

**TỔNG CÔNG TY VIỄN THÔNG VIETTEL**

**KHỐI CÔNG NGHỆ THÔNG TIN**

**PYC TRIỂN KHAI RECOMMENDATION CHO TV360 THEO KẾ HOẠCH TỐI ƯU RECOMMEND CHO NHÓM NGƯỜI DÙNG**

**TÀI LIỆU THIẾT KẾ CHI TIẾT**

**Mã hiệu dự án:** **MyViettel\_0008**

**Mã hiệu tài liệu: MyViettel\_0008**

# **<Địa điểm, Thời gian>**

# **MỤC LỤC**

[**<Địa điểm, Thời gian>**](#_heading=h.92x47ua4lmdc) **2**

[**MỤC LỤC**](#_heading=h.nmtuty9e12u) **3**

[**I. Phân tích tập dữ liệu**](#_heading=h.twhpscq2dbgg) **6**

[1.1 Phân tích tổng hợp dữ liệu cho phim](#_heading=h.1fob9te) 6

[1.2 Tìm trọng số cho phim](#_heading=h.3znysh7) 7

[**1.3 Xử lý missing, outlier**](#_heading=h.jqtrvpqmjxp5) **9**

[**1.4 Xử lý normalization**](#_heading=h.bnddnec37tcy) **10**

[**1.5 Tạo và lưu dữ liệu dạng đồ thị**](#_heading=h.unqof96571a9) **11**

[**1.5.1 Tạo dữ liệu dạng đồ thị và khớp input mô hình**](#_heading=h.gbn9c7ice8sc) **11**

[**1.6 Xử lý dataloader**](#_heading=h.o0f3c05mhykv) **12**

[**1.7 Phân chia dữ liệu**](#_heading=h.2v6z58hziyca) **13**

[**1.8 Đánh giá kết quả**](#_heading=h.rhd50ulurz99) **14**

[**II. Huấn luyện, fine-tune mô hình embedding với graphsage**](#_heading=h.rhmj5v100y6) **15**

[**2.1 Xây dựng mô hình**](#_heading=h.ba8fz2hm9kp4) **15**

[**2.1.1 Xây dựng mô hình**](#_heading=h.edqklarae5ei) **15**

[**2.1.2 Tiến hành training**](#_heading=h.o142zyrkenno) **17**

[**2.1.3 Thực hiện inference**](#_heading=h.gvqqck8f6ac) **20**

[**2.1.4 Đánh giá kết quả ban đầu**](#_heading=h.iyrjlyv4pd8l) **22**

[**2.2 Fine-tune mô hình**](#_heading=h.rx26o9xdc3q) **22**

[**2.2.1 Fine-tune mô hình lần 1**](#_heading=h.if1wm2okjyga) **22**

[**2.2.1.1 Thông số hyperparameter**](#_heading=h.6pott7gefzyo) **22**

[**2.2.1.2 Training**](#_heading=h.w5zd5bo17w91) **22**

[**2.2.1.3 Kết quả**](#_heading=h.mgewp1xi2ax7) **27**

[**2.2.2 Fine-tune mô hình lần 2**](#_heading=h.qwzvmusm8xau) **27**

[**2.2.2.1 Thông số hyperparameter**](#_heading=h.jnd6jwzdqgoh) **27**

[**2.2.2.2 Kết quả training**](#_heading=h.kqwirue5bu1f) **28**

[**2.2.2.3 Kết quả**](#_heading=h.ctvdxd1egcju) **32**

[**2.2.3 Fine-tune mô hình lần 3**](#_heading=h.9e85zfyt4gzc) **33**

[**2.2.3.1 Thông số hyperparameter**](#_heading=h.h7rorsq8we2r) **33**

[**2.2.3.2 Kết quả training**](#_heading=h.se5uqoucq9f1) **33**

[**2.2.3.3 Kết quả**](#_heading=h.9kdyt7qqlcdy) **40**

[**2.2.4 Fine-tune mô hình lần 4**](#_heading=h.wsdbid77hhv) **41**

[**2.2.4.1 Thông số hyperparameter**](#_heading=h.ghggvqlch4d1) **41**

[**2.2.4.2 Kết quả training**](#_heading=h.r9v1zah7p11k) **41**

[**2.2.4.3 Kết quả**](#_heading=h.68mqgpci7gbp) **43**

[**2.2.5 Fine-tune mô hình lần 5**](#_heading=h.7mhn71dhacno) **43**

[**2.2.5.1 Thông số hyperparameter**](#_heading=h.hn7ft1uou79m) **43**

[**2.2.5.2 Kết quả training**](#_heading=h.ap8fluj8qma3) **44**

[**2.2.5.3 Kết quả**](#_heading=h.r2v59sw10mtw) **52**

[**2.2.6 Fine-tune mô hình lần 6**](#_heading=h.2w9u58wzh7ud) **52**

[**2.2.6.1 Thông số hyperparameter**](#_heading=h.7re2ozklwhxw) **52**

[**2.2.6.2 Kết quả training**](#_heading=h.nimxnr2t8zy8) **53**

[**2.2.6.3 Kết quả**](#_heading=h.opmhuq2szy5h) **57**

[**2.2.7 Fine-tune mô hình lần 7**](#_heading=h.l8zh02xtydxw) **57**

[**2.2.7.1 Thông số hyperparameter**](#_heading=h.h4yd4sfd7l3e) **57**

[**2.2.7.2 Kết quả training**](#_heading=h.vudp99s2dl8) **57**

[**2.2.7.3 Kết quả**](#_heading=h.gp08l1az3jqg) **61**

[**2.2.8 Fine-tune mô hình lần 8**](#_heading=h.rxcqojhkg0a6) **61**

[**2.2.8.1 Thông số hyperparameter**](#_heading=h.2jnyvcf1znz9) **61**

[**2.2.8.2 Kết quả training**](#_heading=h.d14iq6vhjhr7) **62**

[**2.2.8.3 Kết quả**](#_heading=h.mas92q6ft7nl) **68**

[**III. Build mô hình Graph Attention Network**](#_heading=h.5nkbaa7be15w) **68**

[**3.1. Phân tích tập dữ liệu**](#_heading=h.xlb4rn2povtr) **68**

[**3.1.1 Phân tích tổng hợp dữ liệu cho phim**](#_heading=h.o822cbl74udq) **68**

[**3.1.2 Tìm trọng số cho phim**](#_heading=h.tp3y55yrq7fi) **70**

[**3.1.3 Xử lý missing, outlier**](#_heading=h.wb1h3jodrcpo) **72**

[**3.1.4 Xử lý normalization**](#_heading=h.f2cqkn67sdr) **73**

[**3.1.5 Tạo và lưu dữ liệu dạng đồ thị**](#_heading=h.ppq5xvswk8nq) **74**

[**3.1.5.1 Tạo dữ liệu dạng đồ thị và khớp input mô hình**](#_heading=h.1yifdf2oo5jz) **74**

[**3.1.6 Xử lý dataloader**](#_heading=h.8e9qza1lecn2) **74**

[**3.1.7 Phân chia dữ liệu**](#_heading=h.6mpfk7eldqo2) **75**

[**3.1.8 Đánh giá kết quả**](#_heading=h.hhra6pkam1v4) **76**

[**3.2. Xây dựng kiến trúc mô hình GAT**](#_heading=h.wzqf67bbdz8n) **76**

[**3.2.1. Xây dựng lớp Attention**](#_heading=h.rjy5fw1b5im1) **76**

[**3.2.2. Xây dựng hàm Unsupervised Loss cho model:**](#_heading=h.4z57q78gx6z5) **77**

[**3.2.2.1. Xây dựng hàm extend node cho Unsupervised Loss**](#_heading=h.1vz6q4savevd) **77**

[**3.2.2.2. Xây dựng hàm Unsupervised Loss**](#_heading=h.h3ikxpb9st4u) **78**

[**3.3. Xử lý dữ liệu đầu vào cho mô hình**](#_heading=h.c82kp1x6ne3a) **81**

[**3.3.1. Load input data và xây dựng node mapping lại id film:**](#_heading=h.kewo7t74ojz8) **81**

[**3.3.2. Tạo sparse matrix - input model**](#_heading=h.napfurbd418y) **82**

[**3.3. Quá trình huấn luyện mô hình**](#_heading=h.ra4lzge2g2ln) **82**

[**3.3.1. Khởi tạo tham số**](#_heading=h.62xc965stkhy) **82**

[**3.3.2. Quá trình huấn luyện**](#_heading=h.ctmlovj473ne) **83**

[**IV. Fine-Tune và test mô hình GAT**](#_heading=h.lxc825p4mh5u) **85**

[**4.1 Fine Tune mô hình lần 1**](#_heading=h.19h9gp6v0prq) **85**

[**4..1.1. Thông số hyperparameter:**](#_heading=h.y8amfdfsdjo3) **85**

[**4.1.2. Kết quả train mô hình:**](#_heading=h.bi1miqi8yuia) **86**

[**4.1.3. Kết quả test:**](#_heading=h.71qjdr1d67mh) **96**

[**4.2 Fine Tune mô hình lần 2**](#_heading=h.bkjdqbc55jkz) **96**

[**4.2.1. Thông số hyperparameter:**](#_heading=h.orga4d7d0124) **96**

[**4.2.2. Kết quả train mô hình:**](#_heading=h.ene9q9lllt7o) **96**

[**4.2.3. Kết quả test:**](#_heading=h.bzdsv6fgibh8) **105**

[**4.3 Fine Tune mô hình lần 3**](#_heading=h.r3znagrtkakl) **106**

[**4.3.1. Thông số hyperparameter:**](#_heading=h.1q8neyxsdn0r) **106**

[**4.3.2. Kết quả train mô hình:**](#_heading=h.8gxqp5xqsz12) **106**

[**4.3.3. Kết quả test:**](#_heading=h.5xij5eu7yj1t) **115**

[**4.4 Fine Tune mô hình lần 4**](#_heading=h.jh10djpf7zv1) **115**

[**4.4.1. Thông số hyperparameter:**](#_heading=h.2ozf6s19vegj) **115**

[**4.4.2. Kết quả train mô hình:**](#_heading=h.fn0xaruhntvb) **116**

[**4.4.3. Kết quả test:**](#_heading=h.c2us8iv6ltir) **125**

[**4.5 Fine Tune mô hình lần 5**](#_heading=h.r95iavp0besk) **125**

[**4.5.1. Thông số hyperparameter:**](#_heading=h.9nel4bzbo1j) **125**

[**4.5.2. Kết quả train mô hình:**](#_heading=h.xvbqgsc1d8cp) **125**

[**4.5.3. Kết quả test:**](#_heading=h.rm00vbgi7qco) **130**

[**4.6. Fine Tune mô hình lần 6**](#_heading=h.4g2udx60nox5) **130**

[**4.6.1. Thông số hyperparameter:**](#_heading=h.2bb3pr38r8ai) **131**

[**4.6.2. Kết quả train mô hình:**](#_heading=h.5h8sobsgkq39) **131**

[**4.6.3. Kết quả test:**](#_heading=h.seez9wwvoxft) **141**

[**4.7 Fine Tune mô hình lần 7**](#_heading=h.mgt10pqpiuub) **141**

[**4.7.1. Thông số hyperparameter:**](#_heading=h.52cvscs5c8af) **141**

[**4.7.2. Kết quả train mô hình:**](#_heading=h.6kjcqtep8u5p) **141**

[**4.7.3. Kết quả test:**](#_heading=h.q6xwtrxzjs8m) **146**

[**4.8 Fine Tune mô hình lần 8**](#_heading=h.8ofp85gud9p7) **146**

[**4.8.1. Thông số hyperparameter:**](#_heading=h.1nh0i4z8j9q5) **146**

[**4.8.2. Kết quả train mô hình:**](#_heading=h.36nml4v871n7) **147**

[**4.8.3. Kết quả test:**](#_heading=h.jf4mgehfhdv8) **160**

[**4.9 Fine Tune mô hình lần 9**](#_heading=h.w8biz8t4u57d) **161**

[**4.9.1. Thông số hyperparameter:**](#_heading=h.r0wl0wow5nu4) **161**

[**4.9.2. Kết quả train mô hình:**](#_heading=h.nlays6twinpu) **161**

[**4.9.3. Kết quả test:**](#_heading=h.7j4yblnstrxn) **171**

# 

# **I. Phân tích tập dữ liệu**

## **1.1 Phân tích tổng hợp dữ liệu cho phim**

Tổng hợp dữ liệu phim lấy ra embedding làm input

| import random  import numpy as np  import json  import argparse  import torch  from tqdm import tqdm  import os  # torch.multiprocessing.set\_start\_method('spawn')  from multiprocessing import set\_start\_method  from config\_pr import opt  from sentence\_transformers import SentenceTransformer  from sklearn.metrics import accuracy\_score  import warnings  warnings.filterwarnings(action='ignore', category=UserWarning)  # from pytorchtools import EarlyStopping  import time  from sklearn.preprocessing import OneHotEncoder  from sklearn.preprocessing import MultiLabelBinarizer  import pandas as pd  import math  import re  from torch.nn.functional import normalize  from pyvi.ViTokenizer import tokenize  from torch.nn import functional as F  from transformers import AutoModel, AutoTokenizer  from scipy import sparse  import csv  import pickle  def normalizeString(s):  # Tách dấu câu nếu kí tự liền nhau  s = re.sub(r"([.!?,\-\&\(\)\[\]])", r" \1 ", s)  # Thay thế nhiều spaces bằng 1 space.  s = re.sub(r"\s+", r" ", s).strip()  return s  def get\_unique\_category(pd\_film):  list\_category\_unique = []  categorys = pd\_film[pd\_film['raw\_category\_name'].notnull()]['raw\_category\_name'].apply(lambda x: x.split(","))  for list\_category in categorys:  # print(list\_category)  for category in list\_category:  if category not in list\_category\_unique:  list\_category\_unique.append(category)  # print(list\_category\_unique)  return list\_category\_unique  def get\_all\_category(pd\_film\_series):  unique\_category\_film\_series = get\_unique\_category(pd\_film\_series)  return unique\_category\_film\_series  pd\_film\_series = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_series)  pd\_film\_episode = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_episode)  dict\_films\_duration = pd\_film\_episode.groupby('series\_id')['duration'].agg([("duration", "sum")]).reset\_index().set\_index('series\_id').T.to\_dict('list')  ccai = pd.read\_csv(opt.folder + opt.path\_file\_user\_info)  ccai\_drop\_nan = pd.read\_csv(opt.folder + opt.path\_file\_user\_info)  ccai\_drop\_nan.dropna(inplace=True)  pd\_film\_series\_drop\_nan = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_series)  pd\_film\_series\_drop\_nan.dropna(inplace=True)    onehot\_is\_series=OneHotEncoder(handle\_unknown='ignore',sparse=False)  onehot\_is\_series.fit(pd\_film\_series\_drop\_nan[['is\_series']])  all\_films\_id = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_series)['series\_id'].apply(lambda x: str(x)).tolist()  onehot\_categorical=MultiLabelBinarizer()  all\_category = get\_all\_category(pd\_film\_series)  onehot\_categorical.fit([all\_category])    onehot\_country=OneHotEncoder(handle\_unknown='ignore',sparse=False)  pd\_film\_series\_country = pd.DataFrame(pd\_film\_series, columns = ['country'])  pd\_film\_series\_country = pd\_film\_series\_country[pd\_film\_series\_country['country'].notnull()]  onehot\_country.fit(pd\_film\_series\_country[['country']])  model\_tokenizer= AutoTokenizer.from\_pretrained("vinai/phobert-base")  bertsentence= SentenceTransformer('VoVanPhuc/sup-SimCSE-VietNamese-phobert-base', device="cpu")  def get\_record\_by\_item\_id(item\_id, pd\_film\_series):  record = pd\_film\_series[pd\_film\_series['series\_id'] == int(item\_id)].to\_dict('records')[0]  return record  def get\_ft\_item(film\_id):  record\_trg\_item = get\_record\_by\_item\_id(film\_id, pd\_film\_series)  duration = dict\_films\_duration[int(film\_id)][0]  fe\_record\_trg\_item = embedding\_item(duration, record\_trg\_item, bertsentence,onehot\_is\_series,onehot\_country,onehot\_categorical,model\_tokenizer)  return fe\_record\_trg\_item  def embedding\_item(duration, record, bertsentence,onehot\_is\_series,onehot\_country,onehot\_categorical,bert\_words):  data={}    if type(record['description']) != str:  return None  data['description']= normalizeString(str(record['series\_name']) + " " + str(record['description']))    data['country']=[record['country']]  try:  data['raw\_category\_name'] = record['raw\_category\_name'].split(",")  except:  data['raw\_category\_name'] = ""    data['director\_name']=record['director\_name']    data['actor\_name']=record['actor\_name']    data['is\_series']=[record['is\_series']]    data['duration']= duration    if np.isnan(record['release\_year']):  return None  # data['release\_year'] = 2022  else:  data['release\_year']=record['release\_year']    sentences=[tokenize(data['description'])]    description\_emb= torch.FloatTensor(bertsentence.encode(sentences))    is\_series\_emb=onehot\_is\_series.transform([data['is\_series']])  is\_series\_emb=torch.FloatTensor(is\_series\_emb)    duration=torch.FloatTensor([[data['duration']]])    release\_year=torch.FloatTensor([[data['release\_year']]])  if type(data['country']) == str:  country=onehot\_country.transform([data['country']])  else:  country=onehot\_country.transform([[""]])  country=torch.FloatTensor(country)    category=onehot\_categorical.transform([data['raw\_category\_name']])  category=torch.FloatTensor(category)    if type(data['actor\_name']) == str:  actor=[bert\_words.encode(data['actor\_name'])]  else:  actor=[bert\_words.encode("")]  actor=torch.FloatTensor(actor)  if actor.shape[1]<16:  actor=F.pad(actor,(1,15-actor.shape[1]),mode='constant', value=0)  elif actor.shape[1]>16:  actor=actor[:,:16]    if type(data['director\_name']) == str:  director=[bert\_words.encode(data['director\_name'])]  else:  director=[bert\_words.encode('')]    director=torch.FloatTensor(director)  if director.shape[1]<16:  director=F.pad(director,(1,15-director.shape[1]),mode='constant', value=0)  elif director.shape[1]>16:  director=director[:,:16]  # emb\_film = torch.concat([normalize(description\_emb), normalize(country), normalize(category),normalize(actor), normalize(director), is\_series\_emb, duration,release\_year], 1)  # print(emb\_film.size())  # return emb\_film.detach().cpu().numpy()[0]  return (  normalize(description\_emb).to(opt.device), normalize(country).to(opt.device), normalize(category).to(opt.device),  normalize(actor).to(opt.device), normalize(director).to(opt.device), is\_series\_emb.to(opt.device),  duration.to(opt.device), release\_year.to(opt.device))    pd\_film\_series = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_series)  list\_film\_id = pd\_film\_series['series\_id'].apply(lambda x: str(x)).tolist()  dict\_fe\_item = {}  list\_film\_remove = []  list\_ft\_film = []  for item\_id in list\_film\_id:  dict\_fe\_item[item\_id] = get\_ft\_item(item\_id)  # if dict\_fe\_item[item\_id] is None:  # list\_film\_remove.append(item\_id)  # for item\_id in list\_film\_remove:  # list\_film\_id.remove(item\_id)  with open('raw\_features.pickle', 'wb') as handle:  pickle.dump(dict\_fe\_item, handle, protocol=pickle.HIGHEST\_PROTOCOL) |
| --- |

## **1.2 Tìm trọng số cho phim**

Điểm của 2 phim được tính bằng số người dùng xem chung cả 2 bộ phim.

| for file\_path in os.listdir(opt.folder + "data/"):  if file\_path.find("log\_film") >= 0:  path\_list\_file\_log\_film.append(file\_path)  users\_info = pd.read\_csv(opt.folder + opt.path\_file\_user\_info)  # users\_info.dropna()  all\_users\_id = [str(user\_id) for user\_id in users\_info['user\_id'].tolist()]  # users\_items = {}  list\_hst\_users\_info = []  for log\_film\_path in path\_list\_file\_log\_film:  print(opt.folder + "data/" + log\_film\_path)  hst\_users\_info\_5\_days = pd.read\_csv(opt.folder + "data/" + log\_film\_path)  list\_hst\_users\_info.append(hst\_users\_info\_5\_days)  hst\_users\_info = pd.concat(list\_hst\_users\_info, ignore\_index=True, sort=False)  hst\_users\_info['content\_id'] = hst\_users\_info['content\_id'].apply(lambda x: find\_seri\_id(x))  hst\_users\_info['profile\_id'] = hst\_users\_info['profile\_id'].apply(lambda x: clean(x))  dict\_film\_profile = hst\_users\_info.groupby(['content\_id'])['profile\_id'].apply(list).reset\_index()  dict\_film\_profile = dict\_film\_profile[dict\_film\_profile['content\_id'] != "-1"]  dict\_film\_profile = dict\_film\_profile.set\_index('content\_id').T.to\_dict('list')  # print(dict\_film\_profile)  dict\_ground\_truth\_film\_profile = {}  sort\_key = list(dict\_film\_profile.keys())  sort\_key.sort()  print(sort\_key)  print(len(sort\_key))  for key1 in sort\_key:  for key2 in sort\_key:  if key1 == key2:  continue  if (key1, key2) not in dict\_ground\_truth\_film\_profile.keys() and (key2, key1) not in dict\_ground\_truth\_film\_profile.keys():  # print(dict\_film\_profile[key1])  # print(dict\_film\_profile[key2])  intersect = intersection(dict\_film\_profile[key1], dict\_film\_profile[key2])  if intersect > opt.threshold\_nb\_of\_user:  score = 1  else:  score = intersect / opt.threshold\_nb\_of\_user  dict\_ground\_truth\_film\_profile[(key1, key2)] = score  # dict\_ground\_truth\_film\_profile[(key2, key1)] = score  else:  continue  with open('groundtruth\_feature\_weighting.pickle', 'wb') as handle:  pickle.dump(dict\_ground\_truth\_film\_profile, handle, protocol=pickle.HIGHEST\_PROTOCOL) |
| --- |

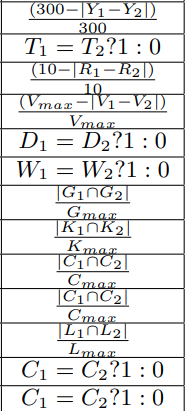
Dùng linear để tìm ra các trọng số phù hợp:

| with open("groundtruth\_feature\_weighting.pickle", 'rb') as f:  ground\_truth = pickle.load(f)  with open("feature\_weighting.pickle", 'rb') as f:  score\_weight = pickle.load(f)    X = []  y = []  for key in sorted(ground\_truth.keys()):  if "-1" in key:  continue  if 0 not in score\_weight[key] and ground\_truth[key] > 0 and score\_weight[key][0] > 0:  X.append(score\_weight[key][1:])  y.append(ground\_truth[key])  # print(X)  model = LinearRegression()  model.fit(X,y)  print(model.coef\_)  [0, 0.11547538, 0, 0.99209856, 0, 0.55746724]  [0, 0.1304048, 0, 0.7227898, 0, 0.3818457] |
| --- |

## **1.3 Xử lý missing, outlier**

| def get\_unique\_category(pd\_film):  list\_category\_unique = []  categorys = pd\_film[pd\_film['raw\_category\_id'].notnull()]['raw\_category\_id'].apply(lambda x: x.split(","))  for list\_category in categorys:  # print(list\_category)  for category in list\_category:  if category not in list\_category\_unique:  list\_category\_unique.append(category)  # print(list\_category\_unique)  return list\_category\_unique  def get\_all\_category(pd\_film\_series):  unique\_category\_film\_series = get\_unique\_category(pd\_film\_series)  return unique\_category\_film\_series  def process\_actor\_director(x):  if type(x) != str:  return ["other"]  else:  if len(x)==0:  return ["other"]  return x.split(",")  def process\_release\_year(x):  if np.isnan(x):  return 2022  else:  return x    def process\_rating(x):  if np.isnan(x):  return 6.5  else:  return x |
| --- |

## **1.4 Xử lý normalization**



Chuẩn hóa các trường năm, rating, category, country, actor

| def score\_release\_year(year1, year2):  score = (100 - abs(int(year1) - int(year2)))/100  print(year1)  print(year2)  print(score)  return score  def score\_imdb\_rating(film1, film2):  score = (10 - abs(film1 - film2))/10  return score  def score\_category(list\_category\_film1, list\_category\_film2):  intersect= intersection(list\_category\_film1, list\_category\_film2)  if intersect > opt.threshold\_category:  return 1.0  else:  return intersect/opt.threshold\_category  def score\_country(country1, country2):  if country1 == country2:  return 1.0  else:  return 0.0    def score\_actor(list\_actor\_film1, list\_actor\_film2):  intersect = intersection(list\_actor\_film1, list\_actor\_film2)  if intersect > opt.threshold\_actor:  return 1.0  else:  return intersect/opt.threshold\_actor    def score\_director(list\_director\_film1, list\_director\_film2):  intersect = intersection(list\_director\_film1, list\_director\_film2)  if intersect > opt.threshold\_director:  return 1.0  else:  return intersect/opt.threshold\_director |
| --- |

## **1.5 Chỉ số Sihoutte Score**

Hệ số Silhouette sử dụng để tính toán mức độ tốt của kỹ thuật phân cụm. Giá trị của nó nằm trong khoảng từ -1 đến 1.

* 1: Có nghĩa là các cụm cách xa nhau và được phân biệt rõ ràng.
* 0: Có nghĩa là các cụm không quan tâm, hay có thể nói rằng khoảng cách giữa các cụm là không đáng kể.
* -1: Có nghĩa là các cụm được chỉ định sai cách.

**silhouette score =(b-a)/max(a,b)**

a = khoảng cách trung bình trong cụm tức là khoảng cách trung bình giữa mỗi điểm trong một cụm.

b= khoảng cách trung bình giữa các cụm tức là khoảng cách trung bình giữa tất cả các cụm.

| silhouette\_score\_average = silhouette\_score(df\_scaled, model.predict(df\_scaled))  print("Score sil arg: ",silhouette\_score\_average)  silhouette\_score\_individual = silhouette\_samples(df\_scaled, model.predict(df\_scaled))  bad\_k\_values = {}  for each\_silhouette in silhouette\_score\_individual:    if each\_silhouette < 0:    if each\_value not in bad\_k\_values:  bad\_k\_values[each\_value] = 1    else:  bad\_k\_values[each\_value] += 1  for key, val in bad\_k\_values.items():  print(f' This Many Clusters: {key} | Number of Negative Values: {val}') |
| --- |

## **1.6 Xây dựng ml-flow sinh trọng số cạnh**

Chạy file weight\_emb\_film để tính hệ số của các trường giữa 2 phim

| import random  import numpy as np  import json  import argparse  import torch  from tqdm import tqdm  import os  # torch.multiprocessing.set\_start\_method('spawn')  from multiprocessing import set\_start\_method  from sentence\_transformers import SentenceTransformer  from sklearn.metrics import accuracy\_score  import warnings  # warnings.filterwarnings(action='ignore', category=UserWarning)  from sklearn.metrics import classification\_report  # from pytorchtools import EarlyStopping  import time  from sklearn.preprocessing import OneHotEncoder  from sklearn.preprocessing import MultiLabelBinarizer  import pandas as pd  import math  import re  from config\_path import opt  from torch.nn.functional import normalize  from pyvi.ViTokenizer import tokenize  from torch.nn import functional as F  from transformers import AutoModel, AutoTokenizer  from scipy import sparse  import bottleneck as bn  import pickle  def intersection(lst1, lst2):  return len(list(set(lst1) & set(lst2)))  def score\_release\_year(year1, year2):  score = (100 - abs(int(year1) - int(year2)))/100  print(year1)  print(year2)  print(score)  return score  def score\_imdb\_rating(film1, film2):  score = (10 - abs(film1 - film2))/10  return score  def score\_category(list\_category\_film1, list\_category\_film2):  intersect= intersection(list\_category\_film1, list\_category\_film2)  if intersect > opt.threshold\_category:  return 1.0  else:  return intersect/opt.threshold\_category  def score\_country(country1, country2):  if country1 == country2:  return 1.0  else:  return 0.0    def score\_actor(list\_actor\_film1, list\_actor\_film2):  intersect = intersection(list\_actor\_film1, list\_actor\_film2)  if intersect > opt.threshold\_actor:  return 1.0  else:  return intersect/opt.threshold\_actor    def score\_director(list\_director\_film1, list\_director\_film2):  intersect = intersection(list\_director\_film1, list\_director\_film2)  if intersect > opt.threshold\_director:  return 1.0  else:  return intersect/opt.threshold\_director    def get\_unique\_category(pd\_film):  list\_category\_unique = []  categorys = pd\_film[pd\_film['raw\_category\_id'].notnull()]['raw\_category\_id'].apply(lambda x: x.split(","))  for list\_category in categorys:  # print(list\_category)  for category in list\_category:  if category not in list\_category\_unique:  list\_category\_unique.append(category)  # print(list\_category\_unique)  return list\_category\_unique  def get\_all\_category(pd\_film\_series):  unique\_category\_film\_series = get\_unique\_category(pd\_film\_series)  return unique\_category\_film\_series  def process\_actor\_director(x):  if type(x) != str:  return ["other"]  else:  if len(x)==0:  return ["other"]  return x.split(",")  def process\_release\_year(x):  if np.isnan(x):  return 2022  else:  return x    def process\_rating(x):  if np.isnan(x):  return 6.5  else:  return x    pd\_film\_series = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_series)  pd\_film\_series['series\_id'] = pd\_film\_series['series\_id'].apply(lambda x: str(int(x)))  #Rating  pd\_film\_series['imdb\_rating'] = pd\_film\_series['imdb\_rating'].apply(lambda x: process\_rating(x))  #Release Year  pd\_film\_series['release\_year'] = pd\_film\_series['release\_year'].apply(lambda x: process\_release\_year(x))  #Director  pd\_film\_series['director\_id'] = pd\_film\_series['director\_id'].apply(lambda x: process\_actor\_director(x))  list\_director = pd\_film\_series['director\_id'].tolist()  unique\_list\_director = []  for x in list\_director:  unique\_list\_director.extend(x)  unique\_list\_director = list(set(unique\_list\_director))  #Actor  pd\_film\_series['actor\_id'] = pd\_film\_series['actor\_id'].apply(lambda x: process\_actor\_director(x))  list\_actor = pd\_film\_series['actor\_id'].tolist()  unique\_list\_actor = []  for x in list\_actor:  unique\_list\_actor.extend(x)  unique\_list\_actor = list(set(unique\_list\_actor))  #Raw Category  list\_unique\_raw\_category = get\_all\_category(pd\_film\_series)  pd\_film\_series['raw\_category\_id'] = pd\_film\_series['raw\_category\_id'].apply(lambda x: process\_actor\_director(x))  dict\_pd\_film\_series = pd\_film\_series[["series\_id", "release\_year", "imdb\_rating", "country", "raw\_category\_id", "director\_id", "actor\_id"]].set\_index('series\_id').T.to\_dict('list')    # list\_director = pd\_film\_series['director\_id'].tolist()  len\_list\_unique\_raw\_category = len(list\_unique\_raw\_category)  len\_unique\_list\_director = len(unique\_list\_director)  len\_unique\_list\_actor = len(unique\_list\_actor)  print(dict\_pd\_film\_series['1850'])  dict\_weights\_film = {}  print(len(dict\_pd\_film\_series))  sort\_key = list(dict\_pd\_film\_series.keys())  sort\_key.sort()  print(sort\_key)  print(len(sort\_key))  #Score Film  for key1 in sort\_key:  for key2 in sort\_key:  if key2 == key1:  continue  if (key1, key2) not in dict\_weights\_film.keys() and (key2, key1) not in dict\_weights\_film.keys():  sc\_category = score\_category(dict\_pd\_film\_series[key1][3], dict\_pd\_film\_series[key2][3])  sc\_actor = score\_actor(dict\_pd\_film\_series[key1][5], dict\_pd\_film\_series[key2][5])  sc\_year = score\_release\_year(dict\_pd\_film\_series[key1][0], dict\_pd\_film\_series[key2][0])  sc\_country = score\_country(dict\_pd\_film\_series[key1][2], dict\_pd\_film\_series[key2][2])  sc\_director = score\_director(dict\_pd\_film\_series[key1][4], dict\_pd\_film\_series[key2][4])  sc\_rating = score\_imdb\_rating(dict\_pd\_film\_series[key1][1], dict\_pd\_film\_series[key2][1])  dict\_weights\_film[(key1, key2)] = [sc\_year, sc\_rating, sc\_country, sc\_category, sc\_director, sc\_actor]  # dict\_weights\_film[(key2, key1)] = dict\_weights\_film[(key1, key2)]  else:  continue  exit()  with open('feature\_weighting.pickle', 'wb') as handle:  pickle.dump(dict\_weights\_film, handle, protocol=pickle.HIGHEST\_PROTOCOL) |
| --- |

Chạy file save\_ground\_truth để tính toán score giữa 2 phim theo số người dùng xem chung

| import random  import numpy as np  import json  import argparse  import torch  from tqdm import tqdm  import os  # torch.multiprocessing.set\_start\_method('spawn')  from multiprocessing import set\_start\_method  from sentence\_transformers import SentenceTransformer  from sklearn.metrics import accuracy\_score  import warnings  warnings.filterwarnings(action='ignore', category=UserWarning)  from sklearn.metrics import classification\_report  # from pytorchtools import EarlyStopping  import time  from sklearn.preprocessing import OneHotEncoder  from sklearn.preprocessing import MultiLabelBinarizer  import pandas as pd  import math  import re  from config\_path import opt  from torch.nn.functional import normalize  from pyvi.ViTokenizer import tokenize  from torch.nn import functional as F  from transformers import AutoModel, AutoTokenizer  from scipy import sparse  import bottleneck as bn  from config\_path import opt  import pickle  from multiprocessing import Pool  all\_films\_id = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_series)['series\_id'].apply(lambda x: str(x)).tolist()  all\_episode\_id = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_episode)  dict\_films\_duration = all\_episode\_id.groupby('series\_id')['duration'].agg([("duration", "sum")]).reset\_index().set\_index('series\_id').T.to\_dict('list')  list\_eps\_series = all\_episode\_id[['episode\_id', 'series\_id']].set\_index('episode\_id').T.to\_dict('dict')  def intersection(lst1, lst2):  # print(list(set(lst1[0]) & set(lst2[0])))  return len(list(set(lst1[0]) & set(lst2[0])))  def clean(x):  if str(x).find("\'") >= 0 or str(x).find("\"") >= 0 or str(x).find("-") >= 0 or str(x).find("=") >= 0 \  or str(x).find("<") >= 0 or re.search('[a-zA-Z]', str(x)) is not None:  return "-1"  else:  return str(int(x))    def find\_seri\_id(x):  if str(x).find("\'") >= 0 or str(x).find("\"") >= 0 or str(x).find("-") >= 0 or str(x).find("=") >= 0 \  or str(x).find("<") >= 0 or re.search('[a-zA-Z]', str(x)) is not None:  return "-1"  else:  film\_id = int(x)  # print(film\_id)  if film\_id in list\_eps\_series.keys():  # print(film\_id)  return str(list\_eps\_series[film\_id]['series\_id'])  else:  return "-1"    path\_list\_file\_log\_film = []  for file\_path in os.listdir(opt.folder + "data/"):  if file\_path.find("log\_film") >= 0:  path\_list\_file\_log\_film.append(file\_path)  users\_info = pd.read\_csv(opt.folder + opt.path\_file\_user\_info)  # users\_info.dropna()  all\_users\_id = [str(user\_id) for user\_id in users\_info['user\_id'].tolist()]  # users\_items = {}  list\_hst\_users\_info = []  for log\_film\_path in path\_list\_file\_log\_film:  print(opt.folder + "data/" + log\_film\_path)  hst\_users\_info\_5\_days = pd.read\_csv(opt.folder + "data/" + log\_film\_path)  list\_hst\_users\_info.append(hst\_users\_info\_5\_days)  hst\_users\_info = pd.concat(list\_hst\_users\_info, ignore\_index=True, sort=False)  hst\_users\_info['content\_id'] = hst\_users\_info['content\_id'].apply(lambda x: find\_seri\_id(x))  hst\_users\_info['profile\_id'] = hst\_users\_info['profile\_id'].apply(lambda x: clean(x))  dict\_film\_profile = hst\_users\_info.groupby(['content\_id'])['profile\_id'].apply(list).reset\_index()  dict\_film\_profile = dict\_film\_profile[dict\_film\_profile['content\_id'] != "-1"]  dict\_film\_profile = dict\_film\_profile.set\_index('content\_id').T.to\_dict('list')  # print(dict\_film\_profile)  dict\_ground\_truth\_film\_profile = {}  sort\_key = list(dict\_film\_profile.keys())  sort\_key.sort()  print(sort\_key)  print(len(sort\_key))  for key1 in sort\_key:  for key2 in sort\_key:  if key1 == key2:  continue  if (key1, key2) not in dict\_ground\_truth\_film\_profile.keys() and (key2, key1) not in dict\_ground\_truth\_film\_profile.keys():  # print(dict\_film\_profile[key1])  # print(dict\_film\_profile[key2])  intersect = intersection(dict\_film\_profile[key1], dict\_film\_profile[key2])  if intersect > opt.threshold\_nb\_of\_user:  score = 1  else:  score = intersect / opt.threshold\_nb\_of\_user  dict\_ground\_truth\_film\_profile[(key1, key2)] = score  # dict\_ground\_truth\_film\_profile[(key2, key1)] = score  else:  continue    with open('groundtruth\_feature\_weighting\_1.pickle', 'wb') as handle:  pickle.dump(dict\_ground\_truth\_film\_profile, handle, protocol=pickle.HIGHEST\_PROTOCOL) |
| --- |

Chạy file linear để tính ra trọng số chung

| import pandas as pd  import numpy as np  import matplotlib.pyplot as plt  from sklearn.model\_selection import train\_test\_split  from sklearn.linear\_model import LinearRegression  from sklearn.metrics import mean\_squared\_error, mean\_absolute\_error  from sklearn import preprocessing  import pickle  with open("groundtruth\_feature\_weighting.pickle", 'rb') as f:  ground\_truth = pickle.load(f)  with open("feature\_weighting.pickle", 'rb') as f:  score\_weight = pickle.load(f)  # matrix = [0.11547538, 0, 0.99209856, 0, 0.55746724]  # matrix = [0.1304048, 0, 0.7227898, 0, 0.3818457]  # for key in score\_weight.keys():  # if score\_weight[key][0] < 0:  # print(score\_weight[key])  # # a = np.dot(matrix, score\_weight[key][1:])  # # if a>0.8:  # # print(a)  # exit()  X = []  y = []  for key in sorted(ground\_truth.keys()):  if "-1" in key:  continue  if 0 not in score\_weight[key] and ground\_truth[key] > 0 and score\_weight[key][0] > 0:  X.append(score\_weight[key][1:])  y.append(ground\_truth[key])  # print(X)  model = LinearRegression()  model.fit(X,y)  print(model.coef\_) |
| --- |

