:08:49,516 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=12, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-17 12:08:49,533 - INFO - CUDA available. Using device: cuda:0

2025-07-17 12:08:49,533 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-17 12:09:15,486 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-17 12:09:15,490 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-17 12:09:15,499 - INFO - Numerical features scaled.

2025-07-17 12:09:15,598 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-17 12:09:15,602 - INFO - Loading pre-built graphs from directory: ./data

2025-07-17 12:09:15,648 - INFO - Loaded time graph: 807056 edges.

2025-07-17 12:09:15,658 - INFO - Loaded space graph: 890250 edges.

2025-07-17 12:09:15,670 - INFO - Loaded attr graph: 982548 edges.

2025-07-17 12:09:15,670 - INFO - Initializing model components...

2025-07-17 12:09:15,695 - INFO - Pretraining encoder...

2025-07-17 12:09:15,696 - WARNING - The main training loop might still encounter OutOfMemoryError due to the N x N matrix calculation

2025-07-17 12:09:15,696 - WARNING - in the clustering loss module (ZZ^T for SVD). This is inherent to the standard EGAE Jc loss formulation.

2025-07-17 12:09:15,696 - WARNING - If OOM occurs in the main loop, consider using a GPU with more memory or exploring approximations if available.

2025-07-17 12:11:28,145 - INFO - Pretrain Epoch 10/100 - Time: 13.60s: Recon Loss = 0.2130, Reg Loss = 0.1389, Total Loss = 0.3519

2025-07-17 12:13:40,986 - INFO - Pretrain Epoch 20/100 - Time: 12.86s: Recon Loss = 0.1892, Reg Loss = 0.1171, Total Loss = 0.3063

2025-07-17 12:15:51,380 - INFO - Pretrain Epoch 30/100 - Time: 13.27s: Recon Loss = 0.1625, Reg Loss = 0.0983, Total Loss = 0.2609

2025-07-17 12:18:25,356 - INFO - Pretrain Epoch 40/100 - Time: 15.35s: Recon Loss = 0.1618, Reg Loss = 0.0817, Total Loss = 0.2434

2025-07-17 12:21:00,893 - INFO - Pretrain Epoch 50/100 - Time: 14.73s: Recon Loss = 0.1618, Reg Loss = 0.0675, Total Loss = 0.2293

2025-07-17 12:23:28,287 - INFO - Pretrain Epoch 60/100 - Time: 15.17s: Recon Loss = 0.1619, Reg Loss = 0.0558, Total Loss = 0.2177

2025-07-17 12:25:59,322 - INFO - Pretrain Epoch 70/100 - Time: 15.50s: Recon Loss = 0.1619, Reg Loss = 0.0462, Total Loss = 0.2082

2025-07-17 12:28:33,672 - INFO - Pretrain Epoch 80/100 - Time: 15.29s: Recon Loss = 0.1627, Reg Loss = 0.0385, Total Loss = 0.2012

2025-07-17 12:31:05,542 - INFO - Pretrain Epoch 90/100 - Time: 15.72s: Recon Loss = 0.1619, Reg Loss = 0.0322, Total Loss = 0.1941

2025-07-17 12:33:43,273 - INFO - Pretrain Epoch 100/100 - Time: 16.33s: Recon Loss = 0.1622, Reg Loss = 0.0271, Total Loss = 0.1892

2025-07-17 12:33:43,273 - INFO -

Pretraining finished. Evaluating pretraining results with standard K-Means...

2025-07-17 12:33:47,156 - INFO - Running standard KMeans on pretrain embeddings ((7181, 64))...

2025-07-17 12:33:47,392 - INFO - Standard KMeans finished.

2025-07-17 12:33:48,188 - INFO - Pretraining Standard K-Means Clustering Evaluation:

2025-07-17 12:33:48,188 - INFO - silhouette: 0.24870827794075012

2025-07-17 12:33:48,188 - INFO - davies\_bouldin: 1.4346

2025-07-17 12:33:48,188 - INFO - calinski\_harabasz: 2415.4311

2025-07-17 12:33:48,188 - INFO - cohesion: -1.1817675828933716

2025-07-17 12:33:48,188 - INFO - separation: 3.4698

2025-07-17 12:33:48,188 - INFO - separation\_to\_cohesion: 2.9361

2025-07-17 12:33:48,188 - INFO - size\_balance: 0.3042

2025-07-17 12:33:48,188 - INFO - cluster\_count: 12.0000

2025-07-17 12:33:48,188 - INFO - avg\_cluster\_size: 598.4167

2025-07-17 12:33:48,189 - INFO - cluster\_size\_std: 416.3973

2025-07-17 12:33:48,189 - INFO - cluster\_sizes: [1156, 788, 288, 1385, 258, 352, 495, 455, 142, 1094, 20, 748]

2025-07-17 12:33:52,747 - INFO - Pretraining standard KMeans++ results saved to ./results/n12\_pretrain\_standard\_kmeans\_clustering\_gz\_ptype0\_no\_cat.csv

2025-07-17 12:33:52,761 - INFO - Pretraining standard KMeans++ evaluation metrics saved to ./results/n12\_pretrain\_standard\_kmeans\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 12:33:52,829 - INFO - Pretraining encoder saved to ./results/n12\_pretrain\_encoder\_gz\_pytpe0\_no\_cat.pth

2025-07-17 12:33:52,829 - INFO -

Starting main training loop (Alternating Optimization)...

2025-07-17 12:33:52,831 - INFO - Initializing indicator matrix P for main training...

2025-07-17 12:33:56,834 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 12:33:56,834 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 12:33:58,436 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 12:33:58,436 - INFO - Evaluating initial main training clustering results (SVD + KMeans++ on P)...

2025-07-17 12:33:59,243 - INFO - Initial Main Training SVD + KMeans++ Clustering Evaluation:

2025-07-17 12:33:59,244 - INFO - silhouette: 0.13655498623847961

2025-07-17 12:33:59,244 - INFO - davies\_bouldin: 2.2676

2025-07-17 12:33:59,244 - INFO - calinski\_harabasz: 762.0528

2025-07-17 12:33:59,244 - INFO - cohesion: -1.471700668334961

2025-07-17 12:33:59,244 - INFO - separation: 2.2666

2025-07-17 12:33:59,244 - INFO - separation\_to\_cohesion: 1.5401

2025-07-17 12:33:59,244 - INFO - size\_balance: 0.1094

2025-07-17 12:33:59,244 - INFO - cluster\_count: 12.0000

2025-07-17 12:33:59,244 - INFO - avg\_cluster\_size: 598.4167

2025-07-17 12:33:59,244 - INFO - cluster\_size\_std: 532.9277

2025-07-17 12:33:59,245 - INFO - cluster\_sizes: [1313, 1410, 537, 34, 277, 215, 792, 211, 238, 1650, 290, 214]

2025-07-17 12:34:45,461 - INFO - Epoch 1/80 - Time: 46.22s:Recon Loss=0.1699, Cluster Loss=9.2169,Reg Loss=0.0267,Last Inner Loss=9.4134

2025-07-17 12:35:31,891 - INFO - Epoch 2/80 - Time: 46.43s:Recon Loss=0.2043, Cluster Loss=3.1277,Reg Loss=0.0268,Last Inner Loss=3.3588

2025-07-17 12:36:17,087 - INFO - Epoch 3/80 - Time: 45.20s:Recon Loss=0.2191, Cluster Loss=1.6417,Reg Loss=0.0269,Last Inner Loss=1.8878

2025-07-17 12:37:03,244 - INFO - Epoch 4/80 - Time: 46.16s:Recon Loss=0.2309, Cluster Loss=0.9772,Reg Loss=0.0271,Last Inner Loss=1.2351

2025-07-17 12:37:50,130 - INFO - Epoch 5/80 - Time: 46.89s:Recon Loss=0.2382, Cluster Loss=0.7058,Reg Loss=0.0272,Last Inner Loss=0.9712

2025-07-17 12:38:38,737 - INFO - Epoch 6/80 - Time: 48.61s:Recon Loss=0.2408, Cluster Loss=0.6167,Reg Loss=0.0273,Last Inner Loss=0.8848

2025-07-17 12:39:24,896 - INFO - Epoch 7/80 - Time: 46.16s:Recon Loss=0.2480, Cluster Loss=0.4383,Reg Loss=0.0274,Last Inner Loss=0.7137

2025-07-17 12:40:12,320 - INFO - Epoch 8/80 - Time: 47.42s:Recon Loss=0.2432, Cluster Loss=0.3632,Reg Loss=0.0275,Last Inner Loss=0.6339

2025-07-17 12:40:59,530 - INFO - Epoch 9/80 - Time: 47.21s:Recon Loss=0.2365, Cluster Loss=0.3047,Reg Loss=0.0276,Last Inner Loss=0.5688

2025-07-17 12:41:49,958 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 12:41:49,958 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 12:41:51,581 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 12:41:52,383 - INFO - Epoch 10/80 (Eval) - Time: 52.85s (Eval Time: 6.31s):

2025-07-17 12:41:52,384 - INFO - Evaluation Metrics:

2025-07-17 12:41:52,384 - INFO - silhouette: 0.03817977383732796

2025-07-17 12:41:52,384 - INFO - davies\_bouldin: 2.4429

2025-07-17 12:41:52,384 - INFO - calinski\_harabasz: 1506.3117

2025-07-17 12:41:52,384 - INFO - cohesion: -0.07008480280637741

2025-07-17 12:41:52,384 - INFO - separation: 0.9253

2025-07-17 12:41:52,384 - INFO - separation\_to\_cohesion: 13.2019

2025-07-17 12:41:52,384 - INFO - size\_balance: 0.1377

2025-07-17 12:41:52,384 - INFO - cluster\_count: 12.0000

2025-07-17 12:41:52,384 - INFO - avg\_cluster\_size: 598.4167

2025-07-17 12:41:52,384 - INFO - cluster\_size\_std: 516.0085

2025-07-17 12:41:52,384 - INFO - cluster\_sizes: [1316, 1118, 1261, 1, 114, 672, 184, 1408, 508, 262, 336, 1]

2025-07-17 12:42:38,736 - INFO - Epoch 11/80 - Time: 46.35s:Recon Loss=0.2166, Cluster Loss=0.1411,Reg Loss=0.0277,Last Inner Loss=0.3854

2025-07-17 12:43:24,745 - INFO - Epoch 12/80 - Time: 46.01s:Recon Loss=0.2092, Cluster Loss=0.1273,Reg Loss=0.0277,Last Inner Loss=0.3642

2025-07-17 12:44:13,969 - INFO - Epoch 13/80 - Time: 49.22s:Recon Loss=0.1970, Cluster Loss=0.1064,Reg Loss=0.0277,Last Inner Loss=0.3311

2025-07-17 12:45:02,934 - INFO - Epoch 14/80 - Time: 48.96s:Recon Loss=0.1907, Cluster Loss=0.1120,Reg Loss=0.0277,Last Inner Loss=0.3305

2025-07-17 12:45:51,525 - INFO - Epoch 15/80 - Time: 48.59s:Recon Loss=0.1828, Cluster Loss=0.1010,Reg Loss=0.0277,Last Inner Loss=0.3115

2025-07-17 12:46:38,556 - INFO - Epoch 16/80 - Time: 47.03s:Recon Loss=0.1801, Cluster Loss=0.0899,Reg Loss=0.0277,Last Inner Loss=0.2977

2025-07-17 12:47:24,940 - INFO - Epoch 17/80 - Time: 46.38s:Recon Loss=0.1794, Cluster Loss=0.0801,Reg Loss=0.0277,Last Inner Loss=0.2872

2025-07-17 12:48:11,085 - INFO - Epoch 18/80 - Time: 46.14s:Recon Loss=0.1804, Cluster Loss=0.0809,Reg Loss=0.0277,Last Inner Loss=0.2890

2025-07-17 12:48:57,063 - INFO - Epoch 19/80 - Time: 45.98s:Recon Loss=0.1809, Cluster Loss=0.1350,Reg Loss=0.0277,Last Inner Loss=0.3436

2025-07-17 12:49:48,083 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 12:49:48,083 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 12:49:49,742 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 12:49:50,580 - INFO - Epoch 20/80 (Eval) - Time: 53.52s (Eval Time: 6.68s):

2025-07-17 12:49:50,581 - INFO - Evaluation Metrics:

2025-07-17 12:49:50,581 - INFO - silhouette: 0.07931282371282578

2025-07-17 12:49:50,581 - INFO - davies\_bouldin: 1.9274

2025-07-17 12:49:50,581 - INFO - calinski\_harabasz: 1644.6160

2025-07-17 12:49:50,581 - INFO - cohesion: -0.10882207006216049

2025-07-17 12:49:50,581 - INFO - separation: 0.9719

2025-07-17 12:49:50,581 - INFO - separation\_to\_cohesion: 8.9309

2025-07-17 12:49:50,581 - INFO - size\_balance: 0.0000

2025-07-17 12:49:50,581 - INFO - cluster\_count: 12.0000

2025-07-17 12:49:50,581 - INFO - avg\_cluster\_size: 598.4167

2025-07-17 12:49:50,582 - INFO - cluster\_size\_std: 677.8648

2025-07-17 12:49:50,582 - INFO - cluster\_sizes: [1940, 1, 679, 176, 138, 741, 1124, 73, 2, 1, 1881, 425]

2025-07-17 12:50:38,965 - INFO - Epoch 21/80 - Time: 48.38s:Recon Loss=0.1813, Cluster Loss=0.0680,Reg Loss=0.0277,Last Inner Loss=0.2770

2025-07-17 12:51:22,136 - INFO - Epoch 22/80 - Time: 43.17s:Recon Loss=0.1767, Cluster Loss=0.0830,Reg Loss=0.0277,Last Inner Loss=0.2875

2025-07-17 12:52:06,287 - INFO - Epoch 23/80 - Time: 44.15s:Recon Loss=0.1737, Cluster Loss=0.0794,Reg Loss=0.0278,Last Inner Loss=0.2809

2025-07-17 12:52:51,708 - INFO - Epoch 24/80 - Time: 45.42s:Recon Loss=0.1716, Cluster Loss=0.0726,Reg Loss=0.0278,Last Inner Loss=0.2719

2025-07-17 12:53:37,631 - INFO - Epoch 25/80 - Time: 45.92s:Recon Loss=0.1745, Cluster Loss=0.1142,Reg Loss=0.0278,Last Inner Loss=0.3164

2025-07-17 12:54:22,299 - INFO - Epoch 26/80 - Time: 44.67s:Recon Loss=0.1723, Cluster Loss=0.1413,Reg Loss=0.0278,Last Inner Loss=0.3415

2025-07-17 12:55:08,344 - INFO - Epoch 27/80 - Time: 46.05s:Recon Loss=0.1690, Cluster Loss=0.1453,Reg Loss=0.0278,Last Inner Loss=0.3421

2025-07-17 12:55:55,638 - INFO - Epoch 28/80 - Time: 47.29s:Recon Loss=0.1697, Cluster Loss=0.1262,Reg Loss=0.0278,Last Inner Loss=0.3238

2025-07-17 12:56:42,722 - INFO - Epoch 29/80 - Time: 47.08s:Recon Loss=0.1777, Cluster Loss=0.1649,Reg Loss=0.0278,Last Inner Loss=0.3705

2025-07-17 12:57:31,017 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 12:57:31,017 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 12:57:32,601 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 12:57:33,396 - INFO - Epoch 30/80 (Eval) - Time: 50.67s (Eval Time: 6.04s):

2025-07-17 12:57:33,396 - INFO - Evaluation Metrics:

2025-07-17 12:57:33,396 - INFO - silhouette: 0.13425493240356445

2025-07-17 12:57:33,397 - INFO - davies\_bouldin: 1.9284

2025-07-17 12:57:33,397 - INFO - calinski\_harabasz: 1530.9112

2025-07-17 12:57:33,397 - INFO - cohesion: -0.10317661613225937

2025-07-17 12:57:33,397 - INFO - separation: 0.7110

2025-07-17 12:57:33,397 - INFO - separation\_to\_cohesion: 6.8907

2025-07-17 12:57:33,397 - INFO - size\_balance: 0.0723

2025-07-17 12:57:33,397 - INFO - cluster\_count: 12.0000

2025-07-17 12:57:33,397 - INFO - avg\_cluster\_size: 598.4167

2025-07-17 12:57:33,397 - INFO - cluster\_size\_std: 555.1257

2025-07-17 12:57:33,397 - INFO - cluster\_sizes: [2098, 573, 650, 567, 168, 270, 1200, 74, 559, 1, 245, 776]

2025-07-17 12:58:18,537 - INFO - Epoch 31/80 - Time: 45.14s:Recon Loss=0.1801, Cluster Loss=0.0925,Reg Loss=0.0279,Last Inner Loss=0.3006

2025-07-17 12:59:04,555 - INFO - Epoch 32/80 - Time: 46.02s:Recon Loss=0.1754, Cluster Loss=0.0782,Reg Loss=0.0280,Last Inner Loss=0.2815

2025-07-17 12:59:50,864 - INFO - Epoch 33/80 - Time: 46.31s:Recon Loss=0.1707, Cluster Loss=0.0800,Reg Loss=0.0280,Last Inner Loss=0.2787

2025-07-17 13:00:35,911 - INFO - Epoch 34/80 - Time: 45.05s:Recon Loss=0.1707, Cluster Loss=0.0837,Reg Loss=0.0280,Last Inner Loss=0.2825

2025-07-17 13:01:22,128 - INFO - Epoch 35/80 - Time: 46.22s:Recon Loss=0.1705, Cluster Loss=0.0777,Reg Loss=0.0281,Last Inner Loss=0.2763

2025-07-17 13:02:09,498 - INFO - Epoch 36/80 - Time: 47.37s:Recon Loss=0.1671, Cluster Loss=0.0665,Reg Loss=0.0281,Last Inner Loss=0.2618

2025-07-17 13:02:55,304 - INFO - Epoch 37/80 - Time: 45.81s:Recon Loss=0.1656, Cluster Loss=0.0624,Reg Loss=0.0281,Last Inner Loss=0.2561

2025-07-17 13:03:39,308 - INFO - Epoch 38/80 - Time: 44.00s:Recon Loss=0.1650, Cluster Loss=0.0595,Reg Loss=0.0281,Last Inner Loss=0.2526

2025-07-17 13:04:23,933 - INFO - Epoch 39/80 - Time: 44.63s:Recon Loss=0.1645, Cluster Loss=0.0702,Reg Loss=0.0281,Last Inner Loss=0.2628

2025-07-17 13:05:14,277 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 13:05:14,278 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 13:05:15,925 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 13:05:16,707 - INFO - Epoch 40/80 (Eval) - Time: 52.77s (Eval Time: 6.21s):

2025-07-17 13:05:16,708 - INFO - Evaluation Metrics:

2025-07-17 13:05:16,708 - INFO - silhouette: 0.17539151012897491

2025-07-17 13:05:16,708 - INFO - davies\_bouldin: 1.8647

2025-07-17 13:05:16,708 - INFO - calinski\_harabasz: 1963.0686

2025-07-17 13:05:16,708 - INFO - cohesion: -0.11652619391679764

2025-07-17 13:05:16,708 - INFO - separation: 0.6862

2025-07-17 13:05:16,708 - INFO - separation\_to\_cohesion: 5.8888

2025-07-17 13:05:16,708 - INFO - size\_balance: 0.0000

2025-07-17 13:05:16,708 - INFO - cluster\_count: 12.0000

2025-07-17 13:05:16,708 - INFO - avg\_cluster\_size: 598.4167

2025-07-17 13:05:16,709 - INFO - cluster\_size\_std: 603.2816

2025-07-17 13:05:16,709 - INFO - cluster\_sizes: [2338, 1, 510, 533, 1058, 576, 610, 659, 151, 17, 597, 131]

2025-07-17 13:06:02,236 - INFO - Epoch 41/80 - Time: 45.53s:Recon Loss=0.1667, Cluster Loss=0.0631,Reg Loss=0.0281,Last Inner Loss=0.2579

2025-07-17 13:06:47,911 - INFO - Epoch 42/80 - Time: 45.67s:Recon Loss=0.1681, Cluster Loss=0.0559,Reg Loss=0.0281,Last Inner Loss=0.2522

2025-07-17 13:07:33,931 - INFO - Epoch 43/80 - Time: 46.02s:Recon Loss=0.1694, Cluster Loss=0.0598,Reg Loss=0.0281,Last Inner Loss=0.2573

2025-07-17 13:08:22,117 - INFO - Epoch 44/80 - Time: 48.19s:Recon Loss=0.1668, Cluster Loss=0.0535,Reg Loss=0.0281,Last Inner Loss=0.2484

2025-07-17 13:09:10,897 - INFO - Epoch 45/80 - Time: 48.78s:Recon Loss=0.1656, Cluster Loss=0.0547,Reg Loss=0.0281,Last Inner Loss=0.2484

2025-07-17 13:09:59,869 - INFO - Epoch 46/80 - Time: 48.97s:Recon Loss=0.1647, Cluster Loss=0.0567,Reg Loss=0.0281,Last Inner Loss=0.2496

2025-07-17 13:10:48,681 - INFO - Epoch 47/80 - Time: 48.81s:Recon Loss=0.1636, Cluster Loss=0.0539,Reg Loss=0.0281,Last Inner Loss=0.2456

2025-07-17 13:11:35,127 - INFO - Epoch 48/80 - Time: 46.44s:Recon Loss=0.1638, Cluster Loss=0.0619,Reg Loss=0.0281,Last Inner Loss=0.2539

2025-07-17 13:12:20,738 - INFO - Epoch 49/80 - Time: 45.61s:Recon Loss=0.1637, Cluster Loss=0.0526,Reg Loss=0.0281,Last Inner Loss=0.2444

2025-07-17 13:13:10,653 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 13:13:10,653 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 13:13:12,218 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 13:13:13,076 - INFO - Epoch 50/80 (Eval) - Time: 52.34s (Eval Time: 6.12s):

2025-07-17 13:13:13,076 - INFO - Evaluation Metrics:

2025-07-17 13:13:13,076 - INFO - silhouette: 0.18246926367282867

2025-07-17 13:13:13,076 - INFO - davies\_bouldin: 1.4612

2025-07-17 13:13:13,076 - INFO - calinski\_harabasz: 2427.7421

2025-07-17 13:13:13,076 - INFO - cohesion: -0.12493520975112915

2025-07-17 13:13:13,076 - INFO - separation: 0.7407

2025-07-17 13:13:13,076 - INFO - separation\_to\_cohesion: 5.9286

2025-07-17 13:13:13,076 - INFO - size\_balance: 0.0000

2025-07-17 13:13:13,076 - INFO - cluster\_count: 12.0000

2025-07-17 13:13:13,076 - INFO - avg\_cluster\_size: 598.4167

2025-07-17 13:13:13,077 - INFO - cluster\_size\_std: 672.5130

2025-07-17 13:13:13,077 - INFO - cluster\_sizes: [2561, 635, 172, 1, 669, 638, 292, 344, 573, 5, 1152, 139]

2025-07-17 13:13:59,442 - INFO - Epoch 51/80 - Time: 46.36s:Recon Loss=0.1771, Cluster Loss=0.0757,Reg Loss=0.0282,Last Inner Loss=0.2809

2025-07-17 13:14:45,907 - INFO - Epoch 52/80 - Time: 46.47s:Recon Loss=0.1768, Cluster Loss=0.1070,Reg Loss=0.0282,Last Inner Loss=0.3120

2025-07-17 13:15:29,633 - INFO - Epoch 53/80 - Time: 43.73s:Recon Loss=0.1755, Cluster Loss=0.1132,Reg Loss=0.0283,Last Inner Loss=0.3170

2025-07-17 13:16:14,343 - INFO - Epoch 54/80 - Time: 44.71s:Recon Loss=0.1706, Cluster Loss=0.1165,Reg Loss=0.0283,Last Inner Loss=0.3154

2025-07-17 13:17:00,062 - INFO - Epoch 55/80 - Time: 45.72s:Recon Loss=0.1677, Cluster Loss=0.1092,Reg Loss=0.0283,Last Inner Loss=0.3052

2025-07-17 13:17:45,757 - INFO - Epoch 56/80 - Time: 45.69s:Recon Loss=0.1668, Cluster Loss=0.1042,Reg Loss=0.0283,Last Inner Loss=0.2993

2025-07-17 13:18:30,519 - INFO - Epoch 57/80 - Time: 44.76s:Recon Loss=0.1660, Cluster Loss=0.0908,Reg Loss=0.0283,Last Inner Loss=0.2851

2025-07-17 13:19:16,267 - INFO - Epoch 58/80 - Time: 45.75s:Recon Loss=0.1654, Cluster Loss=0.0919,Reg Loss=0.0284,Last Inner Loss=0.2857

2025-07-17 13:20:03,232 - INFO - Epoch 59/80 - Time: 46.96s:Recon Loss=0.1646, Cluster Loss=0.0775,Reg Loss=0.0283,Last Inner Loss=0.2704

2025-07-17 13:20:53,185 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 13:20:53,185 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 13:20:54,785 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 13:20:55,612 - INFO - Epoch 60/80 (Eval) - Time: 52.38s (Eval Time: 6.15s):

2025-07-17 13:20:55,612 - INFO - Evaluation Metrics:

2025-07-17 13:20:55,612 - INFO - silhouette: 0.13655999302864075

2025-07-17 13:20:55,613 - INFO - davies\_bouldin: 1.8433

2025-07-17 13:20:55,613 - INFO - calinski\_harabasz: 2373.3956

2025-07-17 13:20:55,613 - INFO - cohesion: -0.1512935906648636

2025-07-17 13:20:55,613 - INFO - separation: 0.7568

2025-07-17 13:20:55,613 - INFO - separation\_to\_cohesion: 5.0025

2025-07-17 13:20:55,614 - INFO - size\_balance: 0.1662

2025-07-17 13:20:55,614 - INFO - cluster\_count: 12.0000

2025-07-17 13:20:55,614 - INFO - avg\_cluster\_size: 598.4167

2025-07-17 13:20:55,614 - INFO - cluster\_size\_std: 498.9672

2025-07-17 13:20:55,614 - INFO - cluster\_sizes: [1263, 609, 165, 1, 662, 999, 573, 127, 468, 5, 595, 1714]

2025-07-17 13:21:39,638 - INFO - Epoch 61/80 - Time: 44.02s:Recon Loss=0.1649, Cluster Loss=0.0571,Reg Loss=0.0283,Last Inner Loss=0.2503

2025-07-17 13:22:23,720 - INFO - Epoch 62/80 - Time: 44.08s:Recon Loss=0.1649, Cluster Loss=0.0514,Reg Loss=0.0283,Last Inner Loss=0.2446

2025-07-17 13:23:10,072 - INFO - Epoch 63/80 - Time: 46.35s:Recon Loss=0.1647, Cluster Loss=0.0651,Reg Loss=0.0283,Last Inner Loss=0.2581

2025-07-17 13:23:55,139 - INFO - Epoch 64/80 - Time: 45.07s:Recon Loss=0.1645, Cluster Loss=0.0492,Reg Loss=0.0283,Last Inner Loss=0.2420

2025-07-17 13:24:39,819 - INFO - Epoch 65/80 - Time: 44.68s:Recon Loss=0.1642, Cluster Loss=0.0502,Reg Loss=0.0283,Last Inner Loss=0.2427

2025-07-17 13:25:24,935 - INFO - Epoch 66/80 - Time: 45.12s:Recon Loss=0.1640, Cluster Loss=0.0532,Reg Loss=0.0283,Last Inner Loss=0.2454

2025-07-17 13:26:12,258 - INFO - Epoch 67/80 - Time: 47.32s:Recon Loss=0.1631, Cluster Loss=0.0493,Reg Loss=0.0283,Last Inner Loss=0.2407

2025-07-17 13:26:57,819 - INFO - Epoch 68/80 - Time: 45.56s:Recon Loss=0.1627, Cluster Loss=0.0464,Reg Loss=0.0282,Last Inner Loss=0.2373

2025-07-17 13:27:41,307 - INFO - Epoch 69/80 - Time: 43.49s:Recon Loss=0.1623, Cluster Loss=0.0481,Reg Loss=0.0282,Last Inner Loss=0.2386

2025-07-17 13:28:28,458 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 13:28:28,458 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 13:28:30,108 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 13:28:30,976 - INFO - Epoch 70/80 (Eval) - Time: 49.67s (Eval Time: 6.50s):

2025-07-17 13:28:30,976 - INFO - Evaluation Metrics:

2025-07-17 13:28:30,976 - INFO - silhouette: 0.13333220779895782

2025-07-17 13:28:30,976 - INFO - davies\_bouldin: 1.6187

2025-07-17 13:28:30,976 - INFO - calinski\_harabasz: 2343.7307

2025-07-17 13:28:30,976 - INFO - cohesion: -0.1425580084323883

2025-07-17 13:28:30,976 - INFO - separation: 0.6617

2025-07-17 13:28:30,976 - INFO - separation\_to\_cohesion: 4.6413

2025-07-17 13:28:30,976 - INFO - size\_balance: 0.0000

2025-07-17 13:28:30,977 - INFO - cluster\_count: 12.0000

2025-07-17 13:28:30,977 - INFO - avg\_cluster\_size: 598.4167

2025-07-17 13:28:30,977 - INFO - cluster\_size\_std: 708.9614

2025-07-17 13:28:30,977 - INFO - cluster\_sizes: [2723, 366, 1105, 1, 500, 167, 577, 621, 129, 5, 322, 665]

2025-07-17 13:29:17,634 - INFO - Epoch 71/80 - Time: 46.66s:Recon Loss=0.1622, Cluster Loss=0.0444,Reg Loss=0.0282,Last Inner Loss=0.2348

2025-07-17 13:30:03,428 - INFO - Epoch 72/80 - Time: 45.79s:Recon Loss=0.1628, Cluster Loss=0.0472,Reg Loss=0.0282,Last Inner Loss=0.2382

2025-07-17 13:30:49,158 - INFO - Epoch 73/80 - Time: 45.73s:Recon Loss=0.1629, Cluster Loss=0.0429,Reg Loss=0.0282,Last Inner Loss=0.2340

2025-07-17 13:31:36,048 - INFO - Epoch 74/80 - Time: 46.89s:Recon Loss=0.1626, Cluster Loss=0.0461,Reg Loss=0.0282,Last Inner Loss=0.2369

2025-07-17 13:32:25,152 - INFO - Epoch 75/80 - Time: 49.10s:Recon Loss=0.1627, Cluster Loss=0.0518,Reg Loss=0.0282,Last Inner Loss=0.2426

2025-07-17 13:33:09,956 - INFO - Epoch 76/80 - Time: 44.80s:Recon Loss=0.1628, Cluster Loss=0.0654,Reg Loss=0.0281,Last Inner Loss=0.2564

2025-07-17 13:33:55,282 - INFO - Epoch 77/80 - Time: 45.32s:Recon Loss=0.1626, Cluster Loss=0.0693,Reg Loss=0.0281,Last Inner Loss=0.2600

2025-07-17 13:34:40,075 - INFO - Epoch 78/80 - Time: 44.79s:Recon Loss=0.1625, Cluster Loss=0.0758,Reg Loss=0.0281,Last Inner Loss=0.2664

2025-07-17 13:35:26,728 - INFO - Epoch 79/80 - Time: 46.65s:Recon Loss=0.1663, Cluster Loss=0.1087,Reg Loss=0.0281,Last Inner Loss=0.3032

2025-07-17 13:36:16,045 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 13:36:16,046 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 13:36:17,615 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 13:36:18,457 - INFO - Epoch 80/80 (Eval) - Time: 51.73s (Eval Time: 6.19s):

2025-07-17 13:36:18,457 - INFO - Evaluation Metrics:

2025-07-17 13:36:18,457 - INFO - silhouette: 0.15084759891033173

2025-07-17 13:36:18,457 - INFO - davies\_bouldin: 1.6721

2025-07-17 13:36:18,457 - INFO - calinski\_harabasz: 2013.1307

2025-07-17 13:36:18,457 - INFO - cohesion: -0.17884771525859833

2025-07-17 13:36:18,457 - INFO - separation: 0.5046

2025-07-17 13:36:18,457 - INFO - separation\_to\_cohesion: 2.8215

2025-07-17 13:36:18,458 - INFO - size\_balance: 0.0062

2025-07-17 13:36:18,458 - INFO - cluster\_count: 12.0000

2025-07-17 13:36:18,458 - INFO - avg\_cluster\_size: 598.4167

2025-07-17 13:36:18,458 - INFO - cluster\_size\_std: 594.7286

2025-07-17 13:36:18,458 - INFO - cluster\_sizes: [2094, 593, 1572, 335, 472, 551, 475, 633, 153, 6, 121, 176]

2025-07-17 13:36:18,458 - INFO -

Training completed!

2025-07-17 13:36:18,458 - INFO -

Saving final trained model...

2025-07-17 13:36:20,696 - INFO - Final trained model saved to ./results/n12\_final\_model\_gz\_ptype0\_no\_cat.pth

2025-07-17 13:36:20,696 - INFO -

Evaluating final trained model...

2025-07-17 13:36:24,449 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 13:36:24,449 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 13:36:26,018 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 13:36:26,816 - INFO -

Detailed Clustering Evaluation of Final Model:

2025-07-17 13:36:26,816 - INFO - silhouette: 0.15068425238132477

2025-07-17 13:36:26,816 - INFO - davies\_bouldin: 1.6732

2025-07-17 13:36:26,816 - INFO - calinski\_harabasz: 2012.4104

2025-07-17 13:36:26,816 - INFO - cohesion: -0.17884892225265503

2025-07-17 13:36:26,816 - INFO - separation: 0.5046

2025-07-17 13:36:26,817 - INFO - separation\_to\_cohesion: 2.8214

2025-07-17 13:36:26,817 - INFO - size\_balance: 0.0051

2025-07-17 13:36:26,817 - INFO - cluster\_count: 12.0000

2025-07-17 13:36:26,817 - INFO - avg\_cluster\_size: 598.4167

2025-07-17 13:36:26,817 - INFO - cluster\_size\_std: 595.3437

2025-07-17 13:36:26,817 - INFO - cluster\_sizes: [2104, 593, 1561, 335, 472, 551, 475, 634, 153, 6, 121, 176]

2025-07-17 13:36:26,817 - INFO -

--- Detailed Clustering Evaluation of Final Model (based on P indicator matrix as embeddings) ---

2025-07-17 13:36:27,595 - INFO - P\_based\_silhouette: 0.22803455591201782

2025-07-17 13:36:27,595 - INFO - P\_based\_davies\_bouldin: 1.1254

2025-07-17 13:36:27,595 - INFO - P\_based\_calinski\_harabasz: 1139.8209

2025-07-17 13:36:27,595 - INFO - P\_based\_cohesion: -0.030443042516708374

2025-07-17 13:36:27,596 - INFO - P\_based\_separation: 0.0966

2025-07-17 13:36:27,596 - INFO - P\_based\_separation\_to\_cohesion: 3.1737

2025-07-17 13:36:27,596 - INFO - P\_based\_size\_balance: 0.0051

2025-07-17 13:36:27,596 - INFO - P\_based\_cluster\_count: 12.0000

2025-07-17 13:36:27,596 - INFO - P\_based\_avg\_cluster\_size: 598.4167

2025-07-17 13:36:27,596 - INFO - P\_based\_cluster\_size\_std: 595.3437

2025-07-17 13:36:27,596 - INFO - P\_based\_cluster\_sizes: [2104, 593, 1561, 335, 472, 551, 475, 634, 153, 6, 121, 176]

2025-07-17 13:36:27,596 - INFO - Saving final results with embeddings and view weights...

2025-07-17 13:36:30,617 - INFO - Final results saved to ./results/n12\_final\_clustering\_gz\_pytpe0\_no\_cat.csv

2025-07-17 13:36:30,632 - INFO - Final evaluation metrics saved to ./results/n12\_final\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 15:29:41,425 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=13, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-17 15:29:41,441 - INFO - CUDA available. Using device: cuda:0

2025-07-17 15:29:41,442 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-17 15:30:07,146 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-17 15:30:07,150 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-17 15:30:07,159 - INFO - Numerical features scaled.

2025-07-17 15:30:07,272 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-17 15:30:07,277 - INFO - Loading pre-built graphs from directory: ./data

2025-07-17 15:30:07,324 - INFO - Loaded time graph: 807056 edges.