## **1.7 Xây dựng ml-flow lấy trọng số cạnh training và testing**

Chạy process\_weight\_node nhân trong số cạnh với hệ số node lưu thanh file score

| import pickle  import json  import numpy as np  from config\_pr import opt  def unique(list1):  list\_set = set(list1)  unique\_list = (list(list\_set))  return unique\_list  with open("/home/gemai/mnt\_raid1/datpt1/Viettel/T11-2022/folder\_pickle/feature\_weighting.pickle", 'rb') as f:  dict\_film\_weights = pickle.load(f)  feature\_weights = [0, 0.1304048, 0, 0.7227898, 0, 0.3818457]  dict\_keys = {}  dict\_scores = {}  dict\_key\_scores = {}  for key in dict\_film\_weights.keys():  score = np.dot(feature\_weights, dict\_film\_weights[key])  dict\_scores[key] = np.dot(feature\_weights, dict\_film\_weights[key])    if dict\_keys.get(key[0]) is None:  dict\_keys[key[0]] = []  dict\_key\_scores[key[0]] = []  dict\_keys[key[0]].append(key[1])  dict\_key\_scores[key[0]].append(score)  else:  dict\_keys[key[0]].append(key[1])  dict\_key\_scores[key[0]].append(score)  count\_node = 0  for key in dict\_keys.keys():  if max(dict\_key\_scores[key]) < opt.score\_threshold:  count\_node+=1  max\_index = dict\_key\_scores[key].index(max(dict\_key\_scores[key]))  dict\_scores[key, dict\_keys[key][max\_index]] = opt.score\_threshold  print(count\_node)  with open('score.pickle', 'wb') as handle:  pickle.dump(dict\_scores, handle, protocol=pickle.HIGHEST\_PROTOCOL) |
| --- |

Chay example\_usage\_unsup để embedding data

| import numpy as np  from scipy.sparse import csr\_matrix  from sklearn.metrics import f1\_score  from sklearn.linear\_model import LogisticRegression  from GNNs\_unsupervised import GNN  import pandas as pd  import pickle  from config\_pr import opt  def intersection(lst1, lst2):  return list(set(lst1) & set(lst2))  def example\_with\_cora():  raw\_features\_file = '/home/gemai/mnt\_raid1/datpt1/Viettel/T11-2022/folder\_pickle/raw\_features\_gnn.pickle'  with open(raw\_features\_file, 'rb') as f:  data = pickle.load(f)  del data["0"]  key\_none = []  for key in data.keys():  if data[key] is None:  key\_none.append(key)  for key in key\_none:  del data[key]    list\_film\_id = list(data.keys())  list\_film\_id = [int(id) for id in list\_film\_id]  list\_film\_id.sort()  # print(list\_film\_id)  # Load features  feat\_data = []  node\_map = {} # map node to Node\_ID    for i, film\_id in enumerate(list\_film\_id):  feat\_data.append(data[str(film\_id)].tolist()[:-4])  # print(feat\_data)  # exit()  node\_map[film\_id] = i  with open("/home/gemai/mnt\_raid1/datpt1/Viettel/T11-2022/folder\_pickle/score.pickle", 'rb') as f:  dict\_score = pickle.load(f)    raw\_features = np.asarray(feat\_data)  print(raw\_features[0])  # load adjacency matrix  row = []  col = []  count = 0  for key in dict\_score.keys():  node\_1, node\_2 = key  if (int(node\_1) not in list\_film\_id) or (int(node\_2) not in list\_film\_id):  continue  weights = dict\_score[key]  # print(weights)  if weights >= opt.score\_threshold:  row.extend([node\_map[int(node\_1)], node\_map[int(node\_2)]])  col.extend([node\_map[int(node\_2)], node\_map[int(node\_1)]])  count+=1  print("Count: ", count)  row = np.asarray(row)  col = np.asarray(col)  adj\_matrix = csr\_matrix((np.ones(len(row)), (row, col)), shape=(len(node\_map), len(node\_map)))  """  Example of using GraphSAGE for unsupervised learning.  using CUDA and print training progress  """  gnn = GNN(adj\_matrix, features=raw\_features, supervised=False, model=opt.model, device='auto',epochs=opt.epochs, lr=opt.lr, unsup\_loss\_type=opt.loss)  # train the model  gnn.fit()  # get the node embeddings with the trained GAT  embs = gnn.generate\_embeddings()  # evaluate the embeddings with logistic regression  print(len(embs))  print(type(embs))  name = opt.model + '\_default\_emb'  with open(f'result/{name}.pickle', 'wb') as handle:  pickle.dump(embs, handle, protocol=pickle.HIGHEST\_PROTOCOL)  # print(len(embs))  print("EDone")  if \_\_name\_\_ == "\_\_main\_\_":  example\_with\_cora() |
| --- |

Phân cụm đánh giá embedding

| import pandas as pd  import matplotlib.pyplot as plt  import pickle  from sklearn.cluster import KMeans  from sklearn.preprocessing import MinMaxScaler  from sklearn.metrics import silhouette\_samples, silhouette\_score  # cleaning, plotting and dataframes  import matplotlib.pyplot as plt  import pandas as pd  import numpy as np  with open('/home/gemai/mnt\_raid1/datpt1/Viettel/T11-2022/EmbeddingFilm/GNNs-easy-to-use/result/graphsage\_default\_emb.pickle', 'rb') as pickle\_file:  content = pickle.load(pickle\_file)  data = pd.DataFrame.from\_dict(content)  scaler = MinMaxScaler()  # scale down our data  df\_scaled = scaler.fit\_transform(data)  from sklearn.decomposition import PCA  pca = PCA(2)  data = pca.fit\_transform(df\_scaled)  model = KMeans(n\_clusters = 15, init = "k-means++")  label = model.fit\_predict(data)  plt.figure(figsize=(10,10))  uniq = np.unique(label)  for i in uniq:  plt.scatter(data[label == i , 0] , data[label == i , 1] , label = i)  plt.legend()  plt.savefig('foo1.png')  silhouette\_score\_average = silhouette\_score(df\_scaled, model.predict(df\_scaled))  print("Score sil arg: ",silhouette\_score\_average)  silhouette\_score\_individual = silhouette\_samples(df\_scaled, model.predict(df\_scaled))  bad\_k\_values = {}  # iterate through to find any negative values  for each\_silhouette in silhouette\_score\_individual:    # if we find a negative, lets start counting them  if each\_silhouette < 0:    if each\_value not in bad\_k\_values:  bad\_k\_values[each\_value] = 1    else:  bad\_k\_values[each\_value] += 1  for key, val in bad\_k\_values.items():  print(f' This Many Clusters: {key} | Number of Negative Values: {val}') |
| --- |

# **II. Huấn luyện, fine-tune mô hình embedding với graphsage**

## **2.1 Fine-tune mô hình**

### 2.1.1 Fine-tune mô hình lần 1

#### 2.1.1.1 Thông số hyperparameter

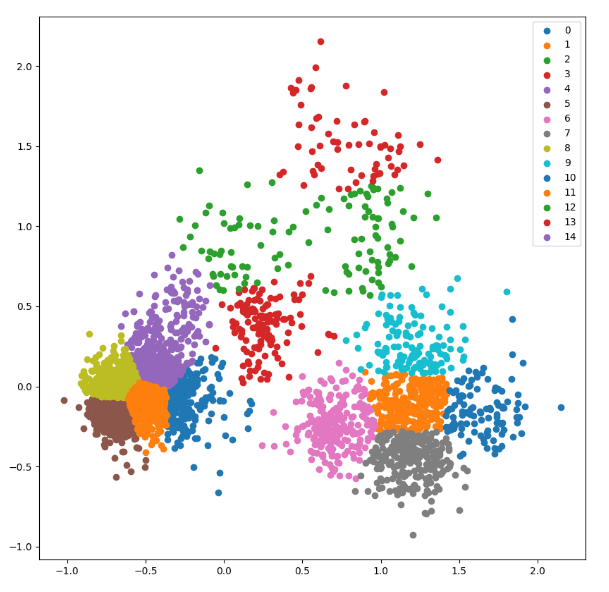
| feature\_weights = [0, 0.1304048, 0, 0.7227898, 0, 0.3818457]  raw\_features\_file\_dir = 'raw\_features.pickle'  ########hyper parameter##################  numbers\_of\_hst\_films = 10  numbers\_of\_user = 4000  prefer\_threshold = 0.1  score\_threshold = 0.35  device = "cuda:0"  loss = 'margin'  epochs = 2  lr = 0.1  model = 'graphsage' |
| --- |

#### 2.1.1.2 Training

| 0%| | 0/85 [00:00<?, ?it/s]GraphSAGE Epoch: [1/2], current loss: 10.4782, touched nodes [308/1686]  GraphSAGE Epoch: [1/2], current loss: 10.4782, touched nodes [308/1686] : 1%|2 | 1/85 [00:03<04:14, 3.02s/it]GraphSAGE Epoch: [1/2], current loss: 7.7760, touched nodes [573/1686]  GraphSAGE Epoch: [1/2], current loss: 7.7760, touched nodes [573/1686] : 2%|5 | 2/85 [00:05<03:40, 2.66s/it]GraphSAGE Epoch: [1/2], current loss: 7.2742, touched nodes [785/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2742, touched nodes [785/1686] : 4%|8 | 3/85 [00:07<03:27, 2.54s/it]GraphSAGE Epoch: [1/2], current loss: 7.2514, touched nodes [949/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2514, touched nodes [949/1686] : 5%|#1 | 4/85 [00:10<03:22, 2.50s/it]GraphSAGE Epoch: [1/2], current loss: 7.2517, touched nodes [1075/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2517, touched nodes [1075/1686] : 6%|#3 | 5/85 [00:12<03:21, 2.52s/it]GraphSAGE Epoch: [1/2], current loss: 7.2523, touched nodes [1182/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2523, touched nodes [1182/1686] : 7%|#6 | 6/85 [00:15<03:19, 2.52s/it]GraphSAGE Epoch: [1/2], current loss: 7.2509, touched nodes [1274/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2509, touched nodes [1274/1686] : 8%|#8 | 7/85 [00:17<03:15, 2.51s/it]GraphSAGE Epoch: [1/2], current loss: 7.2504, touched nodes [1347/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2504, touched nodes [1347/1686] : 9%|##1 | 8/85 [00:20<03:18, 2.58s/it]GraphSAGE Epoch: [1/2], current loss: 7.2505, touched nodes [1411/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2505, touched nodes [1411/1686] : 11%|##4 | 9/85 [00:23<03:13, 2.54s/it]GraphSAGE Epoch: [1/2], current loss: 7.2488, touched nodes [1462/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2488, touched nodes [1462/1686] : 12%|##5 | 10/85 [00:25<03:07, 2.50s/it]GraphSAGE Epoch: [1/2], current loss: 7.2498, touched nodes [1498/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2498, touched nodes [1498/1686] : 13%|##8 | 11/85 [00:28<03:09, 2.56s/it]GraphSAGE Epoch: [1/2], current loss: 7.2489, touched nodes [1532/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2489, touched nodes [1532/1686] : 14%|###1 | 12/85 [00:30<03:08, 2.59s/it]GraphSAGE Epoch: [1/2], current loss: 7.2487, touched nodes [1562/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2487, touched nodes [1562/1686] : 15%|###3 | 13/85 [00:33<03:09, 2.63s/it]GraphSAGE Epoch: [1/2], current loss: 7.2477, touched nodes [1583/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2477, touched nodes [1583/1686] : 16%|###6 | 14/85 [00:36<03:08, 2.66s/it]GraphSAGE Epoch: [1/2], current loss: 7.2480, touched nodes [1599/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2480, touched nodes [1599/1686] : 18%|###8 | 15/85 [00:38<03:07, 2.68s/it]GraphSAGE Epoch: [1/2], current loss: 7.2481, touched nodes [1616/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2481, touched nodes [1616/1686] : 19%|####1 | 16/85 [00:41<03:06, 2.70s/it]GraphSAGE Epoch: [1/2], current loss: 7.2475, touched nodes [1634/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2475, touched nodes [1634/1686] : 20%|####4 | 17/85 [00:44<03:01, 2.67s/it]GraphSAGE Epoch: [1/2], current loss: 7.2473, touched nodes [1642/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2473, touched nodes [1642/1686] : 21%|####6 | 18/85 [00:47<02:59, 2.69s/it]GraphSAGE Epoch: [1/2], current loss: 7.2474, touched nodes [1647/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2474, touched nodes [1647/1686] : 22%|####9 | 19/85 [00:49<02:57, 2.69s/it]GraphSAGE Epoch: [1/2], current loss: 7.2472, touched nodes [1657/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2472, touched nodes [1657/1686] : 24%|#####1 | 20/85 [00:52<02:54, 2.68s/it]GraphSAGE Epoch: [1/2], current loss: 7.2476, touched nodes [1665/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2476, touched nodes [1665/1686] : 25%|#####4 | 21/85 [00:55<02:51, 2.67s/it]GraphSAGE Epoch: [1/2], current loss: 7.2469, touched nodes [1666/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2469, touched nodes [1666/1686] : 26%|#####6 | 22/85 [00:57<02:49, 2.69s/it]GraphSAGE Epoch: [1/2], current loss: 7.2468, touched nodes [1670/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2468, touched nodes [1670/1686] : 27%|#####9 | 23/85 [01:00<02:45, 2.68s/it]GraphSAGE Epoch: [1/2], current loss: 7.2468, touched nodes [1673/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2468, touched nodes [1673/1686] : 28%|######2 | 24/85 [01:03<02:43, 2.67s/it]GraphSAGE Epoch: [1/2], current loss: 7.2466, touched nodes [1674/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2466, touched nodes [1674/1686] : 29%|######4 | 25/85 [01:05<02:41, 2.69s/it]GraphSAGE Epoch: [1/2], current loss: 7.2465, touched nodes [1675/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2465, touched nodes [1675/1686] : 31%|######7 | 26/85 [01:08<02:38, 2.68s/it]GraphSAGE Epoch: [1/2], current loss: 7.2466, touched nodes [1681/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2466, touched nodes [1681/1686] : 32%|######9 | 27/85 [01:11<02:36, 2.70s/it]GraphSAGE Epoch: [1/2], current loss: 7.2463, touched nodes [1683/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2463, touched nodes [1683/1686] : 33%|#######2 | 28/85 [01:13<02:33, 2.69s/it]GraphSAGE Epoch: [1/2], current loss: 7.2463, touched nodes [1684/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2463, touched nodes [1684/1686] : 34%|#######5 | 29/85 [01:16<02:33, 2.73s/it]GraphSAGE Epoch: [1/2], current loss: 7.2461, touched nodes [1684/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2461, touched nodes [1684/1686] : 35%|#######7 | 30/85 [01:19<02:30, 2.74s/it]GraphSAGE Epoch: [1/2], current loss: 7.2462, touched nodes [1684/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2462, touched nodes [1684/1686] : 36%|######## | 31/85 [01:22<02:27, 2.73s/it]GraphSAGE Epoch: [1/2], current loss: 7.2463, touched nodes [1685/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2463, touched nodes [1685/1686] : 38%|########2 | 32/85 [01:24<02:25, 2.75s/it]GraphSAGE Epoch: [1/2], current loss: 7.2463, touched nodes [1685/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2463, touched nodes [1685/1686] : 39%|########5 | 33/85 [01:27<02:21, 2.72s/it]GraphSAGE Epoch: [1/2], current loss: 7.2458, touched nodes [1685/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2458, touched nodes [1685/1686] : 40%|########8 | 34/85 [01:30<02:13, 2.62s/it]GraphSAGE Epoch: [1/2], current loss: 7.2462, touched nodes [1685/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2462, touched nodes [1685/1686] : 41%|######### | 35/85 [01:32<02:06, 2.54s/it]GraphSAGE Epoch: [1/2], current loss: 7.2459, touched nodes [1685/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2459, touched nodes [1685/1686] : 42%|#########3 | 36/85 [01:34<02:05, 2.57s/it]GraphSAGE Epoch: [1/2], current loss: 7.2457, touched nodes [1685/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2457, touched nodes [1685/1686] : 44%|#########5 | 37/85 [01:37<02:00, 2.50s/it]GraphSAGE Epoch: [1/2], current loss: 7.2459, touched nodes [1685/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2459, touched nodes [1685/1686] : 45%|#########8 | 38/85 [01:39<01:55, 2.46s/it]GraphSAGE Epoch: [1/2], current loss: 7.2457, touched nodes [1685/1686]  GraphSAGE Epoch: [1/2], current loss: 7.2457, touched nodes [1685/1686] : 46%|########## | 39/85 [01:42<01:51, 2.43s/it]GraphSAGE Epoch: [1/2], current loss: 7.2458, touched nodes [1686/1686]  0%| | 0/85 [00:00<?, ?it/s]GraphSAGE Epoch: [2/2], current loss: 7.2458, touched nodes [314/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2458, touched nodes [314/1686] : 1%|2 | 1/85 [00:02<03:18, 2.37s/it]GraphSAGE Epoch: [2/2], current loss: 7.2457, touched nodes [561/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2457, touched nodes [561/1686] : 2%|5 | 2/85 [00:04<03:16, 2.36s/it]GraphSAGE Epoch: [2/2], current loss: 7.2456, touched nodes [770/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2456, touched nodes [770/1686] : 4%|8 | 3/85 [00:07<03:13, 2.36s/it]GraphSAGE Epoch: [2/2], current loss: 7.2458, touched nodes [941/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2458, touched nodes [941/1686] : 5%|#1 | 4/85 [00:09<03:10, 2.35s/it]GraphSAGE Epoch: [2/2], current loss: 7.2455, touched nodes [1080/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2455, touched nodes [1080/1686] : 6%|#3 | 5/85 [00:11<03:07, 2.35s/it]GraphSAGE Epoch: [2/2], current loss: 7.2455, touched nodes [1183/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2455, touched nodes [1183/1686] : 7%|#6 | 6/85 [00:14<03:05, 2.35s/it]GraphSAGE Epoch: [2/2], current loss: 7.2456, touched nodes [1275/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2456, touched nodes [1275/1686] : 8%|#8 | 7/85 [00:16<03:03, 2.36s/it]GraphSAGE Epoch: [2/2], current loss: 7.2455, touched nodes [1328/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2455, touched nodes [1328/1686] : 9%|##1 | 8/85 [00:18<03:01, 2.36s/it]GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1399/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1399/1686] : 11%|##4 | 9/85 [00:21<02:59, 2.36s/it]GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1460/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1460/1686] : 12%|##5 | 10/85 [00:23<02:56, 2.36s/it]GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1498/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1498/1686] : 13%|##8 | 11/85 [00:25<02:54, 2.36s/it]GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1543/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1543/1686] : 14%|###1 | 12/85 [00:28<02:49, 2.33s/it]GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1565/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1565/1686] : 15%|###3 | 13/85 [00:30<02:47, 2.33s/it]GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1600/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1600/1686] : 16%|###6 | 14/85 [00:32<02:45, 2.33s/it]GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1619/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1619/1686] : 18%|###8 | 15/85 [00:35<02:43, 2.34s/it]GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1633/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1633/1686] : 19%|####1 | 16/85 [00:37<02:41, 2.35s/it]GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1641/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1641/1686] : 20%|####4 | 17/85 [00:39<02:39, 2.35s/it]GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1647/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1647/1686] : 21%|####6 | 18/85 [00:42<02:37, 2.35s/it]GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1653/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1653/1686] : 22%|####9 | 19/85 [00:44<02:34, 2.35s/it]GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1664/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1664/1686] : 24%|#####1 | 20/85 [00:46<02:32, 2.34s/it]GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1666/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1666/1686] : 25%|#####4 | 21/85 [00:49<02:29, 2.34s/it]GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1669/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2454, touched nodes [1669/1686] : 26%|#####6 | 22/85 [00:51<02:27, 2.35s/it]GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1674/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1674/1686] : 27%|#####9 | 23/85 [00:53<02:25, 2.34s/it]GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1674/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1674/1686] : 28%|######2 | 24/85 [00:56<02:22, 2.34s/it]GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1676/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1676/1686] : 29%|######4 | 25/85 [00:58<02:20, 2.34s/it]GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1678/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1678/1686] : 31%|######7 | 26/85 [01:00<02:17, 2.34s/it]GraphSAGE Epoch: [2/2], current loss: 7.2451, touched nodes [1679/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2451, touched nodes [1679/1686] : 32%|######9 | 27/85 [01:03<02:15, 2.33s/it]GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1681/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1681/1686] : 33%|#######2 | 28/85 [01:05<02:13, 2.34s/it]GraphSAGE Epoch: [2/2], current loss: 7.2451, touched nodes [1681/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2451, touched nodes [1681/1686] : 34%|#######5 | 29/85 [01:07<02:10, 2.34s/it]GraphSAGE Epoch: [2/2], current loss: 7.2451, touched nodes [1684/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2451, touched nodes [1684/1686] : 35%|#######7 | 30/85 [01:10<02:08, 2.34s/it]GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1684/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1684/1686] : 36%|######## | 31/85 [01:12<02:06, 2.34s/it]GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1684/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1684/1686] : 38%|########2 | 32/85 [01:14<02:03, 2.33s/it]GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1685/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2453, touched nodes [1685/1686] : 39%|########5 | 33/85 [01:17<02:01, 2.33s/it]GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1685/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1685/1686] : 40%|########8 | 34/85 [01:19<01:59, 2.33s/it]GraphSAGE Epoch: [2/2], current loss: 7.2451, touched nodes [1685/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2451, touched nodes [1685/1686] : 41%|######### | 35/85 [01:21<01:56, 2.33s/it]GraphSAGE Epoch: [2/2], current loss: 7.2450, touched nodes [1685/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2450, touched nodes [1685/1686] : 42%|#########3 | 36/85 [01:24<01:54, 2.33s/it]GraphSAGE Epoch: [2/2], current loss: 7.2451, touched nodes [1685/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2451, touched nodes [1685/1686] : 44%|#########5 | 37/85 [01:26<01:52, 2.33s/it]GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1685/1686]  GraphSAGE Epoch: [2/2], current loss: 7.2452, touched nodes [1685/1686] : 45%|#########8 | 38/85 [01:28<01:49, 2.33s/it]GraphSAGE Epoch: [2/2], current loss: 7.2450, touched nodes [1686/1686]  <class 'numpy.ndarray'>  EDone |
| --- |

#### 2.1.1.3 Kết quả

| Score sil arg: 0.0904072 |
| --- |



### 2.1.2 Fine-tune mô hình lần 2

#### 2.1.2.1 Thông số hyperparameter

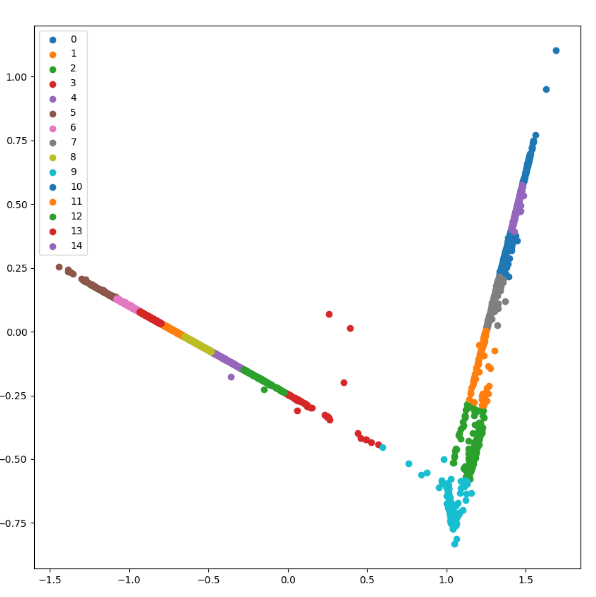
| feature\_weights = [0, 0.1304048, 0, 0.7227898, 0, 0.3818457]  raw\_features\_file\_dir = 'raw\_features.pickle'  ########hyper parameter##################  numbers\_of\_hst\_films = 10  numbers\_of\_user = 4000  prefer\_threshold = 0.1  score\_threshold = 0.35  device = "cuda:0"  loss = 'margin'  epochs = 50  lr = 0.1  model = 'graphsage' |
| --- |

#### 2.1.2.2 Kết quả training

| GraphSAGE Epoch: [50/50], current loss: 2.6692, touched nodes [3619/3649] : 57%|##################7 | 104/183 [00:42<00:30, 2.59it/s]GraphSAGE Epoch: [50/50], current loss: 2.6335, touched nodes [3619/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6335, touched nodes [3619/3649] : 57%|##################9 | 105/183 [00:42<00:30, 2.54it/s]GraphSAGE Epoch: [50/50], current loss: 2.6665, touched nodes [3621/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6665, touched nodes [3621/3649] : 58%|###################1 | 106/183 [00:43<00:30, 2.51it/s]GraphSAGE Epoch: [50/50], current loss: 2.6501, touched nodes [3621/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6501, touched nodes [3621/3649] : 58%|###################2 | 107/183 [00:43<00:30, 2.52it/s]GraphSAGE Epoch: [50/50], current loss: 2.6401, touched nodes [3623/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6401, touched nodes [3623/3649] : 59%|###################4 | 108/183 [00:43<00:29, 2.50it/s]GraphSAGE Epoch: [50/50], current loss: 2.6225, touched nodes [3623/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6225, touched nodes [3623/3649] : 60%|###################6 | 109/183 [00:44<00:29, 2.51it/s]GraphSAGE Epoch: [50/50], current loss: 2.6448, touched nodes [3623/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6448, touched nodes [3623/3649] : 60%|###################8 | 110/183 [00:44<00:27, 2.61it/s]GraphSAGE Epoch: [50/50], current loss: 2.6488, touched nodes [3625/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6488, touched nodes [3625/3649] : 61%|#################### | 111/183 [00:44<00:27, 2.59it/s]GraphSAGE Epoch: [50/50], current loss: 2.6398, touched nodes [3626/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6398, touched nodes [3626/3649] : 61%|####################1 | 112/183 [00:45<00:27, 2.58it/s]GraphSAGE Epoch: [50/50], current loss: 2.6826, touched nodes [3627/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6826, touched nodes [3627/3649] : 62%|####################3 | 113/183 [00:45<00:26, 2.69it/s]GraphSAGE Epoch: [50/50], current loss: 2.6574, touched nodes [3627/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6574, touched nodes [3627/3649] : 62%|####################5 | 114/183 [00:46<00:26, 2.58it/s]GraphSAGE Epoch: [50/50], current loss: 2.6305, touched nodes [3628/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6305, touched nodes [3628/3649] : 63%|####################7 | 115/183 [00:46<00:26, 2.55it/s]GraphSAGE Epoch: [50/50], current loss: 2.7291, touched nodes [3628/3649]  GraphSAGE Epoch: [50/50], current loss: 2.7291, touched nodes [3628/3649] : 63%|####################9 | 116/183 [00:46<00:26, 2.53it/s]GraphSAGE Epoch: [50/50], current loss: 2.7170, touched nodes [3628/3649]  GraphSAGE Epoch: [50/50], current loss: 2.7170, touched nodes [3628/3649] : 64%|##################### | 117/183 [00:47<00:26, 2.51it/s]GraphSAGE Epoch: [50/50], current loss: 2.6477, touched nodes [3629/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6477, touched nodes [3629/3649] : 64%|#####################2 | 118/183 [00:47<00:27, 2.38it/s]GraphSAGE Epoch: [50/50], current loss: 2.6316, touched nodes [3630/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6316, touched nodes [3630/3649] : 65%|#####################4 | 119/183 [00:48<00:26, 2.37it/s]GraphSAGE Epoch: [50/50], current loss: 2.6210, touched nodes [3630/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6210, touched nodes [3630/3649] : 66%|#####################6 | 120/183 [00:48<00:26, 2.34it/s]GraphSAGE Epoch: [50/50], current loss: 2.7090, touched nodes [3631/3649]  GraphSAGE Epoch: [50/50], current loss: 2.7090, touched nodes [3631/3649] : 66%|#####################8 | 121/183 [00:49<00:28, 2.21it/s]GraphSAGE Epoch: [50/50], current loss: 2.6395, touched nodes [3631/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6395, touched nodes [3631/3649] : 67%|###################### | 122/183 [00:49<00:27, 2.25it/s]GraphSAGE Epoch: [50/50], current loss: 2.6484, touched nodes [3631/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6484, touched nodes [3631/3649] : 67%|######################1 | 123/183 [00:49<00:25, 2.34it/s]GraphSAGE Epoch: [50/50], current loss: 2.6789, touched nodes [3632/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6789, touched nodes [3632/3649] : 68%|######################3 | 124/183 [00:50<00:24, 2.41it/s]GraphSAGE Epoch: [50/50], current loss: 2.6358, touched nodes [3633/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6358, touched nodes [3633/3649] : 68%|######################5 | 125/183 [00:50<00:24, 2.41it/s]GraphSAGE Epoch: [50/50], current loss: 2.6329, touched nodes [3634/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6329, touched nodes [3634/3649] : 69%|######################7 | 126/183 [00:51<00:23, 2.46it/s]GraphSAGE Epoch: [50/50], current loss: 2.6456, touched nodes [3634/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6456, touched nodes [3634/3649] : 69%|######################9 | 127/183 [00:51<00:22, 2.54it/s]GraphSAGE Epoch: [50/50], current loss: 2.6711, touched nodes [3634/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6711, touched nodes [3634/3649] : 70%|####################### | 128/183 [00:51<00:21, 2.53it/s]GraphSAGE Epoch: [50/50], current loss: 2.6518, touched nodes [3635/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6518, touched nodes [3635/3649] : 70%|#######################2 | 129/183 [00:52<00:20, 2.58it/s]GraphSAGE Epoch: [50/50], current loss: 2.6834, touched nodes [3635/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6834, touched nodes [3635/3649] : 71%|#######################4 | 130/183 [00:52<00:20, 2.61it/s]GraphSAGE Epoch: [50/50], current loss: 2.6495, touched nodes [3635/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6495, touched nodes [3635/3649] : 72%|#######################6 | 131/183 [00:53<00:20, 2.54it/s]GraphSAGE Epoch: [50/50], current loss: 2.7134, touched nodes [3635/3649]  GraphSAGE Epoch: [50/50], current loss: 2.7134, touched nodes [3635/3649] : 72%|#######################8 | 132/183 [00:53<00:19, 2.57it/s]GraphSAGE Epoch: [50/50], current loss: 2.6558, touched nodes [3636/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6558, touched nodes [3636/3649] : 73%|#######################9 | 133/183 [00:53<00:19, 2.52it/s]GraphSAGE Epoch: [50/50], current loss: 2.6223, touched nodes [3636/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6223, touched nodes [3636/3649] : 73%|########################1 | 134/183 [00:54<00:19, 2.55it/s]GraphSAGE Epoch: [50/50], current loss: 2.6280, touched nodes [3636/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6280, touched nodes [3636/3649] : 74%|########################3 | 135/183 [00:54<00:18, 2.55it/s]GraphSAGE Epoch: [50/50], current loss: 2.6629, touched nodes [3636/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6629, touched nodes [3636/3649] : 74%|########################5 | 136/183 [00:55<00:18, 2.53it/s]GraphSAGE Epoch: [50/50], current loss: 2.6925, touched nodes [3637/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6925, touched nodes [3637/3649] : 75%|########################7 | 137/183 [00:55<00:17, 2.57it/s]GraphSAGE Epoch: [50/50], current loss: 2.6778, touched nodes [3637/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6778, touched nodes [3637/3649] : 75%|########################8 | 138/183 [00:55<00:16, 2.65it/s]GraphSAGE Epoch: [50/50], current loss: 2.6351, touched nodes [3637/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6351, touched nodes [3637/3649] : 76%|######################### | 139/183 [00:56<00:16, 2.61it/s]GraphSAGE Epoch: [50/50], current loss: 2.6336, touched nodes [3637/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6336, touched nodes [3637/3649] : 77%|#########################2 | 140/183 [00:56<00:16, 2.62it/s]GraphSAGE Epoch: [50/50], current loss: 2.6330, touched nodes [3637/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6330, touched nodes [3637/3649] : 77%|#########################4 | 141/183 [00:56<00:16, 2.56it/s]GraphSAGE Epoch: [50/50], current loss: 2.6213, touched nodes [3637/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6213, touched nodes [3637/3649] : 78%|#########################6 | 142/183 [00:57<00:15, 2.58it/s]GraphSAGE Epoch: [50/50], current loss: 2.6875, touched nodes [3638/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6875, touched nodes [3638/3649] : 78%|#########################7 | 143/183 [00:57<00:15, 2.51it/s]GraphSAGE Epoch: [50/50], current loss: 2.6948, touched nodes [3639/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6948, touched nodes [3639/3649] : 79%|#########################9 | 144/183 [00:58<00:15, 2.53it/s]GraphSAGE Epoch: [50/50], current loss: 2.6563, touched nodes [3639/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6563, touched nodes [3639/3649] : 79%|##########################1 | 145/183 [00:58<00:15, 2.52it/s]GraphSAGE Epoch: [50/50], current loss: 2.6385, touched nodes [3639/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6385, touched nodes [3639/3649] : 80%|##########################3 | 146/183 [00:59<00:14, 2.47it/s]GraphSAGE Epoch: [50/50], current loss: 2.6369, touched nodes [3639/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6369, touched nodes [3639/3649] : 80%|##########################5 | 147/183 [00:59<00:14, 2.45it/s]GraphSAGE Epoch: [50/50], current loss: 2.6585, touched nodes [3639/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6585, touched nodes [3639/3649] : 81%|##########################6 | 148/183 [00:59<00:15, 2.30it/s]GraphSAGE Epoch: [50/50], current loss: 2.6303, touched nodes [3639/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6303, touched nodes [3639/3649] : 81%|##########################8 | 149/183 [01:00<00:14, 2.33it/s]GraphSAGE Epoch: [50/50], current loss: 2.6412, touched nodes [3639/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6412, touched nodes [3639/3649] : 82%|########################### | 150/183 [01:00<00:13, 2.47it/s]GraphSAGE Epoch: [50/50], current loss: 2.6458, touched nodes [3641/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6458, touched nodes [3641/3649] : 83%|###########################2 | 151/183 [01:01<00:12, 2.51it/s]GraphSAGE Epoch: [50/50], current loss: 2.6275, touched nodes [3641/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6275, touched nodes [3641/3649] : 83%|###########################4 | 152/183 [01:01<00:12, 2.49it/s]GraphSAGE Epoch: [50/50], current loss: 2.6608, touched nodes [3641/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6608, touched nodes [3641/3649] : 84%|###########################5 | 153/183 [01:01<00:11, 2.52it/s]GraphSAGE Epoch: [50/50], current loss: 2.6723, touched nodes [3641/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6723, touched nodes [3641/3649] : 84%|###########################7 | 154/183 [01:02<00:11, 2.55it/s]GraphSAGE Epoch: [50/50], current loss: 2.6337, touched nodes [3641/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6337, touched nodes [3641/3649] : 85%|###########################9 | 155/183 [01:02<00:11, 2.48it/s]GraphSAGE Epoch: [50/50], current loss: 2.6704, touched nodes [3642/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6704, touched nodes [3642/3649] : 85%|############################1 | 156/183 [01:03<00:10, 2.54it/s]GraphSAGE Epoch: [50/50], current loss: 2.6268, touched nodes [3642/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6268, touched nodes [3642/3649] : 86%|############################3 | 157/183 [01:03<00:10, 2.59it/s]GraphSAGE Epoch: [50/50], current loss: 2.6668, touched nodes [3642/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6668, touched nodes [3642/3649] : 86%|############################4 | 158/183 [01:03<00:09, 2.65it/s]GraphSAGE Epoch: [50/50], current loss: 2.6899, touched nodes [3643/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6899, touched nodes [3643/3649] : 87%|############################6 | 159/183 [01:04<00:09, 2.50it/s]GraphSAGE Epoch: [50/50], current loss: 2.6647, touched nodes [3645/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6647, touched nodes [3645/3649] : 87%|############################8 | 160/183 [01:04<00:09, 2.52it/s]GraphSAGE Epoch: [50/50], current loss: 2.6666, touched nodes [3645/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6666, touched nodes [3645/3649] : 88%|############################# | 161/183 [01:04<00:08, 2.57it/s]GraphSAGE Epoch: [50/50], current loss: 2.6485, touched nodes [3645/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6485, touched nodes [3645/3649] : 89%|#############################2 | 162/183 [01:05<00:07, 2.64it/s]GraphSAGE Epoch: [50/50], current loss: 2.6356, touched nodes [3645/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6356, touched nodes [3645/3649] : 89%|#############################3 | 163/183 [01:05<00:07, 2.58it/s]GraphSAGE Epoch: [50/50], current loss: 2.6280, touched nodes [3646/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6280, touched nodes [3646/3649] : 90%|#############################5 | 164/183 [01:06<00:07, 2.52it/s]GraphSAGE Epoch: [50/50], current loss: 2.6690, touched nodes [3646/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6690, touched nodes [3646/3649] : 90%|#############################7 | 165/183 [01:06<00:07, 2.50it/s]GraphSAGE Epoch: [50/50], current loss: 2.6987, touched nodes [3646/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6987, touched nodes [3646/3649] : 91%|#############################9 | 166/183 [01:06<00:06, 2.52it/s]GraphSAGE Epoch: [50/50], current loss: 2.6233, touched nodes [3646/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6233, touched nodes [3646/3649] : 91%|##############################1 | 167/183 [01:07<00:06, 2.55it/s]GraphSAGE Epoch: [50/50], current loss: 2.6609, touched nodes [3646/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6609, touched nodes [3646/3649] : 92%|##############################2 | 168/183 [01:07<00:06, 2.35it/s]GraphSAGE Epoch: [50/50], current loss: 2.6501, touched nodes [3647/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6501, touched nodes [3647/3649] : 92%|##############################4 | 169/183 [01:08<00:05, 2.36it/s]GraphSAGE Epoch: [50/50], current loss: 2.6745, touched nodes [3647/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6745, touched nodes [3647/3649] : 93%|##############################6 | 170/183 [01:08<00:05, 2.47it/s]GraphSAGE Epoch: [50/50], current loss: 2.6275, touched nodes [3647/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6275, touched nodes [3647/3649] : 93%|##############################8 | 171/183 [01:09<00:04, 2.44it/s]GraphSAGE Epoch: [50/50], current loss: 2.6555, touched nodes [3647/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6555, touched nodes [3647/3649] : 94%|############################### | 172/183 [01:09<00:04, 2.45it/s]GraphSAGE Epoch: [50/50], current loss: 2.6644, touched nodes [3647/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6644, touched nodes [3647/3649] : 95%|###############################1 | 173/183 [01:09<00:04, 2.45it/s]GraphSAGE Epoch: [50/50], current loss: 2.6577, touched nodes [3647/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6577, touched nodes [3647/3649] : 95%|###############################3 | 174/183 [01:10<00:03, 2.41it/s]GraphSAGE Epoch: [50/50], current loss: 2.6205, touched nodes [3647/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6205, touched nodes [3647/3649] : 96%|###############################5 | 175/183 [01:10<00:03, 2.38it/s]GraphSAGE Epoch: [50/50], current loss: 2.6404, touched nodes [3648/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6404, touched nodes [3648/3649] : 96%|###############################7 | 176/183 [01:11<00:02, 2.44it/s]GraphSAGE Epoch: [50/50], current loss: 2.6691, touched nodes [3648/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6691, touched nodes [3648/3649] : 97%|###############################9 | 177/183 [01:11<00:02, 2.48it/s]GraphSAGE Epoch: [50/50], current loss: 2.6631, touched nodes [3648/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6631, touched nodes [3648/3649] : 97%|################################ | 178/183 [01:11<00:01, 2.51it/s]GraphSAGE Epoch: [50/50], current loss: 2.6468, touched nodes [3648/3649]  GraphSAGE Epoch: [50/50], current loss: 2.6468, touched nodes [3648/3649] : 98%|################################2| 179/183 [01:12<00:01, 2.49it/s]GraphSAGE Epoch: [50/50], current loss: 2.6625, touched nodes [3649/3649]  3649 |
| --- |

#### 2.1.2.3 Kết quả

| Score sil arg: 0.42589885 |
| --- |



### 2.1.3 Fine-tune mô hình lần 3

#### 2.1.3.1 Thông số hyperparameter

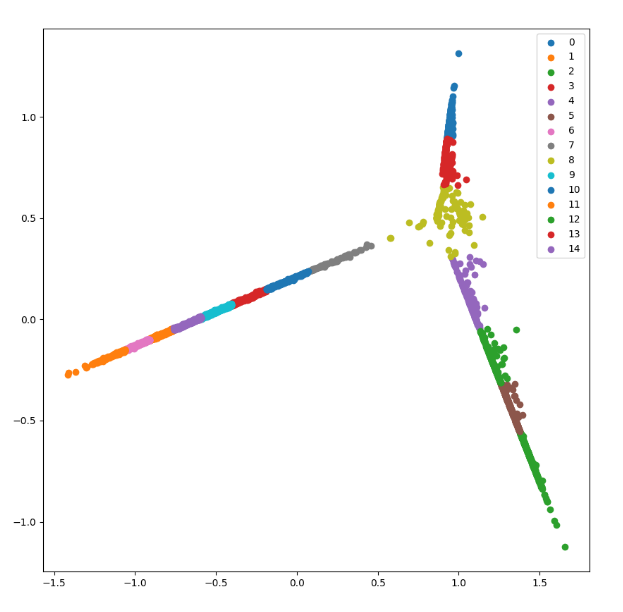
| feature\_weights = [0, 0.11547538, 0, 0.99209856, 0, 0.55746724]  raw\_features\_file\_dir = 'raw\_features.pickle'  ########hyper parameter##################  numbers\_of\_hst\_films = 10  numbers\_of\_user = 4000  prefer\_threshold = 0.1  score\_threshold = 0.35  device = "cuda:0"  loss = 'normal'  epochs = 5  lr = 0.01  model = 'graphsage' |
| --- |