2025-07-17 15:30:07,334 - INFO - Loaded space graph: 890250 edges.

2025-07-17 15:30:07,344 - INFO - Loaded attr graph: 982548 edges.

2025-07-17 15:30:07,344 - INFO - Initializing model components...

2025-07-17 15:30:07,369 - INFO - Pretraining encoder...

2025-07-17 15:30:07,369 - WARNING - The main training loop might still encounter OutOfMemoryError due to the N x N matrix calculation

2025-07-17 15:30:07,369 - WARNING - in the clustering loss module (ZZ^T for SVD). This is inherent to the standard EGAE Jc loss formulation.

2025-07-17 15:30:07,370 - WARNING - If OOM occurs in the main loop, consider using a GPU with more memory or exploring approximations if available.

2025-07-17 15:32:32,518 - INFO - Pretrain Epoch 10/100 - Time: 14.71s: Recon Loss = 0.2130, Reg Loss = 0.1389, Total Loss = 0.3519

2025-07-17 15:34:57,987 - INFO - Pretrain Epoch 20/100 - Time: 14.49s: Recon Loss = 0.1893, Reg Loss = 0.1171, Total Loss = 0.3064

2025-07-17 15:37:21,618 - INFO - Pretrain Epoch 30/100 - Time: 13.85s: Recon Loss = 0.1628, Reg Loss = 0.0984, Total Loss = 0.2612

2025-07-17 15:39:49,319 - INFO - Pretrain Epoch 40/100 - Time: 15.07s: Recon Loss = 0.1618, Reg Loss = 0.0817, Total Loss = 0.2435

2025-07-17 15:42:14,041 - INFO - Pretrain Epoch 50/100 - Time: 14.44s: Recon Loss = 0.1620, Reg Loss = 0.0675, Total Loss = 0.2295

2025-07-17 15:44:42,272 - INFO - Pretrain Epoch 60/100 - Time: 15.12s: Recon Loss = 0.1619, Reg Loss = 0.0557, Total Loss = 0.2177

2025-07-17 15:47:07,012 - INFO - Pretrain Epoch 70/100 - Time: 15.01s: Recon Loss = 0.1619, Reg Loss = 0.0462, Total Loss = 0.2081

2025-07-17 15:49:35,261 - INFO - Pretrain Epoch 80/100 - Time: 15.14s: Recon Loss = 0.1629, Reg Loss = 0.0384, Total Loss = 0.2013

2025-07-17 15:52:03,252 - INFO - Pretrain Epoch 90/100 - Time: 14.39s: Recon Loss = 0.1622, Reg Loss = 0.0321, Total Loss = 0.1943

2025-07-17 15:54:22,184 - INFO - Pretrain Epoch 100/100 - Time: 14.15s: Recon Loss = 0.1619, Reg Loss = 0.0270, Total Loss = 0.1889

2025-07-17 15:54:22,184 - INFO -

Pretraining finished. Evaluating pretraining results with standard K-Means...

2025-07-17 15:54:25,594 - INFO - Running standard KMeans on pretrain embeddings ((7181, 64))...

2025-07-17 15:54:25,808 - INFO - Standard KMeans finished.

2025-07-17 15:54:26,563 - INFO - Pretraining Standard K-Means Clustering Evaluation:

2025-07-17 15:54:26,563 - INFO - silhouette: 0.22372940182685852

2025-07-17 15:54:26,563 - INFO - davies\_bouldin: 1.5615

2025-07-17 15:54:26,563 - INFO - calinski\_harabasz: 2518.6401

2025-07-17 15:54:26,563 - INFO - cohesion: -1.0631041526794434

2025-07-17 15:54:26,563 - INFO - separation: 3.1806

2025-07-17 15:54:26,564 - INFO - separation\_to\_cohesion: 2.9918

2025-07-17 15:54:26,564 - INFO - size\_balance: 0.2210

2025-07-17 15:54:26,564 - INFO - cluster\_count: 13.0000

2025-07-17 15:54:26,564 - INFO - avg\_cluster\_size: 552.3846

2025-07-17 15:54:26,564 - INFO - cluster\_size\_std: 430.2882

2025-07-17 15:54:26,564 - INFO - cluster\_sizes: [1138, 517, 1382, 1022, 63, 140, 1012, 282, 631, 169, 50, 381, 394]

2025-07-17 15:54:35,535 - INFO - Pretraining standard KMeans++ results saved to ./results/n13\_pretrain\_standard\_kmeans\_clustering\_gz\_ptype0\_no\_cat.csv

2025-07-17 15:54:35,550 - INFO - Pretraining standard KMeans++ evaluation metrics saved to ./results/n13\_pretrain\_standard\_kmeans\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 15:54:35,629 - INFO - Pretraining encoder saved to ./results/n13\_pretrain\_encoder\_gz\_pytpe0\_no\_cat.pth

2025-07-17 15:54:35,629 - INFO -

Starting main training loop (Alternating Optimization)...

2025-07-17 15:54:35,629 - INFO - Initializing indicator matrix P for main training...

2025-07-17 15:54:39,179 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 15:54:39,179 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 15:54:40,801 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 15:54:40,801 - INFO - Evaluating initial main training clustering results (SVD + KMeans++ on P)...

2025-07-17 15:54:41,665 - INFO - Initial Main Training SVD + KMeans++ Clustering Evaluation:

2025-07-17 15:54:41,665 - INFO - silhouette: 0.1065247654914856

2025-07-17 15:54:41,666 - INFO - davies\_bouldin: 2.5364

2025-07-17 15:54:41,666 - INFO - calinski\_harabasz: 528.1469

2025-07-17 15:54:41,666 - INFO - cohesion: -1.6448007822036743

2025-07-17 15:54:41,666 - INFO - separation: 2.6632

2025-07-17 15:54:41,666 - INFO - separation\_to\_cohesion: 1.6192

2025-07-17 15:54:41,666 - INFO - size\_balance: 0.0000

2025-07-17 15:54:41,666 - INFO - cluster\_count: 13.0000

2025-07-17 15:54:41,667 - INFO - avg\_cluster\_size: 552.3846

2025-07-17 15:54:41,667 - INFO - cluster\_size\_std: 618.4487

2025-07-17 15:54:41,667 - INFO - cluster\_sizes: [1726, 1616, 17, 579, 234, 275, 301, 186, 337, 44, 1607, 243, 16]

2025-07-17 15:55:23,278 - INFO - Epoch 1/80 - Time: 41.61s:Recon Loss=0.1730, Cluster Loss=7.3427,Reg Loss=0.0266,Last Inner Loss=7.5422

2025-07-17 15:56:08,199 - INFO - Epoch 2/80 - Time: 44.92s:Recon Loss=0.2005, Cluster Loss=3.3440,Reg Loss=0.0267,Last Inner Loss=3.5712

2025-07-17 15:56:54,092 - INFO - Epoch 3/80 - Time: 45.89s:Recon Loss=0.2175, Cluster Loss=1.6733,Reg Loss=0.0268,Last Inner Loss=1.9176

2025-07-17 15:57:36,799 - INFO - Epoch 4/80 - Time: 42.71s:Recon Loss=0.2318, Cluster Loss=1.0573,Reg Loss=0.0270,Last Inner Loss=1.3161

2025-07-17 15:58:19,785 - INFO - Epoch 5/80 - Time: 42.99s:Recon Loss=0.2373, Cluster Loss=0.6939,Reg Loss=0.0271,Last Inner Loss=0.9583

2025-07-17 15:59:05,996 - INFO - Epoch 6/80 - Time: 46.21s:Recon Loss=0.2383, Cluster Loss=0.5918,Reg Loss=0.0272,Last Inner Loss=0.8573

2025-07-17 15:59:52,103 - INFO - Epoch 7/80 - Time: 46.11s:Recon Loss=0.2410, Cluster Loss=0.4330,Reg Loss=0.0274,Last Inner Loss=0.7013

2025-07-17 16:00:36,690 - INFO - Epoch 8/80 - Time: 44.59s:Recon Loss=0.2384, Cluster Loss=0.3869,Reg Loss=0.0274,Last Inner Loss=0.6527

2025-07-17 16:01:23,186 - INFO - Epoch 9/80 - Time: 46.50s:Recon Loss=0.2311, Cluster Loss=0.3395,Reg Loss=0.0275,Last Inner Loss=0.5981

2025-07-17 16:02:08,410 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 16:02:08,410 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 16:02:10,102 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 16:02:10,924 - INFO - Epoch 10/80 (Eval) - Time: 47.74s (Eval Time: 5.97s):

2025-07-17 16:02:10,924 - INFO - Evaluation Metrics:

2025-07-17 16:02:10,924 - INFO - silhouette: 0.06137949228286743

2025-07-17 16:02:10,924 - INFO - davies\_bouldin: 2.1121

2025-07-17 16:02:10,924 - INFO - calinski\_harabasz: 1193.3054

2025-07-17 16:02:10,924 - INFO - cohesion: -0.13648031651973724

2025-07-17 16:02:10,924 - INFO - separation: 1.1878

2025-07-17 16:02:10,924 - INFO - separation\_to\_cohesion: 8.7032

2025-07-17 16:02:10,924 - INFO - size\_balance: 0.0000

2025-07-17 16:02:10,924 - INFO - cluster\_count: 13.0000

2025-07-17 16:02:10,925 - INFO - avg\_cluster\_size: 552.3846

2025-07-17 16:02:10,925 - INFO - cluster\_size\_std: 618.0187

2025-07-17 16:02:10,925 - INFO - cluster\_sizes: [1128, 1805, 1172, 1, 198, 302, 431, 1, 2, 16, 1605, 247, 273]

2025-07-17 16:02:56,066 - INFO - Epoch 11/80 - Time: 45.14s:Recon Loss=0.2061, Cluster Loss=0.1315,Reg Loss=0.0276,Last Inner Loss=0.3652

2025-07-17 16:03:39,599 - INFO - Epoch 12/80 - Time: 43.53s:Recon Loss=0.1983, Cluster Loss=0.1178,Reg Loss=0.0276,Last Inner Loss=0.3437

2025-07-17 16:04:22,848 - INFO - Epoch 13/80 - Time: 43.25s:Recon Loss=0.1876, Cluster Loss=0.1676,Reg Loss=0.0276,Last Inner Loss=0.3829

2025-07-17 16:05:04,301 - INFO - Epoch 14/80 - Time: 41.45s:Recon Loss=0.1816, Cluster Loss=0.1442,Reg Loss=0.0276,Last Inner Loss=0.3534

2025-07-17 16:05:45,093 - INFO - Epoch 15/80 - Time: 40.79s:Recon Loss=0.1759, Cluster Loss=0.1178,Reg Loss=0.0276,Last Inner Loss=0.3212

2025-07-17 16:06:26,448 - INFO - Epoch 16/80 - Time: 41.35s:Recon Loss=0.1730, Cluster Loss=0.0975,Reg Loss=0.0276,Last Inner Loss=0.2981

2025-07-17 16:07:07,878 - INFO - Epoch 17/80 - Time: 41.43s:Recon Loss=0.1721, Cluster Loss=0.0858,Reg Loss=0.0276,Last Inner Loss=0.2856

2025-07-17 16:07:50,246 - INFO - Epoch 18/80 - Time: 42.37s:Recon Loss=0.1729, Cluster Loss=0.0869,Reg Loss=0.0276,Last Inner Loss=0.2874

2025-07-17 16:08:33,476 - INFO - Epoch 19/80 - Time: 43.23s:Recon Loss=0.1710, Cluster Loss=0.0955,Reg Loss=0.0276,Last Inner Loss=0.2941

2025-07-17 16:09:21,156 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 16:09:21,156 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 16:09:22,767 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 16:09:23,704 - INFO - Epoch 20/80 (Eval) - Time: 50.23s (Eval Time: 6.06s):

2025-07-17 16:09:23,704 - INFO - Evaluation Metrics:

2025-07-17 16:09:23,704 - INFO - silhouette: 0.05022955685853958

2025-07-17 16:09:23,704 - INFO - davies\_bouldin: 2.0102

2025-07-17 16:09:23,705 - INFO - calinski\_harabasz: 858.6868

2025-07-17 16:09:23,705 - INFO - cohesion: -0.11993984133005142

2025-07-17 16:09:23,705 - INFO - separation: 1.1524

2025-07-17 16:09:23,705 - INFO - separation\_to\_cohesion: 9.6080

2025-07-17 16:09:23,705 - INFO - size\_balance: 0.0121

2025-07-17 16:09:23,705 - INFO - cluster\_count: 13.0000

2025-07-17 16:09:23,705 - INFO - avg\_cluster\_size: 552.3846

2025-07-17 16:09:23,705 - INFO - cluster\_size\_std: 545.7058

2025-07-17 16:09:23,705 - INFO - cluster\_sizes: [1072, 1, 319, 421, 1688, 1048, 1321, 1, 2, 3, 451, 700, 154]

2025-07-17 16:10:06,804 - INFO - Epoch 21/80 - Time: 43.10s:Recon Loss=0.1757, Cluster Loss=0.0786,Reg Loss=0.0276,Last Inner Loss=0.2819

2025-07-17 16:10:47,476 - INFO - Epoch 22/80 - Time: 40.67s:Recon Loss=0.1811, Cluster Loss=0.1081,Reg Loss=0.0276,Last Inner Loss=0.3168

2025-07-17 16:11:28,745 - INFO - Epoch 23/80 - Time: 41.27s:Recon Loss=0.1785, Cluster Loss=0.1502,Reg Loss=0.0277,Last Inner Loss=0.3564

2025-07-17 16:12:10,379 - INFO - Epoch 24/80 - Time: 41.63s:Recon Loss=0.1759, Cluster Loss=0.1555,Reg Loss=0.0277,Last Inner Loss=0.3590

2025-07-17 16:12:51,782 - INFO - Epoch 25/80 - Time: 41.40s:Recon Loss=0.1708, Cluster Loss=0.1628,Reg Loss=0.0277,Last Inner Loss=0.3613

2025-07-17 16:13:31,887 - INFO - Epoch 26/80 - Time: 40.11s:Recon Loss=0.1689, Cluster Loss=0.1580,Reg Loss=0.0277,Last Inner Loss=0.3546

2025-07-17 16:14:13,982 - INFO - Epoch 27/80 - Time: 42.09s:Recon Loss=0.1678, Cluster Loss=0.1459,Reg Loss=0.0277,Last Inner Loss=0.3414

2025-07-17 16:14:58,259 - INFO - Epoch 28/80 - Time: 44.28s:Recon Loss=0.1688, Cluster Loss=0.1343,Reg Loss=0.0277,Last Inner Loss=0.3308

2025-07-17 16:15:42,254 - INFO - Epoch 29/80 - Time: 44.00s:Recon Loss=0.1661, Cluster Loss=0.1246,Reg Loss=0.0277,Last Inner Loss=0.3184

2025-07-17 16:16:29,503 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 16:16:29,503 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 16:16:31,221 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 16:16:32,032 - INFO - Epoch 30/80 (Eval) - Time: 49.78s (Eval Time: 6.01s):

2025-07-17 16:16:32,032 - INFO - Evaluation Metrics:

2025-07-17 16:16:32,032 - INFO - silhouette: 0.08838718384504318

2025-07-17 16:16:32,033 - INFO - davies\_bouldin: 1.9908

2025-07-17 16:16:32,033 - INFO - calinski\_harabasz: 948.6856

2025-07-17 16:16:32,033 - INFO - cohesion: -0.17943017184734344

2025-07-17 16:16:32,033 - INFO - separation: 1.0280

2025-07-17 16:16:32,033 - INFO - separation\_to\_cohesion: 5.7290

2025-07-17 16:16:32,033 - INFO - size\_balance: 0.1204

2025-07-17 16:16:32,033 - INFO - cluster\_count: 13.0000

2025-07-17 16:16:32,033 - INFO - avg\_cluster\_size: 552.3846

2025-07-17 16:16:32,033 - INFO - cluster\_size\_std: 485.8624

2025-07-17 16:16:32,033 - INFO - cluster\_sizes: [1512, 1359, 584, 1, 402, 850, 392, 690, 2, 4, 478, 2, 905]

2025-07-17 16:17:13,649 - INFO - Epoch 31/80 - Time: 41.62s:Recon Loss=0.1684, Cluster Loss=0.0812,Reg Loss=0.0278,Last Inner Loss=0.2774

2025-07-17 16:17:55,879 - INFO - Epoch 32/80 - Time: 42.23s:Recon Loss=0.1685, Cluster Loss=0.0590,Reg Loss=0.0278,Last Inner Loss=0.2553

2025-07-17 16:18:39,126 - INFO - Epoch 33/80 - Time: 43.25s:Recon Loss=0.1660, Cluster Loss=0.0654,Reg Loss=0.0279,Last Inner Loss=0.2593

2025-07-17 16:19:20,792 - INFO - Epoch 34/80 - Time: 41.67s:Recon Loss=0.1654, Cluster Loss=0.0604,Reg Loss=0.0279,Last Inner Loss=0.2536

2025-07-17 16:20:04,323 - INFO - Epoch 35/80 - Time: 43.53s:Recon Loss=0.1653, Cluster Loss=0.0660,Reg Loss=0.0279,Last Inner Loss=0.2592

2025-07-17 16:20:49,750 - INFO - Epoch 36/80 - Time: 45.43s:Recon Loss=0.1641, Cluster Loss=0.0556,Reg Loss=0.0279,Last Inner Loss=0.2476

2025-07-17 16:21:34,670 - INFO - Epoch 37/80 - Time: 44.92s:Recon Loss=0.1665, Cluster Loss=0.0962,Reg Loss=0.0279,Last Inner Loss=0.2905

2025-07-17 16:22:17,287 - INFO - Epoch 38/80 - Time: 42.62s:Recon Loss=0.1642, Cluster Loss=0.0635,Reg Loss=0.0279,Last Inner Loss=0.2556

2025-07-17 16:23:01,036 - INFO - Epoch 39/80 - Time: 43.75s:Recon Loss=0.1637, Cluster Loss=0.0872,Reg Loss=0.0279,Last Inner Loss=0.2788

2025-07-17 16:23:43,227 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 16:23:43,227 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 16:23:44,866 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 16:23:45,662 - INFO - Epoch 40/80 (Eval) - Time: 44.63s (Eval Time: 5.44s):

2025-07-17 16:23:45,662 - INFO - Evaluation Metrics:

2025-07-17 16:23:45,662 - INFO - silhouette: 0.06473223865032196

2025-07-17 16:23:45,662 - INFO - davies\_bouldin: 2.3064

2025-07-17 16:23:45,662 - INFO - calinski\_harabasz: 705.2425

2025-07-17 16:23:45,663 - INFO - cohesion: -0.10784721374511719

2025-07-17 16:23:45,663 - INFO - separation: 0.9032

2025-07-17 16:23:45,663 - INFO - separation\_to\_cohesion: 8.3745

2025-07-17 16:23:45,663 - INFO - size\_balance: 0.0778

2025-07-17 16:23:45,663 - INFO - cluster\_count: 13.0000

2025-07-17 16:23:45,663 - INFO - avg\_cluster\_size: 552.3846

2025-07-17 16:23:45,663 - INFO - cluster\_size\_std: 509.4206

2025-07-17 16:23:45,663 - INFO - cluster\_sizes: [710, 1, 629, 792, 863, 307, 423, 333, 2, 68, 1420, 1, 1632]

2025-07-17 16:24:24,369 - INFO - Epoch 41/80 - Time: 38.71s:Recon Loss=0.1638, Cluster Loss=0.0855,Reg Loss=0.0279,Last Inner Loss=0.2772

2025-07-17 16:25:05,180 - INFO - Epoch 42/80 - Time: 40.81s:Recon Loss=0.1649, Cluster Loss=0.1401,Reg Loss=0.0279,Last Inner Loss=0.3329

2025-07-17 16:25:43,829 - INFO - Epoch 43/80 - Time: 38.65s:Recon Loss=0.1665, Cluster Loss=0.1780,Reg Loss=0.0279,Last Inner Loss=0.3724

2025-07-17 16:26:23,017 - INFO - Epoch 44/80 - Time: 39.19s:Recon Loss=0.1647, Cluster Loss=0.1638,Reg Loss=0.0279,Last Inner Loss=0.3565

2025-07-17 16:27:05,607 - INFO - Epoch 45/80 - Time: 42.59s:Recon Loss=0.1647, Cluster Loss=0.1483,Reg Loss=0.0279,Last Inner Loss=0.3410

2025-07-17 16:27:52,021 - INFO - Epoch 46/80 - Time: 46.41s:Recon Loss=0.1638, Cluster Loss=0.1371,Reg Loss=0.0279,Last Inner Loss=0.3288

2025-07-17 16:28:35,258 - INFO - Epoch 47/80 - Time: 43.24s:Recon Loss=0.1634, Cluster Loss=0.1269,Reg Loss=0.0279,Last Inner Loss=0.3182

2025-07-17 16:29:15,635 - INFO - Epoch 48/80 - Time: 40.38s:Recon Loss=0.1633, Cluster Loss=0.1220,Reg Loss=0.0279,Last Inner Loss=0.3132

2025-07-17 16:29:54,191 - INFO - Epoch 49/80 - Time: 38.56s:Recon Loss=0.1637, Cluster Loss=0.1044,Reg Loss=0.0279,Last Inner Loss=0.2960

2025-07-17 16:30:35,521 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 16:30:35,521 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 16:30:37,125 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 16:30:37,947 - INFO - Epoch 50/80 (Eval) - Time: 43.76s (Eval Time: 5.89s):

2025-07-17 16:30:37,947 - INFO - Evaluation Metrics:

2025-07-17 16:30:37,947 - INFO - silhouette: 0.06471626460552216

2025-07-17 16:30:37,947 - INFO - davies\_bouldin: 2.2774

2025-07-17 16:30:37,947 - INFO - calinski\_harabasz: 760.2902

2025-07-17 16:30:37,947 - INFO - cohesion: -0.1078055277466774

2025-07-17 16:30:37,947 - INFO - separation: 0.9142

2025-07-17 16:30:37,947 - INFO - separation\_to\_cohesion: 8.4800

2025-07-17 16:30:37,948 - INFO - size\_balance: 0.1950

2025-07-17 16:30:37,948 - INFO - cluster\_count: 13.0000

2025-07-17 16:30:37,948 - INFO - avg\_cluster\_size: 552.3846

2025-07-17 16:30:37,948 - INFO - cluster\_size\_std: 444.6749

2025-07-17 16:30:37,948 - INFO - cluster\_sizes: [692, 792, 741, 1, 1342, 75, 645, 1367, 2, 411, 598, 1, 514]

2025-07-17 16:31:17,172 - INFO - Epoch 51/80 - Time: 39.22s:Recon Loss=0.1633, Cluster Loss=0.0476,Reg Loss=0.0279,Last Inner Loss=0.2387

2025-07-17 16:31:55,867 - INFO - Epoch 52/80 - Time: 38.69s:Recon Loss=0.1630, Cluster Loss=0.0496,Reg Loss=0.0278,Last Inner Loss=0.2404

2025-07-17 16:32:35,964 - INFO - Epoch 53/80 - Time: 40.10s:Recon Loss=0.1635, Cluster Loss=0.0489,Reg Loss=0.0278,Last Inner Loss=0.2402

2025-07-17 16:33:18,423 - INFO - Epoch 54/80 - Time: 42.46s:Recon Loss=0.1643, Cluster Loss=0.0451,Reg Loss=0.0278,Last Inner Loss=0.2372

2025-07-17 16:34:04,396 - INFO - Epoch 55/80 - Time: 45.97s:Recon Loss=0.1636, Cluster Loss=0.0516,Reg Loss=0.0278,Last Inner Loss=0.2430

2025-07-17 16:34:47,471 - INFO - Epoch 56/80 - Time: 43.08s:Recon Loss=0.1632, Cluster Loss=0.0387,Reg Loss=0.0278,Last Inner Loss=0.2296

2025-07-17 16:35:27,694 - INFO - Epoch 57/80 - Time: 40.22s:Recon Loss=0.1629, Cluster Loss=0.0372,Reg Loss=0.0278,Last Inner Loss=0.2279

2025-07-17 16:36:05,215 - INFO - Epoch 58/80 - Time: 37.52s:Recon Loss=0.1627, Cluster Loss=0.0364,Reg Loss=0.0278,Last Inner Loss=0.2269

2025-07-17 16:36:43,401 - INFO - Epoch 59/80 - Time: 38.19s:Recon Loss=0.1641, Cluster Loss=0.0614,Reg Loss=0.0277,Last Inner Loss=0.2532

2025-07-17 16:37:25,579 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 16:37:25,579 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 16:37:27,151 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 16:37:27,899 - INFO - Epoch 60/80 (Eval) - Time: 44.50s (Eval Time: 5.46s):

2025-07-17 16:37:27,899 - INFO - Evaluation Metrics:

2025-07-17 16:37:27,899 - INFO - silhouette: 0.07130653411149979

2025-07-17 16:37:27,900 - INFO - davies\_bouldin: 2.0728

2025-07-17 16:37:27,900 - INFO - calinski\_harabasz: 925.5695

2025-07-17 16:37:27,900 - INFO - cohesion: -0.1612965166568756

2025-07-17 16:37:27,900 - INFO - separation: 1.0055

2025-07-17 16:37:27,900 - INFO - separation\_to\_cohesion: 6.2340

2025-07-17 16:37:27,900 - INFO - size\_balance: 0.0000

2025-07-17 16:37:27,900 - INFO - cluster\_count: 13.0000

2025-07-17 16:37:27,900 - INFO - avg\_cluster\_size: 552.3846

2025-07-17 16:37:27,900 - INFO - cluster\_size\_std: 595.2541

2025-07-17 16:37:27,900 - INFO - cluster\_sizes: [417, 1680, 1, 1, 654, 728, 898, 73, 2, 1832, 609, 3, 283]

2025-07-17 16:38:05,762 - INFO - Epoch 61/80 - Time: 37.86s:Recon Loss=0.1625, Cluster Loss=0.0358,Reg Loss=0.0277,Last Inner Loss=0.2261

2025-07-17 16:38:46,192 - INFO - Epoch 62/80 - Time: 40.43s:Recon Loss=0.1629, Cluster Loss=0.0349,Reg Loss=0.0277,Last Inner Loss=0.2256

2025-07-17 16:39:28,590 - INFO - Epoch 63/80 - Time: 42.40s:Recon Loss=0.2418, Cluster Loss=0.0809,Reg Loss=0.0277,Last Inner Loss=0.3503

2025-07-17 16:40:13,195 - INFO - Epoch 64/80 - Time: 44.60s:Recon Loss=0.2686, Cluster Loss=0.0983,Reg Loss=0.0277,Last Inner Loss=0.3945

2025-07-17 16:40:56,007 - INFO - Epoch 65/80 - Time: 42.81s:Recon Loss=0.2567, Cluster Loss=0.1021,Reg Loss=0.0277,Last Inner Loss=0.3864

2025-07-17 16:41:34,607 - INFO - Epoch 66/80 - Time: 38.60s:Recon Loss=0.2170, Cluster Loss=0.0893,Reg Loss=0.0277,Last Inner Loss=0.3340

2025-07-17 16:42:11,471 - INFO - Epoch 67/80 - Time: 36.86s:Recon Loss=0.1967, Cluster Loss=0.0865,Reg Loss=0.0277,Last Inner Loss=0.3108

2025-07-17 16:42:51,880 - INFO - Epoch 68/80 - Time: 40.41s:Recon Loss=0.1836, Cluster Loss=0.0725,Reg Loss=0.0276,Last Inner Loss=0.2837

2025-07-17 16:43:30,684 - INFO - Epoch 69/80 - Time: 38.80s:Recon Loss=0.1744, Cluster Loss=0.0689,Reg Loss=0.0276,Last Inner Loss=0.2709

2025-07-17 16:44:11,978 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 16:44:11,978 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 16:44:13,543 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 16:44:14,373 - INFO - Epoch 70/80 (Eval) - Time: 43.69s (Eval Time: 5.38s):

2025-07-17 16:44:14,373 - INFO - Evaluation Metrics:

2025-07-17 16:44:14,373 - INFO - silhouette: 0.055108748376369476

2025-07-17 16:44:14,373 - INFO - davies\_bouldin: 2.0066

2025-07-17 16:44:14,373 - INFO - calinski\_harabasz: 869.3815

2025-07-17 16:44:14,373 - INFO - cohesion: -0.07888410985469818

2025-07-17 16:44:14,373 - INFO - separation: 0.9340

2025-07-17 16:44:14,373 - INFO - separation\_to\_cohesion: 11.8402

2025-07-17 16:44:14,373 - INFO - size\_balance: 0.1887

2025-07-17 16:44:14,374 - INFO - cluster\_count: 13.0000

2025-07-17 16:44:14,374 - INFO - avg\_cluster\_size: 552.3846

2025-07-17 16:44:14,374 - INFO - cluster\_size\_std: 448.1388

2025-07-17 16:44:14,374 - INFO - cluster\_sizes: [477, 1034, 360, 1596, 437, 737, 386, 1, 1062, 1, 545, 1, 544]

2025-07-17 16:44:57,872 - INFO - Epoch 71/80 - Time: 43.50s:Recon Loss=0.1709, Cluster Loss=0.0466,Reg Loss=0.0276,Last Inner Loss=0.2452

2025-07-17 16:45:40,652 - INFO - Epoch 72/80 - Time: 42.78s:Recon Loss=0.1708, Cluster Loss=0.0535,Reg Loss=0.0276,Last Inner Loss=0.2520

2025-07-17 16:46:25,279 - INFO - Epoch 73/80 - Time: 44.63s:Recon Loss=0.1690, Cluster Loss=0.0519,Reg Loss=0.0276,Last Inner Loss=0.2485

2025-07-17 16:47:06,676 - INFO - Epoch 74/80 - Time: 41.40s:Recon Loss=0.1684, Cluster Loss=0.0489,Reg Loss=0.0276,Last Inner Loss=0.2450

2025-07-17 16:47:45,053 - INFO - Epoch 75/80 - Time: 38.38s:Recon Loss=0.1680, Cluster Loss=0.0442,Reg Loss=0.0276,Last Inner Loss=0.2399

2025-07-17 16:48:22,882 - INFO - Epoch 76/80 - Time: 37.83s:Recon Loss=0.1680, Cluster Loss=0.0413,Reg Loss=0.0276,Last Inner Loss=0.2369

2025-07-17 16:49:03,822 - INFO - Epoch 77/80 - Time: 40.94s:Recon Loss=0.1670, Cluster Loss=0.0435,Reg Loss=0.0275,Last Inner Loss=0.2380

2025-07-17 16:49:42,033 - INFO - Epoch 78/80 - Time: 38.21s:Recon Loss=0.1666, Cluster Loss=0.0468,Reg Loss=0.0275,Last Inner Loss=0.2410

2025-07-17 16:50:22,073 - INFO - Epoch 79/80 - Time: 40.04s:Recon Loss=0.1664, Cluster Loss=0.0641,Reg Loss=0.0275,Last Inner Loss=0.2580

2025-07-17 16:51:09,675 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 16:51:09,676 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 16:51:11,302 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 16:51:12,110 - INFO - Epoch 80/80 (Eval) - Time: 50.04s (Eval Time: 5.75s):

2025-07-17 16:51:12,110 - INFO - Evaluation Metrics:

2025-07-17 16:51:12,110 - INFO - silhouette: 0.06815723329782486

2025-07-17 16:51:12,110 - INFO - davies\_bouldin: 2.1234

2025-07-17 16:51:12,110 - INFO - calinski\_harabasz: 975.1542

2025-07-17 16:51:12,111 - INFO - cohesion: -0.08870650082826614

2025-07-17 16:51:12,111 - INFO - separation: 0.7419

2025-07-17 16:51:12,111 - INFO - separation\_to\_cohesion: 8.3633

2025-07-17 16:51:12,111 - INFO - size\_balance: 0.1516

2025-07-17 16:51:12,111 - INFO - cluster\_count: 13.0000

2025-07-17 16:51:12,111 - INFO - avg\_cluster\_size: 552.3846

2025-07-17 16:51:12,111 - INFO - cluster\_size\_std: 468.6179

2025-07-17 16:51:12,111 - INFO - cluster\_sizes: [542, 1736, 207, 424, 1, 324, 540, 730, 230, 1, 359, 1078, 1009]

2025-07-17 16:51:12,112 - INFO -

Training completed!

2025-07-17 16:51:12,112 - INFO -

Saving final trained model...

2025-07-17 16:51:13,362 - INFO - Final trained model saved to ./results/n13\_final\_model\_gz\_ptype0\_no\_cat.pth

2025-07-17 16:51:13,362 - INFO -

Evaluating final trained model...

2025-07-17 16:51:16,692 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 16:51:16,692 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 16:51:18,315 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 16:51:19,210 - INFO -

Detailed Clustering Evaluation of Final Model:

2025-07-17 16:51:19,211 - INFO - silhouette: 0.06815721839666367

2025-07-17 16:51:19,211 - INFO - davies\_bouldin: 2.1234

2025-07-17 16:51:19,211 - INFO - calinski\_harabasz: 975.1542

2025-07-17 16:51:19,211 - INFO - cohesion: -0.08870650082826614

2025-07-17 16:51:19,211 - INFO - separation: 0.7419

2025-07-17 16:51:19,211 - INFO - separation\_to\_cohesion: 8.3633

2025-07-17 16:51:19,211 - INFO - size\_balance: 0.1516

2025-07-17 16:51:19,212 - INFO - cluster\_count: 13.0000

2025-07-17 16:51:19,212 - INFO - avg\_cluster\_size: 552.3846

2025-07-17 16:51:19,212 - INFO - cluster\_size\_std: 468.6179

2025-07-17 16:51:19,212 - INFO - cluster\_sizes: [542, 1736, 207, 424, 1, 324, 540, 730, 230, 1, 359, 1078, 1009]

2025-07-17 16:51:19,212 - INFO -

--- Detailed Clustering Evaluation of Final Model (based on P indicator matrix as embeddings) ---

2025-07-17 16:51:19,931 - INFO - P\_based\_silhouette: 0.18684977293014526

2025-07-17 16:51:19,932 - INFO - P\_based\_davies\_bouldin: 1.2104

2025-07-17 16:51:19,932 - INFO - P\_based\_calinski\_harabasz: 678.5724

2025-07-17 16:51:19,932 - INFO - P\_based\_cohesion: -0.020715363323688507

2025-07-17 16:51:19,932 - INFO - P\_based\_separation: 0.2774

2025-07-17 16:51:19,932 - INFO - P\_based\_separation\_to\_cohesion: 13.3907

2025-07-17 16:51:19,932 - INFO - P\_based\_size\_balance: 0.1516

2025-07-17 16:51:19,932 - INFO - P\_based\_cluster\_count: 13.0000

2025-07-17 16:51:19,932 - INFO - P\_based\_avg\_cluster\_size: 552.3846

2025-07-17 16:51:19,932 - INFO - P\_based\_cluster\_size\_std: 468.6179

2025-07-17 16:51:19,932 - INFO - P\_based\_cluster\_sizes: [542, 1736, 207, 424, 1, 324, 540, 730, 230, 1, 359, 1078, 1009]

2025-07-17 16:51:19,932 - INFO - Saving final results with embeddings and view weights...

2025-07-17 16:51:39,308 - INFO - Final results saved to ./results/n13\_final\_clustering\_gz\_pytpe0\_no\_cat.csv

2025-07-17 16:51:39,333 - INFO - Final evaluation metrics saved to ./results/n13\_final\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 17:03:07,542 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=14, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-17 17:03:07,558 - INFO - CUDA available. Using device: cuda:0

2025-07-17 17:03:07,558 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-17 17:03:32,909 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-17 17:03:32,913 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-17 17:03:32,922 - INFO - Numerical features scaled.

2025-07-17 17:03:33,010 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-17 17:03:33,014 - INFO - Loading pre-built graphs from directory: ./data

2025-07-17 17:03:33,058 - INFO - Loaded time graph: 807056 edges.

2025-07-17 17:03:33,068 - INFO - Loaded space graph: 890250 edges.

2025-07-17 17:03:33,078 - INFO - Loaded attr graph: 982548 edges.

2025-07-17 17:03:33,078 - INFO - Initializing model components...

2025-07-17 17:03:33,102 - INFO - Pretraining encoder...