#### 2.1.3.2 Kết quả training

| Count: 294496  0%| | 0/183 [00:00<?, ?it/s]GraphSAGE Epoch: [1/5], current loss: 11.3728, touched nodes [985/3649]  GraphSAGE Epoch: [1/5], current loss: 11.3728, touched nodes [985/3649] : 1%|2 | 1/183 [00:00<01:51, 1.63it/s]GraphSAGE Epoch: [1/5], current loss: 10.6526, touched nodes [1477/3649]  GraphSAGE Epoch: [1/5], current loss: 10.6526, touched nodes [1477/3649] : 1%|3 | 2/183 [00:01<01:38, 1.85it/s]GraphSAGE Epoch: [1/5], current loss: 10.0242, touched nodes [1914/3649]  GraphSAGE Epoch: [1/5], current loss: 10.0242, touched nodes [1914/3649] : 2%|5 | 3/183 [00:01<01:29, 2.02it/s]GraphSAGE Epoch: [1/5], current loss: 9.5747, touched nodes [2211/3649]  GraphSAGE Epoch: [1/5], current loss: 9.5747, touched nodes [2211/3649] : 2%|8 | 4/183 [00:01<01:25, 2.10it/s]GraphSAGE Epoch: [1/5], current loss: 9.4224, touched nodes [2444/3649]  GraphSAGE Epoch: [1/5], current loss: 9.4224, touched nodes [2444/3649] : 3%|# | 5/183 [00:02<01:21, 2.18it/s]GraphSAGE Epoch: [1/5], current loss: 9.4757, touched nodes [2710/3649]  GraphSAGE Epoch: [1/5], current loss: 9.4757, touched nodes [2710/3649] : 3%|#2 | 6/183 [00:03<01:36, 1.84it/s]GraphSAGE Epoch: [1/5], current loss: 9.1692, touched nodes [2806/3649]  GraphSAGE Epoch: [1/5], current loss: 9.1692, touched nodes [2806/3649] : 4%|#4 | 7/183 [00:03<01:29, 1.96it/s]GraphSAGE Epoch: [1/5], current loss: 9.2256, touched nodes [2952/3649]  GraphSAGE Epoch: [1/5], current loss: 9.2256, touched nodes [2952/3649] : 4%|#6 | 8/183 [00:03<01:22, 2.11it/s]GraphSAGE Epoch: [1/5], current loss: 8.9922, touched nodes [3050/3649]  GraphSAGE Epoch: [1/5], current loss: 8.9922, touched nodes [3050/3649] : 5%|#8 | 9/183 [00:04<01:19, 2.18it/s]GraphSAGE Epoch: [1/5], current loss: 8.9921, touched nodes [3168/3649]  GraphSAGE Epoch: [1/5], current loss: 8.9921, touched nodes [3168/3649] : 5%|#9 | 10/183 [00:04<01:17, 2.22it/s]GraphSAGE Epoch: [1/5], current loss: 8.8254, touched nodes [3242/3649]  GraphSAGE Epoch: [1/5], current loss: 8.8254, touched nodes [3242/3649] : 6%|##1 | 11/183 [00:05<01:16, 2.24it/s]GraphSAGE Epoch: [1/5], current loss: 8.7591, touched nodes [3297/3649]  GraphSAGE Epoch: [1/5], current loss: 8.7591, touched nodes [3297/3649] : 7%|##3 | 12/183 [00:05<01:17, 2.20it/s]GraphSAGE Epoch: [1/5], current loss: 8.8537, touched nodes [3340/3649]  GraphSAGE Epoch: [1/5], current loss: 8.8537, touched nodes [3340/3649] : 7%|##5 | 13/183 [00:06<01:16, 2.21it/s]GraphSAGE Epoch: [1/5], current loss: 8.8048, touched nodes [3387/3649]  GraphSAGE Epoch: [1/5], current loss: 8.8048, touched nodes [3387/3649] : 8%|##7 | 14/183 [00:06<01:16, 2.21it/s]GraphSAGE Epoch: [1/5], current loss: 8.6145, touched nodes [3423/3649]  GraphSAGE Epoch: [1/5], current loss: 8.6145, touched nodes [3423/3649] : 8%|##9 | 15/183 [00:07<01:22, 2.04it/s]GraphSAGE Epoch: [1/5], current loss: 8.5712, touched nodes [3457/3649]  GraphSAGE Epoch: [1/5], current loss: 8.5712, touched nodes [3457/3649] : 9%|###1 | 16/183 [00:07<01:19, 2.10it/s]GraphSAGE Epoch: [1/5], current loss: 8.6792, touched nodes [3469/3649]  GraphSAGE Epoch: [1/5], current loss: 8.6792, touched nodes [3469/3649] : 9%|###3 | 17/183 [00:08<01:16, 2.17it/s]GraphSAGE Epoch: [1/5], current loss: 8.5654, touched nodes [3484/3649]  GraphSAGE Epoch: [1/5], current loss: 8.5654, touched nodes [3484/3649] : 10%|###5 | 18/183 [00:08<01:14, 2.20it/s]GraphSAGE Epoch: [1/5], current loss: 8.4970, touched nodes [3506/3649]  GraphSAGE Epoch: [1/5], current loss: 8.4970, touched nodes [3506/3649] : 10%|###7 | 19/183 [00:08<01:13, 2.24it/s]GraphSAGE Epoch: [1/5], current loss: 8.3648, touched nodes [3523/3649]  GraphSAGE Epoch: [1/5], current loss: 8.3648, touched nodes [3523/3649] : 11%|###9 | 20/183 [00:09<01:12, 2.24it/s]GraphSAGE Epoch: [1/5], current loss: 8.4229, touched nodes [3538/3649]  GraphSAGE Epoch: [1/5], current loss: 8.4229, touched nodes [3538/3649] : 11%|####1 | 21/183 [00:09<01:09, 2.31it/s]GraphSAGE Epoch: [1/5], current loss: 8.4311, touched nodes [3547/3649]  GraphSAGE Epoch: [1/5], current loss: 8.4311, touched nodes [3547/3649] : 12%|####3 | 22/183 [00:10<01:10, 2.30it/s]GraphSAGE Epoch: [1/5], current loss: 8.3183, touched nodes [3557/3649]  GraphSAGE Epoch: [1/5], current loss: 8.3183, touched nodes [3557/3649] : 13%|####5 | 23/183 [00:10<01:10, 2.28it/s]GraphSAGE Epoch: [1/5], current loss: 8.1685, touched nodes [3560/3649]  GraphSAGE Epoch: [1/5], current loss: 8.1685, touched nodes [3560/3649] : 13%|####7 | 24/183 [00:11<01:09, 2.27it/s]GraphSAGE Epoch: [1/5], current loss: 8.1119, touched nodes [3570/3649]  GraphSAGE Epoch: [1/5], current loss: 8.1119, touched nodes [3570/3649] : 14%|####9 | 25/183 [00:11<01:14, 2.11it/s]GraphSAGE Epoch: [1/5], current loss: 8.1795, touched nodes [3581/3649]  GraphSAGE Epoch: [1/5], current loss: 8.1795, touched nodes [3581/3649] : 14%|#####1 | 26/183 [00:12<01:12, 2.16it/s]GraphSAGE Epoch: [1/5], current loss: 8.1148, touched nodes [3589/3649]  GraphSAGE Epoch: [1/5], current loss: 8.1148, touched nodes [3589/3649] : 15%|#####3 | 27/183 [00:12<01:10, 2.22it/s]GraphSAGE Epoch: [1/5], current loss: 7.9783, touched nodes [3594/3649]  GraphSAGE Epoch: [1/5], current loss: 7.9783, touched nodes [3594/3649] : 15%|#####5 | 28/183 [00:12<01:09, 2.23it/s]GraphSAGE Epoch: [1/5], current loss: 7.9788, touched nodes [3597/3649]  GraphSAGE Epoch: [1/5], current loss: 7.9788, touched nodes [3597/3649] : 16%|#####7 | 29/183 [00:13<01:08, 2.24it/s]GraphSAGE Epoch: [1/5], current loss: 7.9748, touched nodes [3607/3649]  GraphSAGE Epoch: [1/5], current loss: 7.9748, touched nodes [3607/3649] : 16%|#####9 | 30/183 [00:13<01:06, 2.29it/s]GraphSAGE Epoch: [1/5], current loss: 8.1043, touched nodes [3609/3649]  GraphSAGE Epoch: [1/5], current loss: 8.1043, touched nodes [3609/3649] : 17%|###### | 31/183 [00:14<01:05, 2.31it/s]GraphSAGE Epoch: [1/5], current loss: 7.9856, touched nodes [3611/3649]  GraphSAGE Epoch: [1/5], current loss: 7.9856, touched nodes [3611/3649] : 17%|######2 | 32/183 [00:14<01:04, 2.32it/s]GraphSAGE Epoch: [1/5], current loss: 7.8776, touched nodes [3614/3649]  GraphSAGE Epoch: [1/5], current loss: 7.8776, touched nodes [3614/3649] : 18%|######4 | 33/183 [00:15<01:09, 2.15it/s]GraphSAGE Epoch: [1/5], current loss: 7.9314, touched nodes [3614/3649]  GraphSAGE Epoch: [1/5], current loss: 7.9314, touched nodes [3614/3649] : 19%|######6 | 34/183 [00:15<01:08, 2.16it/s]GraphSAGE Epoch: [1/5], current loss: 7.7993, touched nodes [3618/3649]  GraphSAGE Epoch: [1/5], current loss: 7.7993, touched nodes [3618/3649] : 19%|######8 | 35/183 [00:16<01:08, 2.15it/s]GraphSAGE Epoch: [1/5], current loss: 7.7808, touched nodes [3619/3649]  GraphSAGE Epoch: [1/5], current loss: 7.7808, touched nodes [3619/3649] : 20%|####### | 36/183 [00:16<01:07, 2.19it/s]GraphSAGE Epoch: [1/5], current loss: 7.7847, touched nodes [3620/3649]  GraphSAGE Epoch: [1/5], current loss: 7.7847, touched nodes [3620/3649] : 20%|#######2 | 37/183 [00:17<01:06, 2.18it/s]GraphSAGE Epoch: [1/5], current loss: 7.8437, touched nodes [3621/3649]  GraphSAGE Epoch: [1/5], current loss: 7.8437, touched nodes [3621/3649] : 21%|#######4 | 38/183 [00:17<01:05, 2.21it/s]GraphSAGE Epoch: [1/5], current loss: 7.5750, touched nodes [3623/3649]  GraphSAGE Epoch: [1/5], current loss: 7.5750, touched nodes [3623/3649] : 21%|#######6 | 39/183 [00:17<01:05, 2.20it/s]GraphSAGE Epoch: [1/5], current loss: 7.7168, touched nodes [3626/3649]  GraphSAGE Epoch: [1/5], current loss: 7.7168, touched nodes [3626/3649] : 22%|#######8 | 40/183 [00:18<01:04, 2.21it/s]GraphSAGE Epoch: [1/5], current loss: 7.6413, touched nodes [3631/3649]  GraphSAGE Epoch: [1/5], current loss: 7.6413, touched nodes [3631/3649] : 22%|######## | 41/183 [00:18<01:04, 2.21it/s]GraphSAGE Epoch: [1/5], current loss: 7.6985, touched nodes [3634/3649]  GraphSAGE Epoch: [1/5], current loss: 7.6985, touched nodes [3634/3649] : 23%|########2 | 42/183 [00:19<01:07, 2.08it/s]GraphSAGE Epoch: [1/5], current loss: 7.7512, touched nodes [3637/3649]  GraphSAGE Epoch: [1/5], current loss: 7.7512, touched nodes [3637/3649] : 23%|########4 | 43/183 [00:19<01:05, 2.14it/s]GraphSAGE Epoch: [1/5], current loss: 7.9155, touched nodes [3638/3649]  GraphSAGE Epoch: [1/5], current loss: 7.9155, touched nodes [3638/3649] : 24%|########6 | 44/183 [00:20<01:02, 2.22it/s]GraphSAGE Epoch: [1/5], current loss: 7.6764, touched nodes [3639/3649]  GraphSAGE Epoch: [1/5], current loss: 7.6764, touched nodes [3639/3649] : 25%|########8 | 45/183 [00:20<01:01, 2.23it/s]GraphSAGE Epoch: [1/5], current loss: 7.7221, touched nodes [3640/3649]  GraphSAGE Epoch: [1/5], current loss: 7.7221, touched nodes [3640/3649] : 25%|######### | 46/183 [00:21<01:04, 2.13it/s]GraphSAGE Epoch: [1/5], current loss: 7.8825, touched nodes [3640/3649]  GraphSAGE Epoch: [1/5], current loss: 7.8825, touched nodes [3640/3649] : 26%|#########2 | 47/183 [00:21<01:05, 2.07it/s]GraphSAGE Epoch: [1/5], current loss: 7.5947, touched nodes [3641/3649]  GraphSAGE Epoch: [1/5], current loss: 7.5947, touched nodes [3641/3649] : 26%|#########4 | 48/183 [00:22<01:04, 2.10it/s]GraphSAGE Epoch: [1/5], current loss: 7.6704, touched nodes [3641/3649]  GraphSAGE Epoch: [1/5], current loss: 7.6704, touched nodes [3641/3649] : 27%|#########6 | 49/183 [00:22<01:02, 2.16it/s]GraphSAGE Epoch: [1/5], current loss: 7.7133, touched nodes [3641/3649]  GraphSAGE Epoch: [1/5], current loss: 7.7133, touched nodes [3641/3649] : 27%|#########8 | 50/183 [00:23<01:00, 2.18it/s]GraphSAGE Epoch: [1/5], current loss: 7.5483, touched nodes [3642/3649]  GraphSAGE Epoch: [1/5], current loss: 7.5483, touched nodes [3642/3649] : 28%|########## | 51/183 [00:23<01:04, 2.05it/s]GraphSAGE Epoch: [1/5], current loss: 7.5731, touched nodes [3642/3649]  GraphSAGE Epoch: [1/5], current loss: 7.5731, touched nodes [3642/3649] : 28%|##########2 | 52/183 [00:24<01:01, 2.14it/s]GraphSAGE Epoch: [1/5], current loss: 7.6394, touched nodes [3643/3649]  GraphSAGE Epoch: [1/5], current loss: 7.6394, touched nodes [3643/3649] : 29%|##########4 | 53/183 [00:24<00:59, 2.18it/s]GraphSAGE Epoch: [1/5], current loss: 7.8738, touched nodes [3643/3649]  GraphSAGE Epoch: [1/5], current loss: 7.8738, touched nodes [3643/3649] : 30%|##########6 | 54/183 [00:24<00:59, 2.18it/s]GraphSAGE Epoch: [1/5], current loss: 7.6612, touched nodes [3645/3649]  GraphSAGE Epoch: [1/5], current loss: 7.6612, touched nodes [3645/3649] : 30%|##########8 | 55/183 [00:25<00:57, 2.22it/s]GraphSAGE Epoch: [1/5], current loss: 7.6130, touched nodes [3646/3649]  GraphSAGE Epoch: [1/5], current loss: 7.6130, touched nodes [3646/3649] : 31%|########### | 56/183 [00:25<00:58, 2.19it/s]GraphSAGE Epoch: [1/5], current loss: 7.6082, touched nodes [3646/3649]  GraphSAGE Epoch: [1/5], current loss: 7.6082, touched nodes [3646/3649] : 31%|###########2 | 57/183 [00:26<00:56, 2.21it/s]GraphSAGE Epoch: [1/5], current loss: 7.6204, touched nodes [3646/3649]  GraphSAGE Epoch: [1/5], current loss: 7.6204, touched nodes [3646/3649] : 32%|###########4 | 58/183 [00:26<00:55, 2.25it/s]GraphSAGE Epoch: [1/5], current loss: 7.6440, touched nodes [3646/3649]  GraphSAGE Epoch: [1/5], current loss: 7.6440, touched nodes [3646/3649] : 32%|###########6 | 59/183 [00:27<00:59, 2.09it/s]GraphSAGE Epoch: [1/5], current loss: 7.6898, touched nodes [3647/3649]  GraphSAGE Epoch: [1/5], current loss: 7.6898, touched nodes [3647/3649] : 33%|###########8 | 60/183 [00:27<00:57, 2.15it/s]GraphSAGE Epoch: [1/5], current loss: 7.5877, touched nodes [3648/3649]  GraphSAGE Epoch: [1/5], current loss: 7.5877, touched nodes [3648/3649] : 33%|############ | 61/183 [00:28<00:55, 2.19it/s]GraphSAGE Epoch: [1/5], current loss: 7.5140, touched nodes [3648/3649]  GraphSAGE Epoch: [1/5], current loss: 7.5140, touched nodes [3648/3649] : 34%|############1 | 62/183 [00:28<00:55, 2.20it/s]GraphSAGE Epoch: [1/5], current loss: 7.5574, touched nodes [3648/3649]  GraphSAGE Epoch: [1/5], current loss: 7.5574, touched nodes [3648/3649] : 34%|############3 | 63/183 [00:29<00:54, 2.22it/s]GraphSAGE Epoch: [1/5], current loss: 7.5080, touched nodes [3649/3649]  0%| | 0/183 [00:00<?, ?it/s]GraphSAGE Epoch: [2/5], current loss: 7.5800, touched nodes [884/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5800, touched nodes [884/3649] : 1%|2 | 1/183 [00:00<01:19, 2.29it/s]GraphSAGE Epoch: [2/5], current loss: 8.0984, touched nodes [1408/3649]  GraphSAGE Epoch: [2/5], current loss: 8.0984, touched nodes [1408/3649] : 1%|4 | 2/183 [00:00<01:20, 2.24it/s]GraphSAGE Epoch: [2/5], current loss: 7.6819, touched nodes [1783/3649]  GraphSAGE Epoch: [2/5], current loss: 7.6819, touched nodes [1783/3649] : 2%|6 | 3/183 [00:01<01:20, 2.25it/s]GraphSAGE Epoch: [2/5], current loss: 7.5237, touched nodes [2156/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5237, touched nodes [2156/3649] : 2%|8 | 4/183 [00:01<01:17, 2.30it/s]GraphSAGE Epoch: [2/5], current loss: 7.5267, touched nodes [2430/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5267, touched nodes [2430/3649] : 3%|# | 5/183 [00:02<01:25, 2.08it/s]GraphSAGE Epoch: [2/5], current loss: 7.5995, touched nodes [2617/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5995, touched nodes [2617/3649] : 3%|#2 | 6/183 [00:02<01:22, 2.14it/s]GraphSAGE Epoch: [2/5], current loss: 7.4726, touched nodes [2769/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4726, touched nodes [2769/3649] : 4%|#4 | 7/183 [00:03<01:20, 2.19it/s]GraphSAGE Epoch: [2/5], current loss: 7.5536, touched nodes [2858/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5536, touched nodes [2858/3649] : 4%|#6 | 8/183 [00:03<01:17, 2.26it/s]GraphSAGE Epoch: [2/5], current loss: 7.5584, touched nodes [3012/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5584, touched nodes [3012/3649] : 5%|#8 | 9/183 [00:03<01:14, 2.34it/s]GraphSAGE Epoch: [2/5], current loss: 7.3771, touched nodes [3089/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3771, touched nodes [3089/3649] : 5%|#9 | 10/183 [00:04<01:13, 2.34it/s]GraphSAGE Epoch: [2/5], current loss: 7.4365, touched nodes [3159/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4365, touched nodes [3159/3649] : 6%|##1 | 11/183 [00:04<01:14, 2.31it/s]GraphSAGE Epoch: [2/5], current loss: 7.6181, touched nodes [3203/3649]  GraphSAGE Epoch: [2/5], current loss: 7.6181, touched nodes [3203/3649] : 7%|##3 | 12/183 [00:05<01:13, 2.32it/s]GraphSAGE Epoch: [2/5], current loss: 7.5960, touched nodes [3262/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5960, touched nodes [3262/3649] : 7%|##5 | 13/183 [00:05<01:20, 2.11it/s]GraphSAGE Epoch: [2/5], current loss: 7.4184, touched nodes [3319/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4184, touched nodes [3319/3649] : 8%|##7 | 14/183 [00:06<01:19, 2.13it/s]GraphSAGE Epoch: [2/5], current loss: 7.4435, touched nodes [3351/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4435, touched nodes [3351/3649] : 8%|##9 | 15/183 [00:06<01:19, 2.11it/s]GraphSAGE Epoch: [2/5], current loss: 7.5865, touched nodes [3385/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5865, touched nodes [3385/3649] : 9%|###1 | 16/183 [00:07<01:17, 2.14it/s]GraphSAGE Epoch: [2/5], current loss: 7.5418, touched nodes [3418/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5418, touched nodes [3418/3649] : 9%|###3 | 17/183 [00:07<01:15, 2.21it/s]GraphSAGE Epoch: [2/5], current loss: 7.4316, touched nodes [3442/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4316, touched nodes [3442/3649] : 10%|###5 | 18/183 [00:08<01:13, 2.25it/s]GraphSAGE Epoch: [2/5], current loss: 7.5626, touched nodes [3469/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5626, touched nodes [3469/3649] : 10%|###7 | 19/183 [00:08<01:11, 2.28it/s]GraphSAGE Epoch: [2/5], current loss: 8.2760, touched nodes [3496/3649]  GraphSAGE Epoch: [2/5], current loss: 8.2760, touched nodes [3496/3649] : 11%|###9 | 20/183 [00:08<01:10, 2.30it/s]GraphSAGE Epoch: [2/5], current loss: 7.5454, touched nodes [3507/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5454, touched nodes [3507/3649] : 11%|####1 | 21/183 [00:09<01:18, 2.07it/s]GraphSAGE Epoch: [2/5], current loss: 7.4898, touched nodes [3515/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4898, touched nodes [3515/3649] : 12%|####3 | 22/183 [00:10<01:16, 2.09it/s]GraphSAGE Epoch: [2/5], current loss: 7.5617, touched nodes [3537/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5617, touched nodes [3537/3649] : 13%|####5 | 23/183 [00:10<01:15, 2.12it/s]GraphSAGE Epoch: [2/5], current loss: 7.5821, touched nodes [3557/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5821, touched nodes [3557/3649] : 13%|####7 | 24/183 [00:10<01:12, 2.18it/s]GraphSAGE Epoch: [2/5], current loss: 7.3730, touched nodes [3570/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3730, touched nodes [3570/3649] : 14%|####9 | 25/183 [00:11<01:11, 2.20it/s]GraphSAGE Epoch: [2/5], current loss: 7.4489, touched nodes [3579/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4489, touched nodes [3579/3649] : 14%|#####1 | 26/183 [00:11<01:12, 2.18it/s]GraphSAGE Epoch: [2/5], current loss: 7.3944, touched nodes [3587/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3944, touched nodes [3587/3649] : 15%|#####3 | 27/183 [00:12<01:10, 2.20it/s]GraphSAGE Epoch: [2/5], current loss: 7.4448, touched nodes [3594/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4448, touched nodes [3594/3649] : 15%|#####5 | 28/183 [00:12<01:08, 2.27it/s]GraphSAGE Epoch: [2/5], current loss: 7.4237, touched nodes [3597/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4237, touched nodes [3597/3649] : 16%|#####7 | 29/183 [00:13<01:06, 2.31it/s]GraphSAGE Epoch: [2/5], current loss: 7.4160, touched nodes [3602/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4160, touched nodes [3602/3649] : 16%|#####9 | 30/183 [00:13<01:14, 2.07it/s]GraphSAGE Epoch: [2/5], current loss: 7.5423, touched nodes [3605/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5423, touched nodes [3605/3649] : 17%|###### | 31/183 [00:14<01:13, 2.07it/s]GraphSAGE Epoch: [2/5], current loss: 7.4805, touched nodes [3610/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4805, touched nodes [3610/3649] : 17%|######2 | 32/183 [00:14<01:10, 2.14it/s]GraphSAGE Epoch: [2/5], current loss: 7.4768, touched nodes [3617/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4768, touched nodes [3617/3649] : 18%|######4 | 33/183 [00:15<01:07, 2.21it/s]GraphSAGE Epoch: [2/5], current loss: 7.6049, touched nodes [3620/3649]  GraphSAGE Epoch: [2/5], current loss: 7.6049, touched nodes [3620/3649] : 19%|######6 | 34/183 [00:15<01:07, 2.22it/s]GraphSAGE Epoch: [2/5], current loss: 7.4360, touched nodes [3621/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4360, touched nodes [3621/3649] : 19%|######8 | 35/183 [00:15<01:06, 2.22it/s]GraphSAGE Epoch: [2/5], current loss: 7.4788, touched nodes [3622/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4788, touched nodes [3622/3649] : 20%|####### | 36/183 [00:16<01:06, 2.21it/s]GraphSAGE Epoch: [2/5], current loss: 7.5222, touched nodes [3627/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5222, touched nodes [3627/3649] : 20%|#######2 | 37/183 [00:16<01:05, 2.24it/s]GraphSAGE Epoch: [2/5], current loss: 7.4639, touched nodes [3629/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4639, touched nodes [3629/3649] : 21%|#######4 | 38/183 [00:17<01:03, 2.28it/s]GraphSAGE Epoch: [2/5], current loss: 7.3977, touched nodes [3631/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3977, touched nodes [3631/3649] : 21%|#######6 | 39/183 [00:17<01:08, 2.09it/s]GraphSAGE Epoch: [2/5], current loss: 7.3458, touched nodes [3634/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3458, touched nodes [3634/3649] : 22%|#######8 | 40/183 [00:18<01:06, 2.14it/s]GraphSAGE Epoch: [2/5], current loss: 7.3794, touched nodes [3635/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3794, touched nodes [3635/3649] : 22%|######## | 41/183 [00:18<01:05, 2.16it/s]GraphSAGE Epoch: [2/5], current loss: 7.4252, touched nodes [3637/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4252, touched nodes [3637/3649] : 23%|########2 | 42/183 [00:19<01:04, 2.19it/s]GraphSAGE Epoch: [2/5], current loss: 7.3865, touched nodes [3637/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3865, touched nodes [3637/3649] : 23%|########4 | 43/183 [00:19<01:03, 2.19it/s]GraphSAGE Epoch: [2/5], current loss: 7.4492, touched nodes [3637/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4492, touched nodes [3637/3649] : 24%|########6 | 44/183 [00:20<01:03, 2.19it/s]GraphSAGE Epoch: [2/5], current loss: 7.5274, touched nodes [3640/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5274, touched nodes [3640/3649] : 25%|########8 | 45/183 [00:20<01:02, 2.21it/s]GraphSAGE Epoch: [2/5], current loss: 7.5128, touched nodes [3640/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5128, touched nodes [3640/3649] : 25%|######### | 46/183 [00:20<01:02, 2.19it/s]GraphSAGE Epoch: [2/5], current loss: 7.3546, touched nodes [3641/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3546, touched nodes [3641/3649] : 26%|#########2 | 47/183 [00:21<01:02, 2.18it/s]GraphSAGE Epoch: [2/5], current loss: 7.4218, touched nodes [3644/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4218, touched nodes [3644/3649] : 26%|#########4 | 48/183 [00:21<01:00, 2.23it/s]GraphSAGE Epoch: [2/5], current loss: 7.4381, touched nodes [3645/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4381, touched nodes [3645/3649] : 27%|#########6 | 49/183 [00:22<01:04, 2.09it/s]GraphSAGE Epoch: [2/5], current loss: 7.4150, touched nodes [3645/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4150, touched nodes [3645/3649] : 27%|#########8 | 50/183 [00:22<01:01, 2.16it/s]GraphSAGE Epoch: [2/5], current loss: 7.4270, touched nodes [3645/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4270, touched nodes [3645/3649] : 28%|########## | 51/183 [00:23<01:00, 2.20it/s]GraphSAGE Epoch: [2/5], current loss: 7.3080, touched nodes [3645/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3080, touched nodes [3645/3649] : 28%|##########2 | 52/183 [00:23<00:59, 2.21it/s]GraphSAGE Epoch: [2/5], current loss: 7.3937, touched nodes [3645/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3937, touched nodes [3645/3649] : 29%|##########4 | 53/183 [00:24<00:58, 2.24it/s]GraphSAGE Epoch: [2/5], current loss: 7.4400, touched nodes [3646/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4400, touched nodes [3646/3649] : 30%|##########6 | 54/183 [00:24<00:56, 2.29it/s]GraphSAGE Epoch: [2/5], current loss: 7.4687, touched nodes [3647/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4687, touched nodes [3647/3649] : 30%|##########8 | 55/183 [00:24<00:55, 2.31it/s]GraphSAGE Epoch: [2/5], current loss: 7.3578, touched nodes [3647/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3578, touched nodes [3647/3649] : 31%|########### | 56/183 [00:25<00:55, 2.28it/s]GraphSAGE Epoch: [2/5], current loss: 7.3590, touched nodes [3647/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3590, touched nodes [3647/3649] : 31%|###########2 | 57/183 [00:25<00:55, 2.26it/s]GraphSAGE Epoch: [2/5], current loss: 7.4352, touched nodes [3647/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4352, touched nodes [3647/3649] : 32%|###########4 | 58/183 [00:26<00:55, 2.25it/s]GraphSAGE Epoch: [2/5], current loss: 7.4118, touched nodes [3647/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4118, touched nodes [3647/3649] : 32%|###########6 | 59/183 [00:26<01:00, 2.04it/s]GraphSAGE Epoch: [2/5], current loss: 7.4101, touched nodes [3647/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4101, touched nodes [3647/3649] : 33%|###########8 | 60/183 [00:27<00:58, 2.11it/s]GraphSAGE Epoch: [2/5], current loss: 7.4103, touched nodes [3647/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4103, touched nodes [3647/3649] : 33%|############ | 61/183 [00:27<00:56, 2.14it/s]GraphSAGE Epoch: [2/5], current loss: 7.4510, touched nodes [3647/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4510, touched nodes [3647/3649] : 34%|############1 | 62/183 [00:28<00:54, 2.21it/s]GraphSAGE Epoch: [2/5], current loss: 7.4129, touched nodes [3648/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4129, touched nodes [3648/3649] : 34%|############3 | 63/183 [00:28<00:53, 2.26it/s]GraphSAGE Epoch: [2/5], current loss: 7.3197, touched nodes [3648/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3197, touched nodes [3648/3649] : 35%|############5 | 64/183 [00:29<00:52, 2.25it/s]GraphSAGE Epoch: [2/5], current loss: 7.5159, touched nodes [3648/3649]  GraphSAGE Epoch: [2/5], current loss: 7.5159, touched nodes [3648/3649] : 36%|############7 | 65/183 [00:29<00:51, 2.30it/s]GraphSAGE Epoch: [2/5], current loss: 7.3880, touched nodes [3648/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3880, touched nodes [3648/3649] : 36%|############9 | 66/183 [00:29<00:51, 2.27it/s]GraphSAGE Epoch: [2/5], current loss: 7.3775, touched nodes [3648/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3775, touched nodes [3648/3649] : 37%|#############1 | 67/183 [00:30<00:50, 2.28it/s]GraphSAGE Epoch: [2/5], current loss: 7.3344, touched nodes [3648/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3344, touched nodes [3648/3649] : 37%|#############3 | 68/183 [00:30<00:51, 2.25it/s]GraphSAGE Epoch: [2/5], current loss: 7.4065, touched nodes [3648/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4065, touched nodes [3648/3649] : 38%|#############5 | 69/183 [00:31<00:49, 2.32it/s]GraphSAGE Epoch: [2/5], current loss: 7.6700, touched nodes [3648/3649]  GraphSAGE Epoch: [2/5], current loss: 7.6700, touched nodes [3648/3649] : 38%|#############7 | 70/183 [00:31<00:52, 2.16it/s]GraphSAGE Epoch: [2/5], current loss: 7.4973, touched nodes [3648/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4973, touched nodes [3648/3649] : 39%|#############9 | 71/183 [00:32<00:50, 2.24it/s]GraphSAGE Epoch: [2/5], current loss: 7.3723, touched nodes [3648/3649]  GraphSAGE Epoch: [2/5], current loss: 7.3723, touched nodes [3648/3649] : 39%|##############1 | 72/183 [00:32<00:50, 2.21it/s]GraphSAGE Epoch: [2/5], current loss: 7.4503, touched nodes [3648/3649]  GraphSAGE Epoch: [2/5], current loss: 7.4503, touched nodes [3648/3649] : 40%|##############3 | 73/183 [00:33<00:49, 2.24it/s]GraphSAGE Epoch: [2/5], current loss: 7.4780, touched nodes [3649/3649]  0%| | 0/183 [00:00<?, ?it/s]GraphSAGE Epoch: [3/5], current loss: 7.3578, touched nodes [1006/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3578, touched nodes [1006/3649] : 1%|2 | 1/183 [00:00<01:20, 2.26it/s]GraphSAGE Epoch: [3/5], current loss: 7.4375, touched nodes [1513/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4375, touched nodes [1513/3649] : 1%|4 | 2/183 [00:00<01:20, 2.24it/s]GraphSAGE Epoch: [3/5], current loss: 7.3429, touched nodes [1849/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3429, touched nodes [1849/3649] : 2%|6 | 3/183 [00:01<01:19, 2.26it/s]GraphSAGE Epoch: [3/5], current loss: 7.3849, touched nodes [2235/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3849, touched nodes [2235/3649] : 2%|8 | 4/183 [00:01<01:17, 2.30it/s]GraphSAGE Epoch: [3/5], current loss: 7.3793, touched nodes [2466/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3793, touched nodes [2466/3649] : 3%|# | 5/183 [00:02<01:24, 2.10it/s]GraphSAGE Epoch: [3/5], current loss: 7.4024, touched nodes [2625/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4024, touched nodes [2625/3649] : 3%|#2 | 6/183 [00:02<01:22, 2.14it/s]GraphSAGE Epoch: [3/5], current loss: 7.4362, touched nodes [2785/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4362, touched nodes [2785/3649] : 4%|#4 | 7/183 [00:03<01:22, 2.12it/s]GraphSAGE Epoch: [3/5], current loss: 7.7232, touched nodes [2933/3649]  GraphSAGE Epoch: [3/5], current loss: 7.7232, touched nodes [2933/3649] : 4%|#6 | 8/183 [00:03<01:21, 2.15it/s]GraphSAGE Epoch: [3/5], current loss: 7.4747, touched nodes [3022/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4747, touched nodes [3022/3649] : 5%|#8 | 9/183 [00:04<01:20, 2.16it/s]GraphSAGE Epoch: [3/5], current loss: 7.4258, touched nodes [3115/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4258, touched nodes [3115/3649] : 5%|#9 | 10/183 [00:04<01:19, 2.19it/s]GraphSAGE Epoch: [3/5], current loss: 7.6476, touched nodes [3186/3649]  GraphSAGE Epoch: [3/5], current loss: 7.6476, touched nodes [3186/3649] : 6%|##1 | 11/183 [00:05<01:17, 2.22it/s]GraphSAGE Epoch: [3/5], current loss: 7.5890, touched nodes [3246/3649]  GraphSAGE Epoch: [3/5], current loss: 7.5890, touched nodes [3246/3649] : 7%|##3 | 12/183 [00:05<01:14, 2.29it/s]GraphSAGE Epoch: [3/5], current loss: 7.4897, touched nodes [3292/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4897, touched nodes [3292/3649] : 7%|##5 | 13/183 [00:05<01:19, 2.13it/s]GraphSAGE Epoch: [3/5], current loss: 7.4115, touched nodes [3331/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4115, touched nodes [3331/3649] : 8%|##7 | 14/183 [00:06<01:18, 2.16it/s]GraphSAGE Epoch: [3/5], current loss: 7.4101, touched nodes [3376/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4101, touched nodes [3376/3649] : 8%|##9 | 15/183 [00:06<01:15, 2.22it/s]GraphSAGE Epoch: [3/5], current loss: 7.3896, touched nodes [3398/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3896, touched nodes [3398/3649] : 9%|###1 | 16/183 [00:07<01:15, 2.22it/s]GraphSAGE Epoch: [3/5], current loss: 7.3610, touched nodes [3443/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3610, touched nodes [3443/3649] : 9%|###3 | 17/183 [00:07<01:14, 2.23it/s]GraphSAGE Epoch: [3/5], current loss: 7.3859, touched nodes [3462/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3859, touched nodes [3462/3649] : 10%|###5 | 18/183 [00:08<01:13, 2.25it/s]GraphSAGE Epoch: [3/5], current loss: 7.3894, touched nodes [3485/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3894, touched nodes [3485/3649] : 10%|###7 | 19/183 [00:08<01:12, 2.27it/s]GraphSAGE Epoch: [3/5], current loss: 7.4187, touched nodes [3505/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4187, touched nodes [3505/3649] : 11%|###9 | 20/183 [00:09<01:11, 2.27it/s]GraphSAGE Epoch: [3/5], current loss: 7.5035, touched nodes [3526/3649]  GraphSAGE Epoch: [3/5], current loss: 7.5035, touched nodes [3526/3649] : 11%|####1 | 21/183 [00:09<01:15, 2.13it/s]GraphSAGE Epoch: [3/5], current loss: 7.4679, touched nodes [3540/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4679, touched nodes [3540/3649] : 12%|####3 | 22/183 [00:09<01:12, 2.23it/s]GraphSAGE Epoch: [3/5], current loss: 7.3315, touched nodes [3547/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3315, touched nodes [3547/3649] : 13%|####5 | 23/183 [00:10<01:12, 2.22it/s]GraphSAGE Epoch: [3/5], current loss: 7.3780, touched nodes [3554/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3780, touched nodes [3554/3649] : 13%|####7 | 24/183 [00:10<01:10, 2.25it/s]GraphSAGE Epoch: [3/5], current loss: 7.3611, touched nodes [3561/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3611, touched nodes [3561/3649] : 14%|####9 | 25/183 [00:11<01:10, 2.24it/s]GraphSAGE Epoch: [3/5], current loss: 7.4323, touched nodes [3567/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4323, touched nodes [3567/3649] : 14%|#####1 | 26/183 [00:11<01:08, 2.28it/s]GraphSAGE Epoch: [3/5], current loss: 7.3996, touched nodes [3570/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3996, touched nodes [3570/3649] : 15%|#####3 | 27/183 [00:12<01:07, 2.30it/s]GraphSAGE Epoch: [3/5], current loss: 7.3496, touched nodes [3577/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3496, touched nodes [3577/3649] : 15%|#####5 | 28/183 [00:12<01:09, 2.23it/s]GraphSAGE Epoch: [3/5], current loss: 7.4661, touched nodes [3585/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4661, touched nodes [3585/3649] : 16%|#####7 | 29/183 [00:13<01:08, 2.25it/s]GraphSAGE Epoch: [3/5], current loss: 7.3638, touched nodes [3594/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3638, touched nodes [3594/3649] : 16%|#####9 | 30/183 [00:13<01:15, 2.03it/s]GraphSAGE Epoch: [3/5], current loss: 7.4238, touched nodes [3597/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4238, touched nodes [3597/3649] : 17%|###### | 31/183 [00:14<01:12, 2.10it/s]GraphSAGE Epoch: [3/5], current loss: 7.3897, touched nodes [3608/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3897, touched nodes [3608/3649] : 17%|######2 | 32/183 [00:14<01:10, 2.14it/s]GraphSAGE Epoch: [3/5], current loss: 7.3610, touched nodes [3612/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3610, touched nodes [3612/3649] : 18%|######4 | 33/183 [00:14<01:07, 2.21it/s]GraphSAGE Epoch: [3/5], current loss: 7.4327, touched nodes [3622/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4327, touched nodes [3622/3649] : 19%|######6 | 34/183 [00:15<01:08, 2.19it/s]GraphSAGE Epoch: [3/5], current loss: 7.4523, touched nodes [3624/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4523, touched nodes [3624/3649] : 19%|######8 | 35/183 [00:15<01:06, 2.23it/s]GraphSAGE Epoch: [3/5], current loss: 7.4426, touched nodes [3626/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4426, touched nodes [3626/3649] : 20%|####### | 36/183 [00:16<01:04, 2.30it/s]GraphSAGE Epoch: [3/5], current loss: 7.4126, touched nodes [3631/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4126, touched nodes [3631/3649] : 20%|#######2 | 37/183 [00:16<01:04, 2.27it/s]GraphSAGE Epoch: [3/5], current loss: 7.3717, touched nodes [3632/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3717, touched nodes [3632/3649] : 21%|#######4 | 38/183 [00:17<01:04, 2.27it/s]GraphSAGE Epoch: [3/5], current loss: 7.3362, touched nodes [3634/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3362, touched nodes [3634/3649] : 21%|#######6 | 39/183 [00:17<01:05, 2.19it/s]GraphSAGE Epoch: [3/5], current loss: 7.4170, touched nodes [3636/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4170, touched nodes [3636/3649] : 22%|#######8 | 40/183 [00:18<01:03, 2.24it/s]GraphSAGE Epoch: [3/5], current loss: 7.3541, touched nodes [3636/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3541, touched nodes [3636/3649] : 22%|######## | 41/183 [00:18<01:08, 2.08it/s]GraphSAGE Epoch: [3/5], current loss: 7.3876, touched nodes [3636/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3876, touched nodes [3636/3649] : 23%|########2 | 42/183 [00:19<01:05, 2.15it/s]GraphSAGE Epoch: [3/5], current loss: 7.4915, touched nodes [3638/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4915, touched nodes [3638/3649] : 23%|########4 | 43/183 [00:19<01:04, 2.16it/s]GraphSAGE Epoch: [3/5], current loss: 7.4334, touched nodes [3638/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4334, touched nodes [3638/3649] : 24%|########6 | 44/183 [00:19<01:03, 2.20it/s]GraphSAGE Epoch: [3/5], current loss: 7.4446, touched nodes [3639/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4446, touched nodes [3639/3649] : 25%|########8 | 45/183 [00:20<01:01, 2.26it/s]GraphSAGE Epoch: [3/5], current loss: 7.3612, touched nodes [3639/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3612, touched nodes [3639/3649] : 25%|######### | 46/183 [00:20<01:00, 2.25it/s]GraphSAGE Epoch: [3/5], current loss: 7.3212, touched nodes [3639/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3212, touched nodes [3639/3649] : 26%|#########2 | 47/183 [00:21<01:01, 2.21it/s]GraphSAGE Epoch: [3/5], current loss: 7.3852, touched nodes [3639/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3852, touched nodes [3639/3649] : 26%|#########4 | 48/183 [00:21<01:00, 2.25it/s]GraphSAGE Epoch: [3/5], current loss: 7.4725, touched nodes [3641/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4725, touched nodes [3641/3649] : 27%|#########6 | 49/183 [00:22<00:58, 2.27it/s]GraphSAGE Epoch: [3/5], current loss: 7.3644, touched nodes [3641/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3644, touched nodes [3641/3649] : 27%|#########8 | 50/183 [00:22<01:05, 2.03it/s]GraphSAGE Epoch: [3/5], current loss: 7.3905, touched nodes [3644/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3905, touched nodes [3644/3649] : 28%|########## | 51/183 [00:23<01:02, 2.10it/s]GraphSAGE Epoch: [3/5], current loss: 7.4087, touched nodes [3644/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4087, touched nodes [3644/3649] : 28%|##########2 | 52/183 [00:23<01:01, 2.14it/s]GraphSAGE Epoch: [3/5], current loss: 7.3462, touched nodes [3645/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3462, touched nodes [3645/3649] : 29%|##########4 | 53/183 [00:24<01:01, 2.12it/s]GraphSAGE Epoch: [3/5], current loss: 7.3361, touched nodes [3645/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3361, touched nodes [3645/3649] : 30%|##########6 | 54/183 [00:24<01:00, 2.15it/s]GraphSAGE Epoch: [3/5], current loss: 7.3666, touched nodes [3645/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3666, touched nodes [3645/3649] : 30%|##########8 | 55/183 [00:25<00:58, 2.18it/s]GraphSAGE Epoch: [3/5], current loss: 7.4492, touched nodes [3646/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4492, touched nodes [3646/3649] : 31%|########### | 56/183 [00:25<00:57, 2.23it/s]GraphSAGE Epoch: [3/5], current loss: 7.3354, touched nodes [3646/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3354, touched nodes [3646/3649] : 31%|###########2 | 57/183 [00:25<00:56, 2.24it/s]GraphSAGE Epoch: [3/5], current loss: 7.4625, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4625, touched nodes [3647/3649] : 32%|###########4 | 58/183 [00:26<00:59, 2.10it/s]GraphSAGE Epoch: [3/5], current loss: 7.3250, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3250, touched nodes [3647/3649] : 32%|###########6 | 59/183 [00:26<00:56, 2.18it/s]GraphSAGE Epoch: [3/5], current loss: 7.3139, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3139, touched nodes [3647/3649] : 33%|###########8 | 60/183 [00:27<00:56, 2.19it/s]GraphSAGE Epoch: [3/5], current loss: 7.3072, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3072, touched nodes [3647/3649] : 33%|############ | 61/183 [00:27<00:55, 2.18it/s]GraphSAGE Epoch: [3/5], current loss: 7.3704, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3704, touched nodes [3647/3649] : 34%|############1 | 62/183 [00:28<00:54, 2.22it/s]GraphSAGE Epoch: [3/5], current loss: 7.3693, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3693, touched nodes [3647/3649] : 34%|############3 | 63/183 [00:28<00:53, 2.24it/s]GraphSAGE Epoch: [3/5], current loss: 7.4293, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4293, touched nodes [3647/3649] : 35%|############5 | 64/183 [00:29<00:52, 2.26it/s]GraphSAGE Epoch: [3/5], current loss: 7.4481, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4481, touched nodes [3647/3649] : 36%|############7 | 65/183 [00:29<00:50, 2.33it/s]GraphSAGE Epoch: [3/5], current loss: 7.4239, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4239, touched nodes [3647/3649] : 36%|############9 | 66/183 [00:30<00:54, 2.16it/s]GraphSAGE Epoch: [3/5], current loss: 7.3653, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3653, touched nodes [3647/3649] : 37%|#############1 | 67/183 [00:30<00:52, 2.20it/s]GraphSAGE Epoch: [3/5], current loss: 7.3293, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3293, touched nodes [3647/3649] : 37%|#############3 | 68/183 [00:30<00:51, 2.22it/s]GraphSAGE Epoch: [3/5], current loss: 7.3620, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3620, touched nodes [3647/3649] : 38%|#############5 | 69/183 [00:31<00:50, 2.25it/s]GraphSAGE Epoch: [3/5], current loss: 7.3682, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3682, touched nodes [3647/3649] : 38%|#############7 | 70/183 [00:31<00:50, 2.24it/s]GraphSAGE Epoch: [3/5], current loss: 7.3668, touched nodes [3647/3649]  GraphSAGE Epoch: [3/5], current loss: 7.3668, touched nodes [3647/3649] : 39%|#############9 | 71/183 [00:32<00:49, 2.27it/s]GraphSAGE Epoch: [3/5], current loss: 7.4722, touched nodes [3648/3649]  GraphSAGE Epoch: [3/5], current loss: 7.4722, touched nodes [3648/3649] : 39%|##############1 | 72/183 [00:32<00:49, 2.24it/s]GraphSAGE Epoch: [3/5], current loss: 7.4405, touched nodes [3649/3649]  0%| | 0/183 [00:00<?, ?it/s]GraphSAGE Epoch: [4/5], current loss: 7.4061, touched nodes [1100/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4061, touched nodes [1100/3649] : 1%|2 | 1/183 [00:00<01:22, 2.20it/s]GraphSAGE Epoch: [4/5], current loss: 7.3909, touched nodes [1524/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3909, touched nodes [1524/3649] : 1%|4 | 2/183 [00:00<01:23, 2.17it/s]GraphSAGE Epoch: [4/5], current loss: 7.3424, touched nodes [1796/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3424, touched nodes [1796/3649] : 2%|6 | 3/183 [00:01<01:22, 2.17it/s]GraphSAGE Epoch: [4/5], current loss: 7.3929, touched nodes [2177/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3929, touched nodes [2177/3649] : 2%|8 | 4/183 [00:01<01:27, 2.04it/s]GraphSAGE Epoch: [4/5], current loss: 7.3552, touched nodes [2409/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3552, touched nodes [2409/3649] : 3%|# | 5/183 [00:02<01:25, 2.09it/s]GraphSAGE Epoch: [4/5], current loss: 7.3960, touched nodes [2676/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3960, touched nodes [2676/3649] : 3%|#2 | 6/183 [00:02<01:19, 2.21it/s]GraphSAGE Epoch: [4/5], current loss: 7.3905, touched nodes [2848/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3905, touched nodes [2848/3649] : 4%|#4 | 7/183 [00:03<01:20, 2.20it/s]GraphSAGE Epoch: [4/5], current loss: 7.4576, touched nodes [2995/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4576, touched nodes [2995/3649] : 4%|#6 | 8/183 [00:03<01:15, 2.31it/s]GraphSAGE Epoch: [4/5], current loss: 7.3994, touched nodes [3079/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3994, touched nodes [3079/3649] : 5%|#8 | 9/183 [00:04<01:16, 2.28it/s]GraphSAGE Epoch: [4/5], current loss: 7.3920, touched nodes [3158/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3920, touched nodes [3158/3649] : 5%|#9 | 10/183 [00:04<01:16, 2.26it/s]GraphSAGE Epoch: [4/5], current loss: 7.4082, touched nodes [3226/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4082, touched nodes [3226/3649] : 6%|##1 | 11/183 [00:04<01:16, 2.25it/s]GraphSAGE Epoch: [4/5], current loss: 7.3713, touched nodes [3289/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3713, touched nodes [3289/3649] : 7%|##3 | 12/183 [00:05<01:20, 2.11it/s]GraphSAGE Epoch: [4/5], current loss: 7.4472, touched nodes [3320/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4472, touched nodes [3320/3649] : 7%|##5 | 13/183 [00:05<01:18, 2.17it/s]GraphSAGE Epoch: [4/5], current loss: 7.4389, touched nodes [3357/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4389, touched nodes [3357/3649] : 8%|##7 | 14/183 [00:06<01:17, 2.18it/s]GraphSAGE Epoch: [4/5], current loss: 7.4278, touched nodes [3377/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4278, touched nodes [3377/3649] : 8%|##9 | 15/183 [00:06<01:16, 2.20it/s]GraphSAGE Epoch: [4/5], current loss: 7.4317, touched nodes [3421/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4317, touched nodes [3421/3649] : 9%|###1 | 16/183 [00:07<01:14, 2.24it/s]GraphSAGE Epoch: [4/5], current loss: 7.4212, touched nodes [3449/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4212, touched nodes [3449/3649] : 9%|###3 | 17/183 [00:07<01:12, 2.28it/s]GraphSAGE Epoch: [4/5], current loss: 7.4349, touched nodes [3471/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4349, touched nodes [3471/3649] : 10%|###5 | 18/183 [00:08<01:11, 2.32it/s]GraphSAGE Epoch: [4/5], current loss: 7.3786, touched nodes [3489/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3786, touched nodes [3489/3649] : 10%|###7 | 19/183 [00:08<01:10, 2.32it/s]GraphSAGE Epoch: [4/5], current loss: 7.3825, touched nodes [3506/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3825, touched nodes [3506/3649] : 11%|###9 | 20/183 [00:08<01:09, 2.34it/s]GraphSAGE Epoch: [4/5], current loss: 7.3305, touched nodes [3526/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3305, touched nodes [3526/3649] : 11%|####1 | 21/183 [00:09<01:10, 2.30it/s]GraphSAGE Epoch: [4/5], current loss: 7.4168, touched nodes [3545/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4168, touched nodes [3545/3649] : 12%|####3 | 22/183 [00:09<01:16, 2.12it/s]GraphSAGE Epoch: [4/5], current loss: 7.4784, touched nodes [3555/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4784, touched nodes [3555/3649] : 13%|####5 | 23/183 [00:10<01:12, 2.21it/s]GraphSAGE Epoch: [4/5], current loss: 7.3812, touched nodes [3560/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3812, touched nodes [3560/3649] : 13%|####7 | 24/183 [00:10<01:10, 2.26it/s]GraphSAGE Epoch: [4/5], current loss: 7.3859, touched nodes [3574/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3859, touched nodes [3574/3649] : 14%|####9 | 25/183 [00:11<01:08, 2.29it/s]GraphSAGE Epoch: [4/5], current loss: 7.3714, touched nodes [3584/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3714, touched nodes [3584/3649] : 14%|#####1 | 26/183 [00:11<01:08, 2.30it/s]GraphSAGE Epoch: [4/5], current loss: 7.2903, touched nodes [3595/3649]  GraphSAGE Epoch: [4/5], current loss: 7.2903, touched nodes [3595/3649] : 15%|#####3 | 27/183 [00:12<01:08, 2.29it/s]GraphSAGE Epoch: [4/5], current loss: 7.2928, touched nodes [3602/3649]  GraphSAGE Epoch: [4/5], current loss: 7.2928, touched nodes [3602/3649] : 15%|#####5 | 28/183 [00:12<01:07, 2.29it/s]GraphSAGE Epoch: [4/5], current loss: 7.3681, touched nodes [3602/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3681, touched nodes [3602/3649] : 16%|#####7 | 29/183 [00:12<01:06, 2.32it/s]GraphSAGE Epoch: [4/5], current loss: 7.3977, touched nodes [3606/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3977, touched nodes [3606/3649] : 16%|#####9 | 30/183 [00:13<01:06, 2.31it/s]GraphSAGE Epoch: [4/5], current loss: 7.4303, touched nodes [3607/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4303, touched nodes [3607/3649] : 17%|###### | 31/183 [00:13<01:10, 2.16it/s]GraphSAGE Epoch: [4/5], current loss: 7.4306, touched nodes [3610/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4306, touched nodes [3610/3649] : 17%|######2 | 32/183 [00:14<01:07, 2.23it/s]GraphSAGE Epoch: [4/5], current loss: 7.3856, touched nodes [3615/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3856, touched nodes [3615/3649] : 18%|######4 | 33/183 [00:14<01:06, 2.24it/s]GraphSAGE Epoch: [4/5], current loss: 7.3552, touched nodes [3617/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3552, touched nodes [3617/3649] : 19%|######6 | 34/183 [00:15<01:05, 2.27it/s]GraphSAGE Epoch: [4/5], current loss: 7.4255, touched nodes [3618/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4255, touched nodes [3618/3649] : 19%|######8 | 35/183 [00:15<01:03, 2.32it/s]GraphSAGE Epoch: [4/5], current loss: 7.3892, touched nodes [3623/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3892, touched nodes [3623/3649] : 20%|####### | 36/183 [00:16<01:02, 2.35it/s]GraphSAGE Epoch: [4/5], current loss: 7.4498, touched nodes [3624/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4498, touched nodes [3624/3649] : 20%|#######2 | 37/183 [00:16<01:01, 2.39it/s]GraphSAGE Epoch: [4/5], current loss: 7.3751, touched nodes [3628/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3751, touched nodes [3628/3649] : 21%|#######4 | 38/183 [00:16<01:01, 2.37it/s]GraphSAGE Epoch: [4/5], current loss: 7.4055, touched nodes [3631/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4055, touched nodes [3631/3649] : 21%|#######6 | 39/183 [00:17<01:00, 2.37it/s]GraphSAGE Epoch: [4/5], current loss: 7.4351, touched nodes [3634/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4351, touched nodes [3634/3649] : 22%|#######8 | 40/183 [00:17<01:06, 2.16it/s]GraphSAGE Epoch: [4/5], current loss: 7.3974, touched nodes [3637/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3974, touched nodes [3637/3649] : 22%|######## | 41/183 [00:18<01:04, 2.19it/s]GraphSAGE Epoch: [4/5], current loss: 7.4120, touched nodes [3641/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4120, touched nodes [3641/3649] : 23%|########2 | 42/183 [00:18<01:04, 2.18it/s]GraphSAGE Epoch: [4/5], current loss: 7.4097, touched nodes [3643/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4097, touched nodes [3643/3649] : 23%|########4 | 43/183 [00:19<01:02, 2.22it/s]GraphSAGE Epoch: [4/5], current loss: 7.4073, touched nodes [3643/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4073, touched nodes [3643/3649] : 24%|########6 | 44/183 [00:19<01:03, 2.18it/s]GraphSAGE Epoch: [4/5], current loss: 7.4140, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4140, touched nodes [3644/3649] : 25%|########8 | 45/183 [00:20<01:03, 2.18it/s]GraphSAGE Epoch: [4/5], current loss: 7.3502, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3502, touched nodes [3644/3649] : 25%|######### | 46/183 [00:20<01:03, 2.16it/s]GraphSAGE Epoch: [4/5], current loss: 7.4192, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4192, touched nodes [3644/3649] : 26%|#########2 | 47/183 [00:21<01:02, 2.19it/s]GraphSAGE Epoch: [4/5], current loss: 7.3826, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3826, touched nodes [3644/3649] : 26%|#########4 | 48/183 [00:21<01:05, 2.08it/s]GraphSAGE Epoch: [4/5], current loss: 7.4089, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4089, touched nodes [3644/3649] : 27%|#########6 | 49/183 [00:21<01:02, 2.13it/s]GraphSAGE Epoch: [4/5], current loss: 7.4483, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4483, touched nodes [3644/3649] : 27%|#########8 | 50/183 [00:22<01:00, 2.19it/s]GraphSAGE Epoch: [4/5], current loss: 7.4448, touched nodes [3645/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4448, touched nodes [3645/3649] : 28%|########## | 51/183 [00:22<00:58, 2.24it/s]GraphSAGE Epoch: [4/5], current loss: 7.3858, touched nodes [3645/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3858, touched nodes [3645/3649] : 28%|##########2 | 52/183 [00:23<00:58, 2.25it/s]GraphSAGE Epoch: [4/5], current loss: 7.3693, touched nodes [3645/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3693, touched nodes [3645/3649] : 29%|##########4 | 53/183 [00:23<00:57, 2.25it/s]GraphSAGE Epoch: [4/5], current loss: 7.3209, touched nodes [3645/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3209, touched nodes [3645/3649] : 30%|##########6 | 54/183 [00:24<00:58, 2.19it/s]GraphSAGE Epoch: [4/5], current loss: 7.3590, touched nodes [3646/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3590, touched nodes [3646/3649] : 30%|##########8 | 55/183 [00:24<00:58, 2.17it/s]GraphSAGE Epoch: [4/5], current loss: 7.3969, touched nodes [3646/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3969, touched nodes [3646/3649] : 31%|########### | 56/183 [00:25<00:57, 2.22it/s]GraphSAGE Epoch: [4/5], current loss: 7.4337, touched nodes [3646/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4337, touched nodes [3646/3649] : 31%|###########2 | 57/183 [00:25<01:00, 2.09it/s]GraphSAGE Epoch: [4/5], current loss: 7.3857, touched nodes [3647/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3857, touched nodes [3647/3649] : 32%|###########4 | 58/183 [00:26<00:58, 2.15it/s]GraphSAGE Epoch: [4/5], current loss: 7.4003, touched nodes [3647/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4003, touched nodes [3647/3649] : 32%|###########6 | 59/183 [00:26<00:56, 2.18it/s]GraphSAGE Epoch: [4/5], current loss: 7.3643, touched nodes [3647/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3643, touched nodes [3647/3649] : 33%|###########8 | 60/183 [00:26<00:55, 2.20it/s]GraphSAGE Epoch: [4/5], current loss: 7.3492, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3492, touched nodes [3648/3649] : 33%|############ | 61/183 [00:27<00:54, 2.23it/s]GraphSAGE Epoch: [4/5], current loss: 7.3608, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3608, touched nodes [3648/3649] : 34%|############1 | 62/183 [00:27<00:53, 2.26it/s]GraphSAGE Epoch: [4/5], current loss: 7.3847, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3847, touched nodes [3648/3649] : 34%|############3 | 63/183 [00:28<00:52, 2.28it/s]GraphSAGE Epoch: [4/5], current loss: 7.3603, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3603, touched nodes [3648/3649] : 35%|############5 | 64/183 [00:28<00:51, 2.32it/s]GraphSAGE Epoch: [4/5], current loss: 7.3626, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3626, touched nodes [3648/3649] : 36%|############7 | 65/183 [00:29<00:50, 2.35it/s]GraphSAGE Epoch: [4/5], current loss: 7.3896, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3896, touched nodes [3648/3649] : 36%|############9 | 66/183 [00:29<00:53, 2.18it/s]GraphSAGE Epoch: [4/5], current loss: 7.4199, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 7.4199, touched nodes [3648/3649] : 37%|#############1 | 67/183 [00:30<00:51, 2.24it/s]GraphSAGE Epoch: [4/5], current loss: 7.3906, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3906, touched nodes [3648/3649] : 37%|#############3 | 68/183 [00:30<00:50, 2.26it/s]GraphSAGE Epoch: [4/5], current loss: 7.3808, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 7.3808, touched nodes [3648/3649] : 38%|#############5 | 69/183 [00:30<00:50, 2.28it/s]GraphSAGE Epoch: [4/5], current loss: 7.3572, touched nodes [3649/3649]  0%| | 0/183 [00:00<?, ?it/s]GraphSAGE Epoch: [5/5], current loss: 7.3913, touched nodes [1054/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3913, touched nodes [1054/3649] : 1%|2 | 1/183 [00:00<01:16, 2.39it/s]GraphSAGE Epoch: [5/5], current loss: 7.3253, touched nodes [1401/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3253, touched nodes [1401/3649] : 1%|4 | 2/183 [00:00<01:17, 2.35it/s]GraphSAGE Epoch: [5/5], current loss: 7.4383, touched nodes [1841/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4383, touched nodes [1841/3649] : 2%|6 | 3/183 [00:01<01:14, 2.42it/s]GraphSAGE Epoch: [5/5], current loss: 7.3421, touched nodes [2251/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3421, touched nodes [2251/3649] : 2%|8 | 4/183 [00:01<01:20, 2.23it/s]GraphSAGE Epoch: [5/5], current loss: 7.4088, touched nodes [2471/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4088, touched nodes [2471/3649] : 3%|# | 5/183 [00:02<01:17, 2.31it/s]GraphSAGE Epoch: [5/5], current loss: 7.4010, touched nodes [2635/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4010, touched nodes [2635/3649] : 3%|#2 | 6/183 [00:02<01:16, 2.32it/s]GraphSAGE Epoch: [5/5], current loss: 7.3769, touched nodes [2755/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3769, touched nodes [2755/3649] : 4%|#4 | 7/183 [00:02<01:14, 2.36it/s]GraphSAGE Epoch: [5/5], current loss: 7.2725, touched nodes [2864/3649]  GraphSAGE Epoch: [5/5], current loss: 7.2725, touched nodes [2864/3649] : 4%|#6 | 8/183 [00:03<01:14, 2.36it/s]GraphSAGE Epoch: [5/5], current loss: 7.3499, touched nodes [2986/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3499, touched nodes [2986/3649] : 5%|#8 | 9/183 [00:03<01:12, 2.39it/s]GraphSAGE Epoch: [5/5], current loss: 7.4298, touched nodes [3104/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4298, touched nodes [3104/3649] : 5%|#9 | 10/183 [00:04<01:11, 2.42it/s]GraphSAGE Epoch: [5/5], current loss: 7.4264, touched nodes [3178/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4264, touched nodes [3178/3649] : 6%|##1 | 11/183 [00:04<01:09, 2.49it/s]GraphSAGE Epoch: [5/5], current loss: 7.3548, touched nodes [3247/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3548, touched nodes [3247/3649] : 7%|##3 | 12/183 [00:05<01:09, 2.45it/s]GraphSAGE Epoch: [5/5], current loss: 7.3499, touched nodes [3277/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3499, touched nodes [3277/3649] : 7%|##5 | 13/183 [00:05<01:14, 2.27it/s]GraphSAGE Epoch: [5/5], current loss: 7.3638, touched nodes [3338/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3638, touched nodes [3338/3649] : 8%|##7 | 14/183 [00:05<01:13, 2.29it/s]GraphSAGE Epoch: [5/5], current loss: 7.3539, touched nodes [3370/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3539, touched nodes [3370/3649] : 8%|##9 | 15/183 [00:06<01:13, 2.28it/s]GraphSAGE Epoch: [5/5], current loss: 7.3739, touched nodes [3406/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3739, touched nodes [3406/3649] : 9%|###1 | 16/183 [00:06<01:12, 2.29it/s]GraphSAGE Epoch: [5/5], current loss: 7.3772, touched nodes [3440/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3772, touched nodes [3440/3649] : 9%|###3 | 17/183 [00:08<02:08, 1.29it/s]GraphSAGE Epoch: [5/5], current loss: 7.4018, touched nodes [3476/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4018, touched nodes [3476/3649] : 10%|###5 | 18/183 [00:09<02:27, 1.12it/s]GraphSAGE Epoch: [5/5], current loss: 7.3625, touched nodes [3490/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3625, touched nodes [3490/3649] : 10%|###7 | 19/183 [00:10<02:32, 1.08it/s]GraphSAGE Epoch: [5/5], current loss: 7.3559, touched nodes [3502/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3559, touched nodes [3502/3649] : 11%|###9 | 20/183 [00:11<02:16, 1.19it/s]GraphSAGE Epoch: [5/5], current loss: 7.4173, touched nodes [3524/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4173, touched nodes [3524/3649] : 11%|####1 | 21/183 [00:11<02:01, 1.33it/s]GraphSAGE Epoch: [5/5], current loss: 7.4274, touched nodes [3540/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4274, touched nodes [3540/3649] : 12%|####3 | 22/183 [00:12<01:50, 1.46it/s]GraphSAGE Epoch: [5/5], current loss: 7.3921, touched nodes [3556/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3921, touched nodes [3556/3649] : 13%|####5 | 23/183 [00:12<01:44, 1.54it/s]GraphSAGE Epoch: [5/5], current loss: 7.3805, touched nodes [3570/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3805, touched nodes [3570/3649] : 13%|####7 | 24/183 [00:13<01:39, 1.60it/s]GraphSAGE Epoch: [5/5], current loss: 7.4082, touched nodes [3571/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4082, touched nodes [3571/3649] : 14%|####9 | 25/183 [00:14<01:37, 1.63it/s]GraphSAGE Epoch: [5/5], current loss: 7.4162, touched nodes [3578/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4162, touched nodes [3578/3649] : 14%|#####1 | 26/183 [00:14<01:35, 1.65it/s]GraphSAGE Epoch: [5/5], current loss: 7.3942, touched nodes [3587/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3942, touched nodes [3587/3649] : 15%|#####3 | 27/183 [00:15<01:40, 1.55it/s]GraphSAGE Epoch: [5/5], current loss: 7.3701, touched nodes [3593/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3701, touched nodes [3593/3649] : 15%|#####5 | 28/183 [00:15<01:36, 1.61it/s]GraphSAGE Epoch: [5/5], current loss: 7.3890, touched nodes [3602/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3890, touched nodes [3602/3649] : 16%|#####7 | 29/183 [00:16<01:31, 1.68it/s]GraphSAGE Epoch: [5/5], current loss: 7.3129, touched nodes [3605/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3129, touched nodes [3605/3649] : 16%|#####9 | 30/183 [00:17<01:30, 1.68it/s]GraphSAGE Epoch: [5/5], current loss: 7.4140, touched nodes [3610/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4140, touched nodes [3610/3649] : 17%|###### | 31/183 [00:17<01:28, 1.72it/s]GraphSAGE Epoch: [5/5], current loss: 7.4031, touched nodes [3617/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4031, touched nodes [3617/3649] : 17%|######2 | 32/183 [00:18<01:26, 1.74it/s]GraphSAGE Epoch: [5/5], current loss: 7.4947, touched nodes [3619/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4947, touched nodes [3619/3649] : 18%|######4 | 33/183 [00:18<01:38, 1.52it/s]GraphSAGE Epoch: [5/5], current loss: 7.5389, touched nodes [3622/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5389, touched nodes [3622/3649] : 19%|######6 | 34/183 [00:19<01:37, 1.53it/s]GraphSAGE Epoch: [5/5], current loss: 7.4647, touched nodes [3625/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4647, touched nodes [3625/3649] : 19%|######8 | 35/183 [00:20<01:34, 1.57it/s]GraphSAGE Epoch: [5/5], current loss: 7.5175, touched nodes [3625/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5175, touched nodes [3625/3649] : 20%|####### | 36/183 [00:20<01:31, 1.61it/s]GraphSAGE Epoch: [5/5], current loss: 7.5448, touched nodes [3628/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5448, touched nodes [3628/3649] : 20%|#######2 | 37/183 [00:21<01:28, 1.65it/s]GraphSAGE Epoch: [5/5], current loss: 7.5412, touched nodes [3628/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5412, touched nodes [3628/3649] : 21%|#######4 | 38/183 [00:21<01:25, 1.70it/s]GraphSAGE Epoch: [5/5], current loss: 7.5404, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5404, touched nodes [3631/3649] : 21%|#######6 | 39/183 [00:22<01:24, 1.71it/s]GraphSAGE Epoch: [5/5], current loss: 7.5113, touched nodes [3633/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5113, touched nodes [3633/3649] : 22%|#######8 | 40/183 [00:23<01:23, 1.72it/s]GraphSAGE Epoch: [5/5], current loss: 7.5143, touched nodes [3635/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5143, touched nodes [3635/3649] : 22%|######## | 41/183 [00:23<01:22, 1.73it/s]GraphSAGE Epoch: [5/5], current loss: 7.5166, touched nodes [3635/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5166, touched nodes [3635/3649] : 23%|########2 | 42/183 [00:24<01:30, 1.57it/s]GraphSAGE Epoch: [5/5], current loss: 7.5360, touched nodes [3637/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5360, touched nodes [3637/3649] : 23%|########4 | 43/183 [00:25<01:27, 1.59it/s]GraphSAGE Epoch: [5/5], current loss: 7.4445, touched nodes [3637/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4445, touched nodes [3637/3649] : 24%|########6 | 44/183 [00:25<01:26, 1.60it/s]GraphSAGE Epoch: [5/5], current loss: 7.4726, touched nodes [3638/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4726, touched nodes [3638/3649] : 25%|########8 | 45/183 [00:26<01:23, 1.66it/s]GraphSAGE Epoch: [5/5], current loss: 7.4890, touched nodes [3638/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4890, touched nodes [3638/3649] : 25%|######### | 46/183 [00:26<01:21, 1.67it/s]GraphSAGE Epoch: [5/5], current loss: 7.5201, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5201, touched nodes [3640/3649] : 26%|#########2 | 47/183 [00:27<01:18, 1.74it/s]GraphSAGE Epoch: [5/5], current loss: 7.4744, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4744, touched nodes [3642/3649] : 26%|#########4 | 48/183 [00:27<01:17, 1.73it/s]GraphSAGE Epoch: [5/5], current loss: 7.4423, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4423, touched nodes [3642/3649] : 27%|#########6 | 49/183 [00:28<01:26, 1.54it/s]GraphSAGE Epoch: [5/5], current loss: 7.4527, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4527, touched nodes [3642/3649] : 27%|#########8 | 50/183 [00:29<01:23, 1.59it/s]GraphSAGE Epoch: [5/5], current loss: 7.5384, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5384, touched nodes [3643/3649] : 28%|########## | 51/183 [00:29<01:24, 1.56it/s]GraphSAGE Epoch: [5/5], current loss: 7.4450, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4450, touched nodes [3643/3649] : 28%|##########2 | 52/183 [00:30<01:22, 1.59it/s]GraphSAGE Epoch: [5/5], current loss: 7.4581, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4581, touched nodes [3643/3649] : 29%|##########4 | 53/183 [00:31<01:18, 1.65it/s]GraphSAGE Epoch: [5/5], current loss: 7.4682, touched nodes [3645/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4682, touched nodes [3645/3649] : 30%|##########6 | 54/183 [00:31<01:17, 1.67it/s]GraphSAGE Epoch: [5/5], current loss: 7.4964, touched nodes [3645/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4964, touched nodes [3645/3649] : 30%|##########8 | 55/183 [00:32<01:17, 1.65it/s]GraphSAGE Epoch: [5/5], current loss: 7.4563, touched nodes [3646/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4563, touched nodes [3646/3649] : 31%|########### | 56/183 [00:32<01:16, 1.66it/s]GraphSAGE Epoch: [5/5], current loss: 7.4930, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4930, touched nodes [3647/3649] : 31%|###########2 | 57/183 [00:33<01:15, 1.66it/s]GraphSAGE Epoch: [5/5], current loss: 7.4101, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4101, touched nodes [3647/3649] : 32%|###########4 | 58/183 [00:34<01:22, 1.51it/s]GraphSAGE Epoch: [5/5], current loss: 7.4098, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4098, touched nodes [3648/3649] : 32%|###########6 | 59/183 [00:34<01:15, 1.64it/s]GraphSAGE Epoch: [5/5], current loss: 7.4404, touched nodes [3649/3649]  3649  <class 'numpy.ndarray'>  EDone |
| --- |

#### 2.1.3.3 Kết quả

| Score sil arg: 0.29595262 |
| --- |



### 2.1.4 Fine-tune mô hình lần 4

#### 2.1.4.1 Thông số hyperparameter

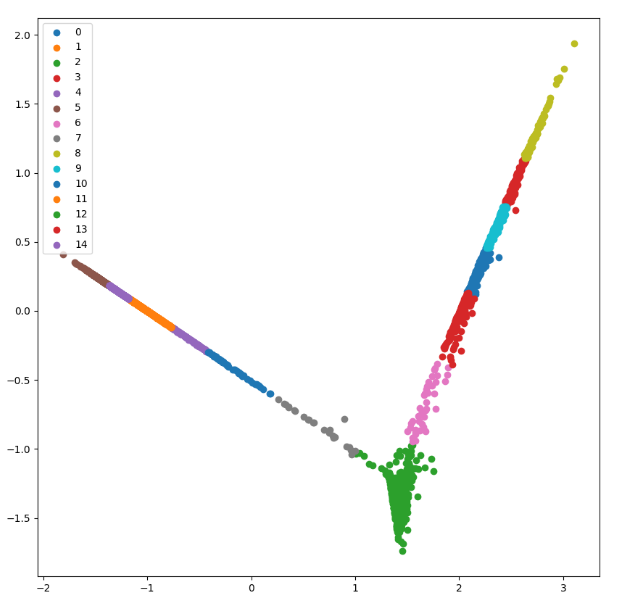
| feature\_weights = [0, 0.1304048, 0, 0.7227898, 0, 0.3818457]  raw\_features\_file\_dir = 'raw\_features.pickle'  ########hyper parameter##################  numbers\_of\_hst\_films = 10  numbers\_of\_user = 4000  emb\_size=128  prefer\_threshold = 0.1  score\_threshold = 0.35  device = "cuda:0"  loss = 'margin'  epochs = 50  lr = 0.1  model = 'graphsage' |
| --- |

#### 2.1.4.2 Kết quả training

| GraphSAGE Epoch: [4/5], current loss: 2.8114, touched nodes [3634/3649]  GraphSAGE Epoch: [4/5], current loss: 2.8114, touched nodes [3634/3649] : 63%|######################1 | 116/183 [00:46<00:27, 2.41it/s]GraphSAGE Epoch: [4/5], current loss: 2.7670, touched nodes [3634/3649]  GraphSAGE Epoch: [4/5], current loss: 2.7670, touched nodes [3634/3649] : 64%|######################3 | 117/183 [00:46<00:27, 2.42it/s]GraphSAGE Epoch: [4/5], current loss: 2.8035, touched nodes [3634/3649]  GraphSAGE Epoch: [4/5], current loss: 2.8035, touched nodes [3634/3649] : 64%|######################5 | 118/183 [00:47<00:26, 2.46it/s]GraphSAGE Epoch: [4/5], current loss: 2.7864, touched nodes [3634/3649]  GraphSAGE Epoch: [4/5], current loss: 2.7864, touched nodes [3634/3649] : 65%|######################7 | 119/183 [00:47<00:26, 2.44it/s]GraphSAGE Epoch: [4/5], current loss: 2.7948, touched nodes [3636/3649]  GraphSAGE Epoch: [4/5], current loss: 2.7948, touched nodes [3636/3649] : 66%|######################9 | 120/183 [00:47<00:25, 2.46it/s]GraphSAGE Epoch: [4/5], current loss: 2.7330, touched nodes [3637/3649]  GraphSAGE Epoch: [4/5], current loss: 2.7330, touched nodes [3637/3649] : 66%|#######################1 | 121/183 [00:48<00:24, 2.53it/s]GraphSAGE Epoch: [4/5], current loss: 2.7020, touched nodes [3637/3649]  GraphSAGE Epoch: [4/5], current loss: 2.7020, touched nodes [3637/3649] : 67%|#######################3 | 122/183 [00:48<00:23, 2.55it/s]GraphSAGE Epoch: [4/5], current loss: 2.7745, touched nodes [3637/3649]  GraphSAGE Epoch: [4/5], current loss: 2.7745, touched nodes [3637/3649] : 67%|#######################5 | 123/183 [00:49<00:23, 2.52it/s]GraphSAGE Epoch: [4/5], current loss: 2.7027, touched nodes [3638/3649]  GraphSAGE Epoch: [4/5], current loss: 2.7027, touched nodes [3638/3649] : 68%|#######################7 | 124/183 [00:49<00:23, 2.52it/s]GraphSAGE Epoch: [4/5], current loss: 2.7356, touched nodes [3638/3649]  GraphSAGE Epoch: [4/5], current loss: 2.7356, touched nodes [3638/3649] : 68%|#######################9 | 125/183 [00:49<00:23, 2.52it/s]GraphSAGE Epoch: [4/5], current loss: 2.7905, touched nodes [3638/3649]  GraphSAGE Epoch: [4/5], current loss: 2.7905, touched nodes [3638/3649] : 69%|######################## | 126/183 [00:50<00:23, 2.47it/s]GraphSAGE Epoch: [4/5], current loss: 2.9850, touched nodes [3638/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9850, touched nodes [3638/3649] : 69%|########################2 | 127/183 [00:50<00:22, 2.46it/s]GraphSAGE Epoch: [4/5], current loss: 2.9359, touched nodes [3638/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9359, touched nodes [3638/3649] : 70%|########################4 | 128/183 [00:51<00:22, 2.50it/s]GraphSAGE Epoch: [4/5], current loss: 2.8822, touched nodes [3638/3649]  GraphSAGE Epoch: [4/5], current loss: 2.8822, touched nodes [3638/3649] : 70%|########################6 | 129/183 [00:51<00:21, 2.51it/s]GraphSAGE Epoch: [4/5], current loss: 2.8450, touched nodes [3640/3649]  GraphSAGE Epoch: [4/5], current loss: 2.8450, touched nodes [3640/3649] : 71%|########################8 | 130/183 [00:51<00:20, 2.62it/s]GraphSAGE Epoch: [4/5], current loss: 2.9647, touched nodes [3640/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9647, touched nodes [3640/3649] : 72%|######################### | 131/183 [00:52<00:19, 2.61it/s]GraphSAGE Epoch: [4/5], current loss: 2.9998, touched nodes [3641/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9998, touched nodes [3641/3649] : 72%|#########################2 | 132/183 [00:52<00:19, 2.62it/s]GraphSAGE Epoch: [4/5], current loss: 2.9997, touched nodes [3642/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9997, touched nodes [3642/3649] : 73%|#########################4 | 133/183 [00:52<00:19, 2.53it/s]GraphSAGE Epoch: [4/5], current loss: 2.9998, touched nodes [3643/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9998, touched nodes [3643/3649] : 73%|#########################6 | 134/183 [00:53<00:19, 2.49it/s]GraphSAGE Epoch: [4/5], current loss: 2.9996, touched nodes [3643/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9996, touched nodes [3643/3649] : 74%|#########################8 | 135/183 [00:53<00:19, 2.51it/s]GraphSAGE Epoch: [4/5], current loss: 2.9995, touched nodes [3643/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9995, touched nodes [3643/3649] : 74%|########################## | 136/183 [00:54<00:18, 2.54it/s]GraphSAGE Epoch: [4/5], current loss: 2.9996, touched nodes [3643/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9996, touched nodes [3643/3649] : 75%|##########################2 | 137/183 [00:54<00:18, 2.49it/s]GraphSAGE Epoch: [4/5], current loss: 2.9993, touched nodes [3643/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9993, touched nodes [3643/3649] : 75%|##########################3 | 138/183 [00:54<00:17, 2.54it/s]GraphSAGE Epoch: [4/5], current loss: 2.9996, touched nodes [3643/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9996, touched nodes [3643/3649] : 76%|##########################5 | 139/183 [00:55<00:16, 2.62it/s]GraphSAGE Epoch: [4/5], current loss: 2.9997, touched nodes [3643/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9997, touched nodes [3643/3649] : 77%|##########################7 | 140/183 [00:55<00:16, 2.59it/s]GraphSAGE Epoch: [4/5], current loss: 2.9995, touched nodes [3643/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9995, touched nodes [3643/3649] : 77%|##########################9 | 141/183 [00:56<00:15, 2.66it/s]GraphSAGE Epoch: [4/5], current loss: 2.9995, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9995, touched nodes [3644/3649] : 78%|###########################1 | 142/183 [00:56<00:16, 2.43it/s]GraphSAGE Epoch: [4/5], current loss: 2.9995, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9995, touched nodes [3644/3649] : 78%|###########################3 | 143/183 [00:56<00:16, 2.45it/s]GraphSAGE Epoch: [4/5], current loss: 2.9996, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9996, touched nodes [3644/3649] : 79%|###########################5 | 144/183 [00:57<00:15, 2.47it/s]GraphSAGE Epoch: [4/5], current loss: 2.9996, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9996, touched nodes [3644/3649] : 79%|###########################7 | 145/183 [00:57<00:15, 2.48it/s]GraphSAGE Epoch: [4/5], current loss: 2.9992, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9992, touched nodes [3644/3649] : 80%|###########################9 | 146/183 [00:58<00:14, 2.52it/s]GraphSAGE Epoch: [4/5], current loss: 2.9995, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9995, touched nodes [3644/3649] : 80%|############################1 | 147/183 [00:58<00:14, 2.47it/s]GraphSAGE Epoch: [4/5], current loss: 2.9993, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9993, touched nodes [3644/3649] : 81%|############################3 | 148/183 [00:58<00:13, 2.54it/s]GraphSAGE Epoch: [4/5], current loss: 2.9990, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9990, touched nodes [3644/3649] : 81%|############################4 | 149/183 [00:59<00:13, 2.52it/s]GraphSAGE Epoch: [4/5], current loss: 2.9990, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9990, touched nodes [3644/3649] : 82%|############################6 | 150/183 [00:59<00:12, 2.57it/s]GraphSAGE Epoch: [4/5], current loss: 2.9993, touched nodes [3644/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9993, touched nodes [3644/3649] : 83%|############################8 | 151/183 [01:00<00:12, 2.51it/s]GraphSAGE Epoch: [4/5], current loss: 2.9990, touched nodes [3646/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9990, touched nodes [3646/3649] : 83%|############################# | 152/183 [01:00<00:12, 2.50it/s]GraphSAGE Epoch: [4/5], current loss: 2.9991, touched nodes [3646/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9991, touched nodes [3646/3649] : 84%|#############################2 | 153/183 [01:00<00:12, 2.49it/s]GraphSAGE Epoch: [4/5], current loss: 2.9992, touched nodes [3646/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9992, touched nodes [3646/3649] : 84%|#############################4 | 154/183 [01:01<00:11, 2.53it/s]GraphSAGE Epoch: [4/5], current loss: 2.9992, touched nodes [3646/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9992, touched nodes [3646/3649] : 85%|#############################6 | 155/183 [01:01<00:11, 2.51it/s]GraphSAGE Epoch: [4/5], current loss: 2.9990, touched nodes [3646/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9990, touched nodes [3646/3649] : 85%|#############################8 | 156/183 [01:02<00:10, 2.52it/s]GraphSAGE Epoch: [4/5], current loss: 2.9989, touched nodes [3646/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9989, touched nodes [3646/3649] : 86%|############################## | 157/183 [01:02<00:10, 2.43it/s]GraphSAGE Epoch: [4/5], current loss: 2.9987, touched nodes [3646/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9987, touched nodes [3646/3649] : 86%|##############################2 | 158/183 [01:03<00:10, 2.38it/s]GraphSAGE Epoch: [4/5], current loss: 2.9989, touched nodes [3646/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9989, touched nodes [3646/3649] : 87%|##############################4 | 159/183 [01:03<00:09, 2.51it/s]GraphSAGE Epoch: [4/5], current loss: 2.9985, touched nodes [3647/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9985, touched nodes [3647/3649] : 87%|##############################6 | 160/183 [01:03<00:09, 2.48it/s]GraphSAGE Epoch: [4/5], current loss: 2.9982, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9982, touched nodes [3648/3649] : 88%|##############################7 | 161/183 [01:04<00:08, 2.48it/s]GraphSAGE Epoch: [4/5], current loss: 2.9987, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9987, touched nodes [3648/3649] : 89%|##############################9 | 162/183 [01:04<00:08, 2.52it/s]GraphSAGE Epoch: [4/5], current loss: 2.9987, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9987, touched nodes [3648/3649] : 89%|###############################1 | 163/183 [01:04<00:08, 2.47it/s]GraphSAGE Epoch: [4/5], current loss: 2.9989, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9989, touched nodes [3648/3649] : 90%|###############################3 | 164/183 [01:05<00:07, 2.49it/s]GraphSAGE Epoch: [4/5], current loss: 2.9981, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9981, touched nodes [3648/3649] : 90%|###############################5 | 165/183 [01:05<00:07, 2.45it/s]GraphSAGE Epoch: [4/5], current loss: 2.9988, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9988, touched nodes [3648/3649] : 91%|###############################7 | 166/183 [01:06<00:07, 2.29it/s]GraphSAGE Epoch: [4/5], current loss: 2.9982, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9982, touched nodes [3648/3649] : 91%|###############################9 | 167/183 [01:06<00:06, 2.29it/s]GraphSAGE Epoch: [4/5], current loss: 2.9984, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9984, touched nodes [3648/3649] : 92%|################################1 | 168/183 [01:07<00:06, 2.38it/s]GraphSAGE Epoch: [4/5], current loss: 2.9982, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9982, touched nodes [3648/3649] : 92%|################################3 | 169/183 [01:07<00:05, 2.42it/s]GraphSAGE Epoch: [4/5], current loss: 2.9979, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9979, touched nodes [3648/3649] : 93%|################################5 | 170/183 [01:07<00:05, 2.43it/s]GraphSAGE Epoch: [4/5], current loss: 2.9982, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9982, touched nodes [3648/3649] : 93%|################################7 | 171/183 [01:08<00:04, 2.49it/s]GraphSAGE Epoch: [4/5], current loss: 2.9971, touched nodes [3648/3649]  GraphSAGE Epoch: [4/5], current loss: 2.9971, touched nodes [3648/3649] : 94%|################################8 | 172/183 [01:08<00:04, 2.54it/s]GraphSAGE Epoch: [4/5], current loss: 2.9980, touched nodes [3649/3649]  0%| | 0/183 [00:00<?, ?it/s]GraphSAGE Epoch: [5/5], current loss: 2.9975, touched nodes [377/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9975, touched nodes [377/3649] : 1%|2 | 1/183 [00:00<01:11, 2.53it/s]GraphSAGE Epoch: [5/5], current loss: 2.9973, touched nodes [731/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9973, touched nodes [731/3649] : 1%|4 | 2/183 [00:00<01:17, 2.34it/s]GraphSAGE Epoch: [5/5], current loss: 2.9978, touched nodes [1006/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9978, touched nodes [1006/3649] : 2%|6 | 3/183 [00:01<01:14, 2.41it/s]GraphSAGE Epoch: [5/5], current loss: 2.9966, touched nodes [1272/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9966, touched nodes [1272/3649] : 2%|8 | 4/183 [00:01<01:11, 2.51it/s]GraphSAGE Epoch: [5/5], current loss: 2.9974, touched nodes [1488/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9974, touched nodes [1488/3649] : 3%|# | 5/183 [00:02<01:11, 2.50it/s]GraphSAGE Epoch: [5/5], current loss: 2.9970, touched nodes [1668/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9970, touched nodes [1668/3649] : 3%|#2 | 6/183 [00:02<01:12, 2.43it/s]GraphSAGE Epoch: [5/5], current loss: 2.9964, touched nodes [1830/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9964, touched nodes [1830/3649] : 4%|#4 | 7/183 [00:02<01:11, 2.47it/s]GraphSAGE Epoch: [5/5], current loss: 2.9954, touched nodes [1967/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9954, touched nodes [1967/3649] : 4%|#6 | 8/183 [00:03<01:11, 2.46it/s]GraphSAGE Epoch: [5/5], current loss: 2.9971, touched nodes [2104/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9971, touched nodes [2104/3649] : 5%|#8 | 9/183 [00:03<01:09, 2.51it/s]GraphSAGE Epoch: [5/5], current loss: 2.9965, touched nodes [2220/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9965, touched nodes [2220/3649] : 5%|#9 | 10/183 [00:04<01:07, 2.56it/s]GraphSAGE Epoch: [5/5], current loss: 2.9977, touched nodes [2337/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9977, touched nodes [2337/3649] : 6%|##1 | 11/183 [00:04<01:04, 2.66it/s]GraphSAGE Epoch: [5/5], current loss: 2.9950, touched nodes [2452/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9950, touched nodes [2452/3649] : 7%|##3 | 12/183 [00:04<01:05, 2.62it/s]GraphSAGE Epoch: [5/5], current loss: 2.9946, touched nodes [2545/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9946, touched nodes [2545/3649] : 7%|##5 | 13/183 [00:05<01:06, 2.57it/s]GraphSAGE Epoch: [5/5], current loss: 2.9966, touched nodes [2628/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9966, touched nodes [2628/3649] : 8%|##7 | 14/183 [00:05<01:12, 2.34it/s]GraphSAGE Epoch: [5/5], current loss: 2.9951, touched nodes [2700/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9951, touched nodes [2700/3649] : 8%|##9 | 15/183 [00:06<01:09, 2.41it/s]GraphSAGE Epoch: [5/5], current loss: 2.9956, touched nodes [2765/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9956, touched nodes [2765/3649] : 9%|###1 | 16/183 [00:06<01:08, 2.44it/s]GraphSAGE Epoch: [5/5], current loss: 2.9948, touched nodes [2826/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9948, touched nodes [2826/3649] : 9%|###3 | 17/183 [00:06<01:08, 2.41it/s]GraphSAGE Epoch: [5/5], current loss: 2.9951, touched nodes [2880/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9951, touched nodes [2880/3649] : 10%|###5 | 18/183 [00:07<01:06, 2.48it/s]GraphSAGE Epoch: [5/5], current loss: 2.9952, touched nodes [2929/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9952, touched nodes [2929/3649] : 10%|###7 | 19/183 [00:07<01:06, 2.47it/s]GraphSAGE Epoch: [5/5], current loss: 2.9938, touched nodes [2976/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9938, touched nodes [2976/3649] : 11%|###9 | 20/183 [00:08<01:06, 2.44it/s]GraphSAGE Epoch: [5/5], current loss: 2.9931, touched nodes [3009/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9931, touched nodes [3009/3649] : 11%|####1 | 21/183 [00:08<01:07, 2.41it/s]GraphSAGE Epoch: [5/5], current loss: 2.9954, touched nodes [3055/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9954, touched nodes [3055/3649] : 12%|####3 | 22/183 [00:08<01:04, 2.48it/s]GraphSAGE Epoch: [5/5], current loss: 2.9951, touched nodes [3089/3649]  GraphSAGE Epoch: [5/5], current loss: 2.9951, touched nodes [3089/3649] : 13%|####5 | 23/183 [00:09<01:03, 2.52it/s]GraphSAGE Epoch: [5/5], current loss: 2.9942, touched nodes [3125/3649] |
| --- |

#### 2.1.4.3 Kết quả

| Score sil arg: 0.28856885 |
| --- |



### 2.1.5 Fine-tune mô hình lần 5

#### 2.1.5.1 Thông số hyperparameter

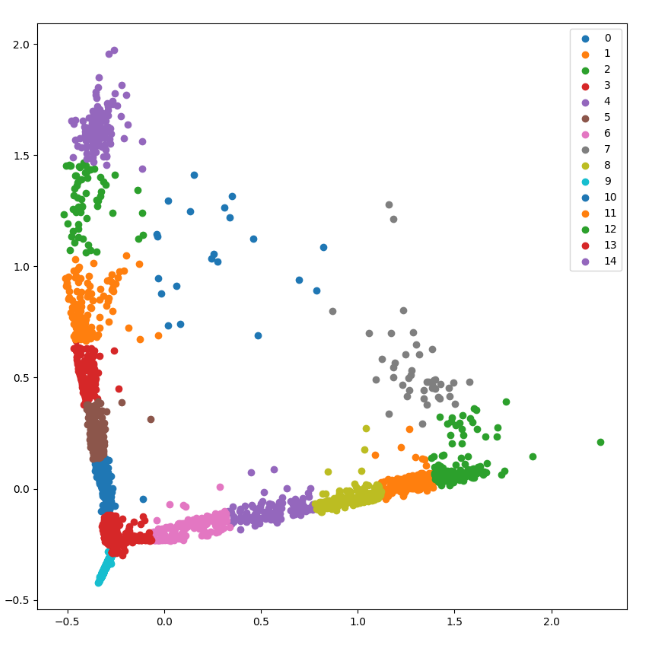
| feature\_weights = [0, 0.1304048, 0, 0.7227898, 0, 0.3818457]  raw\_features\_file\_dir = 'raw\_features.pickle'  ########hyper parameter##################  numbers\_of\_hst\_films = 10  numbers\_of\_user = 4000  prefer\_threshold = 0.1  score\_threshold = 0.5  device = "cuda:0"  loss = 'margin'  epochs = 20  lr = 0.1  model = 'graphsage'  n\_layer=3 |
| --- |