2025-07-17 17:03:33,102 - WARNING - The main training loop might still encounter OutOfMemoryError due to the N x N matrix calculation

2025-07-17 17:03:33,102 - WARNING - in the clustering loss module (ZZ^T for SVD). This is inherent to the standard EGAE Jc loss formulation.

2025-07-17 17:03:33,102 - WARNING - If OOM occurs in the main loop, consider using a GPU with more memory or exploring approximations if available.

2025-07-17 17:05:54,074 - INFO - Pretrain Epoch 10/100 - Time: 13.16s: Recon Loss = 0.2130, Reg Loss = 0.1389, Total Loss = 0.3519

2025-07-17 17:08:08,471 - INFO - Pretrain Epoch 20/100 - Time: 13.57s: Recon Loss = 0.1884, Reg Loss = 0.1171, Total Loss = 0.3055

2025-07-17 17:10:31,076 - INFO - Pretrain Epoch 30/100 - Time: 14.40s: Recon Loss = 0.1628, Reg Loss = 0.0985, Total Loss = 0.2613

2025-07-17 17:12:47,007 - INFO - Pretrain Epoch 40/100 - Time: 13.99s: Recon Loss = 0.1618, Reg Loss = 0.0819, Total Loss = 0.2437

2025-07-17 17:14:58,615 - INFO - Pretrain Epoch 50/100 - Time: 14.29s: Recon Loss = 0.1621, Reg Loss = 0.0677, Total Loss = 0.2298

2025-07-17 17:17:18,610 - INFO - Pretrain Epoch 60/100 - Time: 12.91s: Recon Loss = 0.1619, Reg Loss = 0.0560, Total Loss = 0.2180

2025-07-17 17:19:27,191 - INFO - Pretrain Epoch 70/100 - Time: 12.51s: Recon Loss = 0.1619, Reg Loss = 0.0465, Total Loss = 0.2084

2025-07-17 17:21:40,599 - INFO - Pretrain Epoch 80/100 - Time: 13.85s: Recon Loss = 0.1626, Reg Loss = 0.0387, Total Loss = 0.2013

2025-07-17 17:23:53,067 - INFO - Pretrain Epoch 90/100 - Time: 12.36s: Recon Loss = 0.1620, Reg Loss = 0.0324, Total Loss = 0.1944

2025-07-17 17:26:00,748 - INFO - Pretrain Epoch 100/100 - Time: 13.18s: Recon Loss = 0.1621, Reg Loss = 0.0272, Total Loss = 0.1893

2025-07-17 17:26:00,748 - INFO -

Pretraining finished. Evaluating pretraining results with standard K-Means...

2025-07-17 17:26:04,310 - INFO - Running standard KMeans on pretrain embeddings ((7181, 64))...

2025-07-17 17:26:04,541 - INFO - Standard KMeans finished.

2025-07-17 17:26:05,326 - INFO - Pretraining Standard K-Means Clustering Evaluation:

2025-07-17 17:26:05,326 - INFO - silhouette: 0.19866780936717987

2025-07-17 17:26:05,326 - INFO - davies\_bouldin: 1.5000

2025-07-17 17:26:05,326 - INFO - calinski\_harabasz: 2303.0539

2025-07-17 17:26:05,326 - INFO - cohesion: -0.9586792588233948

2025-07-17 17:26:05,326 - INFO - separation: 2.6063

2025-07-17 17:26:05,327 - INFO - separation\_to\_cohesion: 2.7186

2025-07-17 17:26:05,327 - INFO - size\_balance: 0.3468

2025-07-17 17:26:05,327 - INFO - cluster\_count: 14.0000

2025-07-17 17:26:05,327 - INFO - avg\_cluster\_size: 512.9286

2025-07-17 17:26:05,327 - INFO - cluster\_size\_std: 335.0423

2025-07-17 17:26:05,327 - INFO - cluster\_sizes: [1136, 563, 217, 634, 431, 1192, 637, 128, 339, 240, 793, 82, 553, 236]

2025-07-17 17:26:10,009 - INFO - Pretraining standard KMeans++ results saved to ./results/n14\_pretrain\_standard\_kmeans\_clustering\_gz\_ptype0\_no\_cat.csv

2025-07-17 17:26:10,024 - INFO - Pretraining standard KMeans++ evaluation metrics saved to ./results/n14\_pretrain\_standard\_kmeans\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 17:26:10,092 - INFO - Pretraining encoder saved to ./results/n14\_pretrain\_encoder\_gz\_pytpe0\_no\_cat.pth

2025-07-17 17:26:10,092 - INFO -

Starting main training loop (Alternating Optimization)...

2025-07-17 17:26:10,092 - INFO - Initializing indicator matrix P for main training...

2025-07-17 17:26:13,811 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 17:26:13,812 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 17:26:15,478 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 17:26:15,478 - INFO - Evaluating initial main training clustering results (SVD + KMeans++ on P)...

2025-07-17 17:26:16,337 - INFO - Initial Main Training SVD + KMeans++ Clustering Evaluation:

2025-07-17 17:26:16,337 - INFO - silhouette: 0.029931500554084778

2025-07-17 17:26:16,337 - INFO - davies\_bouldin: 2.3715

2025-07-17 17:26:16,337 - INFO - calinski\_harabasz: 523.0733

2025-07-17 17:26:16,337 - INFO - cohesion: -1.4195737838745117

2025-07-17 17:26:16,337 - INFO - separation: 2.0658

2025-07-17 17:26:16,337 - INFO - separation\_to\_cohesion: 1.4552

2025-07-17 17:26:16,338 - INFO - size\_balance: 0.1694

2025-07-17 17:26:16,338 - INFO - cluster\_count: 14.0000

2025-07-17 17:26:16,338 - INFO - avg\_cluster\_size: 512.9286

2025-07-17 17:26:16,338 - INFO - cluster\_size\_std: 426.0301

2025-07-17 17:26:16,338 - INFO - cluster\_sizes: [1494, 578, 906, 296, 346, 544, 1076, 166, 66, 33, 222, 994, 219, 241]

2025-07-17 17:27:00,227 - INFO - Epoch 1/80 - Time: 43.89s:Recon Loss=0.1700, Cluster Loss=9.4496,Reg Loss=0.0268,Last Inner Loss=9.6464

2025-07-17 17:27:41,462 - INFO - Epoch 2/80 - Time: 41.23s:Recon Loss=0.1854, Cluster Loss=4.5085,Reg Loss=0.0269,Last Inner Loss=4.7207

2025-07-17 17:28:24,141 - INFO - Epoch 3/80 - Time: 42.68s:Recon Loss=0.2026, Cluster Loss=2.1691,Reg Loss=0.0270,Last Inner Loss=2.3987

2025-07-17 17:29:06,995 - INFO - Epoch 4/80 - Time: 42.85s:Recon Loss=0.2200, Cluster Loss=1.3453,Reg Loss=0.0272,Last Inner Loss=1.5925

2025-07-17 17:29:44,949 - INFO - Epoch 5/80 - Time: 37.95s:Recon Loss=0.2361, Cluster Loss=0.9115,Reg Loss=0.0273,Last Inner Loss=1.1749

2025-07-17 17:30:22,546 - INFO - Epoch 6/80 - Time: 37.60s:Recon Loss=0.2330, Cluster Loss=0.7278,Reg Loss=0.0274,Last Inner Loss=0.9883

2025-07-17 17:31:02,814 - INFO - Epoch 7/80 - Time: 40.27s:Recon Loss=0.2335, Cluster Loss=0.5567,Reg Loss=0.0275,Last Inner Loss=0.8177

2025-07-17 17:31:42,155 - INFO - Epoch 8/80 - Time: 39.34s:Recon Loss=0.2284, Cluster Loss=0.4649,Reg Loss=0.0276,Last Inner Loss=0.7209

2025-07-17 17:32:21,597 - INFO - Epoch 9/80 - Time: 39.44s:Recon Loss=0.2255, Cluster Loss=0.4080,Reg Loss=0.0277,Last Inner Loss=0.6612

2025-07-17 17:33:07,727 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 17:33:07,727 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 17:33:09,335 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 17:33:10,130 - INFO - Epoch 10/80 (Eval) - Time: 48.53s (Eval Time: 5.72s):

2025-07-17 17:33:10,131 - INFO - Evaluation Metrics:

2025-07-17 17:33:10,131 - INFO - silhouette: 0.042005088180303574

2025-07-17 17:33:10,131 - INFO - davies\_bouldin: 2.0168

2025-07-17 17:33:10,131 - INFO - calinski\_harabasz: 1051.7660

2025-07-17 17:33:10,131 - INFO - cohesion: -0.12477818876504898

2025-07-17 17:33:10,131 - INFO - separation: 1.1602

2025-07-17 17:33:10,132 - INFO - separation\_to\_cohesion: 9.2982

2025-07-17 17:33:10,132 - INFO - size\_balance: 0.0000

2025-07-17 17:33:10,132 - INFO - cluster\_count: 14.0000

2025-07-17 17:33:10,132 - INFO - avg\_cluster\_size: 512.9286

2025-07-17 17:33:10,132 - INFO - cluster\_size\_std: 516.2031

2025-07-17 17:33:10,132 - INFO - cluster\_sizes: [1328, 1300, 150, 19, 395, 1211, 362, 698, 2, 1, 1258, 157, 299, 1]

2025-07-17 17:33:53,421 - INFO - Epoch 11/80 - Time: 43.29s:Recon Loss=0.2123, Cluster Loss=0.1557,Reg Loss=0.0278,Last Inner Loss=0.3958

2025-07-17 17:34:33,863 - INFO - Epoch 12/80 - Time: 40.44s:Recon Loss=0.2068, Cluster Loss=0.1578,Reg Loss=0.0278,Last Inner Loss=0.3924

2025-07-17 17:35:15,172 - INFO - Epoch 13/80 - Time: 41.31s:Recon Loss=0.1956, Cluster Loss=0.1170,Reg Loss=0.0278,Last Inner Loss=0.3404

2025-07-17 17:35:53,762 - INFO - Epoch 14/80 - Time: 38.59s:Recon Loss=0.1907, Cluster Loss=0.1107,Reg Loss=0.0278,Last Inner Loss=0.3293

2025-07-17 17:36:32,264 - INFO - Epoch 15/80 - Time: 38.50s:Recon Loss=0.1833, Cluster Loss=0.1160,Reg Loss=0.0278,Last Inner Loss=0.3272

2025-07-17 17:37:12,066 - INFO - Epoch 16/80 - Time: 39.80s:Recon Loss=0.1803, Cluster Loss=0.0940,Reg Loss=0.0278,Last Inner Loss=0.3021

2025-07-17 17:37:50,170 - INFO - Epoch 17/80 - Time: 38.10s:Recon Loss=0.1768, Cluster Loss=0.1092,Reg Loss=0.0278,Last Inner Loss=0.3139

2025-07-17 17:38:29,450 - INFO - Epoch 18/80 - Time: 39.28s:Recon Loss=0.1767, Cluster Loss=0.0879,Reg Loss=0.0278,Last Inner Loss=0.2924

2025-07-17 17:39:11,417 - INFO - Epoch 19/80 - Time: 41.97s:Recon Loss=0.1729, Cluster Loss=0.0811,Reg Loss=0.0278,Last Inner Loss=0.2818

2025-07-17 17:40:00,174 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 17:40:00,175 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 17:40:01,826 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 17:40:02,666 - INFO - Epoch 20/80 (Eval) - Time: 51.25s (Eval Time: 6.01s):

2025-07-17 17:40:02,666 - INFO - Evaluation Metrics:

2025-07-17 17:40:02,666 - INFO - silhouette: 0.05208145081996918

2025-07-17 17:40:02,666 - INFO - davies\_bouldin: 1.7786

2025-07-17 17:40:02,666 - INFO - calinski\_harabasz: 1366.3292

2025-07-17 17:40:02,666 - INFO - cohesion: -0.15921933948993683

2025-07-17 17:40:02,666 - INFO - separation: 0.9655

2025-07-17 17:40:02,666 - INFO - separation\_to\_cohesion: 6.0640

2025-07-17 17:40:02,666 - INFO - size\_balance: 0.0339

2025-07-17 17:40:02,666 - INFO - cluster\_count: 14.0000

2025-07-17 17:40:02,666 - INFO - avg\_cluster\_size: 512.9286

2025-07-17 17:40:02,667 - INFO - cluster\_size\_std: 495.5227

2025-07-17 17:40:02,667 - INFO - cluster\_sizes: [1183, 1240, 389, 2, 688, 1218, 157, 129, 1274, 18, 331, 2, 549, 1]

2025-07-17 17:40:45,416 - INFO - Epoch 21/80 - Time: 42.75s:Recon Loss=0.1719, Cluster Loss=0.0747,Reg Loss=0.0278,Last Inner Loss=0.2744

2025-07-17 17:41:25,668 - INFO - Epoch 22/80 - Time: 40.25s:Recon Loss=0.1703, Cluster Loss=0.0571,Reg Loss=0.0278,Last Inner Loss=0.2551

2025-07-17 17:42:03,428 - INFO - Epoch 23/80 - Time: 37.76s:Recon Loss=0.1694, Cluster Loss=0.0609,Reg Loss=0.0278,Last Inner Loss=0.2581

2025-07-17 17:42:41,739 - INFO - Epoch 24/80 - Time: 38.31s:Recon Loss=0.1694, Cluster Loss=0.0489,Reg Loss=0.0278,Last Inner Loss=0.2460

2025-07-17 17:43:19,431 - INFO - Epoch 25/80 - Time: 37.69s:Recon Loss=0.1680, Cluster Loss=0.0509,Reg Loss=0.0278,Last Inner Loss=0.2467

2025-07-17 17:43:57,231 - INFO - Epoch 26/80 - Time: 37.80s:Recon Loss=0.1675, Cluster Loss=0.0609,Reg Loss=0.0278,Last Inner Loss=0.2561

2025-07-17 17:44:37,016 - INFO - Epoch 27/80 - Time: 39.78s:Recon Loss=0.1671, Cluster Loss=0.0553,Reg Loss=0.0278,Last Inner Loss=0.2502

2025-07-17 17:45:18,010 - INFO - Epoch 28/80 - Time: 40.99s:Recon Loss=0.1668, Cluster Loss=0.0470,Reg Loss=0.0277,Last Inner Loss=0.2415

2025-07-17 17:46:03,406 - INFO - Epoch 29/80 - Time: 45.40s:Recon Loss=0.1669, Cluster Loss=0.0430,Reg Loss=0.0277,Last Inner Loss=0.2376

2025-07-17 17:46:50,389 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 17:46:50,389 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 17:46:52,030 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 17:46:52,799 - INFO - Epoch 30/80 (Eval) - Time: 49.39s (Eval Time: 6.21s):

2025-07-17 17:46:52,799 - INFO - Evaluation Metrics:

2025-07-17 17:46:52,799 - INFO - silhouette: 0.061859168112277985

2025-07-17 17:46:52,799 - INFO - davies\_bouldin: 1.8938

2025-07-17 17:46:52,799 - INFO - calinski\_harabasz: 1357.2415

2025-07-17 17:46:52,799 - INFO - cohesion: -0.1638704240322113

2025-07-17 17:46:52,799 - INFO - separation: 0.8275

2025-07-17 17:46:52,800 - INFO - separation\_to\_cohesion: 5.0495

2025-07-17 17:46:52,800 - INFO - size\_balance: 0.1924

2025-07-17 17:46:52,800 - INFO - cluster\_count: 14.0000

2025-07-17 17:46:52,800 - INFO - avg\_cluster\_size: 512.9286

2025-07-17 17:46:52,800 - INFO - cluster\_size\_std: 414.2200

2025-07-17 17:46:52,800 - INFO - cluster\_sizes: [1091, 1051, 1090, 2, 574, 125, 151, 324, 2, 447, 555, 1104, 634, 31]

2025-07-17 17:47:32,037 - INFO - Epoch 31/80 - Time: 39.24s:Recon Loss=0.1720, Cluster Loss=0.0493,Reg Loss=0.0278,Last Inner Loss=0.2490

2025-07-17 17:48:10,375 - INFO - Epoch 32/80 - Time: 38.34s:Recon Loss=0.1752, Cluster Loss=0.0478,Reg Loss=0.0278,Last Inner Loss=0.2507

2025-07-17 17:48:49,557 - INFO - Epoch 33/80 - Time: 39.18s:Recon Loss=0.1719, Cluster Loss=0.0434,Reg Loss=0.0278,Last Inner Loss=0.2430

2025-07-17 17:49:28,411 - INFO - Epoch 34/80 - Time: 38.85s:Recon Loss=0.1736, Cluster Loss=0.0583,Reg Loss=0.0278,Last Inner Loss=0.2597

2025-07-17 17:50:07,057 - INFO - Epoch 35/80 - Time: 38.65s:Recon Loss=0.1724, Cluster Loss=0.1118,Reg Loss=0.0278,Last Inner Loss=0.3120

2025-07-17 17:50:49,260 - INFO - Epoch 36/80 - Time: 42.20s:Recon Loss=0.1703, Cluster Loss=0.1120,Reg Loss=0.0278,Last Inner Loss=0.3101

2025-07-17 17:51:33,614 - INFO - Epoch 37/80 - Time: 44.35s:Recon Loss=0.1714, Cluster Loss=0.1185,Reg Loss=0.0278,Last Inner Loss=0.3177

2025-07-17 17:52:18,526 - INFO - Epoch 38/80 - Time: 44.91s:Recon Loss=0.1797, Cluster Loss=0.1867,Reg Loss=0.0279,Last Inner Loss=0.3943

2025-07-17 17:53:02,006 - INFO - Epoch 39/80 - Time: 43.48s:Recon Loss=0.1766, Cluster Loss=0.2954,Reg Loss=0.0280,Last Inner Loss=0.5000

2025-07-17 17:53:46,701 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 17:53:46,701 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 17:53:48,335 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 17:53:49,194 - INFO - Epoch 40/80 (Eval) - Time: 47.19s (Eval Time: 6.99s):

2025-07-17 17:53:49,194 - INFO - Evaluation Metrics:

2025-07-17 17:53:49,194 - INFO - silhouette: 0.05402682349085808

2025-07-17 17:53:49,194 - INFO - davies\_bouldin: 1.9141

2025-07-17 17:53:49,194 - INFO - calinski\_harabasz: 1398.7666

2025-07-17 17:53:49,194 - INFO - cohesion: -0.1412825733423233

2025-07-17 17:53:49,194 - INFO - separation: 0.8564

2025-07-17 17:53:49,194 - INFO - separation\_to\_cohesion: 6.0618

2025-07-17 17:53:49,195 - INFO - size\_balance: 0.2883

2025-07-17 17:53:49,195 - INFO - cluster\_count: 14.0000

2025-07-17 17:53:49,195 - INFO - avg\_cluster\_size: 512.9286

2025-07-17 17:53:49,195 - INFO - cluster\_size\_std: 365.0737

2025-07-17 17:53:49,195 - INFO - cluster\_sizes: [949, 248, 1, 2, 1120, 653, 322, 939, 121, 522, 729, 883, 550, 142]

2025-07-17 17:54:28,448 - INFO - Epoch 41/80 - Time: 39.25s:Recon Loss=0.1680, Cluster Loss=0.0701,Reg Loss=0.0281,Last Inner Loss=0.2661

2025-07-17 17:55:09,133 - INFO - Epoch 42/80 - Time: 40.68s:Recon Loss=0.1659, Cluster Loss=0.0727,Reg Loss=0.0281,Last Inner Loss=0.2667

2025-07-17 17:55:48,199 - INFO - Epoch 43/80 - Time: 39.07s:Recon Loss=0.1655, Cluster Loss=0.0689,Reg Loss=0.0281,Last Inner Loss=0.2625

2025-07-17 17:56:27,814 - INFO - Epoch 44/80 - Time: 39.61s:Recon Loss=0.1649, Cluster Loss=0.0601,Reg Loss=0.0281,Last Inner Loss=0.2532

2025-07-17 17:57:08,612 - INFO - Epoch 45/80 - Time: 40.80s:Recon Loss=0.1675, Cluster Loss=0.1062,Reg Loss=0.0282,Last Inner Loss=0.3018

2025-07-17 17:57:52,327 - INFO - Epoch 46/80 - Time: 43.71s:Recon Loss=0.1723, Cluster Loss=0.2246,Reg Loss=0.0282,Last Inner Loss=0.4251

2025-07-17 17:58:33,164 - INFO - Epoch 47/80 - Time: 40.84s:Recon Loss=0.1701, Cluster Loss=0.2943,Reg Loss=0.0283,Last Inner Loss=0.4926

2025-07-17 17:59:15,562 - INFO - Epoch 48/80 - Time: 42.40s:Recon Loss=0.1671, Cluster Loss=0.3077,Reg Loss=0.0283,Last Inner Loss=0.5031

2025-07-17 17:59:53,646 - INFO - Epoch 49/80 - Time: 38.08s:Recon Loss=0.1656, Cluster Loss=0.2611,Reg Loss=0.0283,Last Inner Loss=0.4550

2025-07-17 18:00:37,143 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 18:00:37,143 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 18:00:38,711 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 18:00:39,427 - INFO - Epoch 50/80 (Eval) - Time: 45.78s (Eval Time: 5.79s):

2025-07-17 18:00:39,427 - INFO - Evaluation Metrics:

2025-07-17 18:00:39,427 - INFO - silhouette: 0.10840581357479095

2025-07-17 18:00:39,427 - INFO - davies\_bouldin: 1.7961

2025-07-17 18:00:39,427 - INFO - calinski\_harabasz: 1387.0609

2025-07-17 18:00:39,428 - INFO - cohesion: -0.10206539183855057

2025-07-17 18:00:39,428 - INFO - separation: 0.8235

2025-07-17 18:00:39,428 - INFO - separation\_to\_cohesion: 8.0684

2025-07-17 18:00:39,428 - INFO - size\_balance: 0.2449

2025-07-17 18:00:39,428 - INFO - cluster\_count: 14.0000

2025-07-17 18:00:39,428 - INFO - avg\_cluster\_size: 512.9286

2025-07-17 18:00:39,428 - INFO - cluster\_size\_std: 387.3158

2025-07-17 18:00:39,428 - INFO - cluster\_sizes: [1398, 660, 263, 1, 987, 491, 611, 121, 852, 607, 692, 1, 138, 359]

2025-07-17 18:01:19,737 - INFO - Epoch 51/80 - Time: 40.31s:Recon Loss=0.1647, Cluster Loss=0.0643,Reg Loss=0.0283,Last Inner Loss=0.2574

2025-07-17 18:01:59,194 - INFO - Epoch 52/80 - Time: 39.46s:Recon Loss=0.1645, Cluster Loss=0.0648,Reg Loss=0.0283,Last Inner Loss=0.2577

2025-07-17 18:02:41,639 - INFO - Epoch 53/80 - Time: 42.44s:Recon Loss=0.1648, Cluster Loss=0.0630,Reg Loss=0.0283,Last Inner Loss=0.2562

2025-07-17 18:03:24,182 - INFO - Epoch 54/80 - Time: 42.54s:Recon Loss=0.1652, Cluster Loss=0.0591,Reg Loss=0.0283,Last Inner Loss=0.2526

2025-07-17 18:04:09,446 - INFO - Epoch 55/80 - Time: 45.26s:Recon Loss=0.1639, Cluster Loss=0.0793,Reg Loss=0.0283,Last Inner Loss=0.2715

2025-07-17 18:04:53,179 - INFO - Epoch 56/80 - Time: 43.73s:Recon Loss=0.1641, Cluster Loss=0.0582,Reg Loss=0.0283,Last Inner Loss=0.2506

2025-07-17 18:05:32,457 - INFO - Epoch 57/80 - Time: 39.28s:Recon Loss=0.1637, Cluster Loss=0.0579,Reg Loss=0.0283,Last Inner Loss=0.2499

2025-07-17 18:06:10,366 - INFO - Epoch 58/80 - Time: 37.91s:Recon Loss=0.1637, Cluster Loss=0.0523,Reg Loss=0.0283,Last Inner Loss=0.2443

2025-07-17 18:06:51,254 - INFO - Epoch 59/80 - Time: 40.89s:Recon Loss=0.1632, Cluster Loss=0.0488,Reg Loss=0.0283,Last Inner Loss=0.2403

2025-07-17 18:07:32,181 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 18:07:32,181 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 18:07:33,826 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 18:07:34,624 - INFO - Epoch 60/80 (Eval) - Time: 43.37s (Eval Time: 5.62s):

2025-07-17 18:07:34,624 - INFO - Evaluation Metrics:

2025-07-17 18:07:34,624 - INFO - silhouette: 0.10153533518314362

2025-07-17 18:07:34,624 - INFO - davies\_bouldin: 1.8194

2025-07-17 18:07:34,624 - INFO - calinski\_harabasz: 1515.8500

2025-07-17 18:07:34,625 - INFO - cohesion: -0.15061967074871063

2025-07-17 18:07:34,625 - INFO - separation: 0.9008

2025-07-17 18:07:34,625 - INFO - separation\_to\_cohesion: 5.9805

2025-07-17 18:07:34,625 - INFO - size\_balance: 0.0000

2025-07-17 18:07:34,625 - INFO - cluster\_count: 14.0000

2025-07-17 18:07:34,625 - INFO - avg\_cluster\_size: 512.9286

2025-07-17 18:07:34,625 - INFO - cluster\_size\_std: 529.4459

2025-07-17 18:07:34,625 - INFO - cluster\_sizes: [1540, 1, 133, 663, 119, 266, 352, 658, 2, 307, 424, 6, 1664, 1046]

2025-07-17 18:08:12,606 - INFO - Epoch 61/80 - Time: 37.98s:Recon Loss=0.1629, Cluster Loss=0.0466,Reg Loss=0.0283,Last Inner Loss=0.2378

2025-07-17 18:08:54,953 - INFO - Epoch 62/80 - Time: 42.35s:Recon Loss=0.1631, Cluster Loss=0.0454,Reg Loss=0.0282,Last Inner Loss=0.2368

2025-07-17 18:09:37,402 - INFO - Epoch 63/80 - Time: 42.45s:Recon Loss=0.1634, Cluster Loss=0.0439,Reg Loss=0.0282,Last Inner Loss=0.2355

2025-07-17 18:10:21,252 - INFO - Epoch 64/80 - Time: 43.85s:Recon Loss=0.1629, Cluster Loss=0.0410,Reg Loss=0.0282,Last Inner Loss=0.2321

2025-07-17 18:11:06,174 - INFO - Epoch 65/80 - Time: 44.92s:Recon Loss=0.1628, Cluster Loss=0.0420,Reg Loss=0.0282,Last Inner Loss=0.2330

2025-07-17 18:11:46,335 - INFO - Epoch 66/80 - Time: 40.16s:Recon Loss=0.1665, Cluster Loss=0.0587,Reg Loss=0.0282,Last Inner Loss=0.2534

2025-07-17 18:12:23,803 - INFO - Epoch 67/80 - Time: 37.47s:Recon Loss=0.1680, Cluster Loss=0.0701,Reg Loss=0.0282,Last Inner Loss=0.2663

2025-07-17 18:13:03,247 - INFO - Epoch 68/80 - Time: 39.44s:Recon Loss=0.1674, Cluster Loss=0.0775,Reg Loss=0.0282,Last Inner Loss=0.2731

2025-07-17 18:13:40,967 - INFO - Epoch 69/80 - Time: 37.72s:Recon Loss=0.1661, Cluster Loss=0.0788,Reg Loss=0.0283,Last Inner Loss=0.2732

2025-07-17 18:14:22,780 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 18:14:22,780 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 18:14:24,418 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 18:14:25,217 - INFO - Epoch 70/80 (Eval) - Time: 44.25s (Eval Time: 5.57s):

2025-07-17 18:14:25,218 - INFO - Evaluation Metrics:

2025-07-17 18:14:25,218 - INFO - silhouette: 0.07558321207761765

2025-07-17 18:14:25,218 - INFO - davies\_bouldin: 1.8798

2025-07-17 18:14:25,218 - INFO - calinski\_harabasz: 1562.7081

2025-07-17 18:14:25,218 - INFO - cohesion: -0.1400967687368393

2025-07-17 18:14:25,218 - INFO - separation: 0.8253

2025-07-17 18:14:25,218 - INFO - separation\_to\_cohesion: 5.8912

2025-07-17 18:14:25,218 - INFO - size\_balance: 0.1953

2025-07-17 18:14:25,218 - INFO - cluster\_count: 14.0000

2025-07-17 18:14:25,219 - INFO - avg\_cluster\_size: 512.9286

2025-07-17 18:14:25,219 - INFO - cluster\_size\_std: 412.7672

2025-07-17 18:14:25,219 - INFO - cluster\_sizes: [1243, 770, 416, 1, 1338, 695, 116, 358, 2, 271, 129, 500, 445, 897]

2025-07-17 18:15:07,124 - INFO - Epoch 71/80 - Time: 41.90s:Recon Loss=0.1641, Cluster Loss=0.0499,Reg Loss=0.0283,Last Inner Loss=0.2423

2025-07-17 18:15:52,446 - INFO - Epoch 72/80 - Time: 45.32s:Recon Loss=0.1630, Cluster Loss=0.0491,Reg Loss=0.0282,Last Inner Loss=0.2403

2025-07-17 18:16:36,788 - INFO - Epoch 73/80 - Time: 44.34s:Recon Loss=0.1632, Cluster Loss=0.0421,Reg Loss=0.0282,Last Inner Loss=0.2335

2025-07-17 18:17:22,411 - INFO - Epoch 74/80 - Time: 45.62s:Recon Loss=0.1630, Cluster Loss=0.0466,Reg Loss=0.0282,Last Inner Loss=0.2378

2025-07-17 18:18:01,811 - INFO - Epoch 75/80 - Time: 39.40s:Recon Loss=0.1625, Cluster Loss=0.0441,Reg Loss=0.0282,Last Inner Loss=0.2348

2025-07-17 18:18:39,440 - INFO - Epoch 76/80 - Time: 37.63s:Recon Loss=0.1624, Cluster Loss=0.0436,Reg Loss=0.0282,Last Inner Loss=0.2342

2025-07-17 18:19:20,187 - INFO - Epoch 77/80 - Time: 40.75s:Recon Loss=0.1624, Cluster Loss=0.0410,Reg Loss=0.0282,Last Inner Loss=0.2316

2025-07-17 18:19:58,403 - INFO - Epoch 78/80 - Time: 38.21s:Recon Loss=0.1624, Cluster Loss=0.0393,Reg Loss=0.0282,Last Inner Loss=0.2299

2025-07-17 18:20:39,599 - INFO - Epoch 79/80 - Time: 41.20s:Recon Loss=0.1625, Cluster Loss=0.0394,Reg Loss=0.0282,Last Inner Loss=0.2301

2025-07-17 18:21:24,817 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 18:21:24,818 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 18:21:26,455 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 18:21:27,286 - INFO - Epoch 80/80 (Eval) - Time: 47.69s (Eval Time: 5.84s):

2025-07-17 18:21:27,287 - INFO - Evaluation Metrics:

2025-07-17 18:21:27,287 - INFO - silhouette: 0.10873052477836609

2025-07-17 18:21:27,287 - INFO - davies\_bouldin: 1.7743

2025-07-17 18:21:27,287 - INFO - calinski\_harabasz: 1648.0380

2025-07-17 18:21:27,287 - INFO - cohesion: -0.19333818554878235

2025-07-17 18:21:27,287 - INFO - separation: 0.8283

2025-07-17 18:21:27,287 - INFO - separation\_to\_cohesion: 4.2842

2025-07-17 18:21:27,287 - INFO - size\_balance: 0.0994

2025-07-17 18:21:27,287 - INFO - cluster\_count: 14.0000

2025-07-17 18:21:27,287 - INFO - avg\_cluster\_size: 512.9286

2025-07-17 18:21:27,287 - INFO - cluster\_size\_std: 461.9525

2025-07-17 18:21:27,287 - INFO - cluster\_sizes: [1013, 739, 2, 2, 328, 274, 115, 124, 745, 1195, 563, 5, 1503, 573]

2025-07-17 18:21:27,287 - INFO -

Training completed!

2025-07-17 18:21:27,288 - INFO -

Saving final trained model...

2025-07-17 18:21:29,503 - INFO - Final trained model saved to ./results/n14\_final\_model\_gz\_ptype0\_no\_cat.pth

2025-07-17 18:21:29,504 - INFO -

Evaluating final trained model...

2025-07-17 18:21:33,823 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 18:21:33,823 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 18:21:35,444 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 18:21:36,236 - INFO -

Detailed Clustering Evaluation of Final Model:

2025-07-17 18:21:36,236 - INFO - silhouette: 0.10873053222894669

2025-07-17 18:21:36,236 - INFO - davies\_bouldin: 1.7743

2025-07-17 18:21:36,237 - INFO - calinski\_harabasz: 1648.0380

2025-07-17 18:21:36,237 - INFO - cohesion: -0.19333823025226593

2025-07-17 18:21:36,237 - INFO - separation: 0.8283

2025-07-17 18:21:36,237 - INFO - separation\_to\_cohesion: 4.2842

2025-07-17 18:21:36,237 - INFO - size\_balance: 0.0994

2025-07-17 18:21:36,237 - INFO - cluster\_count: 14.0000

2025-07-17 18:21:36,237 - INFO - avg\_cluster\_size: 512.9286

2025-07-17 18:21:36,237 - INFO - cluster\_size\_std: 461.9525

2025-07-17 18:21:36,237 - INFO - cluster\_sizes: [1013, 739, 2, 2, 328, 274, 115, 124, 745, 1195, 563, 5, 1503, 573]

2025-07-17 18:21:36,237 - INFO -

--- Detailed Clustering Evaluation of Final Model (based on P indicator matrix as embeddings) ---

2025-07-17 18:21:36,996 - INFO - P\_based\_silhouette: 0.15940621495246887

2025-07-17 18:21:36,996 - INFO - P\_based\_davies\_bouldin: 1.2432

2025-07-17 18:21:36,996 - INFO - P\_based\_calinski\_harabasz: 772.0749

2025-07-17 18:21:36,997 - INFO - P\_based\_cohesion: -0.058024823665618896

2025-07-17 18:21:36,997 - INFO - P\_based\_separation: 0.2416

2025-07-17 18:21:36,997 - INFO - P\_based\_separation\_to\_cohesion: 4.1641

2025-07-17 18:21:36,997 - INFO - P\_based\_size\_balance: 0.0994

2025-07-17 18:21:36,997 - INFO - P\_based\_cluster\_count: 14.0000

2025-07-17 18:21:36,997 - INFO - P\_based\_avg\_cluster\_size: 512.9286

2025-07-17 18:21:36,997 - INFO - P\_based\_cluster\_size\_std: 461.9525

2025-07-17 18:21:36,997 - INFO - P\_based\_cluster\_sizes: [1013, 739, 2, 2, 328, 274, 115, 124, 745, 1195, 563, 5, 1503, 573]

2025-07-17 18:21:36,997 - INFO - Saving final results with embeddings and view weights...

2025-07-17 18:21:39,992 - INFO - Final results saved to ./results/n14\_final\_clustering\_gz\_pytpe0\_no\_cat.csv

2025-07-17 18:21:40,015 - INFO - Final evaluation metrics saved to ./results/n14\_final\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 18:41:57,348 - INFO - Starting training with arguments: Namespace(feature\_data\_path='./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx', graph\_dir='./data', graph\_prefix='adaptive\_undir\_knn\_graph\_gz\_ptype0', knn\_k=100, output\_path='./results/', hidden\_dim=256, embedding\_dim=64, dropout=0.1, alpha=0.2, n\_clusters=15, lambda\_reg=0.0001, alpha\_cluster=0.005, lr=0.001, weight\_decay=0.0005, epochs=80, pretrain\_epochs=100, update\_interval=10, seed=42, device='cuda:0', scale\_features=True, inner\_iterations=3)

2025-07-17 18:41:57,374 - INFO - CUDA available. Using device: cuda:0

2025-07-17 18:41:57,374 - INFO - Loading node features from: ./data/od\_idv\_train\_ptype0\_gz\_1018.xlsx

2025-07-17 18:42:21,703 - INFO - Full feature data loaded successfully, shape: (7181, 343)

2025-07-17 18:42:21,706 - INFO - Applying StandardScaler to NUMERICAL features...

2025-07-17 18:42:21,714 - INFO - Numerical features scaled.

2025-07-17 18:42:21,847 - INFO - Node features tensor created, shape: torch.Size([7181, 115])

2025-07-17 18:42:21,851 - INFO - Loading pre-built graphs from directory: ./data

2025-07-17 18:42:21,893 - INFO - Loaded time graph: 807056 edges.

2025-07-17 18:42:21,903 - INFO - Loaded space graph: 890250 edges.

2025-07-17 18:42:21,913 - INFO - Loaded attr graph: 982548 edges.

2025-07-17 18:42:21,913 - INFO - Initializing model components...

2025-07-17 18:42:21,936 - INFO - Pretraining encoder...

2025-07-17 18:42:21,936 - WARNING - The main training loop might still encounter OutOfMemoryError due to the N x N matrix calculation

2025-07-17 18:42:21,936 - WARNING - in the clustering loss module (ZZ^T for SVD). This is inherent to the standard EGAE Jc loss formulation.

2025-07-17 18:42:21,936 - WARNING - If OOM occurs in the main loop, consider using a GPU with more memory or exploring approximations if available.

2025-07-17 18:44:17,975 - INFO - Pretrain Epoch 10/100 - Time: 11.47s: Recon Loss = 0.2130, Reg Loss = 0.1389, Total Loss = 0.3519

2025-07-17 18:46:24,188 - INFO - Pretrain Epoch 20/100 - Time: 11.14s: Recon Loss = 0.1895, Reg Loss = 0.1171, Total Loss = 0.3066

2025-07-17 18:48:20,760 - INFO - Pretrain Epoch 30/100 - Time: 10.87s: Recon Loss = 0.1624, Reg Loss = 0.0985, Total Loss = 0.2609

2025-07-17 18:50:17,418 - INFO - Pretrain Epoch 40/100 - Time: 11.18s: Recon Loss = 0.1624, Reg Loss = 0.0820, Total Loss = 0.2444

2025-07-17 18:52:27,512 - INFO - Pretrain Epoch 50/100 - Time: 11.62s: Recon Loss = 0.1620, Reg Loss = 0.0679, Total Loss = 0.2299

2025-07-17 18:54:25,797 - INFO - Pretrain Epoch 60/100 - Time: 12.21s: Recon Loss = 0.1621, Reg Loss = 0.0563, Total Loss = 0.2184

2025-07-17 18:56:20,772 - INFO - Pretrain Epoch 70/100 - Time: 10.96s: Recon Loss = 0.1619, Reg Loss = 0.0468, Total Loss = 0.2088

2025-07-17 18:58:24,934 - INFO - Pretrain Epoch 80/100 - Time: 10.97s: Recon Loss = 0.1622, Reg Loss = 0.0391, Total Loss = 0.2012

2025-07-17 19:00:23,670 - INFO - Pretrain Epoch 90/100 - Time: 12.03s: Recon Loss = 0.1620, Reg Loss = 0.0328, Total Loss = 0.1948

2025-07-17 19:02:21,521 - INFO - Pretrain Epoch 100/100 - Time: 11.79s: Recon Loss = 0.1621, Reg Loss = 0.0276, Total Loss = 0.1897

2025-07-17 19:02:21,521 - INFO -

Pretraining finished. Evaluating pretraining results with standard K-Means...

2025-07-17 19:02:24,839 - INFO - Running standard KMeans on pretrain embeddings ((7181, 64))...

2025-07-17 19:02:25,034 - INFO - Standard KMeans finished.

2025-07-17 19:02:25,692 - INFO - Pretraining Standard K-Means Clustering Evaluation:

2025-07-17 19:02:25,692 - INFO - silhouette: 0.26607581973075867

2025-07-17 19:02:25,692 - INFO - davies\_bouldin: 1.5325

2025-07-17 19:02:25,692 - INFO - calinski\_harabasz: 2355.1631

2025-07-17 19:02:25,692 - INFO - cohesion: -1.327937364578247

2025-07-17 19:02:25,692 - INFO - separation: 3.8561

2025-07-17 19:02:25,692 - INFO - separation\_to\_cohesion: 2.9038

2025-07-17 19:02:25,693 - INFO - size\_balance: 0.2619

2025-07-17 19:02:25,693 - INFO - cluster\_count: 15.0000

2025-07-17 19:02:25,693 - INFO - avg\_cluster\_size: 478.7333

2025-07-17 19:02:25,693 - INFO - cluster\_size\_std: 353.3558

2025-07-17 19:02:25,693 - INFO - cluster\_sizes: [1094, 363, 662, 102, 808, 319, 313, 344, 38, 1146, 442, 143, 964, 174, 269]

2025-07-17 19:02:27,865 - INFO - Pretraining standard KMeans++ results saved to ./results/n15\_pretrain\_standard\_kmeans\_clustering\_gz\_ptype0\_no\_cat.csv

2025-07-17 19:02:27,878 - INFO - Pretraining standard KMeans++ evaluation metrics saved to ./results/n15\_pretrain\_standard\_kmeans\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt

2025-07-17 19:02:27,944 - INFO - Pretraining encoder saved to ./results/n15\_pretrain\_encoder\_gz\_pytpe0\_no\_cat.pth

2025-07-17 19:02:27,944 - INFO -

Starting main training loop (Alternating Optimization)...

2025-07-17 19:02:27,944 - INFO - Initializing indicator matrix P for main training...

2025-07-17 19:02:31,632 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 19:02:31,632 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 19:02:33,339 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 19:02:33,340 - INFO - Evaluating initial main training clustering results (SVD + KMeans++ on P)...

2025-07-17 19:02:34,040 - INFO - Initial Main Training SVD + KMeans++ Clustering Evaluation:

2025-07-17 19:02:34,040 - INFO - silhouette: -0.06950359791517258

2025-07-17 19:02:34,040 - INFO - davies\_bouldin: 2.9440

2025-07-17 19:02:34,040 - INFO - calinski\_harabasz: 428.6236

2025-07-17 19:02:34,040 - INFO - cohesion: -1.8882744312286377

2025-07-17 19:02:34,040 - INFO - separation: 2.7242

2025-07-17 19:02:34,040 - INFO - separation\_to\_cohesion: 1.4427

2025-07-17 19:02:34,040 - INFO - size\_balance: 0.0000

2025-07-17 19:02:34,040 - INFO - cluster\_count: 15.0000

2025-07-17 19:02:34,040 - INFO - avg\_cluster\_size: 478.7333

2025-07-17 19:02:34,041 - INFO - cluster\_size\_std: 772.4419

2025-07-17 19:02:34,041 - INFO - cluster\_sizes: [3248, 294, 106, 55, 175, 599, 209, 229, 23, 643, 280, 192, 822, 141, 165]

2025-07-17 19:03:13,245 - INFO - Epoch 1/80 - Time: 39.20s:Recon Loss=0.1672, Cluster Loss=18.4400,Reg Loss=0.0272,Last Inner Loss=18.6344

2025-07-17 19:03:55,483 - INFO - Epoch 2/80 - Time: 42.24s:Recon Loss=0.1747, Cluster Loss=7.3883,Reg Loss=0.0273,Last Inner Loss=7.5902

2025-07-17 19:04:33,796 - INFO - Epoch 3/80 - Time: 38.31s:Recon Loss=0.2141, Cluster Loss=2.7828,Reg Loss=0.0274,Last Inner Loss=3.0243

2025-07-17 19:05:10,795 - INFO - Epoch 4/80 - Time: 37.00s:Recon Loss=0.2300, Cluster Loss=1.4982,Reg Loss=0.0276,Last Inner Loss=1.7557

2025-07-17 19:05:44,368 - INFO - Epoch 5/80 - Time: 33.57s:Recon Loss=0.2362, Cluster Loss=1.0056,Reg Loss=0.0277,Last Inner Loss=1.2695

2025-07-17 19:06:18,231 - INFO - Epoch 6/80 - Time: 33.86s:Recon Loss=0.2423, Cluster Loss=0.7486,Reg Loss=0.0279,Last Inner Loss=1.0188

2025-07-17 19:06:57,276 - INFO - Epoch 7/80 - Time: 39.04s:Recon Loss=0.2492, Cluster Loss=0.5837,Reg Loss=0.0280,Last Inner Loss=0.8609

2025-07-17 19:07:30,756 - INFO - Epoch 8/80 - Time: 33.48s:Recon Loss=0.2506, Cluster Loss=0.4926,Reg Loss=0.0281,Last Inner Loss=0.7713

2025-07-17 19:08:04,206 - INFO - Epoch 9/80 - Time: 33.45s:Recon Loss=0.2465, Cluster Loss=0.4278,Reg Loss=0.0282,Last Inner Loss=0.7025

2025-07-17 19:08:45,005 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 19:08:45,005 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 19:08:46,713 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 19:08:47,410 - INFO - Epoch 10/80 (Eval) - Time: 43.20s (Eval Time: 6.15s):

2025-07-17 19:08:47,410 - INFO - Evaluation Metrics:

2025-07-17 19:08:47,410 - INFO - silhouette: 0.07562229782342911

2025-07-17 19:08:47,411 - INFO - davies\_bouldin: 2.1205

2025-07-17 19:08:47,411 - INFO - calinski\_harabasz: 1244.6253

2025-07-17 19:08:47,411 - INFO - cohesion: -0.09562266618013382

2025-07-17 19:08:47,411 - INFO - separation: 0.4684

2025-07-17 19:08:47,411 - INFO - separation\_to\_cohesion: 4.8986

2025-07-17 19:08:47,411 - INFO - size\_balance: 0.0000

2025-07-17 19:08:47,411 - INFO - cluster\_count: 15.0000

2025-07-17 19:08:47,411 - INFO - avg\_cluster\_size: 478.7333

2025-07-17 19:08:47,411 - INFO - cluster\_size\_std: 528.2585

2025-07-17 19:08:47,411 - INFO - cluster\_sizes: [658, 1960, 1188, 1097, 136, 110, 154, 160, 416, 1, 192, 584, 98, 250, 177]

2025-07-17 19:09:24,451 - INFO - Epoch 11/80 - Time: 37.04s:Recon Loss=0.2360, Cluster Loss=0.1770,Reg Loss=0.0283,Last Inner Loss=0.4412

2025-07-17 19:10:02,121 - INFO - Epoch 12/80 - Time: 37.67s:Recon Loss=0.2330, Cluster Loss=0.1567,Reg Loss=0.0283,Last Inner Loss=0.4180

2025-07-17 19:10:38,424 - INFO - Epoch 13/80 - Time: 36.30s:Recon Loss=0.2205, Cluster Loss=0.1350,Reg Loss=0.0283,Last Inner Loss=0.3838

2025-07-17 19:11:15,219 - INFO - Epoch 14/80 - Time: 36.80s:Recon Loss=0.2074, Cluster Loss=0.1432,Reg Loss=0.0283,Last Inner Loss=0.3788

2025-07-17 19:11:48,849 - INFO - Epoch 15/80 - Time: 33.63s:Recon Loss=0.1983, Cluster Loss=0.1178,Reg Loss=0.0283,Last Inner Loss=0.3444

2025-07-17 19:12:23,586 - INFO - Epoch 16/80 - Time: 34.74s:Recon Loss=0.1911, Cluster Loss=0.1035,Reg Loss=0.0283,Last Inner Loss=0.3230

2025-07-17 19:13:01,721 - INFO - Epoch 17/80 - Time: 38.13s:Recon Loss=0.1845, Cluster Loss=0.1071,Reg Loss=0.0283,Last Inner Loss=0.3199

2025-07-17 19:13:35,333 - INFO - Epoch 18/80 - Time: 33.61s:Recon Loss=0.1805, Cluster Loss=0.1045,Reg Loss=0.0283,Last Inner Loss=0.3133

2025-07-17 19:14:08,872 - INFO - Epoch 19/80 - Time: 33.54s:Recon Loss=0.1783, Cluster Loss=0.0974,Reg Loss=0.0283,Last Inner Loss=0.3040

2025-07-17 19:14:50,516 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 19:14:50,516 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 19:14:52,172 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 19:14:52,865 - INFO - Epoch 20/80 (Eval) - Time: 43.99s (Eval Time: 5.40s):

2025-07-17 19:14:52,865 - INFO - Evaluation Metrics:

2025-07-17 19:14:52,865 - INFO - silhouette: 0.04458947479724884

2025-07-17 19:14:52,866 - INFO - davies\_bouldin: 2.1715

2025-07-17 19:14:52,866 - INFO - calinski\_harabasz: 1094.4891

2025-07-17 19:14:52,866 - INFO - cohesion: -0.07190155237913132

2025-07-17 19:14:52,866 - INFO - separation: 0.4616

2025-07-17 19:14:52,866 - INFO - separation\_to\_cohesion: 6.4201

2025-07-17 19:14:52,866 - INFO - size\_balance: 0.0478

2025-07-17 19:14:52,866 - INFO - cluster\_count: 15.0000

2025-07-17 19:14:52,866 - INFO - avg\_cluster\_size: 478.7333

2025-07-17 19:14:52,866 - INFO - cluster\_size\_std: 455.8696

2025-07-17 19:14:52,866 - INFO - cluster\_sizes: [321, 555, 1249, 1059, 839, 131, 500, 262, 125, 165, 1507, 1, 221, 1, 245]

2025-07-17 19:15:29,583 - INFO - Epoch 21/80 - Time: 36.72s:Recon Loss=0.1760, Cluster Loss=0.0843,Reg Loss=0.0283,Last Inner Loss=0.2886

2025-07-17 19:16:13,857 - INFO - Epoch 22/80 - Time: 44.27s:Recon Loss=0.1749, Cluster Loss=0.0834,Reg Loss=0.0283,Last Inner Loss=0.2866

2025-07-17 19:16:53,343 - INFO - Epoch 23/80 - Time: 39.48s:Recon Loss=0.1762, Cluster Loss=0.0812,Reg Loss=0.0283,Last Inner Loss=0.2857

2025-07-17 19:17:27,038 - INFO - Epoch 24/80 - Time: 33.69s:Recon Loss=0.1729, Cluster Loss=0.0775,Reg Loss=0.0283,Last Inner Loss=0.2786

2025-07-17 19:18:00,858 - INFO - Epoch 25/80 - Time: 33.82s:Recon Loss=0.1727, Cluster Loss=0.0642,Reg Loss=0.0283,Last Inner Loss=0.2651

2025-07-17 19:18:37,224 - INFO - Epoch 26/80 - Time: 36.37s:Recon Loss=0.1735, Cluster Loss=0.0627,Reg Loss=0.0282,Last Inner Loss=0.2644

2025-07-17 19:19:13,171 - INFO - Epoch 27/80 - Time: 35.95s:Recon Loss=0.1752, Cluster Loss=0.0870,Reg Loss=0.0282,Last Inner Loss=0.2904

2025-07-17 19:19:46,920 - INFO - Epoch 28/80 - Time: 33.75s:Recon Loss=0.1805, Cluster Loss=0.1697,Reg Loss=0.0283,Last Inner Loss=0.3784

2025-07-17 19:20:20,822 - INFO - Epoch 29/80 - Time: 33.90s:Recon Loss=0.1858, Cluster Loss=0.2910,Reg Loss=0.0283,Last Inner Loss=0.5051

2025-07-17 19:21:04,520 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 19:21:04,520 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 19:21:06,168 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 19:21:06,866 - INFO - Epoch 30/80 (Eval) - Time: 46.04s (Eval Time: 5.35s):

2025-07-17 19:21:06,866 - INFO - Evaluation Metrics:

2025-07-17 19:21:06,866 - INFO - silhouette: 0.09863104671239853

2025-07-17 19:21:06,866 - INFO - davies\_bouldin: 1.9907

2025-07-17 19:21:06,866 - INFO - calinski\_harabasz: 1332.0958

2025-07-17 19:21:06,866 - INFO - cohesion: -0.09873693436384201

2025-07-17 19:21:06,866 - INFO - separation: 0.4393

2025-07-17 19:21:06,866 - INFO - separation\_to\_cohesion: 4.4493

2025-07-17 19:21:06,867 - INFO - size\_balance: 0.0000

2025-07-17 19:21:06,867 - INFO - cluster\_count: 15.0000

2025-07-17 19:21:06,867 - INFO - avg\_cluster\_size: 478.7333

2025-07-17 19:21:06,867 - INFO - cluster\_size\_std: 481.3447

2025-07-17 19:21:06,867 - INFO - cluster\_sizes: [1025, 23, 309, 577, 265, 188, 612, 621, 259, 1, 609, 459, 1971, 136, 126]

2025-07-17 19:21:46,370 - INFO - Epoch 31/80 - Time: 39.50s:Recon Loss=0.1787, Cluster Loss=0.0832,Reg Loss=0.0284,Last Inner Loss=0.2903

2025-07-17 19:22:23,836 - INFO - Epoch 32/80 - Time: 37.46s:Recon Loss=0.1794, Cluster Loss=0.0800,Reg Loss=0.0284,Last Inner Loss=0.2878

2025-07-17 19:23:02,862 - INFO - Epoch 33/80 - Time: 39.03s:Recon Loss=0.1810, Cluster Loss=0.1511,Reg Loss=0.0284,Last Inner Loss=0.3605

2025-07-17 19:23:36,588 - INFO - Epoch 34/80 - Time: 33.73s:Recon Loss=0.1794, Cluster Loss=0.2373,Reg Loss=0.0285,Last Inner Loss=0.4451

2025-07-17 19:24:10,871 - INFO - Epoch 35/80 - Time: 34.28s:Recon Loss=0.1820, Cluster Loss=0.3201,Reg Loss=0.0285,Last Inner Loss=0.5306

2025-07-17 19:24:48,987 - INFO - Epoch 36/80 - Time: 38.12s:Recon Loss=0.1744, Cluster Loss=0.3285,Reg Loss=0.0285,Last Inner Loss=0.5314

2025-07-17 19:25:22,693 - INFO - Epoch 37/80 - Time: 33.71s:Recon Loss=0.1707, Cluster Loss=0.3075,Reg Loss=0.0286,Last Inner Loss=0.5067

2025-07-17 19:25:56,520 - INFO - Epoch 38/80 - Time: 33.83s:Recon Loss=0.1715, Cluster Loss=0.2560,Reg Loss=0.0286,Last Inner Loss=0.4561