#### 2.1.5.2 Kết quả training

| GraphSAGE Epoch: [17/20], current loss: 2.8043, touched nodes [3596/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8043, touched nodes [3596/3649] : 37%|############6 | 68/183 [00:08<00:11, 9.95it/s]GraphSAGE Epoch: [17/20], current loss: 2.7569, touched nodes [3600/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7569, touched nodes [3600/3649] : 37%|############6 | 68/183 [00:08<00:11, 9.95it/s]GraphSAGE Epoch: [17/20], current loss: 2.8053, touched nodes [3605/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8053, touched nodes [3605/3649] : 38%|############# | 70/183 [00:08<00:11, 10.02it/s]GraphSAGE Epoch: [17/20], current loss: 2.7621, touched nodes [3605/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7621, touched nodes [3605/3649] : 39%|#############1 | 71/183 [00:08<00:11, 9.99it/s]GraphSAGE Epoch: [17/20], current loss: 2.8458, touched nodes [3605/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8458, touched nodes [3605/3649] : 39%|#############3 | 72/183 [00:08<00:11, 9.94it/s]GraphSAGE Epoch: [17/20], current loss: 2.7953, touched nodes [3607/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7953, touched nodes [3607/3649] : 39%|#############3 | 72/183 [00:08<00:11, 9.94it/s]GraphSAGE Epoch: [17/20], current loss: 2.7655, touched nodes [3612/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7655, touched nodes [3612/3649] : 40%|#############7 | 74/183 [00:08<00:11, 9.83it/s]GraphSAGE Epoch: [17/20], current loss: 2.7757, touched nodes [3613/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7757, touched nodes [3613/3649] : 40%|#############7 | 74/183 [00:08<00:11, 9.83it/s]GraphSAGE Epoch: [17/20], current loss: 2.8129, touched nodes [3615/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8129, touched nodes [3615/3649] : 42%|##############1 | 76/183 [00:08<00:10, 9.78it/s]GraphSAGE Epoch: [17/20], current loss: 2.8127, touched nodes [3615/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8127, touched nodes [3615/3649] : 42%|##############3 | 77/183 [00:09<00:13, 8.11it/s]GraphSAGE Epoch: [17/20], current loss: 2.7834, touched nodes [3616/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7834, touched nodes [3616/3649] : 43%|##############4 | 78/183 [00:09<00:12, 8.36it/s]GraphSAGE Epoch: [17/20], current loss: 2.7976, touched nodes [3617/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7976, touched nodes [3617/3649] : 43%|##############4 | 78/183 [00:09<00:12, 8.36it/s]GraphSAGE Epoch: [17/20], current loss: 2.8271, touched nodes [3618/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8271, touched nodes [3618/3649] : 44%|##############8 | 80/183 [00:09<00:11, 8.92it/s]GraphSAGE Epoch: [17/20], current loss: 2.8199, touched nodes [3620/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8199, touched nodes [3620/3649] : 44%|############### | 81/183 [00:09<00:11, 9.09it/s]GraphSAGE Epoch: [17/20], current loss: 2.7544, touched nodes [3623/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7544, touched nodes [3623/3649] : 45%|###############2 | 82/183 [00:09<00:11, 8.84it/s]GraphSAGE Epoch: [17/20], current loss: 2.7871, touched nodes [3624/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7871, touched nodes [3624/3649] : 45%|###############4 | 83/183 [00:09<00:11, 9.08it/s]GraphSAGE Epoch: [17/20], current loss: 2.8137, touched nodes [3626/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8137, touched nodes [3626/3649] : 46%|###############6 | 84/183 [00:09<00:10, 9.25it/s]GraphSAGE Epoch: [17/20], current loss: 2.8345, touched nodes [3628/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8345, touched nodes [3628/3649] : 46%|###############7 | 85/183 [00:09<00:11, 8.68it/s]GraphSAGE Epoch: [17/20], current loss: 2.7870, touched nodes [3629/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7870, touched nodes [3629/3649] : 47%|###############9 | 86/183 [00:10<00:11, 8.80it/s]GraphSAGE Epoch: [17/20], current loss: 2.8891, touched nodes [3630/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8891, touched nodes [3630/3649] : 48%|################1 | 87/183 [00:10<00:10, 8.99it/s]GraphSAGE Epoch: [17/20], current loss: 2.7306, touched nodes [3630/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7306, touched nodes [3630/3649] : 48%|################3 | 88/183 [00:10<00:10, 8.93it/s]GraphSAGE Epoch: [17/20], current loss: 2.8226, touched nodes [3631/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8226, touched nodes [3631/3649] : 49%|################5 | 89/183 [00:10<00:10, 8.98it/s]GraphSAGE Epoch: [17/20], current loss: 2.9103, touched nodes [3632/3649]  GraphSAGE Epoch: [17/20], current loss: 2.9103, touched nodes [3632/3649] : 49%|################7 | 90/183 [00:10<00:10, 9.25it/s]GraphSAGE Epoch: [17/20], current loss: 2.8388, touched nodes [3632/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8388, touched nodes [3632/3649] : 50%|################9 | 91/183 [00:10<00:09, 9.33it/s]GraphSAGE Epoch: [17/20], current loss: 2.8053, touched nodes [3632/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8053, touched nodes [3632/3649] : 50%|################# | 92/183 [00:10<00:09, 9.47it/s]GraphSAGE Epoch: [17/20], current loss: 2.8786, touched nodes [3634/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8786, touched nodes [3634/3649] : 51%|#################2 | 93/183 [00:10<00:09, 9.52it/s]GraphSAGE Epoch: [17/20], current loss: 2.7547, touched nodes [3635/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7547, touched nodes [3635/3649] : 51%|#################2 | 93/183 [00:10<00:09, 9.52it/s]GraphSAGE Epoch: [17/20], current loss: 2.8561, touched nodes [3635/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8561, touched nodes [3635/3649] : 52%|#################6 | 95/183 [00:10<00:09, 9.69it/s]GraphSAGE Epoch: [17/20], current loss: 2.8642, touched nodes [3635/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8642, touched nodes [3635/3649] : 52%|#################8 | 96/183 [00:11<00:08, 9.74it/s]GraphSAGE Epoch: [17/20], current loss: 2.8043, touched nodes [3636/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8043, touched nodes [3636/3649] : 52%|#################8 | 96/183 [00:11<00:08, 9.74it/s]GraphSAGE Epoch: [17/20], current loss: 2.7881, touched nodes [3637/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7881, touched nodes [3637/3649] : 54%|##################2 | 98/183 [00:11<00:08, 9.82it/s]GraphSAGE Epoch: [17/20], current loss: 2.7977, touched nodes [3638/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7977, touched nodes [3638/3649] : 54%|##################3 | 99/183 [00:11<00:08, 9.83it/s]GraphSAGE Epoch: [17/20], current loss: 2.7425, touched nodes [3638/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7425, touched nodes [3638/3649] : 54%|##################3 | 99/183 [00:11<00:08, 9.83it/s]GraphSAGE Epoch: [17/20], current loss: 2.7274, touched nodes [3639/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7274, touched nodes [3639/3649] : 55%|##################2 | 101/183 [00:11<00:08, 9.70it/s]GraphSAGE Epoch: [17/20], current loss: 2.7574, touched nodes [3641/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7574, touched nodes [3641/3649] : 56%|##################3 | 102/183 [00:11<00:08, 9.57it/s]GraphSAGE Epoch: [17/20], current loss: 2.7838, touched nodes [3643/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7838, touched nodes [3643/3649] : 56%|##################5 | 103/183 [00:11<00:10, 7.74it/s]GraphSAGE Epoch: [17/20], current loss: 2.8945, touched nodes [3643/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8945, touched nodes [3643/3649] : 57%|##################7 | 104/183 [00:12<00:09, 8.11it/s]GraphSAGE Epoch: [17/20], current loss: 2.7825, touched nodes [3644/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7825, touched nodes [3644/3649] : 57%|##################7 | 104/183 [00:12<00:09, 8.11it/s]GraphSAGE Epoch: [17/20], current loss: 2.8286, touched nodes [3644/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8286, touched nodes [3644/3649] : 58%|###################1 | 106/183 [00:12<00:08, 8.98it/s]GraphSAGE Epoch: [17/20], current loss: 2.7877, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7877, touched nodes [3645/3649] : 58%|###################2 | 107/183 [00:12<00:08, 9.07it/s]GraphSAGE Epoch: [17/20], current loss: 2.7466, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7466, touched nodes [3645/3649] : 58%|###################2 | 107/183 [00:12<00:08, 9.07it/s]GraphSAGE Epoch: [17/20], current loss: 2.7818, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7818, touched nodes [3645/3649] : 60%|###################6 | 109/183 [00:12<00:07, 9.60it/s]GraphSAGE Epoch: [17/20], current loss: 2.7456, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7456, touched nodes [3645/3649] : 60%|###################8 | 110/183 [00:12<00:07, 9.63it/s]GraphSAGE Epoch: [17/20], current loss: 2.7766, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7766, touched nodes [3645/3649] : 60%|###################8 | 110/183 [00:12<00:07, 9.63it/s]GraphSAGE Epoch: [17/20], current loss: 2.7900, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7900, touched nodes [3645/3649] : 61%|####################1 | 112/183 [00:12<00:07, 10.00it/s]GraphSAGE Epoch: [17/20], current loss: 2.7217, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7217, touched nodes [3645/3649] : 61%|####################1 | 112/183 [00:12<00:07, 10.00it/s]GraphSAGE Epoch: [17/20], current loss: 2.7960, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7960, touched nodes [3645/3649] : 62%|####################5 | 114/183 [00:12<00:06, 10.08it/s]GraphSAGE Epoch: [17/20], current loss: 2.7602, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7602, touched nodes [3645/3649] : 62%|####################5 | 114/183 [00:13<00:06, 10.08it/s]GraphSAGE Epoch: [17/20], current loss: 2.8166, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8166, touched nodes [3645/3649] : 63%|####################9 | 116/183 [00:13<00:06, 10.26it/s]GraphSAGE Epoch: [17/20], current loss: 2.8103, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8103, touched nodes [3645/3649] : 63%|####################9 | 116/183 [00:13<00:06, 10.26it/s]GraphSAGE Epoch: [17/20], current loss: 2.8535, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8535, touched nodes [3645/3649] : 64%|#####################2 | 118/183 [00:13<00:06, 10.09it/s]GraphSAGE Epoch: [17/20], current loss: 2.8366, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8366, touched nodes [3645/3649] : 64%|#####################2 | 118/183 [00:13<00:06, 10.09it/s]GraphSAGE Epoch: [17/20], current loss: 2.7863, touched nodes [3645/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7863, touched nodes [3645/3649] : 66%|#####################6 | 120/183 [00:13<00:06, 10.19it/s]GraphSAGE Epoch: [17/20], current loss: 2.7963, touched nodes [3646/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7963, touched nodes [3646/3649] : 66%|#####################6 | 120/183 [00:13<00:06, 10.19it/s]GraphSAGE Epoch: [17/20], current loss: 2.8124, touched nodes [3646/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8124, touched nodes [3646/3649] : 67%|###################### | 122/183 [00:13<00:06, 10.06it/s]GraphSAGE Epoch: [17/20], current loss: 2.7141, touched nodes [3646/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7141, touched nodes [3646/3649] : 67%|###################### | 122/183 [00:13<00:06, 10.06it/s]GraphSAGE Epoch: [17/20], current loss: 2.7615, touched nodes [3647/3649]  GraphSAGE Epoch: [17/20], current loss: 2.7615, touched nodes [3647/3649] : 68%|######################3 | 124/183 [00:13<00:05, 10.15it/s]GraphSAGE Epoch: [17/20], current loss: 2.8416, touched nodes [3647/3649]  GraphSAGE Epoch: [17/20], current loss: 2.8416, touched nodes [3647/3649] : 68%|######################3 | 124/183 [00:14<00:05, 10.15it/s]GraphSAGE Epoch: [17/20], current loss: 2.7874, touched nodes [3649/3649]  0%| | 0/183 [00:00<?, ?it/s]GraphSAGE Epoch: [18/20], current loss: 2.7646, touched nodes [295/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7646, touched nodes [295/3649] : 1%|1 | 1/183 [00:00<00:18, 9.98it/s]GraphSAGE Epoch: [18/20], current loss: 2.8421, touched nodes [560/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8421, touched nodes [560/3649] : 1%|3 | 2/183 [00:00<00:18, 9.88it/s]GraphSAGE Epoch: [18/20], current loss: 2.8374, touched nodes [791/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8374, touched nodes [791/3649] : 2%|5 | 3/183 [00:00<00:26, 6.70it/s]GraphSAGE Epoch: [18/20], current loss: 2.6813, touched nodes [989/3649]  GraphSAGE Epoch: [18/20], current loss: 2.6813, touched nodes [989/3649] : 2%|5 | 3/183 [00:00<00:26, 6.70it/s]GraphSAGE Epoch: [18/20], current loss: 2.8135, touched nodes [1171/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8135, touched nodes [1171/3649] : 3%|9 | 5/183 [00:00<00:22, 8.02it/s]GraphSAGE Epoch: [18/20], current loss: 2.7585, touched nodes [1359/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7585, touched nodes [1359/3649] : 3%|#1 | 6/183 [00:00<00:21, 8.38it/s]GraphSAGE Epoch: [18/20], current loss: 2.7896, touched nodes [1523/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7896, touched nodes [1523/3649] : 4%|#3 | 7/183 [00:00<00:20, 8.77it/s]GraphSAGE Epoch: [18/20], current loss: 2.7019, touched nodes [1663/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7019, touched nodes [1663/3649] : 4%|#3 | 7/183 [00:00<00:20, 8.77it/s]GraphSAGE Epoch: [18/20], current loss: 2.7809, touched nodes [1797/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7809, touched nodes [1797/3649] : 5%|#7 | 9/183 [00:01<00:18, 9.26it/s]GraphSAGE Epoch: [18/20], current loss: 2.8362, touched nodes [1920/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8362, touched nodes [1920/3649] : 5%|#8 | 10/183 [00:01<00:18, 9.38it/s]GraphSAGE Epoch: [18/20], current loss: 2.8330, touched nodes [2027/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8330, touched nodes [2027/3649] : 6%|## | 11/183 [00:01<00:18, 9.41it/s]GraphSAGE Epoch: [18/20], current loss: 2.7555, touched nodes [2113/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7555, touched nodes [2113/3649] : 7%|##2 | 12/183 [00:01<00:18, 9.49it/s]GraphSAGE Epoch: [18/20], current loss: 2.9262, touched nodes [2224/3649]  GraphSAGE Epoch: [18/20], current loss: 2.9262, touched nodes [2224/3649] : 7%|##2 | 12/183 [00:01<00:18, 9.49it/s]GraphSAGE Epoch: [18/20], current loss: 2.7941, touched nodes [2324/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7941, touched nodes [2324/3649] : 8%|##6 | 14/183 [00:01<00:17, 9.61it/s]GraphSAGE Epoch: [18/20], current loss: 2.7607, touched nodes [2399/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7607, touched nodes [2399/3649] : 8%|##6 | 14/183 [00:01<00:17, 9.61it/s]GraphSAGE Epoch: [18/20], current loss: 2.8836, touched nodes [2483/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8836, touched nodes [2483/3649] : 9%|##9 | 16/183 [00:01<00:17, 9.76it/s]GraphSAGE Epoch: [18/20], current loss: 2.8786, touched nodes [2570/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8786, touched nodes [2570/3649] : 9%|##9 | 16/183 [00:01<00:17, 9.76it/s]GraphSAGE Epoch: [18/20], current loss: 2.8913, touched nodes [2623/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8913, touched nodes [2623/3649] : 10%|###3 | 18/183 [00:01<00:16, 9.91it/s]GraphSAGE Epoch: [18/20], current loss: 2.8464, touched nodes [2677/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8464, touched nodes [2677/3649] : 10%|###5 | 19/183 [00:02<00:17, 9.38it/s]GraphSAGE Epoch: [18/20], current loss: 2.8411, touched nodes [2743/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8411, touched nodes [2743/3649] : 11%|###7 | 20/183 [00:02<00:18, 8.92it/s]GraphSAGE Epoch: [18/20], current loss: 2.8722, touched nodes [2788/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8722, touched nodes [2788/3649] : 11%|###7 | 20/183 [00:02<00:18, 8.92it/s]GraphSAGE Epoch: [18/20], current loss: 2.7900, touched nodes [2839/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7900, touched nodes [2839/3649] : 12%|#### | 22/183 [00:02<00:18, 8.91it/s]GraphSAGE Epoch: [18/20], current loss: 2.7694, touched nodes [2892/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7694, touched nodes [2892/3649] : 13%|####2 | 23/183 [00:02<00:17, 8.93it/s]GraphSAGE Epoch: [18/20], current loss: 2.8930, touched nodes [2938/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8930, touched nodes [2938/3649] : 13%|####2 | 23/183 [00:02<00:17, 8.93it/s]GraphSAGE Epoch: [18/20], current loss: 2.7196, touched nodes [2982/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7196, touched nodes [2982/3649] : 14%|####6 | 25/183 [00:02<00:20, 7.77it/s]GraphSAGE Epoch: [18/20], current loss: 2.7566, touched nodes [3026/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7566, touched nodes [3026/3649] : 14%|####8 | 26/183 [00:02<00:19, 8.15it/s]GraphSAGE Epoch: [18/20], current loss: 2.8356, touched nodes [3052/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8356, touched nodes [3052/3649] : 15%|##### | 27/183 [00:03<00:18, 8.51it/s]GraphSAGE Epoch: [18/20], current loss: 2.8787, touched nodes [3086/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8787, touched nodes [3086/3649] : 15%|#####2 | 28/183 [00:03<00:17, 8.83it/s]GraphSAGE Epoch: [18/20], current loss: 2.8570, touched nodes [3130/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8570, touched nodes [3130/3649] : 16%|#####3 | 29/183 [00:03<00:16, 9.08it/s]GraphSAGE Epoch: [18/20], current loss: 2.8422, touched nodes [3158/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8422, touched nodes [3158/3649] : 16%|#####3 | 29/183 [00:03<00:16, 9.08it/s]GraphSAGE Epoch: [18/20], current loss: 2.8088, touched nodes [3192/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8088, touched nodes [3192/3649] : 17%|#####7 | 31/183 [00:03<00:16, 9.48it/s]GraphSAGE Epoch: [18/20], current loss: 2.8388, touched nodes [3215/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8388, touched nodes [3215/3649] : 17%|#####9 | 32/183 [00:03<00:15, 9.53it/s]GraphSAGE Epoch: [18/20], current loss: 2.7962, touched nodes [3246/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7962, touched nodes [3246/3649] : 18%|######1 | 33/183 [00:03<00:15, 9.59it/s]GraphSAGE Epoch: [18/20], current loss: 2.7935, touched nodes [3272/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7935, touched nodes [3272/3649] : 18%|######1 | 33/183 [00:03<00:15, 9.59it/s]GraphSAGE Epoch: [18/20], current loss: 2.7857, touched nodes [3286/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7857, touched nodes [3286/3649] : 19%|######5 | 35/183 [00:03<00:15, 9.64it/s]GraphSAGE Epoch: [18/20], current loss: 2.7266, touched nodes [3305/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7266, touched nodes [3305/3649] : 20%|######6 | 36/183 [00:03<00:15, 9.63it/s]GraphSAGE Epoch: [18/20], current loss: 2.7646, touched nodes [3318/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7646, touched nodes [3318/3649] : 20%|######6 | 36/183 [00:04<00:15, 9.63it/s]GraphSAGE Epoch: [18/20], current loss: 2.7643, touched nodes [3335/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7643, touched nodes [3335/3649] : 21%|####### | 38/183 [00:04<00:14, 9.92it/s]GraphSAGE Epoch: [18/20], current loss: 2.7892, touched nodes [3355/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7892, touched nodes [3355/3649] : 21%|#######2 | 39/183 [00:04<00:14, 9.83it/s]GraphSAGE Epoch: [18/20], current loss: 2.8068, touched nodes [3371/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8068, touched nodes [3371/3649] : 22%|#######4 | 40/183 [00:04<00:14, 9.86it/s]GraphSAGE Epoch: [18/20], current loss: 2.7652, touched nodes [3384/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7652, touched nodes [3384/3649] : 22%|#######4 | 40/183 [00:04<00:14, 9.86it/s]GraphSAGE Epoch: [18/20], current loss: 2.7931, touched nodes [3400/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7931, touched nodes [3400/3649] : 23%|#######8 | 42/183 [00:04<00:14, 10.03it/s]GraphSAGE Epoch: [18/20], current loss: 2.7594, touched nodes [3414/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7594, touched nodes [3414/3649] : 23%|#######8 | 42/183 [00:04<00:14, 10.03it/s]GraphSAGE Epoch: [18/20], current loss: 2.7548, touched nodes [3436/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7548, touched nodes [3436/3649] : 24%|########1 | 44/183 [00:04<00:13, 10.07it/s]GraphSAGE Epoch: [18/20], current loss: 2.8090, touched nodes [3448/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8090, touched nodes [3448/3649] : 24%|########1 | 44/183 [00:04<00:13, 10.07it/s]GraphSAGE Epoch: [18/20], current loss: 2.7840, touched nodes [3458/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7840, touched nodes [3458/3649] : 25%|########5 | 46/183 [00:04<00:14, 9.75it/s]GraphSAGE Epoch: [18/20], current loss: 2.7438, touched nodes [3465/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7438, touched nodes [3465/3649] : 26%|########7 | 47/183 [00:05<00:16, 8.04it/s]GraphSAGE Epoch: [18/20], current loss: 2.7579, touched nodes [3482/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7579, touched nodes [3482/3649] : 26%|########9 | 48/183 [00:05<00:16, 8.27it/s]GraphSAGE Epoch: [18/20], current loss: 2.8013, touched nodes [3488/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8013, touched nodes [3488/3649] : 27%|#########1 | 49/183 [00:05<00:15, 8.49it/s]GraphSAGE Epoch: [18/20], current loss: 2.7394, touched nodes [3495/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7394, touched nodes [3495/3649] : 27%|#########2 | 50/183 [00:05<00:15, 8.76it/s]GraphSAGE Epoch: [18/20], current loss: 2.7950, touched nodes [3503/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7950, touched nodes [3503/3649] : 28%|#########4 | 51/183 [00:05<00:14, 8.97it/s]GraphSAGE Epoch: [18/20], current loss: 2.7825, touched nodes [3515/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7825, touched nodes [3515/3649] : 28%|#########4 | 51/183 [00:05<00:14, 8.97it/s]GraphSAGE Epoch: [18/20], current loss: 2.7571, touched nodes [3527/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7571, touched nodes [3527/3649] : 29%|#########8 | 53/183 [00:05<00:13, 9.36it/s]GraphSAGE Epoch: [18/20], current loss: 2.7556, touched nodes [3533/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7556, touched nodes [3533/3649] : 29%|#########8 | 53/183 [00:05<00:13, 9.36it/s]GraphSAGE Epoch: [18/20], current loss: 2.8715, touched nodes [3541/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8715, touched nodes [3541/3649] : 30%|##########2 | 55/183 [00:06<00:13, 9.53it/s]GraphSAGE Epoch: [18/20], current loss: 2.7896, touched nodes [3545/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7896, touched nodes [3545/3649] : 31%|##########4 | 56/183 [00:06<00:13, 9.58it/s]GraphSAGE Epoch: [18/20], current loss: 2.7669, touched nodes [3549/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7669, touched nodes [3549/3649] : 31%|##########4 | 56/183 [00:06<00:13, 9.58it/s]GraphSAGE Epoch: [18/20], current loss: 2.7487, touched nodes [3559/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7487, touched nodes [3559/3649] : 32%|##########7 | 58/183 [00:06<00:12, 9.79it/s]GraphSAGE Epoch: [18/20], current loss: 2.8115, touched nodes [3564/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8115, touched nodes [3564/3649] : 32%|##########9 | 59/183 [00:06<00:12, 9.65it/s]GraphSAGE Epoch: [18/20], current loss: 2.7791, touched nodes [3568/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7791, touched nodes [3568/3649] : 33%|###########1 | 60/183 [00:06<00:12, 9.53it/s]GraphSAGE Epoch: [18/20], current loss: 2.8222, touched nodes [3573/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8222, touched nodes [3573/3649] : 33%|###########1 | 60/183 [00:06<00:12, 9.53it/s]GraphSAGE Epoch: [18/20], current loss: 2.7836, touched nodes [3576/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7836, touched nodes [3576/3649] : 34%|###########5 | 62/183 [00:06<00:12, 9.64it/s]GraphSAGE Epoch: [18/20], current loss: 2.8435, touched nodes [3577/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8435, touched nodes [3577/3649] : 34%|###########5 | 62/183 [00:06<00:12, 9.64it/s]GraphSAGE Epoch: [18/20], current loss: 2.7291, touched nodes [3582/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7291, touched nodes [3582/3649] : 35%|###########8 | 64/183 [00:06<00:12, 9.84it/s]GraphSAGE Epoch: [18/20], current loss: 2.8202, touched nodes [3585/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8202, touched nodes [3585/3649] : 35%|###########8 | 64/183 [00:07<00:12, 9.84it/s]GraphSAGE Epoch: [18/20], current loss: 2.7986, touched nodes [3587/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7986, touched nodes [3587/3649] : 36%|############2 | 66/183 [00:07<00:11, 10.03it/s]GraphSAGE Epoch: [18/20], current loss: 2.8660, touched nodes [3587/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8660, touched nodes [3587/3649] : 37%|############4 | 67/183 [00:07<00:11, 9.99it/s]GraphSAGE Epoch: [18/20], current loss: 2.7491, touched nodes [3588/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7491, touched nodes [3588/3649] : 37%|############4 | 67/183 [00:07<00:11, 9.99it/s]GraphSAGE Epoch: [18/20], current loss: 2.7653, touched nodes [3591/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7653, touched nodes [3591/3649] : 38%|############8 | 69/183 [00:07<00:11, 10.02it/s]GraphSAGE Epoch: [18/20], current loss: 2.7874, touched nodes [3594/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7874, touched nodes [3594/3649] : 38%|############8 | 69/183 [00:07<00:11, 10.02it/s]GraphSAGE Epoch: [18/20], current loss: 2.8023, touched nodes [3596/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8023, touched nodes [3596/3649] : 39%|#############1 | 71/183 [00:07<00:11, 10.14it/s]GraphSAGE Epoch: [18/20], current loss: 2.8122, touched nodes [3597/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8122, touched nodes [3597/3649] : 39%|#############1 | 71/183 [00:07<00:11, 10.14it/s]GraphSAGE Epoch: [18/20], current loss: 2.7408, touched nodes [3602/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7408, touched nodes [3602/3649] : 40%|#############5 | 73/183 [00:07<00:10, 10.24it/s]GraphSAGE Epoch: [18/20], current loss: 2.7696, touched nodes [3602/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7696, touched nodes [3602/3649] : 40%|#############5 | 73/183 [00:07<00:10, 10.24it/s]GraphSAGE Epoch: [18/20], current loss: 2.7825, touched nodes [3604/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7825, touched nodes [3604/3649] : 41%|#############9 | 75/183 [00:08<00:12, 8.82it/s]GraphSAGE Epoch: [18/20], current loss: 2.8426, touched nodes [3606/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8426, touched nodes [3606/3649] : 41%|#############9 | 75/183 [00:08<00:12, 8.82it/s]GraphSAGE Epoch: [18/20], current loss: 2.7823, touched nodes [3608/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7823, touched nodes [3608/3649] : 42%|##############3 | 77/183 [00:08<00:11, 9.16it/s]GraphSAGE Epoch: [18/20], current loss: 2.7475, touched nodes [3611/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7475, touched nodes [3611/3649] : 42%|##############3 | 77/183 [00:08<00:11, 9.16it/s]GraphSAGE Epoch: [18/20], current loss: 2.7591, touched nodes [3613/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7591, touched nodes [3613/3649] : 43%|##############6 | 79/183 [00:08<00:10, 9.54it/s]GraphSAGE Epoch: [18/20], current loss: 2.8053, touched nodes [3614/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8053, touched nodes [3614/3649] : 43%|##############6 | 79/183 [00:08<00:10, 9.54it/s]GraphSAGE Epoch: [18/20], current loss: 2.9002, touched nodes [3617/3649]  GraphSAGE Epoch: [18/20], current loss: 2.9002, touched nodes [3617/3649] : 44%|############### | 81/183 [00:08<00:10, 9.85it/s]GraphSAGE Epoch: [18/20], current loss: 2.8034, touched nodes [3620/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8034, touched nodes [3620/3649] : 44%|############### | 81/183 [00:08<00:10, 9.85it/s]GraphSAGE Epoch: [18/20], current loss: 2.7066, touched nodes [3623/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7066, touched nodes [3623/3649] : 45%|###############4 | 83/183 [00:08<00:10, 9.85it/s]GraphSAGE Epoch: [18/20], current loss: 2.8602, touched nodes [3623/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8602, touched nodes [3623/3649] : 45%|###############4 | 83/183 [00:08<00:10, 9.85it/s]GraphSAGE Epoch: [18/20], current loss: 2.7784, touched nodes [3624/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7784, touched nodes [3624/3649] : 46%|###############7 | 85/183 [00:09<00:09, 9.85it/s]GraphSAGE Epoch: [18/20], current loss: 2.7973, touched nodes [3625/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7973, touched nodes [3625/3649] : 47%|###############9 | 86/183 [00:09<00:09, 9.87it/s]GraphSAGE Epoch: [18/20], current loss: 2.7276, touched nodes [3625/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7276, touched nodes [3625/3649] : 48%|################1 | 87/183 [00:09<00:09, 9.88it/s]GraphSAGE Epoch: [18/20], current loss: 2.7981, touched nodes [3626/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7981, touched nodes [3626/3649] : 48%|################1 | 87/183 [00:09<00:09, 9.88it/s]GraphSAGE Epoch: [18/20], current loss: 2.7950, touched nodes [3626/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7950, touched nodes [3626/3649] : 49%|################5 | 89/183 [00:09<00:09, 9.96it/s]GraphSAGE Epoch: [18/20], current loss: 2.7896, touched nodes [3627/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7896, touched nodes [3627/3649] : 49%|################7 | 90/183 [00:09<00:09, 9.89it/s]GraphSAGE Epoch: [18/20], current loss: 2.7438, touched nodes [3627/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7438, touched nodes [3627/3649] : 50%|################9 | 91/183 [00:09<00:09, 9.65it/s]GraphSAGE Epoch: [18/20], current loss: 2.7845, touched nodes [3629/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7845, touched nodes [3629/3649] : 50%|################# | 92/183 [00:09<00:09, 9.49it/s]GraphSAGE Epoch: [18/20], current loss: 2.7677, touched nodes [3630/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7677, touched nodes [3630/3649] : 51%|#################2 | 93/183 [00:09<00:09, 9.58it/s]GraphSAGE Epoch: [18/20], current loss: 2.8702, touched nodes [3631/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8702, touched nodes [3631/3649] : 51%|#################2 | 93/183 [00:09<00:09, 9.58it/s]GraphSAGE Epoch: [18/20], current loss: 2.7610, touched nodes [3631/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7610, touched nodes [3631/3649] : 52%|#################6 | 95/183 [00:10<00:09, 9.62it/s]GraphSAGE Epoch: [18/20], current loss: 2.8157, touched nodes [3631/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8157, touched nodes [3631/3649] : 52%|#################6 | 95/183 [00:10<00:09, 9.62it/s]GraphSAGE Epoch: [18/20], current loss: 2.8439, touched nodes [3631/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8439, touched nodes [3631/3649] : 53%|################## | 97/183 [00:10<00:09, 9.52it/s]GraphSAGE Epoch: [18/20], current loss: 2.7689, touched nodes [3631/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7689, touched nodes [3631/3649] : 54%|##################2 | 98/183 [00:10<00:09, 9.11it/s]GraphSAGE Epoch: [18/20], current loss: 2.7647, touched nodes [3631/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7647, touched nodes [3631/3649] : 54%|##################2 | 98/183 [00:10<00:09, 9.11it/s]GraphSAGE Epoch: [18/20], current loss: 2.7791, touched nodes [3631/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7791, touched nodes [3631/3649] : 55%|################## | 100/183 [00:10<00:10, 7.58it/s]GraphSAGE Epoch: [18/20], current loss: 2.7997, touched nodes [3633/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7997, touched nodes [3633/3649] : 55%|##################2 | 101/183 [00:10<00:10, 7.97it/s]GraphSAGE Epoch: [18/20], current loss: 2.7702, touched nodes [3633/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7702, touched nodes [3633/3649] : 56%|##################3 | 102/183 [00:11<00:09, 8.34it/s]GraphSAGE Epoch: [18/20], current loss: 2.8146, touched nodes [3633/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8146, touched nodes [3633/3649] : 56%|##################5 | 103/183 [00:11<00:09, 8.62it/s]GraphSAGE Epoch: [18/20], current loss: 2.7367, touched nodes [3633/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7367, touched nodes [3633/3649] : 56%|##################5 | 103/183 [00:11<00:09, 8.62it/s]GraphSAGE Epoch: [18/20], current loss: 2.7756, touched nodes [3633/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7756, touched nodes [3633/3649] : 57%|##################9 | 105/183 [00:11<00:08, 9.01it/s]GraphSAGE Epoch: [18/20], current loss: 2.7623, touched nodes [3633/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7623, touched nodes [3633/3649] : 58%|###################1 | 106/183 [00:11<00:08, 9.22it/s]GraphSAGE Epoch: [18/20], current loss: 2.8777, touched nodes [3633/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8777, touched nodes [3633/3649] : 58%|###################2 | 107/183 [00:11<00:08, 9.39it/s]GraphSAGE Epoch: [18/20], current loss: 2.7929, touched nodes [3633/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7929, touched nodes [3633/3649] : 58%|###################2 | 107/183 [00:11<00:08, 9.39it/s]GraphSAGE Epoch: [18/20], current loss: 2.7930, touched nodes [3633/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7930, touched nodes [3633/3649] : 60%|###################6 | 109/183 [00:11<00:07, 9.92it/s]GraphSAGE Epoch: [18/20], current loss: 2.8745, touched nodes [3633/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8745, touched nodes [3633/3649] : 60%|###################6 | 109/183 [00:11<00:07, 9.92it/s]GraphSAGE Epoch: [18/20], current loss: 2.8480, touched nodes [3633/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8480, touched nodes [3633/3649] : 61%|#################### | 111/183 [00:11<00:07, 10.06it/s]GraphSAGE Epoch: [18/20], current loss: 2.7090, touched nodes [3633/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7090, touched nodes [3633/3649] : 61%|#################### | 111/183 [00:11<00:07, 10.06it/s]GraphSAGE Epoch: [18/20], current loss: 2.7616, touched nodes [3635/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7616, touched nodes [3635/3649] : 62%|####################3 | 113/183 [00:12<00:06, 10.01it/s]GraphSAGE Epoch: [18/20], current loss: 2.7260, touched nodes [3635/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7260, touched nodes [3635/3649] : 62%|####################3 | 113/183 [00:12<00:06, 10.01it/s]GraphSAGE Epoch: [18/20], current loss: 2.7274, touched nodes [3636/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7274, touched nodes [3636/3649] : 63%|####################7 | 115/183 [00:12<00:06, 10.05it/s]GraphSAGE Epoch: [18/20], current loss: 2.8053, touched nodes [3637/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8053, touched nodes [3637/3649] : 63%|####################7 | 115/183 [00:12<00:06, 10.05it/s]GraphSAGE Epoch: [18/20], current loss: 2.8378, touched nodes [3638/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8378, touched nodes [3638/3649] : 64%|##################### | 117/183 [00:12<00:06, 9.97it/s]GraphSAGE Epoch: [18/20], current loss: 2.7914, touched nodes [3639/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7914, touched nodes [3639/3649] : 64%|#####################2 | 118/183 [00:12<00:06, 9.91it/s]GraphSAGE Epoch: [18/20], current loss: 2.7686, touched nodes [3639/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7686, touched nodes [3639/3649] : 65%|#####################4 | 119/183 [00:12<00:06, 9.82it/s]GraphSAGE Epoch: [18/20], current loss: 2.7645, touched nodes [3639/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7645, touched nodes [3639/3649] : 66%|#####################6 | 120/183 [00:12<00:06, 9.65it/s]GraphSAGE Epoch: [18/20], current loss: 2.7718, touched nodes [3639/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7718, touched nodes [3639/3649] : 66%|#####################6 | 120/183 [00:12<00:06, 9.65it/s]GraphSAGE Epoch: [18/20], current loss: 2.7655, touched nodes [3639/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7655, touched nodes [3639/3649] : 67%|###################### | 122/183 [00:13<00:06, 9.98it/s]GraphSAGE Epoch: [18/20], current loss: 2.7875, touched nodes [3639/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7875, touched nodes [3639/3649] : 67%|###################### | 122/183 [00:13<00:06, 9.98it/s]GraphSAGE Epoch: [18/20], current loss: 2.7942, touched nodes [3641/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7942, touched nodes [3641/3649] : 68%|######################3 | 124/183 [00:13<00:05, 10.03it/s]GraphSAGE Epoch: [18/20], current loss: 2.7922, touched nodes [3641/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7922, touched nodes [3641/3649] : 68%|######################5 | 125/183 [00:13<00:07, 8.26it/s]GraphSAGE Epoch: [18/20], current loss: 2.8247, touched nodes [3641/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8247, touched nodes [3641/3649] : 68%|######################5 | 125/183 [00:13<00:07, 8.26it/s]GraphSAGE Epoch: [18/20], current loss: 2.7482, touched nodes [3641/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7482, touched nodes [3641/3649] : 69%|######################9 | 127/183 [00:13<00:06, 8.54it/s]GraphSAGE Epoch: [18/20], current loss: 2.7986, touched nodes [3641/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7986, touched nodes [3641/3649] : 69%|######################9 | 127/183 [00:13<00:06, 8.54it/s]GraphSAGE Epoch: [18/20], current loss: 2.8038, touched nodes [3642/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8038, touched nodes [3642/3649] : 70%|#######################2 | 129/183 [00:13<00:05, 9.02it/s]GraphSAGE Epoch: [18/20], current loss: 2.9873, touched nodes [3643/3649]  GraphSAGE Epoch: [18/20], current loss: 2.9873, touched nodes [3643/3649] : 71%|#######################4 | 130/183 [00:13<00:05, 9.12it/s]GraphSAGE Epoch: [18/20], current loss: 2.9398, touched nodes [3644/3649]  GraphSAGE Epoch: [18/20], current loss: 2.9398, touched nodes [3644/3649] : 71%|#######################4 | 130/183 [00:14<00:05, 9.12it/s]GraphSAGE Epoch: [18/20], current loss: 2.9757, touched nodes [3644/3649]  GraphSAGE Epoch: [18/20], current loss: 2.9757, touched nodes [3644/3649] : 72%|#######################8 | 132/183 [00:14<00:05, 9.43it/s]GraphSAGE Epoch: [18/20], current loss: 2.8527, touched nodes [3644/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8527, touched nodes [3644/3649] : 72%|#######################8 | 132/183 [00:14<00:05, 9.43it/s]GraphSAGE Epoch: [18/20], current loss: 2.8973, touched nodes [3645/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8973, touched nodes [3645/3649] : 73%|########################1 | 134/183 [00:14<00:05, 9.68it/s]GraphSAGE Epoch: [18/20], current loss: 2.8257, touched nodes [3645/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8257, touched nodes [3645/3649] : 74%|########################3 | 135/183 [00:14<00:04, 9.70it/s]GraphSAGE Epoch: [18/20], current loss: 2.8376, touched nodes [3645/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8376, touched nodes [3645/3649] : 74%|########################5 | 136/183 [00:14<00:04, 9.70it/s]GraphSAGE Epoch: [18/20], current loss: 2.7733, touched nodes [3645/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7733, touched nodes [3645/3649] : 74%|########################5 | 136/183 [00:14<00:04, 9.70it/s]GraphSAGE Epoch: [18/20], current loss: 2.8486, touched nodes [3645/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8486, touched nodes [3645/3649] : 75%|########################8 | 138/183 [00:14<00:04, 9.87it/s]GraphSAGE Epoch: [18/20], current loss: 2.8078, touched nodes [3645/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8078, touched nodes [3645/3649] : 75%|########################8 | 138/183 [00:14<00:04, 9.87it/s]GraphSAGE Epoch: [18/20], current loss: 2.8074, touched nodes [3645/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8074, touched nodes [3645/3649] : 77%|#########################2 | 140/183 [00:14<00:04, 9.94it/s]GraphSAGE Epoch: [18/20], current loss: 2.8112, touched nodes [3646/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8112, touched nodes [3646/3649] : 77%|#########################4 | 141/183 [00:15<00:04, 9.83it/s]GraphSAGE Epoch: [18/20], current loss: 2.6965, touched nodes [3646/3649]  GraphSAGE Epoch: [18/20], current loss: 2.6965, touched nodes [3646/3649] : 78%|#########################6 | 142/183 [00:15<00:04, 9.67it/s]GraphSAGE Epoch: [18/20], current loss: 2.7689, touched nodes [3646/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7689, touched nodes [3646/3649] : 78%|#########################7 | 143/183 [00:15<00:04, 9.72it/s]GraphSAGE Epoch: [18/20], current loss: 2.7861, touched nodes [3647/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7861, touched nodes [3647/3649] : 79%|#########################9 | 144/183 [00:15<00:04, 9.65it/s]GraphSAGE Epoch: [18/20], current loss: 2.7882, touched nodes [3647/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7882, touched nodes [3647/3649] : 79%|##########################1 | 145/183 [00:15<00:03, 9.67it/s]GraphSAGE Epoch: [18/20], current loss: 2.7438, touched nodes [3647/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7438, touched nodes [3647/3649] : 80%|##########################3 | 146/183 [00:15<00:03, 9.58it/s]GraphSAGE Epoch: [18/20], current loss: 2.7717, touched nodes [3647/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7717, touched nodes [3647/3649] : 80%|##########################3 | 146/183 [00:15<00:03, 9.58it/s]GraphSAGE Epoch: [18/20], current loss: 2.8205, touched nodes [3647/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8205, touched nodes [3647/3649] : 81%|##########################6 | 148/183 [00:15<00:04, 7.73it/s]GraphSAGE Epoch: [18/20], current loss: 2.7820, touched nodes [3647/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7820, touched nodes [3647/3649] : 81%|##########################8 | 149/183 [00:15<00:04, 8.18it/s]GraphSAGE Epoch: [18/20], current loss: 2.7973, touched nodes [3647/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7973, touched nodes [3647/3649] : 82%|########################### | 150/183 [00:16<00:03, 8.55it/s]GraphSAGE Epoch: [18/20], current loss: 2.7637, touched nodes [3647/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7637, touched nodes [3647/3649] : 83%|###########################2 | 151/183 [00:16<00:03, 8.79it/s]GraphSAGE Epoch: [18/20], current loss: 2.8754, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8754, touched nodes [3648/3649] : 83%|###########################2 | 151/183 [00:16<00:03, 8.79it/s]GraphSAGE Epoch: [18/20], current loss: 2.7787, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7787, touched nodes [3648/3649] : 84%|###########################5 | 153/183 [00:16<00:03, 9.33it/s]GraphSAGE Epoch: [18/20], current loss: 2.8402, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8402, touched nodes [3648/3649] : 84%|###########################7 | 154/183 [00:16<00:03, 9.38it/s]GraphSAGE Epoch: [18/20], current loss: 2.7701, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7701, touched nodes [3648/3649] : 85%|###########################9 | 155/183 [00:16<00:02, 9.44it/s]GraphSAGE Epoch: [18/20], current loss: 2.8297, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8297, touched nodes [3648/3649] : 85%|############################1 | 156/183 [00:16<00:02, 9.48it/s]GraphSAGE Epoch: [18/20], current loss: 2.7836, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7836, touched nodes [3648/3649] : 85%|############################1 | 156/183 [00:16<00:02, 9.48it/s]GraphSAGE Epoch: [18/20], current loss: 2.8093, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8093, touched nodes [3648/3649] : 86%|############################4 | 158/183 [00:16<00:02, 9.81it/s]GraphSAGE Epoch: [18/20], current loss: 2.7634, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7634, touched nodes [3648/3649] : 87%|############################6 | 159/183 [00:17<00:02, 9.32it/s]GraphSAGE Epoch: [18/20], current loss: 2.7743, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7743, touched nodes [3648/3649] : 87%|############################8 | 160/183 [00:17<00:02, 9.43it/s]GraphSAGE Epoch: [18/20], current loss: 2.7846, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7846, touched nodes [3648/3649] : 88%|############################# | 161/183 [00:17<00:02, 9.50it/s]GraphSAGE Epoch: [18/20], current loss: 2.9271, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.9271, touched nodes [3648/3649] : 89%|#############################2 | 162/183 [00:17<00:02, 9.49it/s]GraphSAGE Epoch: [18/20], current loss: 2.7951, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7951, touched nodes [3648/3649] : 89%|#############################3 | 163/183 [00:17<00:02, 9.60it/s]GraphSAGE Epoch: [18/20], current loss: 2.7697, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7697, touched nodes [3648/3649] : 90%|#############################5 | 164/183 [00:17<00:01, 9.61it/s]GraphSAGE Epoch: [18/20], current loss: 2.8038, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.8038, touched nodes [3648/3649] : 90%|#############################7 | 165/183 [00:17<00:01, 9.70it/s]GraphSAGE Epoch: [18/20], current loss: 2.9022, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.9022, touched nodes [3648/3649] : 90%|#############################7 | 165/183 [00:17<00:01, 9.70it/s]GraphSAGE Epoch: [18/20], current loss: 2.7761, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7761, touched nodes [3648/3649] : 91%|##############################1 | 167/183 [00:17<00:01, 10.04it/s]GraphSAGE Epoch: [18/20], current loss: 2.7602, touched nodes [3648/3649]  GraphSAGE Epoch: [18/20], current loss: 2.7602, touched nodes [3648/3649] : 92%|##############################2 | 168/183 [00:17<00:01, 9.99it/s]GraphSAGE Epoch: [18/20], current loss: 2.8421, touched nodes [3649/3649]  0%| | 0/183 [00:00<?, ?it/s]GraphSAGE Epoch: [19/20], current loss: 2.7469, touched nodes [286/3649]  GraphSAGE Epoch: [19/20], current loss: 2.7469, touched nodes [286/3649] : 1%|1 | 1/183 [00:00<00:36, 5.03it/s]GraphSAGE Epoch: [19/20], current loss: 2.8083, touched nodes [537/3649]  GraphSAGE Epoch: [19/20], current loss: 2.8083, touched nodes [537/3649] : 1%|3 | 2/183 [00:00<00:25, 7.08it/s]GraphSAGE Epoch: [19/20], current loss: 2.8375, touched nodes [762/3649]  GraphSAGE Epoch: [19/20], current loss: 2.8375, touched nodes [762/3649] : 1%|3 | 2/183 [00:00<00:25, 7.08it/s]GraphSAGE Epoch: [19/20], current loss: 2.8013, touched nodes [964/3649]  GraphSAGE Epoch: [19/20], current loss: 2.8013, touched nodes [964/3649] : 2%|7 | 4/183 [00:00<00:19, 8.98it/s]GraphSAGE Epoch: [19/20], current loss: 2.7748, touched nodes [1164/3649]  GraphSAGE Epoch: [19/20], current loss: 2.7748, touched nodes [1164/3649] : 2%|7 | 4/183 [00:00<00:19, 8.98it/s]GraphSAGE Epoch: [19/20], current loss: 2.7843, touched nodes [1335/3649]  GraphSAGE Epoch: [19/20], current loss: 2.7843, touched nodes [1335/3649] : 3%|#1 | 6/183 [00:00<00:18, 9.57it/s]GraphSAGE Epoch: [19/20], current loss: 2.7567, touched nodes [1498/3649]  GraphSAGE Epoch: [19/20], current loss: 2.7567, touched nodes [1498/3649] : 4%|#3 | 7/183 [00:00<00:18, 9.56it/s]GraphSAGE Epoch: [19/20], current loss: 2.7524, touched nodes [1649/3649]  GraphSAGE Epoch: [19/20], current loss: 2.7524, touched nodes [1649/3649] : 4%|#3 | 7/183 [00:00<00:18, 9.56it/s]GraphSAGE Epoch: [19/20], current loss: 2.8468, touched nodes [1797/3649]  GraphSAGE Epoch: [19/20], current loss: 2.8468, touched nodes [1797/3649] : 5%|#7 | 9/183 [00:00<00:17, 9.74it/s]GraphSAGE Epoch: [19/20], current loss: 2.8167, touched nodes [1937/3649]  GraphSAGE Epoch: [19/20], current loss: 2.8167, touched nodes [1937/3649] : 5%|#8 | 10/183 [00:01<00:18, 9.16it/s]GraphSAGE Epoch: [19/20], current loss: 2.7415, touched nodes [2048/3649]  GraphSAGE Epoch: [19/20], current loss: 2.7415, touched nodes [2048/3649] : 6%|## | 11/183 [00:01<00:18, 9.25it/s]GraphSAGE Epoch: [19/20], current loss: 2.7619, touched nodes [2134/3649]  GraphSAGE Epoch: [19/20], current loss: 2.7619, touched nodes [2134/3649] : 7%|##2 | 12/183 [00:01<00:18, 9.27it/s] |
| --- |

#### 2.1.5.3 Kết quả

| Score sil arg: 0.35037157 |
| --- |



### 2.1.6 Fine-tune mô hình lần 6

#### 2.1.6.1 Thông số hyperparameter

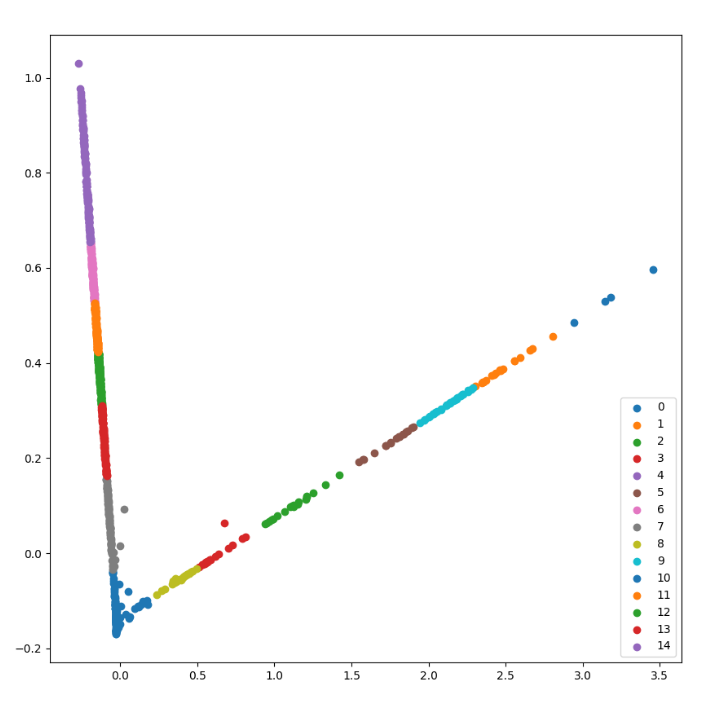
| feature\_weights = [0, 0.1304048, 0, 0.7227898, 0, 0.3818457]  raw\_features\_file\_dir = 'raw\_features.pickle'  ########hyper parameter##################  numbers\_of\_hst\_films = 10  numbers\_of\_user = 4000  prefer\_threshold = 0.1  score\_threshold = 0.35  device = "cuda:0"  loss = 'normal'  epochs = 5  lr = 0.1  model = 'graphsage'  n\_layer=4,  emb\_size=132 |
| --- |