2025-07-17 19:26:32,112 - INFO - Epoch 39/80 - Time: 35.59s:Recon Loss=0.1698, Cluster Loss=0.2315,Reg Loss=0.0286,Last Inner Loss=0.4299

2025-07-17 19:27:14,506 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 19:27:14,506 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 19:27:16,162 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 19:27:16,814 - INFO - Epoch 40/80 (Eval) - Time: 44.70s (Eval Time: 5.24s):

2025-07-17 19:27:16,814 - INFO - Evaluation Metrics:

2025-07-17 19:27:16,814 - INFO - silhouette: 0.1343153715133667

2025-07-17 19:27:16,814 - INFO - davies\_bouldin: 1.9367

2025-07-17 19:27:16,814 - INFO - calinski\_harabasz: 939.8033

2025-07-17 19:27:16,815 - INFO - cohesion: -0.11657284200191498

2025-07-17 19:27:16,815 - INFO - separation: 0.2722

2025-07-17 19:27:16,815 - INFO - separation\_to\_cohesion: 2.3351

2025-07-17 19:27:16,815 - INFO - size\_balance: 0.4040

2025-07-17 19:27:16,815 - INFO - cluster\_count: 15.0000

2025-07-17 19:27:16,815 - INFO - avg\_cluster\_size: 478.7333

2025-07-17 19:27:16,815 - INFO - cluster\_size\_std: 285.3121

2025-07-17 19:27:16,815 - INFO - cluster\_sizes: [535, 129, 860, 920, 433, 725, 916, 694, 304, 198, 252, 223, 470, 520, 2]

2025-07-17 19:27:58,532 - INFO - Epoch 41/80 - Time: 41.72s:Recon Loss=0.1808, Cluster Loss=0.1073,Reg Loss=0.0286,Last Inner Loss=0.3167

2025-07-17 19:28:33,060 - INFO - Epoch 42/80 - Time: 34.53s:Recon Loss=0.1937, Cluster Loss=0.0973,Reg Loss=0.0286,Last Inner Loss=0.3196

2025-07-17 19:29:11,420 - INFO - Epoch 43/80 - Time: 38.36s:Recon Loss=0.1925, Cluster Loss=0.1056,Reg Loss=0.0286,Last Inner Loss=0.3267

2025-07-17 19:29:45,171 - INFO - Epoch 44/80 - Time: 33.75s:Recon Loss=0.1879, Cluster Loss=0.0944,Reg Loss=0.0286,Last Inner Loss=0.3109

2025-07-17 19:30:18,310 - INFO - Epoch 45/80 - Time: 33.14s:Recon Loss=0.1846, Cluster Loss=0.0914,Reg Loss=0.0286,Last Inner Loss=0.3046

2025-07-17 19:30:56,189 - INFO - Epoch 46/80 - Time: 37.88s:Recon Loss=0.1804, Cluster Loss=0.1075,Reg Loss=0.0286,Last Inner Loss=0.3165

2025-07-17 19:31:29,976 - INFO - Epoch 47/80 - Time: 33.79s:Recon Loss=0.1759, Cluster Loss=0.1105,Reg Loss=0.0286,Last Inner Loss=0.3150

2025-07-17 19:32:03,690 - INFO - Epoch 48/80 - Time: 33.71s:Recon Loss=0.1734, Cluster Loss=0.1127,Reg Loss=0.0286,Last Inner Loss=0.3146

2025-07-17 19:32:42,276 - INFO - Epoch 49/80 - Time: 38.59s:Recon Loss=0.1706, Cluster Loss=0.1010,Reg Loss=0.0286,Last Inner Loss=0.3001

2025-07-17 19:33:22,957 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 19:33:22,957 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 19:33:24,682 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 19:33:25,352 - INFO - Epoch 50/80 (Eval) - Time: 43.08s (Eval Time: 5.27s):

2025-07-17 19:33:25,352 - INFO - Evaluation Metrics:

2025-07-17 19:33:25,352 - INFO - silhouette: 0.13866572082042694

2025-07-17 19:33:25,352 - INFO - davies\_bouldin: 1.9987

2025-07-17 19:33:25,352 - INFO - calinski\_harabasz: 1022.7720

2025-07-17 19:33:25,353 - INFO - cohesion: -0.10348330438137054

2025-07-17 19:33:25,353 - INFO - separation: 0.2109

2025-07-17 19:33:25,353 - INFO - separation\_to\_cohesion: 2.0385

2025-07-17 19:33:25,353 - INFO - size\_balance: 0.5048

2025-07-17 19:33:25,353 - INFO - cluster\_count: 15.0000

2025-07-17 19:33:25,353 - INFO - avg\_cluster\_size: 478.7333

2025-07-17 19:33:25,353 - INFO - cluster\_size\_std: 237.0726

2025-07-17 19:33:25,353 - INFO - cluster\_sizes: [493, 628, 250, 615, 603, 199, 542, 967, 312, 122, 440, 311, 743, 196, 760]

2025-07-17 19:34:06,860 - INFO - Epoch 51/80 - Time: 41.51s:Recon Loss=0.1674, Cluster Loss=0.0513,Reg Loss=0.0286,Last Inner Loss=0.2472

2025-07-17 19:34:44,387 - INFO - Epoch 52/80 - Time: 37.53s:Recon Loss=0.1665, Cluster Loss=0.0542,Reg Loss=0.0285,Last Inner Loss=0.2492

2025-07-17 19:35:20,170 - INFO - Epoch 53/80 - Time: 35.78s:Recon Loss=0.1663, Cluster Loss=0.0488,Reg Loss=0.0285,Last Inner Loss=0.2436

2025-07-17 19:35:54,136 - INFO - Epoch 54/80 - Time: 33.96s:Recon Loss=0.1657, Cluster Loss=0.0530,Reg Loss=0.0285,Last Inner Loss=0.2472

2025-07-17 19:36:28,343 - INFO - Epoch 55/80 - Time: 34.21s:Recon Loss=0.1654, Cluster Loss=0.0567,Reg Loss=0.0285,Last Inner Loss=0.2507

2025-07-17 19:37:05,530 - INFO - Epoch 56/80 - Time: 37.19s:Recon Loss=0.1655, Cluster Loss=0.0455,Reg Loss=0.0285,Last Inner Loss=0.2395

2025-07-17 19:37:39,307 - INFO - Epoch 57/80 - Time: 33.78s:Recon Loss=0.1660, Cluster Loss=0.0504,Reg Loss=0.0285,Last Inner Loss=0.2449

2025-07-17 19:38:12,725 - INFO - Epoch 58/80 - Time: 33.42s:Recon Loss=0.1658, Cluster Loss=0.0434,Reg Loss=0.0285,Last Inner Loss=0.2377

2025-07-17 19:38:52,478 - INFO - Epoch 59/80 - Time: 39.75s:Recon Loss=0.1648, Cluster Loss=0.0430,Reg Loss=0.0285,Last Inner Loss=0.2363

2025-07-17 19:39:34,220 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 19:39:34,221 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 19:39:35,918 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 19:39:36,671 - INFO - Epoch 60/80 (Eval) - Time: 44.19s (Eval Time: 6.67s):

2025-07-17 19:39:36,671 - INFO - Evaluation Metrics:

2025-07-17 19:39:36,671 - INFO - silhouette: 0.14274285733699799

2025-07-17 19:39:36,671 - INFO - davies\_bouldin: 1.9624

2025-07-17 19:39:36,672 - INFO - calinski\_harabasz: 1068.9083

2025-07-17 19:39:36,672 - INFO - cohesion: -0.10948719829320908

2025-07-17 19:39:36,672 - INFO - separation: 0.2230

2025-07-17 19:39:36,672 - INFO - separation\_to\_cohesion: 2.0363

2025-07-17 19:39:36,672 - INFO - size\_balance: 0.4334

2025-07-17 19:39:36,672 - INFO - cluster\_count: 15.0000

2025-07-17 19:39:36,672 - INFO - avg\_cluster\_size: 478.7333

2025-07-17 19:39:36,672 - INFO - cluster\_size\_std: 271.2469

2025-07-17 19:39:36,672 - INFO - cluster\_sizes: [485, 721, 1029, 541, 190, 863, 303, 325, 118, 252, 451, 515, 614, 729, 45]

2025-07-17 19:40:15,698 - INFO - Epoch 61/80 - Time: 39.03s:Recon Loss=0.1652, Cluster Loss=0.0430,Reg Loss=0.0285,Last Inner Loss=0.2367

2025-07-17 19:40:55,154 - INFO - Epoch 62/80 - Time: 39.45s:Recon Loss=0.1649, Cluster Loss=0.0372,Reg Loss=0.0284,Last Inner Loss=0.2305

2025-07-17 19:41:29,081 - INFO - Epoch 63/80 - Time: 33.93s:Recon Loss=0.1651, Cluster Loss=0.0552,Reg Loss=0.0284,Last Inner Loss=0.2486

2025-07-17 19:42:03,018 - INFO - Epoch 64/80 - Time: 33.94s:Recon Loss=0.1650, Cluster Loss=0.0359,Reg Loss=0.0284,Last Inner Loss=0.2293

2025-07-17 19:42:38,290 - INFO - Epoch 65/80 - Time: 35.27s:Recon Loss=0.1651, Cluster Loss=0.0356,Reg Loss=0.0284,Last Inner Loss=0.2291

2025-07-17 19:43:13,431 - INFO - Epoch 66/80 - Time: 35.14s:Recon Loss=0.1648, Cluster Loss=0.0359,Reg Loss=0.0284,Last Inner Loss=0.2291

2025-07-17 19:43:47,663 - INFO - Epoch 67/80 - Time: 34.23s:Recon Loss=0.1647, Cluster Loss=0.0369,Reg Loss=0.0284,Last Inner Loss=0.2301

2025-07-17 19:44:21,790 - INFO - Epoch 68/80 - Time: 34.13s:Recon Loss=0.1647, Cluster Loss=0.0372,Reg Loss=0.0284,Last Inner Loss=0.2303

2025-07-17 19:45:01,756 - INFO - Epoch 69/80 - Time: 39.96s:Recon Loss=0.1644, Cluster Loss=0.0326,Reg Loss=0.0284,Last Inner Loss=0.2254

2025-07-17 19:45:43,363 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 19:45:43,364 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 19:45:45,075 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 19:45:45,825 - INFO - Epoch 70/80 (Eval) - Time: 44.07s (Eval Time: 5.36s):

2025-07-17 19:45:45,826 - INFO - Evaluation Metrics:

2025-07-17 19:45:45,826 - INFO - silhouette: 0.15289275348186493

2025-07-17 19:45:45,826 - INFO - davies\_bouldin: 2.0643

2025-07-17 19:45:45,826 - INFO - calinski\_harabasz: 1063.2944

2025-07-17 19:45:45,826 - INFO - cohesion: -0.10297174751758575

2025-07-17 19:45:45,826 - INFO - separation: 0.2128

2025-07-17 19:45:45,826 - INFO - separation\_to\_cohesion: 2.0664

2025-07-17 19:45:45,826 - INFO - size\_balance: 0.4608

2025-07-17 19:45:45,826 - INFO - cluster\_count: 15.0000

2025-07-17 19:45:45,826 - INFO - avg\_cluster\_size: 478.7333

2025-07-17 19:45:45,826 - INFO - cluster\_size\_std: 258.1507

2025-07-17 19:45:45,826 - INFO - cluster\_sizes: [505, 710, 741, 259, 615, 635, 851, 109, 75, 854, 657, 205, 444, 221, 300]

2025-07-17 19:46:21,806 - INFO - Epoch 71/80 - Time: 35.98s:Recon Loss=0.1691, Cluster Loss=0.0480,Reg Loss=0.0284,Last Inner Loss=0.2455

2025-07-17 19:47:02,368 - INFO - Epoch 72/80 - Time: 40.56s:Recon Loss=0.1802, Cluster Loss=0.0906,Reg Loss=0.0284,Last Inner Loss=0.2993

2025-07-17 19:47:36,165 - INFO - Epoch 73/80 - Time: 33.80s:Recon Loss=0.1754, Cluster Loss=0.1124,Reg Loss=0.0285,Last Inner Loss=0.3163

2025-07-17 19:48:09,757 - INFO - Epoch 74/80 - Time: 33.59s:Recon Loss=0.1720, Cluster Loss=0.1375,Reg Loss=0.0285,Last Inner Loss=0.3381

2025-07-17 19:48:46,409 - INFO - Epoch 75/80 - Time: 36.65s:Recon Loss=0.1694, Cluster Loss=0.1291,Reg Loss=0.0286,Last Inner Loss=0.3272

2025-07-17 19:49:20,743 - INFO - Epoch 76/80 - Time: 34.33s:Recon Loss=0.1731, Cluster Loss=0.2347,Reg Loss=0.0286,Last Inner Loss=0.4364

2025-07-17 19:49:54,490 - INFO - Epoch 77/80 - Time: 33.75s:Recon Loss=0.1759, Cluster Loss=0.3747,Reg Loss=0.0287,Last Inner Loss=0.5793

2025-07-17 19:50:28,255 - INFO - Epoch 78/80 - Time: 33.77s:Recon Loss=0.1721, Cluster Loss=0.3995,Reg Loss=0.0288,Last Inner Loss=0.6004

2025-07-17 19:51:08,843 - INFO - Epoch 79/80 - Time: 40.59s:Recon Loss=0.1710, Cluster Loss=0.3569,Reg Loss=0.0288,Last Inner Loss=0.5567

2025-07-17 19:51:54,149 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 19:51:54,149 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 19:51:55,876 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 19:51:56,615 - INFO - Epoch 80/80 (Eval) - Time: 47.77s (Eval Time: 6.45s):

2025-07-17 19:51:56,615 - INFO - Evaluation Metrics:

2025-07-17 19:51:56,615 - INFO - silhouette: 0.17832790315151215

2025-07-17 19:51:56,615 - INFO - davies\_bouldin: 1.8817

2025-07-17 19:51:56,615 - INFO - calinski\_harabasz: 1112.9617

2025-07-17 19:51:56,615 - INFO - cohesion: -0.12511233985424042

2025-07-17 19:51:56,615 - INFO - separation: 0.2563

2025-07-17 19:51:56,615 - INFO - separation\_to\_cohesion: 2.0488

2025-07-17 19:51:56,615 - INFO - size\_balance: 0.5263

2025-07-17 19:51:56,615 - INFO - cluster\_count: 15.0000

2025-07-17 19:51:56,615 - INFO - avg\_cluster\_size: 478.7333

2025-07-17 19:51:56,615 - INFO - cluster\_size\_std: 226.7964

2025-07-17 19:51:56,615 - INFO - cluster\_sizes: [743, 447, 523, 43, 861, 270, 860, 355, 749, 492, 270, 471, 370, 323, 404]

2025-07-17 19:51:56,616 - INFO -

Training completed!

2025-07-17 19:51:56,616 - INFO -

Saving final trained model...

2025-07-17 19:51:58,828 - INFO - Final trained model saved to ./results/n15\_final\_model\_gz\_ptype0\_no\_cat.pth

2025-07-17 19:51:58,829 - INFO -

Evaluating final trained model...

2025-07-17 19:52:01,553 - INFO - Attempting SVD/EIGH for matrix of shape torch.Size([7181, 7181]) on device: cuda:0

2025-07-17 19:52:01,553 - INFO - Attempting torch.linalg.eigh on cuda:0 (for symmetric matrix)...

2025-07-17 19:52:03,278 - INFO - torch.linalg.eigh on cuda:0 successful.

2025-07-17 19:52:04,011 - INFO -

Detailed Clustering Evaluation of Final Model:

2025-07-17 19:52:04,011 - INFO - silhouette: 0.17832791805267334

2025-07-17 19:52:04,011 - INFO - davies\_bouldin: 1.8817

2025-07-17 19:52:04,011 - INFO - calinski\_harabasz: 1112.9617

2025-07-17 19:52:04,011 - INFO - cohesion: -0.12511233985424042

2025-07-17 19:52:04,011 - INFO - separation: 0.2563

2025-07-17 19:52:04,011 - INFO - separation\_to\_cohesion: 2.0488

2025-07-17 19:52:04,011 - INFO - size\_balance: 0.5263

2025-07-17 19:52:04,011 - INFO - cluster\_count: 15.0000

2025-07-17 19:52:04,011 - INFO - avg\_cluster\_size: 478.7333

2025-07-17 19:52:04,011 - INFO - cluster\_size\_std: 226.7964

2025-07-17 19:52:04,012 - INFO - cluster\_sizes: [743, 447, 523, 43, 861, 270, 860, 355, 749, 492, 270, 471, 370, 323, 404]

2025-07-17 19:52:04,012 - INFO -

--- Detailed Clustering Evaluation of Final Model (based on P indicator matrix as embeddings) ---

2025-07-17 19:52:04,710 - INFO - P\_based\_silhouette: 0.1912856251001358

2025-07-17 19:52:04,710 - INFO - P\_based\_davies\_bouldin: 1.5787

2025-07-17 19:52:04,710 - INFO - P\_based\_calinski\_harabasz: 593.2679

2025-07-17 19:52:04,710 - INFO - P\_based\_cohesion: -0.031168151646852493

2025-07-17 19:52:04,710 - INFO - P\_based\_separation: 0.0535

2025-07-17 19:52:04,710 - INFO - P\_based\_separation\_to\_cohesion: 1.7151

2025-07-17 19:52:04,710 - INFO - P\_based\_size\_balance: 0.5263

2025-07-17 19:52:04,710 - INFO - P\_based\_cluster\_count: 15.0000

2025-07-17 19:52:04,711 - INFO - P\_based\_avg\_cluster\_size: 478.7333

2025-07-17 19:52:04,711 - INFO - P\_based\_cluster\_size\_std: 226.7964

2025-07-17 19:52:04,711 - INFO - P\_based\_cluster\_sizes: [743, 447, 523, 43, 861, 270, 860, 355, 749, 492, 270, 471, 370, 323, 404]

2025-07-17 19:52:04,711 - INFO - Saving final results with embeddings and view weights...

2025-07-17 19:52:07,336 - INFO - Final results saved to ./results/n15\_final\_clustering\_gz\_pytpe0\_no\_cat.csv

2025-07-17 19:52:07,362 - INFO - Final evaluation metrics saved to ./results/n15\_final\_evaluation\_metrics\_gz\_ptype0\_no\_cat.txt