#### 2.1.6.2 Kết quả training

| GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3626/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3626/3649] : 20%|######9 | 374/1825 [01:17<04:39, 5.19it/s]GraphSAGE Epoch: [5/5], current loss: 7.5027, touched nodes [3627/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5027, touched nodes [3627/3649] : 21%|######9 | 375/1825 [01:17<04:38, 5.20it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649] : 21%|####### | 376/1825 [01:17<04:13, 5.71it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649] : 21%|####### | 377/1825 [01:18<04:26, 5.43it/s]GraphSAGE Epoch: [5/5], current loss: 7.6130, touched nodes [3627/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6130, touched nodes [3627/3649] : 21%|####### | 378/1825 [01:18<04:29, 5.36it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649] : 21%|####### | 379/1825 [01:18<05:17, 4.56it/s]GraphSAGE Epoch: [5/5], current loss: 7.4822, touched nodes [3627/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4822, touched nodes [3627/3649] : 21%|####### | 380/1825 [01:18<04:59, 4.83it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649] : 21%|####### | 381/1825 [01:18<04:29, 5.35it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649] : 21%|#######1 | 382/1825 [01:19<04:34, 5.26it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649] : 21%|#######1 | 383/1825 [01:19<04:20, 5.53it/s]GraphSAGE Epoch: [5/5], current loss: 7.6592, touched nodes [3627/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6592, touched nodes [3627/3649] : 21%|#######1 | 384/1825 [01:19<04:21, 5.51it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649] : 21%|#######1 | 385/1825 [01:19<05:19, 4.51it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649] : 21%|#######1 | 386/1825 [01:19<05:03, 4.75it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3627/3649] : 21%|#######2 | 387/1825 [01:20<04:47, 5.01it/s]GraphSAGE Epoch: [5/5], current loss: 7.5765, touched nodes [3628/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5765, touched nodes [3628/3649] : 21%|#######2 | 388/1825 [01:20<05:07, 4.67it/s]GraphSAGE Epoch: [5/5], current loss: 7.4903, touched nodes [3628/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4903, touched nodes [3628/3649] : 21%|#######2 | 389/1825 [01:20<05:01, 4.76it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3628/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3628/3649] : 21%|#######2 | 390/1825 [01:20<06:05, 3.93it/s]GraphSAGE Epoch: [5/5], current loss: 7.3361, touched nodes [3628/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3361, touched nodes [3628/3649] : 21%|#######2 | 391/1825 [01:21<06:00, 3.98it/s]GraphSAGE Epoch: [5/5], current loss: 7.3291, touched nodes [3628/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3291, touched nodes [3628/3649] : 21%|#######3 | 392/1825 [01:21<06:00, 3.97it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649] : 22%|#######3 | 393/1825 [01:21<05:38, 4.23it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649] : 22%|#######3 | 394/1825 [01:21<05:07, 4.65it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649] : 22%|#######3 | 395/1825 [01:22<05:05, 4.68it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649] : 22%|#######3 | 396/1825 [01:22<05:43, 4.17it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649] : 22%|#######3 | 397/1825 [01:22<05:10, 4.60it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649] : 22%|#######4 | 398/1825 [01:22<04:54, 4.84it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649] : 22%|#######4 | 399/1825 [01:22<04:43, 5.03it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649] : 22%|#######4 | 400/1825 [01:23<04:53, 4.86it/s]GraphSAGE Epoch: [5/5], current loss: 7.4782, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4782, touched nodes [3629/3649] : 22%|#######4 | 401/1825 [01:23<05:38, 4.20it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649] : 22%|#######4 | 402/1825 [01:23<05:15, 4.52it/s]GraphSAGE Epoch: [5/5], current loss: 7.6176, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6176, touched nodes [3629/3649] : 22%|#######5 | 403/1825 [01:23<04:41, 5.05it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649] : 22%|#######5 | 404/1825 [01:23<04:22, 5.42it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649] : 22%|#######5 | 405/1825 [01:24<04:13, 5.60it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649] : 22%|#######5 | 406/1825 [01:24<04:31, 5.22it/s]GraphSAGE Epoch: [5/5], current loss: 7.4466, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4466, touched nodes [3629/3649] : 22%|#######5 | 407/1825 [01:24<04:12, 5.62it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3629/3649] : 22%|#######6 | 408/1825 [01:24<05:07, 4.60it/s]GraphSAGE Epoch: [5/5], current loss: 7.5178, touched nodes [3629/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5178, touched nodes [3629/3649] : 22%|#######6 | 409/1825 [01:24<04:41, 5.03it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3630/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3630/3649] : 22%|#######6 | 410/1825 [01:25<04:42, 5.01it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3630/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3630/3649] : 23%|#######6 | 411/1825 [01:25<04:41, 5.02it/s]GraphSAGE Epoch: [5/5], current loss: 7.6828, touched nodes [3630/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6828, touched nodes [3630/3649] : 23%|#######6 | 412/1825 [01:25<04:36, 5.10it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649] : 23%|#######6 | 413/1825 [01:25<04:18, 5.46it/s]GraphSAGE Epoch: [5/5], current loss: 7.6363, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6363, touched nodes [3631/3649] : 23%|#######7 | 414/1825 [01:25<05:04, 4.63it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649] : 23%|#######7 | 415/1825 [01:26<04:50, 4.86it/s]GraphSAGE Epoch: [5/5], current loss: 7.4918, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4918, touched nodes [3631/3649] : 23%|#######7 | 416/1825 [01:26<04:37, 5.07it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649] : 23%|#######7 | 417/1825 [01:26<04:27, 5.26it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649] : 23%|#######7 | 418/1825 [01:26<04:30, 5.20it/s]GraphSAGE Epoch: [5/5], current loss: 7.5187, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5187, touched nodes [3631/3649] : 23%|#######8 | 419/1825 [01:26<05:16, 4.45it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649] : 23%|#######8 | 420/1825 [01:27<05:10, 4.52it/s]GraphSAGE Epoch: [5/5], current loss: 7.6127, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6127, touched nodes [3631/3649] : 23%|#######8 | 421/1825 [01:27<04:59, 4.68it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649] : 23%|#######8 | 422/1825 [01:27<04:58, 4.70it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649] : 23%|#######8 | 423/1825 [01:27<04:47, 4.88it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649] : 23%|#######8 | 424/1825 [01:27<04:36, 5.07it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649] : 23%|#######9 | 425/1825 [01:28<05:13, 4.47it/s]GraphSAGE Epoch: [5/5], current loss: 7.6119, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6119, touched nodes [3631/3649] : 23%|#######9 | 426/1825 [01:28<05:01, 4.64it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3631/3649] : 23%|#######9 | 427/1825 [01:28<04:45, 4.90it/s]GraphSAGE Epoch: [5/5], current loss: 7.6373, touched nodes [3631/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6373, touched nodes [3631/3649] : 23%|#######9 | 428/1825 [01:28<04:40, 4.99it/s]GraphSAGE Epoch: [5/5], current loss: 7.6183, touched nodes [3632/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6183, touched nodes [3632/3649] : 24%|#######9 | 429/1825 [01:28<04:43, 4.93it/s]GraphSAGE Epoch: [5/5], current loss: 7.5632, touched nodes [3632/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5632, touched nodes [3632/3649] : 24%|######## | 430/1825 [01:29<04:18, 5.40it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3632/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3632/3649] : 24%|######## | 431/1825 [01:29<05:01, 4.62it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3632/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3632/3649] : 24%|######## | 432/1825 [01:29<04:30, 5.15it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3632/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3632/3649] : 24%|######## | 433/1825 [01:29<04:20, 5.35it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3633/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3633/3649] : 24%|######## | 434/1825 [01:29<04:16, 5.42it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3633/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3633/3649] : 24%|########1 | 435/1825 [01:30<04:21, 5.32it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3633/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3633/3649] : 24%|########1 | 436/1825 [01:30<04:27, 5.19it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3633/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3633/3649] : 24%|########1 | 437/1825 [01:30<05:30, 4.20it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3633/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3633/3649] : 24%|########1 | 438/1825 [01:30<05:04, 4.55it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3634/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3634/3649] : 24%|########1 | 439/1825 [01:31<04:58, 4.64it/s]GraphSAGE Epoch: [5/5], current loss: 7.4180, touched nodes [3634/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4180, touched nodes [3634/3649] : 24%|########1 | 440/1825 [01:31<04:27, 5.17it/s]GraphSAGE Epoch: [5/5], current loss: 7.4553, touched nodes [3635/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4553, touched nodes [3635/3649] : 24%|########2 | 441/1825 [01:31<04:41, 4.91it/s]GraphSAGE Epoch: [5/5], current loss: 7.5997, touched nodes [3636/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5997, touched nodes [3636/3649] : 24%|########2 | 442/1825 [01:31<04:55, 4.68it/s]GraphSAGE Epoch: [5/5], current loss: 7.4798, touched nodes [3636/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4798, touched nodes [3636/3649] : 24%|########2 | 443/1825 [01:31<05:44, 4.01it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3636/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3636/3649] : 24%|########2 | 444/1825 [01:32<05:08, 4.48it/s]GraphSAGE Epoch: [5/5], current loss: 7.5056, touched nodes [3636/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5056, touched nodes [3636/3649] : 24%|########2 | 445/1825 [01:32<04:43, 4.86it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3637/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3637/3649] : 24%|########3 | 446/1825 [01:32<04:14, 5.42it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3638/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3638/3649] : 24%|########3 | 447/1825 [01:32<03:58, 5.78it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3638/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3638/3649] : 25%|########3 | 448/1825 [01:32<04:07, 5.57it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3639/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3639/3649] : 25%|########3 | 449/1825 [01:32<04:02, 5.67it/s]GraphSAGE Epoch: [5/5], current loss: 7.5481, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5481, touched nodes [3640/3649] : 25%|########3 | 450/1825 [01:33<04:57, 4.62it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649] : 25%|########4 | 451/1825 [01:33<04:50, 4.72it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649] : 25%|########4 | 452/1825 [01:33<04:28, 5.11it/s]GraphSAGE Epoch: [5/5], current loss: 7.4411, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4411, touched nodes [3640/3649] : 25%|########4 | 453/1825 [01:33<04:28, 5.10it/s]GraphSAGE Epoch: [5/5], current loss: 7.4706, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4706, touched nodes [3640/3649] : 25%|########4 | 454/1825 [01:33<04:14, 5.39it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649] : 25%|########4 | 455/1825 [01:34<04:20, 5.25it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649] : 25%|########4 | 456/1825 [01:34<05:13, 4.36it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649] : 25%|########5 | 457/1825 [01:34<04:56, 4.61it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649] : 25%|########5 | 458/1825 [01:34<04:37, 4.93it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649] : 25%|########5 | 459/1825 [01:35<04:30, 5.05it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649] : 25%|########5 | 460/1825 [01:35<04:14, 5.37it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649] : 25%|########5 | 461/1825 [01:35<04:12, 5.41it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649] : 25%|########6 | 462/1825 [01:35<04:57, 4.58it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649] : 25%|########6 | 463/1825 [01:35<04:52, 4.66it/s]GraphSAGE Epoch: [5/5], current loss: 7.3427, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3427, touched nodes [3640/3649] : 25%|########6 | 464/1825 [01:36<04:31, 5.02it/s]GraphSAGE Epoch: [5/5], current loss: 7.3763, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3763, touched nodes [3640/3649] : 25%|########6 | 465/1825 [01:36<04:45, 4.77it/s]GraphSAGE Epoch: [5/5], current loss: 7.4451, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4451, touched nodes [3640/3649] : 26%|########6 | 466/1825 [01:36<04:41, 4.83it/s]GraphSAGE Epoch: [5/5], current loss: 7.4903, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4903, touched nodes [3640/3649] : 26%|########7 | 467/1825 [01:36<04:29, 5.04it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649] : 26%|########7 | 468/1825 [01:36<05:06, 4.42it/s]GraphSAGE Epoch: [5/5], current loss: 7.4847, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4847, touched nodes [3640/3649] : 26%|########7 | 469/1825 [01:37<05:05, 4.45it/s]GraphSAGE Epoch: [5/5], current loss: 7.4507, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4507, touched nodes [3640/3649] : 26%|########7 | 470/1825 [01:37<04:51, 4.65it/s]GraphSAGE Epoch: [5/5], current loss: 7.5102, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5102, touched nodes [3640/3649] : 26%|########7 | 471/1825 [01:37<04:35, 4.92it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3640/3649] : 26%|########7 | 472/1825 [01:37<04:33, 4.96it/s]GraphSAGE Epoch: [5/5], current loss: 7.4838, touched nodes [3641/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4838, touched nodes [3641/3649] : 26%|########8 | 473/1825 [01:37<04:38, 4.86it/s]GraphSAGE Epoch: [5/5], current loss: 7.6168, touched nodes [3641/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6168, touched nodes [3641/3649] : 26%|########8 | 474/1825 [01:38<05:30, 4.09it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3641/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3641/3649] : 26%|########8 | 475/1825 [01:38<04:59, 4.51it/s]GraphSAGE Epoch: [5/5], current loss: 7.4739, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4739, touched nodes [3642/3649] : 26%|########8 | 476/1825 [01:38<05:04, 4.44it/s]GraphSAGE Epoch: [5/5], current loss: 7.5560, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5560, touched nodes [3642/3649] : 26%|########8 | 477/1825 [01:38<04:42, 4.77it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 26%|########9 | 478/1825 [01:39<04:43, 4.76it/s]GraphSAGE Epoch: [5/5], current loss: 7.4416, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4416, touched nodes [3642/3649] : 26%|########9 | 479/1825 [01:39<04:22, 5.13it/s]GraphSAGE Epoch: [5/5], current loss: 7.5276, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5276, touched nodes [3642/3649] : 26%|########9 | 480/1825 [01:39<04:47, 4.68it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 26%|########9 | 481/1825 [01:39<04:39, 4.82it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 26%|########9 | 482/1825 [01:39<04:31, 4.95it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 26%|########9 | 483/1825 [01:40<04:23, 5.08it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 27%|######### | 484/1825 [01:40<04:24, 5.06it/s]GraphSAGE Epoch: [5/5], current loss: 7.8588, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.8588, touched nodes [3642/3649] : 27%|######### | 485/1825 [01:40<04:24, 5.07it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 27%|######### | 486/1825 [01:40<05:24, 4.13it/s]GraphSAGE Epoch: [5/5], current loss: 7.4836, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4836, touched nodes [3642/3649] : 27%|######### | 487/1825 [01:41<05:12, 4.29it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 27%|######### | 488/1825 [01:41<04:56, 4.51it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 27%|#########1 | 489/1825 [01:41<04:41, 4.74it/s]GraphSAGE Epoch: [5/5], current loss: 7.3719, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3719, touched nodes [3642/3649] : 27%|#########1 | 490/1825 [01:41<04:44, 4.69it/s]GraphSAGE Epoch: [5/5], current loss: 7.4805, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4805, touched nodes [3642/3649] : 27%|#########1 | 491/1825 [01:41<05:18, 4.19it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 27%|#########1 | 492/1825 [01:42<05:04, 4.38it/s]GraphSAGE Epoch: [5/5], current loss: 7.4474, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4474, touched nodes [3642/3649] : 27%|#########1 | 493/1825 [01:42<04:53, 4.54it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 27%|#########2 | 494/1825 [01:42<04:31, 4.90it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 27%|#########2 | 495/1825 [01:42<04:14, 5.22it/s]GraphSAGE Epoch: [5/5], current loss: 7.4366, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4366, touched nodes [3642/3649] : 27%|#########2 | 496/1825 [01:42<04:11, 5.28it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 27%|#########2 | 497/1825 [01:43<04:03, 5.44it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 27%|#########2 | 498/1825 [01:43<04:45, 4.65it/s]GraphSAGE Epoch: [5/5], current loss: 7.4552, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4552, touched nodes [3642/3649] : 27%|#########2 | 499/1825 [01:43<04:30, 4.90it/s]GraphSAGE Epoch: [5/5], current loss: 7.5569, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5569, touched nodes [3642/3649] : 27%|#########3 | 500/1825 [01:43<04:36, 4.79it/s]GraphSAGE Epoch: [5/5], current loss: 7.4837, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4837, touched nodes [3642/3649] : 27%|#########3 | 501/1825 [01:43<04:22, 5.04it/s]GraphSAGE Epoch: [5/5], current loss: 7.5796, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5796, touched nodes [3642/3649] : 28%|#########3 | 502/1825 [01:44<04:38, 4.75it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 28%|#########3 | 503/1825 [01:44<05:21, 4.12it/s]GraphSAGE Epoch: [5/5], current loss: 7.4416, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4416, touched nodes [3642/3649] : 28%|#########3 | 504/1825 [01:44<04:57, 4.44it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 28%|#########4 | 505/1825 [01:44<04:38, 4.75it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 28%|#########4 | 506/1825 [01:44<04:31, 4.86it/s]GraphSAGE Epoch: [5/5], current loss: 7.5779, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5779, touched nodes [3642/3649] : 28%|#########4 | 507/1825 [01:45<04:21, 5.04it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 28%|#########4 | 508/1825 [01:45<04:21, 5.04it/s]GraphSAGE Epoch: [5/5], current loss: 7.5311, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5311, touched nodes [3642/3649] : 28%|#########4 | 509/1825 [01:45<05:10, 4.23it/s]GraphSAGE Epoch: [5/5], current loss: 7.4912, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4912, touched nodes [3642/3649] : 28%|#########5 | 510/1825 [01:45<04:46, 4.58it/s]GraphSAGE Epoch: [5/5], current loss: 7.5342, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5342, touched nodes [3642/3649] : 28%|#########5 | 511/1825 [01:46<04:38, 4.71it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 28%|#########5 | 512/1825 [01:46<04:24, 4.97it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 28%|#########5 | 513/1825 [01:46<04:29, 4.87it/s]GraphSAGE Epoch: [5/5], current loss: 7.5088, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5088, touched nodes [3642/3649] : 28%|#########5 | 514/1825 [01:46<04:25, 4.93it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3642/3649] : 28%|#########5 | 515/1825 [01:46<04:58, 4.39it/s]GraphSAGE Epoch: [5/5], current loss: 7.5575, touched nodes [3642/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5575, touched nodes [3642/3649] : 28%|#########6 | 516/1825 [01:47<04:31, 4.82it/s]GraphSAGE Epoch: [5/5], current loss: 7.5697, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5697, touched nodes [3643/3649] : 28%|#########6 | 517/1825 [01:47<04:32, 4.79it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 28%|#########6 | 518/1825 [01:47<04:08, 5.25it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 28%|#########6 | 519/1825 [01:47<04:15, 5.11it/s]GraphSAGE Epoch: [5/5], current loss: 7.6912, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6912, touched nodes [3643/3649] : 28%|#########6 | 520/1825 [01:47<04:59, 4.36it/s]GraphSAGE Epoch: [5/5], current loss: 7.3465, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3465, touched nodes [3643/3649] : 29%|#########7 | 521/1825 [01:48<04:52, 4.46it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 29%|#########7 | 522/1825 [01:48<04:40, 4.64it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 29%|#########7 | 523/1825 [01:48<04:30, 4.82it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 29%|#########7 | 524/1825 [01:48<04:10, 5.19it/s]GraphSAGE Epoch: [5/5], current loss: 7.3014, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3014, touched nodes [3643/3649] : 29%|#########7 | 525/1825 [01:48<03:58, 5.46it/s]GraphSAGE Epoch: [5/5], current loss: 7.5531, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5531, touched nodes [3643/3649] : 29%|#########7 | 526/1825 [01:49<04:39, 4.64it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 29%|#########8 | 527/1825 [01:49<04:35, 4.71it/s]GraphSAGE Epoch: [5/5], current loss: 7.5148, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5148, touched nodes [3643/3649] : 29%|#########8 | 528/1825 [01:49<04:42, 4.59it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 29%|#########8 | 529/1825 [01:49<04:25, 4.88it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 29%|#########8 | 530/1825 [01:49<04:18, 5.01it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 29%|#########8 | 531/1825 [01:50<04:20, 4.97it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 29%|#########9 | 532/1825 [01:50<05:13, 4.12it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 29%|#########9 | 533/1825 [01:50<05:00, 4.31it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 29%|#########9 | 534/1825 [01:50<04:39, 4.61it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 29%|#########9 | 535/1825 [01:51<04:28, 4.80it/s]GraphSAGE Epoch: [5/5], current loss: 7.4588, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4588, touched nodes [3643/3649] : 29%|#########9 | 536/1825 [01:51<04:21, 4.94it/s]GraphSAGE Epoch: [5/5], current loss: 7.4667, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4667, touched nodes [3643/3649] : 29%|########## | 537/1825 [01:51<04:39, 4.60it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 29%|########## | 538/1825 [01:51<05:14, 4.09it/s]GraphSAGE Epoch: [5/5], current loss: 7.4484, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4484, touched nodes [3643/3649] : 30%|########## | 539/1825 [01:52<05:02, 4.25it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3643/3649] : 30%|########## | 540/1825 [01:52<04:25, 4.84it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 30%|########## | 541/1825 [01:52<04:27, 4.79it/s]GraphSAGE Epoch: [5/5], current loss: 7.3751, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3751, touched nodes [3644/3649] : 30%|########## | 542/1825 [01:52<04:34, 4.67it/s]GraphSAGE Epoch: [5/5], current loss: 7.4974, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4974, touched nodes [3644/3649] : 30%|##########1 | 543/1825 [01:52<04:21, 4.90it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 30%|##########1 | 544/1825 [01:53<05:01, 4.25it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 30%|##########1 | 545/1825 [01:53<04:43, 4.52it/s]GraphSAGE Epoch: [5/5], current loss: 7.4762, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4762, touched nodes [3644/3649] : 30%|##########1 | 546/1825 [01:53<04:45, 4.48it/s]GraphSAGE Epoch: [5/5], current loss: 7.3755, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3755, touched nodes [3644/3649] : 30%|##########1 | 547/1825 [01:53<04:38, 4.59it/s]GraphSAGE Epoch: [5/5], current loss: 7.5444, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5444, touched nodes [3644/3649] : 30%|##########2 | 548/1825 [01:53<04:30, 4.72it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 30%|##########2 | 549/1825 [01:54<05:08, 4.13it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 30%|##########2 | 550/1825 [01:54<04:37, 4.60it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 30%|##########2 | 551/1825 [01:54<04:21, 4.87it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 30%|##########2 | 552/1825 [01:54<04:15, 4.98it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 30%|##########3 | 553/1825 [01:54<04:04, 5.19it/s]GraphSAGE Epoch: [5/5], current loss: 7.5333, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5333, touched nodes [3644/3649] : 30%|##########3 | 554/1825 [01:55<03:44, 5.67it/s]GraphSAGE Epoch: [5/5], current loss: 7.4784, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4784, touched nodes [3644/3649] : 30%|##########3 | 555/1825 [01:55<04:02, 5.24it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 30%|##########3 | 556/1825 [01:55<04:52, 4.33it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 31%|##########3 | 557/1825 [01:55<04:34, 4.62it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 31%|##########3 | 558/1825 [01:56<04:19, 4.88it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 31%|##########4 | 559/1825 [01:56<04:13, 4.99it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 31%|##########4 | 560/1825 [01:56<04:08, 5.08it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 31%|##########4 | 561/1825 [01:56<03:53, 5.40it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 31%|##########4 | 562/1825 [01:56<04:33, 4.61it/s]GraphSAGE Epoch: [5/5], current loss: 7.4872, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4872, touched nodes [3644/3649] : 31%|##########4 | 563/1825 [01:57<04:22, 4.81it/s]GraphSAGE Epoch: [5/5], current loss: 7.4350, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4350, touched nodes [3644/3649] : 31%|##########5 | 564/1825 [01:57<04:10, 5.03it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 31%|##########5 | 565/1825 [01:57<04:05, 5.14it/s]GraphSAGE Epoch: [5/5], current loss: 7.4386, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4386, touched nodes [3644/3649] : 31%|##########5 | 566/1825 [01:57<04:16, 4.91it/s]GraphSAGE Epoch: [5/5], current loss: 7.5742, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5742, touched nodes [3644/3649] : 31%|##########5 | 567/1825 [01:57<04:58, 4.22it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 31%|##########5 | 568/1825 [01:58<04:45, 4.40it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 31%|##########6 | 569/1825 [01:58<04:36, 4.54it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 31%|##########6 | 570/1825 [01:58<04:04, 5.14it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 31%|##########6 | 571/1825 [01:58<04:03, 5.15it/s]GraphSAGE Epoch: [5/5], current loss: 7.4658, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4658, touched nodes [3644/3649] : 31%|##########6 | 572/1825 [01:58<04:01, 5.18it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 31%|##########6 | 573/1825 [01:58<03:44, 5.59it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3644/3649] : 31%|##########6 | 574/1825 [01:59<04:37, 4.50it/s]GraphSAGE Epoch: [5/5], current loss: 7.5095, touched nodes [3644/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5095, touched nodes [3644/3649] : 32%|##########7 | 575/1825 [01:59<04:38, 4.49it/s]GraphSAGE Epoch: [5/5], current loss: 7.4709, touched nodes [3645/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4709, touched nodes [3645/3649] : 32%|##########7 | 576/1825 [01:59<04:39, 4.47it/s]GraphSAGE Epoch: [5/5], current loss: 7.6309, touched nodes [3645/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6309, touched nodes [3645/3649] : 32%|##########7 | 577/1825 [01:59<04:16, 4.86it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3645/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3645/3649] : 32%|##########7 | 578/1825 [02:00<04:14, 4.90it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3645/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3645/3649] : 32%|##########7 | 579/1825 [02:00<04:00, 5.18it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3645/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3645/3649] : 32%|##########8 | 580/1825 [02:00<04:40, 4.44it/s]GraphSAGE Epoch: [5/5], current loss: 7.2765, touched nodes [3645/3649]  GraphSAGE Epoch: [5/5], current loss: 7.2765, touched nodes [3645/3649] : 32%|##########8 | 581/1825 [02:00<04:39, 4.45it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3645/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3645/3649] : 32%|##########8 | 582/1825 [02:00<04:19, 4.80it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3645/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3645/3649] : 32%|##########8 | 583/1825 [02:01<04:22, 4.73it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3645/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3645/3649] : 32%|##########8 | 584/1825 [02:01<04:08, 5.00it/s]GraphSAGE Epoch: [5/5], current loss: 7.5890, touched nodes [3645/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5890, touched nodes [3645/3649] : 32%|##########8 | 585/1825 [02:01<04:04, 5.08it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3646/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3646/3649] : 32%|##########9 | 586/1825 [02:01<05:11, 3.97it/s]GraphSAGE Epoch: [5/5], current loss: 7.3328, touched nodes [3646/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3328, touched nodes [3646/3649] : 32%|##########9 | 587/1825 [02:02<04:54, 4.20it/s]GraphSAGE Epoch: [5/5], current loss: 7.4395, touched nodes [3646/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4395, touched nodes [3646/3649] : 32%|##########9 | 588/1825 [02:02<04:50, 4.25it/s]GraphSAGE Epoch: [5/5], current loss: 7.4349, touched nodes [3646/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4349, touched nodes [3646/3649] : 32%|##########9 | 589/1825 [02:02<04:49, 4.28it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3646/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3646/3649] : 32%|##########9 | 590/1825 [02:02<04:33, 4.52it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3646/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3646/3649] : 32%|########### | 591/1825 [02:03<04:53, 4.21it/s]GraphSAGE Epoch: [5/5], current loss: 7.2951, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.2951, touched nodes [3647/3649] : 32%|########### | 592/1825 [02:03<04:39, 4.41it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 32%|########### | 593/1825 [02:03<04:28, 4.59it/s]GraphSAGE Epoch: [5/5], current loss: 7.5002, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5002, touched nodes [3647/3649] : 33%|########### | 594/1825 [02:03<04:14, 4.85it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 33%|########### | 595/1825 [02:03<04:05, 5.00it/s]GraphSAGE Epoch: [5/5], current loss: 7.4674, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4674, touched nodes [3647/3649] : 33%|###########1 | 596/1825 [02:04<04:44, 4.32it/s]GraphSAGE Epoch: [5/5], current loss: 7.5924, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5924, touched nodes [3647/3649] : 33%|###########1 | 597/1825 [02:04<04:15, 4.81it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 33%|###########1 | 598/1825 [02:04<03:57, 5.18it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 33%|###########1 | 599/1825 [02:04<03:51, 5.29it/s]GraphSAGE Epoch: [5/5], current loss: 7.4380, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4380, touched nodes [3647/3649] : 33%|###########1 | 600/1825 [02:04<03:41, 5.52it/s]GraphSAGE Epoch: [5/5], current loss: 7.4628, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4628, touched nodes [3647/3649] : 33%|###########1 | 601/1825 [02:05<03:59, 5.12it/s]GraphSAGE Epoch: [5/5], current loss: 7.4362, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4362, touched nodes [3647/3649] : 33%|###########2 | 602/1825 [02:05<03:55, 5.19it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 33%|###########2 | 603/1825 [02:05<04:33, 4.46it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 33%|###########2 | 604/1825 [02:05<04:24, 4.61it/s]GraphSAGE Epoch: [5/5], current loss: 7.4670, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4670, touched nodes [3647/3649] : 33%|###########2 | 605/1825 [02:05<03:51, 5.26it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 33%|###########2 | 606/1825 [02:06<03:49, 5.30it/s]GraphSAGE Epoch: [5/5], current loss: 7.4926, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4926, touched nodes [3647/3649] : 33%|###########3 | 607/1825 [02:06<04:06, 4.95it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 33%|###########3 | 608/1825 [02:06<03:46, 5.37it/s]GraphSAGE Epoch: [5/5], current loss: 7.4369, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4369, touched nodes [3647/3649] : 33%|###########3 | 609/1825 [02:06<04:29, 4.51it/s]GraphSAGE Epoch: [5/5], current loss: 7.4500, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4500, touched nodes [3647/3649] : 33%|###########3 | 610/1825 [02:06<04:21, 4.65it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 33%|###########3 | 611/1825 [02:07<04:00, 5.05it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 34%|###########4 | 612/1825 [02:07<03:56, 5.12it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 34%|###########4 | 613/1825 [02:07<03:44, 5.40it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 34%|###########4 | 614/1825 [02:07<03:47, 5.33it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 34%|###########4 | 615/1825 [02:07<04:26, 4.54it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3647/3649] : 34%|###########4 | 616/1825 [02:08<04:06, 4.91it/s]GraphSAGE Epoch: [5/5], current loss: 7.4376, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4376, touched nodes [3648/3649] : 34%|###########4 | 617/1825 [02:08<04:17, 4.70it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 34%|###########5 | 618/1825 [02:08<04:08, 4.85it/s]GraphSAGE Epoch: [5/5], current loss: 7.4954, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4954, touched nodes [3648/3649] : 34%|###########5 | 619/1825 [02:08<04:00, 5.01it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 34%|###########5 | 620/1825 [02:08<03:53, 5.17it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 34%|###########5 | 621/1825 [02:09<04:37, 4.34it/s]GraphSAGE Epoch: [5/5], current loss: 7.3199, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3199, touched nodes [3648/3649] : 34%|###########5 | 622/1825 [02:09<04:25, 4.54it/s]GraphSAGE Epoch: [5/5], current loss: 7.7219, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.7219, touched nodes [3648/3649] : 34%|###########6 | 623/1825 [02:09<04:29, 4.45it/s]GraphSAGE Epoch: [5/5], current loss: 7.6009, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6009, touched nodes [3648/3649] : 34%|###########6 | 624/1825 [02:09<04:07, 4.85it/s]GraphSAGE Epoch: [5/5], current loss: 7.4353, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4353, touched nodes [3648/3649] : 34%|###########6 | 625/1825 [02:09<03:58, 5.02it/s]GraphSAGE Epoch: [5/5], current loss: 7.4363, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4363, touched nodes [3648/3649] : 34%|###########6 | 626/1825 [02:10<04:45, 4.20it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 34%|###########6 | 627/1825 [02:10<04:24, 4.53it/s]GraphSAGE Epoch: [5/5], current loss: 7.4350, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4350, touched nodes [3648/3649] : 34%|###########6 | 628/1825 [02:10<04:14, 4.70it/s]GraphSAGE Epoch: [5/5], current loss: 7.5866, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5866, touched nodes [3648/3649] : 34%|###########7 | 629/1825 [02:10<03:59, 4.99it/s]GraphSAGE Epoch: [5/5], current loss: 7.4731, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4731, touched nodes [3648/3649] : 35%|###########7 | 630/1825 [02:11<04:13, 4.71it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 35%|###########7 | 631/1825 [02:11<04:09, 4.78it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 35%|###########7 | 632/1825 [02:11<05:00, 3.97it/s]GraphSAGE Epoch: [5/5], current loss: 7.3711, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3711, touched nodes [3648/3649] : 35%|###########7 | 633/1825 [02:11<04:44, 4.18it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 35%|###########8 | 634/1825 [02:12<04:22, 4.53it/s]GraphSAGE Epoch: [5/5], current loss: 7.4524, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4524, touched nodes [3648/3649] : 35%|###########8 | 635/1825 [02:12<04:04, 4.88it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 35%|###########8 | 636/1825 [02:12<03:53, 5.09it/s]GraphSAGE Epoch: [5/5], current loss: 7.3586, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3586, touched nodes [3648/3649] : 35%|###########8 | 637/1825 [02:12<03:52, 5.12it/s]GraphSAGE Epoch: [5/5], current loss: 7.4752, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4752, touched nodes [3648/3649] : 35%|###########8 | 638/1825 [02:12<04:36, 4.30it/s]GraphSAGE Epoch: [5/5], current loss: 7.4974, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4974, touched nodes [3648/3649] : 35%|###########9 | 639/1825 [02:13<04:02, 4.88it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 35%|###########9 | 640/1825 [02:13<03:52, 5.10it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 35%|###########9 | 641/1825 [02:13<04:07, 4.78it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 35%|###########9 | 642/1825 [02:13<03:52, 5.09it/s]GraphSAGE Epoch: [5/5], current loss: 7.5890, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5890, touched nodes [3648/3649] : 35%|###########9 | 643/1825 [02:13<03:48, 5.18it/s]GraphSAGE Epoch: [5/5], current loss: 7.2807, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.2807, touched nodes [3648/3649] : 35%|###########9 | 644/1825 [02:14<04:28, 4.40it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 35%|############ | 645/1825 [02:14<04:20, 4.53it/s]GraphSAGE Epoch: [5/5], current loss: 7.2535, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.2535, touched nodes [3648/3649] : 35%|############ | 646/1825 [02:14<03:55, 5.00it/s]GraphSAGE Epoch: [5/5], current loss: 7.4596, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4596, touched nodes [3648/3649] : 35%|############ | 647/1825 [02:14<04:08, 4.74it/s]GraphSAGE Epoch: [5/5], current loss: 7.5086, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5086, touched nodes [3648/3649] : 36%|############ | 648/1825 [02:14<04:06, 4.78it/s]GraphSAGE Epoch: [5/5], current loss: 7.3820, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3820, touched nodes [3648/3649] : 36%|############ | 649/1825 [02:15<04:12, 4.66it/s]GraphSAGE Epoch: [5/5], current loss: 7.4782, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4782, touched nodes [3648/3649] : 36%|############1 | 650/1825 [02:15<04:48, 4.07it/s]GraphSAGE Epoch: [5/5], current loss: 7.2803, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.2803, touched nodes [3648/3649] : 36%|############1 | 651/1825 [02:15<04:12, 4.65it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 36%|############1 | 652/1825 [02:15<04:03, 4.81it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 36%|############1 | 653/1825 [02:15<03:49, 5.12it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 36%|############1 | 654/1825 [02:16<03:34, 5.46it/s]GraphSAGE Epoch: [5/5], current loss: 7.3694, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.3694, touched nodes [3648/3649] : 36%|############2 | 655/1825 [02:16<03:36, 5.40it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 36%|############2 | 656/1825 [02:16<04:06, 4.74it/s]GraphSAGE Epoch: [5/5], current loss: 7.4429, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4429, touched nodes [3648/3649] : 36%|############2 | 657/1825 [02:16<04:01, 4.84it/s]GraphSAGE Epoch: [5/5], current loss: 7.4348, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4348, touched nodes [3648/3649] : 36%|############2 | 658/1825 [02:16<03:54, 4.97it/s]GraphSAGE Epoch: [5/5], current loss: 7.4293, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4293, touched nodes [3648/3649] : 36%|############2 | 659/1825 [02:17<03:57, 4.92it/s]GraphSAGE Epoch: [5/5], current loss: 7.4849, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4849, touched nodes [3648/3649] : 36%|############2 | 660/1825 [02:17<03:52, 5.02it/s]GraphSAGE Epoch: [5/5], current loss: 7.5227, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5227, touched nodes [3648/3649] : 36%|############3 | 661/1825 [02:17<04:30, 4.31it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 36%|############3 | 662/1825 [02:17<04:13, 4.59it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 36%|############3 | 663/1825 [02:18<04:15, 4.55it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 36%|############3 | 664/1825 [02:18<03:52, 4.98it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 36%|############3 | 665/1825 [02:18<03:45, 5.14it/s]GraphSAGE Epoch: [5/5], current loss: 7.5016, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5016, touched nodes [3648/3649] : 36%|############4 | 666/1825 [02:18<03:32, 5.46it/s]GraphSAGE Epoch: [5/5], current loss: 7.6616, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6616, touched nodes [3648/3649] : 37%|############4 | 667/1825 [02:18<03:35, 5.38it/s]GraphSAGE Epoch: [5/5], current loss: 7.5071, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.5071, touched nodes [3648/3649] : 37%|############4 | 668/1825 [02:19<04:03, 4.75it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 37%|############4 | 669/1825 [02:19<03:59, 4.83it/s]GraphSAGE Epoch: [5/5], current loss: 7.4354, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4354, touched nodes [3648/3649] : 37%|############4 | 670/1825 [02:19<03:47, 5.08it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 37%|############5 | 671/1825 [02:19<03:28, 5.53it/s]GraphSAGE Epoch: [5/5], current loss: 7.4729, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.4729, touched nodes [3648/3649] : 37%|############5 | 672/1825 [02:19<03:45, 5.11it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 37%|############5 | 673/1825 [02:19<03:19, 5.77it/s]GraphSAGE Epoch: [5/5], current loss: 7.6633, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6633, touched nodes [3648/3649] : 37%|############5 | 674/1825 [02:20<03:59, 4.80it/s]GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649]  GraphSAGE Epoch: [5/5], current loss: 7.6246, touched nodes [3648/3649] : 37%|############5 | 675/1825 [02:20<04:07, 4.64it/s]GraphSAGE Epoch: [5/5], current loss: 7.5779, touched nodes [3649/3649]  3649  <class 'numpy.ndarray'>  EDone |
| --- |

#### 2.1.6.3 Kết quả

| Score sil arg: 0.79941124 |
| --- |

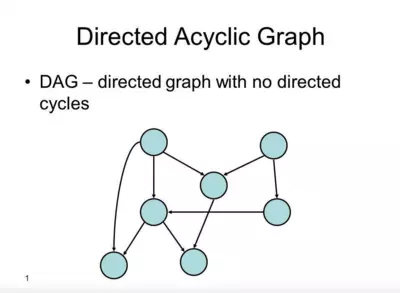


# **IV. Cơ sở lý thuyết Airflow**

## 4.1. Khái niệm về Airflow

Airflow là một công cụ lập lịch trình cho luồng công việc của bạn cũng như hỗ trợ quản lý, theo dõi từng phần trong quy trình giúp bạn sửa lỗi, bảo trì code thuận tiện và dễ dàng.

Airflow có thể tự động hóa quy trình công việc của bạn bằng DAGs ( Directed Acyclic Graphs ).



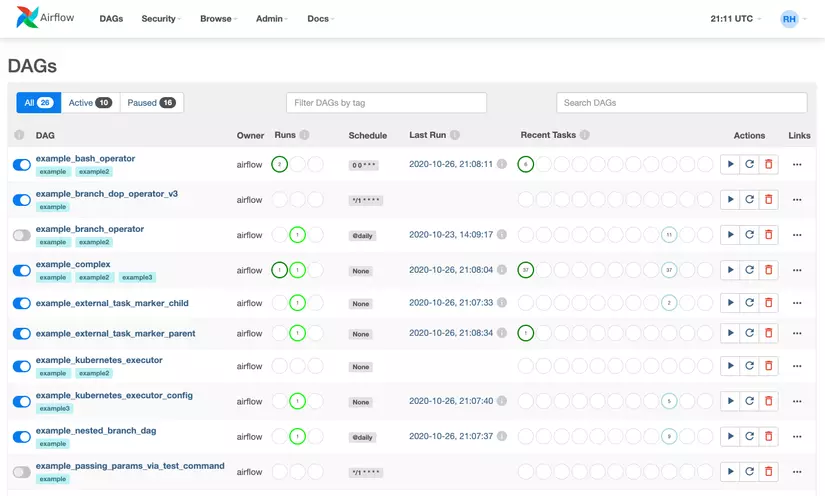
Airflow sẽ thực thi các phần công việc của bạn thông qua các worker mà vẫn đảm bảo các dependencies.

Airflow, một nền tảng nguồn mở, được sử dụng để sắp xếp các luồng công việc dưới dạng biểu đồ chu kỳ theo hướng (DAG) của các tác vụ theo cách lập trình. Một lịch trình luồng không khí được sử dụng để lên lịch các quy trình công việc và đường ống xử lý dữ liệu. Giao diện người dùng Airflow cho phép dễ dàng hình dung các đường ống chạy trong môi trường sản xuất, giám sát tiến trình của quy trình công việc và xử lý sự cố khi cần. Các tiện ích dòng lệnh phong phú được sử dụng để thực hiện các ca phẫu thuật phức tạp trên DAG.

**Apache Airflow** là một open-source project được đội ngũ kỹ sư Airbnb thiết kế từ năm 2014 và được Apache Foundation hỗ trợ từ năm 2016. Apache Airflow là một trong những công nghệ phổ biến hiện nay cho workflow management systems (WMS) được các Data Engineers dùng tới để quản lý quá trình tạo đường dẫn thông tin (data pipeline) trong cơ sở dữ liệu cho việc xử lý và phân tích thông tin. Quá trình tạo data pipeline được Airflow thể hiện bằng directed acyclic graph (DAG) do từng công việc (task) thường phụ thuộc những tasks khác để lấy dữ liệu đã được xử lý.

Cấu trúc của Apache Airflow bao gồm 4 thành phần chính:

1. Metadata Database: là database chính để chứa thông tin về hoạt động của từng task trong hệ thống
2. Scheduler: là hệ thống lập kế hoạch chính để quyết định task nào sẽ được xử lý tiếp theo
3. Executor: là hệ thống message queue để cho Scheduler kết nối với từng bộ phận làm việc (worker) cho việc thi hành từng task
4. Workers: là bộ phận làm việc chính để chạy task được thành lập từ Data Engineer



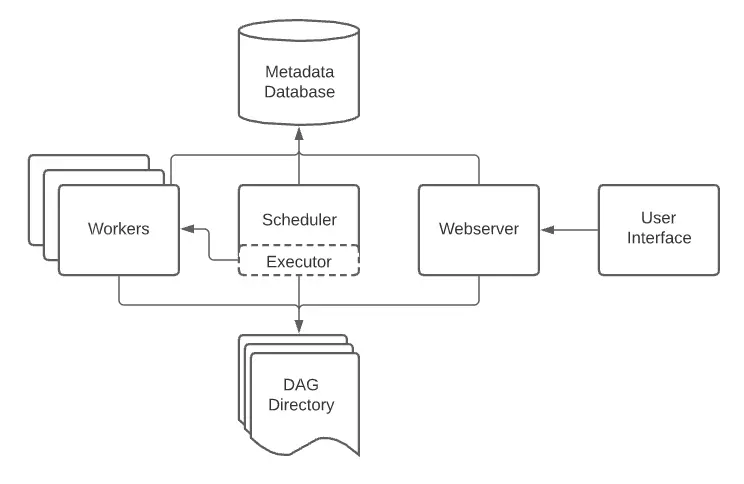
Nguyên tắc của Airflow:

* Tính năng động ( Dynamic ) : Airflow pipeline được config bằng code Python, cho phép bạn thay đổi code dễ dàng để tùy biến luồng làm việc của bạn.
* Tính tăng trưởng ( Scalable ) : Ví dụ đơn giản là bạn có thể mở rộng các task về xử lý dữ liệu để tiết kiệm thời gian
* Tính gọn gàng ( Elegant ) : code gọn gàng, ngăn nắp, rõ ràng giúp bạn đọc hiểu code nhanh chóng.
* Tính mở rộng ( Extensible ) : Bạn có thể thêm thắt thư viện, modules, packages, ... phù hợp với môi trường của bạn.

## 4.2 Kiến trúc

Airflow bao gồm các components sau:

* Scheduler: chạy workflow ( luồng công việc ) , gửi các tasks tới executor
* Executor: quản lý các workers, xử lý các tác vụ đang chạy
* Webserver: giao diện web cho phép kiểm tra, kích hoạt, sửa lỗi các tasks và DAGs
* Folder of DAG files: đọc bởi scheduler và executor ( với mọi worker mà executor có )
* Metadata database: nơi lưu trạng thái của scheduler, executor, webserver



## 4.3. Tổng quan, giới thiệu yêu cầu bài toán

Yêu cầu xây dựng 1 Pipeline Airflow theo yêu cầu sau:

* Lấy dữ liệu: Thực hiện chạy lấy data của n ngày gần nhất ( default n=30) vào lúc 8h sáng hàng ngày từ thứ 2 đến thứ 7 và lưu vào n file csv trong DATA FOLDER, nếu data trả về bị lỗi hay số lượng bản ghi lấy được không thỏa mãn( ví dụ như < 2 triệu bản ghi) thì thực hiện chạy lại task Lấy dữ liệu. Task này sẽ được lặp lại tối đa 5 lần, mỗi lần cách nhau 1 tiếng cho đến khi số lượng file data của n ngày gần nhất và số lượng bản ghi trong từng ngày đã đủ. Sau đó đến Training Task.
* Training Model: Thực hiện pretrained model(tức là train tiếp model từ model ngày hôm qua đã train) nếu ngày hôm đó rơi vào thứ 2 đến thứ 6 trong tuần, nếu rơi vào thứ bảy sẽ thực hiện training lại từ đầu.Sau đó thực hiện song song 2 task: Eval Task và Inference Task( đánh giá model).
* Eval Task: Thực hiện đánh giá model đã training.Khoảng thời gian đánh giá model sẽ là 5 ngày gần nhất với ngày hiện tại.Tham số đánh giá sẽ là Recall và Normalized Discounted Cumulative Gain (NDCG). Sau đó đến Task Inference(suy luận)
* Inference Task: Chạy model RCM cho các user có trong n file csv tương ứng với n ngày gần nhất, mỗi user sẽ dự đoán ra 100 film có confidence được model dự đoán cao nhất của user đó.Sau đó đến task Insert DB Task
* Insert Database Task: Sau khi chạy Inference ta lưu kết quả vào một file txt rồi tiến hành đẩy dữ liệu gồm thông tin user và list film yêu thích của user đó vào DB HDFS
* Done: Khi đã chạy xong Insert Database Task
* Note: Mỗi Task sẽ được lặp lại tối đa 5 lần, mỗi lần cách nhau 1 tiếng

# **V. Xây dựng DAGs cho luồng AirFlow**

Luồng DAGs cho bài toán Recommend TV360

**query\_db\_task >> training\_task >> [eval\_task, inference\_task] >> insert\_db\_task**

# **VI.Tiến hành Xây dựng luồng DAGS Airflow**

## 6.1.Xây dựng base DAG cho luồng

## 

| with DAG(  'tv360',  default\_args={  'email': ['tuanvm@gemvietnam.com'],  'email\_on\_failure': True,  'retries': 3,  'retry\_delay': timedelta(minutes=160),  },  description='TV360 ML training pipeline DAG',  schedule='22 08 \* \* 1-6',  start\_date=datetime.now(pytz.timezone('Asia/Ho\_Chi\_Minh')) - timedelta(days=2), # Start date  tags=['tuanvm'],  ) as dag |
| --- |

### 

## 6.2.Xây dựng function lấy dữ liệu cho Query Database Task của luồng AirFlow

## 

| def query\_db():  data\_folder = "/home/admin1/mnt\_raid/source/tuanvm/Viettel/demographic\_data/data/"  for csv in os.listdir(data\_folder):  shutil.copy("/home/admin1/mnt\_raid/source/tuanvm/Viettel/demographic\_data/data/" + csv, "data/" + csv)  return True |
| --- |

### 

## 6.3.Xây dựng function Training dữ liệu cho Training Task của luồng AirFlow

## 

| # Training Task  # Config for Training  today = datetime.now()  if today.weekday() == 0:  train\_weights = "best.pt"  else:  train\_weights = "None"  train\_epochs = 1  train\_batch\_size = 512  train\_device = "cuda:0"  train\_output\_dir = "/home/admin1/mnt\_raid/source/tuanvm/AirFlow/airflow-tutorial/TV360/RCM/save\_models/"  train\_bash\_command = "source /home/admin1/mnt\_raid/source/tuanvm/AirFlow/airflow-tutorial/dags/run\_train.sh \'" + train\_weights + "\' " + str(  train\_epochs) + " " + str(train\_batch\_size) + " " + str(train\_device) + " \'" + train\_output\_dir + "\'"  training\_task = BashOperator(  task\_id='Training-Task',  bash\_command=train\_bash\_command,  dag=dag  ) |
| --- |

### 

-Phần code hàm training:

| import random  import numpy as np  import json  import argparse  import torch  import torch.nn as nn  import torch.optim as optim  import torch.utils.data as data  import torchvision  from torchvision import models, transforms  import torch.nn.functional as F  from tqdm import tqdm  import model  from model import TV360Recommend  from dataloader import split\_data, Tv360Dataset  import os  # torch.multiprocessing.set\_start\_method('spawn')  from multiprocessing import set\_start\_method  from config\_path import opt  from sentence\_transformers import SentenceTransformer  # from sklearn.metrics import accuracy\_score  import warnings  warnings.filterwarnings(action='ignore', category=UserWarning)  import time  import sys  def collate\_fn(batch):  batch = list(filter(lambda x: x is not None, batch))  if len(batch) == 0:  return None  else:  return torch.utils.data.dataloader.default\_collate(batch)  def parse\_opt(known=False):  parser = argparse.ArgumentParser()  parser.add\_argument('--weights', type=str, default='TV360/RCM/save\_models/193\_best\_accuracy.pth',  help='initial weights path')  parser.add\_argument('--epochs', type=int, default=500)  parser.add\_argument('--batch-size', type=int, default=2048, help='total batch size for all GPUs, -1 for autobatch')  parser.add\_argument('--device', type=str, default='cuda:0', help='cuda device, i.e. 0 or 0,1,2,3 or cpu')  parser.add\_argument('--output-dir', type=str, default='TV360/RCM/save\_models/', help='Save Models Dir')  args = parser.parse\_known\_args()[0] if known else parser.parse\_args()  return args  if \_\_name\_\_ == "\_\_main\_\_":  args = parse\_opt(True)  print("HIHIHIHHIHI")  print(args)  torch.manual\_seed(1234)  np.random.seed(1234)  random.seed(1234)  max = 10  print(args.device)  # Split Data Train, Val and Test  target\_users\_items = split\_data()  # Load Dataset  train\_dataset = Tv360Dataset(target\_users\_items, phase="train")  val\_dataset = Tv360Dataset(target\_users\_items, phase="val")  train\_dataloader = torch.utils.data.DataLoader(train\_dataset, args.batch\_size, collate\_fn=collate\_fn, shuffle=True)  val\_dataloader = torch.utils.data.DataLoader(val\_dataset, args.batch\_size, collate\_fn=collate\_fn, shuffle=False)  # Load Model  model = TV360Recommend()  if str(args.weights) != "None":  model.load\_state\_dict(torch.load(args.weights))  model = model.to(args.device)  # Learning Rate  optimizer = optim.Adam(model.parameters(), lr=1e-4, weight\_decay=0.0005)  # Loss Function  criterior = nn.BCELoss()  for epoch in range(args.epochs):  print("Epoch {}/{}".format(epoch + 1, args.epochs))  epoch\_loss = 0.0  # epoch\_corrects = 0  # Training  # count\_loss = 0  count\_acc = 0  model.train()  for batch\_idx, items in tqdm(enumerate(train\_dataloader), total=len(train\_dataloader)):  if items is None:  continue  (inputs, labels) = items  labels = labels.to(args.device).float()  # print("\n\nstart batch---------------------",epoch)  outputs = model(inputs)  outputs = outputs[:, 0].float()  # epoch\_corrects += get\_evaluation(outputs, labels)  loss = criterior(outputs, labels)  # print(labels.size()[0])  # count\_loss += labels.size()[0]  count\_acc += len(outputs)  # backward  optimizer.zero\_grad()  loss.backward()  optimizer.step()  epoch\_loss += loss.item()  epoch\_loss = epoch\_loss / len(train\_dataloader)  # epoch\_accuracy = epoch\_corrects / count\_acc  # print("Epoch Accuracy: ", epoch\_accuracy)  # if (epoch+1) % 5 == 0:  if not os.path.exists(args.output\_dir):  os.makedirs(args.output\_dir)  PATH = args.output\_dir + "last.pth"  torch.save(model.state\_dict(), PATH)  print("Train loss: {:.10f}".format(epoch\_loss))  # print(epoch\_accuracy)  # Eval  model.eval()  epoch\_loss = 0.0  epoch\_corrects = 0  # count\_loss = 0  count\_acc = 0  with torch.no\_grad():  for batch\_idx, items in tqdm(enumerate(val\_dataloader), total=len(val\_dataloader)):  if items is None:  continue  (inputs, labels) = items  labels = labels.to(args.device).float()  # print("\n\nstart batch---------------------",epoch)  outputs = model(inputs)  outputs = outputs[:, 0].float()  loss = criterior(outputs, labels)  # epoch\_corrects += get\_evaluation(outputs, labels)  epoch\_loss += loss.item()  # count\_loss += labels.size()[0]  count\_acc += len(outputs)  epoch\_loss = epoch\_loss / len(val\_dataloader)  # epoch\_accuracy = epoch\_corrects / count\_acc  if (epoch\_loss < max):  max = epoch\_loss  PATH = args.output\_dir + "best.pth"  torch.save(model.state\_dict(), PATH)  print("Valid loss: {:.10f}".format(epoch\_loss))  # print(epoch\_accuracy) |
| --- |

### 

## 6.4. Xây dựng function Eval dữ liệu cho Eval Task của luồng AirFlow

## 

| # Eval Task  eval\_weights = "/home/admin1/mnt\_raid/source/tuanvm/AirFlow/airflow-tutorial/TV360/RCM/save\_models/85\_best\_accuracy.pth"  eval\_batch\_size = 512  eval\_device = "cuda:0"  eval\_start\_day = 20220626  eval\_end\_day = 20220630  eval\_bash\_command = "source /home/admin1/mnt\_raid/source/tuanvm/AirFlow/airflow-tutorial/dags/run\_eval.sh \'" + eval\_weights + "\' " + str(  eval\_batch\_size) + " \'" + eval\_device + "\' " + str(eval\_start\_day) + " " + str(eval\_end\_day)  print(eval\_bash\_command)  eval\_task = BashOperator(  task\_id='Eval-Task',  bash\_command=eval\_bash\_command,  dag=dag  ) |
| --- |

## 

-Phần code hàm Eval:

## 

| import random  import numpy as np  import json  import argparse  import torch  from tqdm import tqdm  import model  from model import TV360Recommend  from dataloader import Tv360Dataset, normalizeString, clean, unique, get\_all\_category, get\_record\_by\_item\_id, \  find\_seri\_id  import os  # torch.multiprocessing.set\_start\_method('spawn')  from multiprocessing import set\_start\_method  from config\_path import opt  from sentence\_transformers import SentenceTransformer  from sklearn.metrics import accuracy\_score  import warnings  warnings.filterwarnings(action='ignore', category=UserWarning)  from sklearn.metrics import classification\_report  # from pytorchtools import EarlyStopping  import time  from sklearn.preprocessing import OneHotEncoder  from sklearn.preprocessing import MultiLabelBinarizer  import pandas as pd  import math  import re  from torch.nn.functional import normalize  from pyvi.ViTokenizer import tokenize  from torch.nn import functional as F  from transformers import AutoModel, AutoTokenizer  from scipy import sparse  import bottleneck as bn  # import pickle5 as pickle  import pickle  from copy import deepcopy  from pytorch\_model\_summary import summary  def ndcg(X\_pred, heldout\_batch, k=50):  *'''*  *normalized discounted cumulative gain@k for binary relevance*  *ASSUMPTIONS: all the 0's in heldout\_data indicate 0 relevance*  *X\_pred: predicted ranking scores*  *heldout\_batch: binary relevance*  *'''*  batch\_users = X\_pred.shape[0]  idx\_topk\_part = bn.argpartition(-X\_pred, k, axis=1)  topk\_part = X\_pred[np.arange(batch\_users)[:, np.newaxis],  idx\_topk\_part[:, :k]]  idx\_part = np.argsort(-topk\_part, axis=1)  # X\_pred[np.arange(batch\_users)[:, np.newaxis], idx\_topk] is the sorted  # topk predicted score  idx\_topk = idx\_topk\_part[np.arange(batch\_users)[:, np.newaxis], idx\_part]  # build the discount template  tp = 1. / np.log2(np.arange(2, k + 2))  DCG = (heldout\_batch[np.arange(batch\_users)[:, np.newaxis],  idx\_topk].toarray() \* tp).sum(axis=1)  IDCG = np.array([(tp[:min(n, k)]).sum()  for n in heldout\_batch.getnnz(axis=1)])  return DCG / IDCG  def recall(X\_pred, heldout\_batch, k=50):  batch\_users = X\_pred.shape[0]  idx = bn.argpartition(-X\_pred, k, axis=1)  X\_pred\_binary = np.zeros\_like(X\_pred, dtype=bool)  X\_pred\_binary[np.arange(batch\_users)[:, np.newaxis], idx[:, :k]] = True  X\_true\_binary = (heldout\_batch > 0).toarray()  tmp = (np.logical\_and(X\_true\_binary, X\_pred\_binary).sum(axis=1)).astype(  np.float32)  recall = tmp / np.minimum(k, X\_true\_binary.sum(axis=1))  return recall  pd\_film\_series = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_series)  pd\_film\_episode = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_episode)  dict\_films\_duration = pd\_film\_episode.groupby('series\_id')['duration'].agg(  [("duration", "sum")]).reset\_index().set\_index('series\_id').T.to\_dict('list')  ccai = pd.read\_csv(opt.folder + opt.path\_file\_user\_info)  ccai\_drop\_nan = pd.read\_csv(opt.folder + opt.path\_file\_user\_info)  ccai\_drop\_nan.dropna(inplace=True)  pd\_film\_series\_drop\_nan = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_series)  pd\_film\_series\_drop\_nan.dropna(inplace=True)  def get\_ft\_item(film\_id, data):  if data[str(film\_id)] is None:  return None  else:  description\_emb, country, category, actor, director, is\_series\_emb, duration, release\_year = data[str(film\_id)]  return (description\_emb.unsqueeze(0).to(args.device), country.unsqueeze(0).to(args.device),  category.unsqueeze(0).to(args.device),  actor.unsqueeze(0).to(args.device), director.unsqueeze(0).to(args.device),  is\_series\_emb.unsqueeze(0).to(args.device), duration.unsqueeze(0).to(args.device),  release\_year.unsqueeze(0).to(args.device)  )  def get\_ft\_user(user\_id):  try:  user\_info = ccai[ccai["profile\_id"] == int(user\_id)].to\_dict('records')[0]  onehot\_province\_user = OneHotEncoder(handle\_unknown='ignore', sparse=False)  onehot\_province\_user.fit(ccai\_drop\_nan[['province\_name']])  if type(user\_info['province\_name']) == str:  onehot\_province\_user = onehot\_province\_user.transform([[user\_info['province\_name']]])[0]  else:  onehot\_province\_user = onehot\_province\_user.transform([[""]])[0]  except:  print(user\_id)  return None  gender = user\_info['gender']  age = user\_info['age']  if math.isnan(gender):  return None  if math.isnan(age):  return None  ccai\_embedding = np.hstack((np.array([gender, age]), onehot\_province\_user))  ccai\_embedding = torch.FloatTensor(ccai\_embedding)  return ccai\_embedding  def parse\_opt(known=False):  parser = argparse.ArgumentParser()  parser.add\_argument('--weights', type=str, default='TV360/RCM/save\_models/85\_best\_accuracy.pth',  help='initial weights path')  parser.add\_argument('--mask', action='store\_true', help='Che nhung film trong history film cua user')  parser.add\_argument('--batch-size', type=int, default=3, help='total batch size for all GPUs, -1 for autobatch')  parser.add\_argument('--device', default='cuda:0', help='cuda device, i.e. cuda:0 or 0,1,2,3 or cpu')  parser.add\_argument('--start-day', type=int, default=20220626, help='Date from 20220625 to 20220630')  parser.add\_argument('--end-day', type=int, default=20220626, help='Date from 20220625 to 20220630')  args = parser.parse\_known\_args()[0] if known else parser.parse\_args()  return args  if \_\_name\_\_ == "\_\_main\_\_":  args = parse\_opt(True)  if args.start\_day > args.end\_day:  print("Invalid Date!")  exit()  list\_film\_id = pd\_film\_series['series\_id'].apply(lambda x: str(x)).tolist()  dict\_film\_durations = pd\_film\_series[["series\_id", "duration"]]  dict\_film\_durations = dict\_film\_durations.set\_index('series\_id').T.to\_dict('list')  path\_file\_user\_info = opt.path\_file\_user\_info  folder = opt.folder  path\_list\_file\_log\_film = []  for file\_path in os.listdir(folder + "data/"):  if file\_path.find("log\_film") >= 0:  path\_list\_file\_log\_film.append(file\_path)  users\_info = pd.read\_csv(folder + path\_file\_user\_info)  # users\_info.dropna()  # users\_items = {}  list\_hst\_users\_info = []  for log\_film\_path in path\_list\_file\_log\_film:  # print(hst\_users\_info['content\_id'])  if log\_film\_path != "log\_film\_0625\_0630.csv":  hst\_users\_info\_5\_days = pd.read\_csv(opt.folder + "data/" + log\_film\_path)  list\_hst\_users\_info.append(hst\_users\_info\_5\_days)  # hst\_users\_info = hst\_users\_info.dropna()  model = TV360Recommend().to(args.device)  model.load\_state\_dict(torch.load(args.weights))  model.eval()  dict\_fe\_item = {}  list\_film\_remove = []  list\_ft\_film = []  raw\_features\_file = 'raw\_features\_unnormal.pickle'  with open(raw\_features\_file, 'rb') as f:  data = pickle.load(f)  for item\_id in list\_film\_id:  dict\_fe\_item[item\_id] = get\_ft\_item(item\_id, data)  if dict\_fe\_item[item\_id] is None:  list\_film\_remove.append(item\_id)  for item\_id in list\_film\_remove:  list\_film\_id.remove(item\_id)  list\_film\_id.sort()  print("Length Film Eval:", len(list\_film\_id))  for i in range(8):  list\_ft\_i = [dict\_fe\_item[item\_id][i] for item\_id in list\_film\_id]  ft\_i = torch.cat(list\_ft\_i, 0)  # print(ft\_i.size())  list\_ft\_film.append(ft\_i)  # print(dict\_fe\_item['14495'])  length\_list\_ft\_film = len(list\_film\_id)  # List Item Eval  eval\_users\_info = pd.read\_csv(opt.folder + "data/log\_film\_0625\_0630.csv")  # eval\_users\_info.dropna()  eval\_users\_info["profile\_id"] = eval\_users\_info["profile\_id"].apply(lambda x: clean(x))  eval\_users\_info['content\_id'] = eval\_users\_info['content\_id'].apply(lambda x: find\_seri\_id(x))  eval\_users\_info = eval\_users\_info[eval\_users\_info['content\_id'].isin(list\_film\_id)]  eval\_users\_info = eval\_users\_info[(eval\_users\_info['content\_id'] != "-1") & (eval\_users\_info["profile\_id"] != "-1")]  list\_time = range(args.start\_day, args.end\_day + 1)  eval\_users\_info = eval\_users\_info[eval\_users\_info['partition'].isin(list\_time)]  # print(eval\_users\_info)  all\_users\_id\_eval = [str(user\_id) for user\_id in eval\_users\_info["profile\_id"].tolist()]  eval\_users\_info = eval\_users\_info.groupby(["profile\_id"])['content\_id'].apply(list).apply(  lambda x: unique(x)).reset\_index()  eval\_users\_info = eval\_users\_info[["profile\_id", 'content\_id']].set\_index("profile\_id").T.to\_dict('list')  # Hst Film  hst\_users\_info = pd.concat(list\_hst\_users\_info, ignore\_index=True, sort=False)  # hst\_users\_info = pd.read\_csv(opt.folder + "data/log\_film\_0601\_0605.csv")  hst\_users\_info["profile\_id"] = hst\_users\_info["profile\_id"].apply(lambda x: clean(x))  hst\_users\_info = hst\_users\_info[hst\_users\_info["profile\_id"].isin(all\_users\_id\_eval)]  hst\_users\_info['content\_id'] = hst\_users\_info['content\_id'].apply(lambda x: find\_seri\_id(x))  hst\_users\_info = hst\_users\_info[hst\_users\_info['content\_id'].isin(list\_film\_id)]  hst\_users\_info = hst\_users\_info[(hst\_users\_info['content\_id'] != "-1") & (hst\_users\_info["profile\_id"] != "-1")]  hst\_film\_id\_group\_by\_user = hst\_users\_info.groupby(["profile\_id", "content\_id"])['watch\_duration'].agg(  [("watch\_duration", "sum")]).reset\_index()  hst\_film\_id\_group\_by\_user['partition'] = \  hst\_users\_info.groupby(["profile\_id", "content\_id"])['partition'].apply(lambda x: max(x)).reset\_index()['partition']  # hst\_film\_id\_group\_by\_user['partition'] = hst\_users\_info.groupby(["profile\_id", "content\_id"])['partition'].apply(list).reset\_index()['partition']  users\_items = hst\_film\_id\_group\_by\_user.groupby(["profile\_id"])['content\_id'].apply(list).apply(  lambda x: x if len(x) > 0 else -1).reset\_index()  # users\_items = hst\_film\_id\_group\_by\_user.groupby(["profile\_id"])['content\_id'].apply(list).apply(lambda x: x if len(x) >= opt.numbers\_of\_hst\_films else -1).reset\_index()  # apply(lambda x: x if len(x) >= opt.numbers\_of\_hst\_films else -1)  users\_items['partition'] = hst\_film\_id\_group\_by\_user.groupby("profile\_id")['partition'].apply(list).reset\_index()[  'partition']  users\_items['watch\_duration'] = \  hst\_film\_id\_group\_by\_user.groupby("profile\_id")['watch\_duration'].apply(list).reset\_index()['watch\_duration']  users\_items = users\_items[users\_items['content\_id'] != -1]  # print(users\_items)  users\_items = users\_items.set\_index("profile\_id").T.to\_dict('list')  dict\_mask\_index\_film\_user = {}  def sort\_date(key, value):  v = list(zip(value[0], value[1], value[2]))  v.sort(key=lambda x: x[1])  # print(list(zip(value[0], value[1], value[2])).sort(key=lambda x: x[1]))  if len(v) < opt.numbers\_of\_hst\_films:  v.extend((opt.numbers\_of\_hst\_films - len(v)) \* [v[-1]])  dict\_mask\_index\_film\_user[key] = []  list\_film\_remove = []  if args.mask:  ground\_truth = eval\_users\_info[key][0]  for item in v:  if item[0] in ground\_truth:  if item[0] in list\_film\_remove:  continue  else:  list\_film\_remove.append(item[0])  index\_list\_film = list\_film\_id.index(item[0])  dict\_mask\_index\_film\_user[key].append(index\_list\_film)  for item\_id in list\_film\_remove:  eval\_users\_info[key][0].remove(item\_id)  # print(dict\_mask\_index\_film\_user[key])  # print(list\_film\_remove)  # print(eval\_users\_info[key][0])  # print("------------------")  # if '8167' in list\_film\_remove:  # exit()  return v[-opt.numbers\_of\_hst\_films:]  hst\_users\_items = {k: sort\_date(k, v) for k, v in users\_items.items()}  # def sort\_date(value):  # # v = list(zip(value[0], value[1], value[2]))  # # v.sort(key=lambda x: x[1])  # # # print(list(zip(value[0], value[1], value[2])).sort(key=lambda x: x[1]))  # # return v  # v = []  # for film\_id, list\_date, watch\_duration in zip(value[0], value[1], value[2]):  # list\_date = list(set(list\_date))  # len\_date = len(list\_date)  # v.extend(list(zip(len\_date\*[film\_id], list\_date, len\_date\*[watch\_duration])))  # v.sort(key=lambda x: x[1])  # if len(v) < opt.numbers\_of\_hst\_films:  # v.extend((opt.numbers\_of\_hst\_films - len(v)) \* [v[-1]])  # return v[-opt.numbers\_of\_hst\_films:]  # hst\_users\_items = {k: sort\_date(v) for k, v in users\_items.items()}  onehot\_film = MultiLabelBinarizer()  onehot\_film.fit([list\_film\_id])  heldout\_batch = []  pred = []  # print(hst\_users\_items)  print("Length User: ", len(list(hst\_users\_items.keys())))  len\_batch = len(list(hst\_users\_items.keys())) // args.batch\_size + 1  with torch.no\_grad():  for index in range(len\_batch):  if index >= 1000:  break  batch\_hst\_users\_items\_keys = list(hst\_users\_items.keys())[  args.batch\_size \* index: args.batch\_size \* (index + 1)]  # print(len(batch\_hst\_users\_items\_keys))  batch\_fe\_hst\_items = []  batch\_rating = []  list\_ccai\_embedding = []  nb\_user = 0  for idx, key in enumerate(batch\_hst\_users\_items\_keys):  # print(i)  # print(eval\_users\_info[key])  if len(eval\_users\_info[key][0]) == 0:  # print("Empty Film Item")  continue  heldout\_batch\_key = onehot\_film.transform(eval\_users\_info[key])[0]  hst\_films\_key = hst\_users\_items[key]  ccai\_embedding = get\_ft\_user(key)  if ccai\_embedding is None:  continue  heldout\_batch.append(heldout\_batch\_key)  ccai\_embedding = torch.cat(length\_list\_ft\_film \* [ccai\_embedding.unsqueeze(0)], 0)  list\_rating = []  fe\_hst\_items = []  list\_ccai\_embedding.append(ccai\_embedding)  for (film\_id, partition, watch\_duration) in hst\_films\_key:  batch\_fe\_item = []  fe\_item = dict\_fe\_item[film\_id]  for i in range(8):  ft\_i = torch.cat(length\_list\_ft\_film \* [fe\_item[i]], 0)  batch\_fe\_item.append(ft\_i)  if watch\_duration > opt.duration\_threshold:  rating = 1  else:  rating = watch\_duration / opt.duration\_threshold  # if watch\_duration > dict\_film\_durations[int(film\_id)][0]:  # rating = 1  # else:  # rating = watch\_duration/dict\_film\_durations[int(film\_id)][0]  # print(rating)  rating = torch.cat(length\_list\_ft\_film \* [torch.tensor([rating])], 0)  list\_rating.append(rating)  fe\_hst\_items.append(batch\_fe\_item)  batch\_fe\_hst\_items.append(fe\_hst\_items)  batch\_rating.append(list\_rating)  nb\_user += 1  if nb\_user == 0:  continue  ratings = []  hst\_items = []  for i2 in range(opt.numbers\_of\_hst\_films):  list\_rating\_batch = []  for i3 in range(len(batch\_rating)):  list\_rating\_batch.append(batch\_rating[i3][i2])  ratings.append(torch.cat(list\_rating\_batch, 0))  for i2 in range(opt.numbers\_of\_hst\_films):  list\_batch\_hst\_items = []  for i4 in range(8):  list\_hst\_ft\_i = []  for i3 in range(len(batch\_rating)):  list\_hst\_ft\_i.append(batch\_fe\_hst\_items[i3][i2][i4])  list\_batch\_hst\_items.append(torch.cat(list\_hst\_ft\_i, 0))  hst\_items.append(list\_batch\_hst\_items)  batch\_ccai\_embedding = torch.cat(list\_ccai\_embedding, 0)  # print(batch\_ccai\_embedding.size())  batch\_fe\_hst\_items1 = deepcopy(hst\_items)  list\_ft\_film1 = deepcopy(list\_ft\_film)  batch\_ft\_film = []  for idx2 in range(8):  list\_ft\_target\_film = []  for idx3 in range(len(batch\_rating)):  list\_ft\_target\_film.append(list\_ft\_film1[idx2])  batch\_ft\_film.append(torch.cat(list\_ft\_target\_film, 0))  inputs = (batch\_fe\_hst\_items1, batch\_ft\_film, batch\_ccai\_embedding, ratings)  # print(summary(model, inputs))  # print(model)  outputs = model(inputs)  outputs = outputs[:, 0].detach().cpu().numpy()  nb\_films = len(outputs) // length\_list\_ft\_film  for i in range(nb\_films):  pred.append(outputs[length\_list\_ft\_film \* i: length\_list\_ft\_film \* (i + 1)])  if args.mask:  for index in dict\_mask\_index\_film\_user[key]:  outputs[index] = 0  print(len(pred))  pred = np.array(pred)  heldout\_batch = sparse.csr\_matrix(np.array(heldout\_batch))  recall\_ = recall(pred, heldout\_batch)  ndcg\_ = ndcg(pred, heldout\_batch)  print(recall\_)  print("---------")  print(ndcg\_)  print("RECALL MEAN: ")  print(sum(recall\_) / len(recall\_))  print("NDCG MEAN: ")  print(sum(ndcg\_) / len(ndcg\_)) |
| --- |

## 

## 6.5. Xây dựng function Inference dữ liệu và đẩy dữ liệu vào HDFS DB cho Inference Task của luồng Airflow

## 

| # Inference Task  inference\_weights = "/home/admin1/mnt\_raid/source/tuanvm/AirFlow/airflow-tutorial/TV360/RCM/save\_models/85\_best\_accuracy.pth"  inference\_device = 512  inference\_top\_k = 100  inference\_bash\_command = "source /home/admin1/mnt\_raid/source/tuanvm/AirFlow/airflow-tutorial/dags/run\_eval.sh \'" + inference\_weights + "\' " + str(  inference\_device) + " \' " + inference\_top\_k  inference\_task = BashOperator(  task\_id='Inference-Task',  bash\_command=inference\_bash\_command,  dag=dag  ) |
| --- |

* Phần code hàm Inference:

| import random  import numpy as np  import json  import argparse  import torch  from tqdm import tqdm  import model  from model import TV360Recommend  from dataloader import Tv360Dataset, normalizeString, clean, unique, get\_all\_category, get\_record\_by\_item\_id, \  find\_seri\_id  import os  # torch.multiprocessing.set\_start\_method('spawn')  from multiprocessing import set\_start\_method  from config\_path import opt  from sentence\_transformers import SentenceTransformer  from sklearn.metrics import accuracy\_score  import warnings  warnings.filterwarnings(action='ignore', category=UserWarning)  from sklearn.metrics import classification\_report  # from pytorchtools import EarlyStopping  import time  from sklearn.preprocessing import OneHotEncoder  from sklearn.preprocessing import MultiLabelBinarizer  import pandas as pd  import math  import re  from torch.nn.functional import normalize  from pyvi.ViTokenizer import tokenize  from torch.nn import functional as F  from transformers import AutoModel, AutoTokenizer  from scipy import sparse  import bottleneck as bn  import pickle5 as pickle  from copy import deepcopy  from pytorch\_model\_summary import summary  pd\_film\_series = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_series)  pd\_film\_episode = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_episode)  dict\_films\_duration = pd\_film\_episode.groupby('series\_id')['duration'].agg(  [("duration", "sum")]).reset\_index().set\_index('series\_id').T.to\_dict('list')  ccai = pd.read\_csv(opt.folder + opt.path\_file\_user\_info)  all\_profile\_users\_id = ccai['profile\_id'].tolist()  all\_profile\_users\_id = [str(id) for id in all\_profile\_users\_id]  ccai\_drop\_nan = pd.read\_csv(opt.folder + opt.path\_file\_user\_info)  ccai\_drop\_nan.dropna(inplace=True)  pd\_film\_series\_drop\_nan = pd.read\_csv(opt.folder + "data/" + opt.path\_film\_series)  pd\_film\_series\_drop\_nan.dropna(inplace=True)  def get\_ft\_item(film\_id, data):  if data[str(film\_id)] is None:  return None  else:  description\_emb, country, category, actor, director, is\_series\_emb, duration, release\_year = data[str(film\_id)]  return (description\_emb.unsqueeze(0).to(args.device), country.unsqueeze(0).to(args.device),  category.unsqueeze(0).to(args.device),  actor.unsqueeze(0).to(args.device), director.unsqueeze(0).to(args.device),  is\_series\_emb.unsqueeze(0).to(args.device), duration.unsqueeze(0).to(args.device),  release\_year.unsqueeze(0).to(args.device)  )  def get\_ft\_user(user\_id):  try:  user\_info = ccai[ccai["profile\_id"] == int(user\_id)].to\_dict('records')[0]  onehot\_province\_user = OneHotEncoder(handle\_unknown='ignore', sparse=False)  onehot\_province\_user.fit(ccai\_drop\_nan[['province\_name']])  if type(user\_info['province\_name']) == str:  onehot\_province\_user = onehot\_province\_user.transform([[user\_info['province\_name']]])[0]  else:  onehot\_province\_user = onehot\_province\_user.transform([[""]])[0]  except:  print(user\_id)  return None  gender = user\_info['gender']  age = user\_info['age']  if math.isnan(gender):  return None  if math.isnan(age):  return None  ccai\_embedding = np.hstack((np.array([gender, age]), onehot\_province\_user))  ccai\_embedding = torch.FloatTensor(ccai\_embedding)  return ccai\_embedding  def parse\_opt(known=False):  parser = argparse.ArgumentParser()  parser.add\_argument('--weights', type=str, default='TV360/RCM/save\_models/85\_best\_accuracy.pth',  help='initial weights path')  parser.add\_argument('--device', default='cuda:0', help='cuda device, i.e. cuda:0 or 0,1,2,3 or cpu')  parser.add\_argument('--top-k', type=int, default=100, help='top-k film co do yeu thich cao nhat')  args = parser.parse\_known\_args()[0] if known else parser.parse\_args()  return args  if \_\_name\_\_ == "\_\_main\_\_":  args = parse\_opt(True)  list\_film\_id = pd\_film\_series['series\_id'].apply(lambda x: str(x)).tolist()  dict\_film\_durations = pd\_film\_series[["series\_id", "duration"]]  dict\_film\_durations = dict\_film\_durations.set\_index('series\_id').T.to\_dict('list')  path\_file\_user\_info = opt.path\_file\_user\_info  folder = opt.folder  path\_list\_file\_log\_film = []  for file\_path in os.listdir(folder + "data/"):  if file\_path.find("log\_film") >= 0:  path\_list\_file\_log\_film.append(file\_path)  users\_info = pd.read\_csv(folder + path\_file\_user\_info)  # users\_info.dropna()  # users\_items = {}  list\_hst\_users\_info = []  for log\_film\_path in path\_list\_file\_log\_film:  # print(hst\_users\_info['content\_id'])  if log\_film\_path != "log\_film\_0625\_0630.csv":  hst\_users\_info\_5\_days = pd.read\_csv(opt.folder + "data/" + log\_film\_path)  list\_hst\_users\_info.append(hst\_users\_info\_5\_days)  # hst\_users\_info = hst\_users\_info.dropna()  model = TV360Recommend().to(args.device)  model.load\_state\_dict(torch.load(args.weights))  model.eval()  dict\_fe\_item = {}  list\_film\_remove = []  list\_ft\_film = []  raw\_features\_file = 'raw\_features\_unnormal.pickle'  with open(raw\_features\_file, 'rb') as f:  data = pickle.load(f)  for item\_id in list\_film\_id:  dict\_fe\_item[item\_id] = get\_ft\_item(item\_id, data)  if dict\_fe\_item[item\_id] is None:  list\_film\_remove.append(item\_id)  for item\_id in list\_film\_remove:  list\_film\_id.remove(item\_id)  list\_film\_id.sort()  print("Length Film Eval:", len(list\_film\_id))  for i in range(8):  list\_ft\_i = [dict\_fe\_item[item\_id][i] for item\_id in list\_film\_id]  ft\_i = torch.cat(list\_ft\_i, 0)  # print(ft\_i.size())  list\_ft\_film.append(ft\_i)  # print(dict\_fe\_item['14495'])  length\_list\_ft\_film = len(list\_film\_id)  # Hst Film  hst\_users\_info = pd.concat(list\_hst\_users\_info, ignore\_index=True, sort=False)  # hst\_users\_info = pd.read\_csv(opt.folder + "data/log\_film\_0601\_0605.csv")  hst\_users\_info["profile\_id"] = hst\_users\_info["profile\_id"].apply(lambda x: clean(x))  hst\_users\_info = hst\_users\_info[hst\_users\_info["profile\_id"].isin(all\_profile\_users\_id)]  hst\_users\_info['content\_id'] = hst\_users\_info['content\_id'].apply(lambda x: find\_seri\_id(x))  hst\_users\_info = hst\_users\_info[hst\_users\_info['content\_id'].isin(list\_film\_id)]  hst\_users\_info = hst\_users\_info[(hst\_users\_info['content\_id'] != "-1") & (hst\_users\_info["profile\_id"] != "-1")]  hst\_film\_id\_group\_by\_user = hst\_users\_info.groupby(["profile\_id", "content\_id"])['watch\_duration'].agg(  [("watch\_duration", "sum")]).reset\_index()  hst\_film\_id\_group\_by\_user['partition'] = \  hst\_users\_info.groupby(["profile\_id", "content\_id"])['partition'].apply(lambda x: max(x)).reset\_index()['partition']  # hst\_film\_id\_group\_by\_user['partition'] = hst\_users\_info.groupby(["profile\_id", "content\_id"])['partition'].apply(list).reset\_index()['partition']  users\_items = hst\_film\_id\_group\_by\_user.groupby(["profile\_id"])['content\_id'].apply(list).apply(  lambda x: x if len(x) > 0 else -1).reset\_index()  # users\_items = hst\_film\_id\_group\_by\_user.groupby(["profile\_id"])['content\_id'].apply(list).apply(lambda x: x if len(x) >= opt.numbers\_of\_hst\_films else -1).reset\_index()  # apply(lambda x: x if len(x) >= opt.numbers\_of\_hst\_films else -1)  users\_items['partition'] = hst\_film\_id\_group\_by\_user.groupby("profile\_id")['partition'].apply(list).reset\_index()[  'partition']  users\_items['watch\_duration'] = \  hst\_film\_id\_group\_by\_user.groupby("profile\_id")['watch\_duration'].apply(list).reset\_index()['watch\_duration']  users\_items = users\_items[users\_items['content\_id'] != -1]  # print(users\_items)  users\_items = users\_items.set\_index("profile\_id").T.to\_dict('list')  dict\_mask\_index\_film\_user = {}  def sort\_date(key, value):  v = list(zip(value[0], value[1], value[2]))  v.sort(key=lambda x: x[1])  # print(list(zip(value[0], value[1], value[2])).sort(key=lambda x: x[1]))  if len(v) < opt.numbers\_of\_hst\_films:  v.extend((opt.numbers\_of\_hst\_films - len(v)) \* [v[-1]])  return v[-opt.numbers\_of\_hst\_films:]  hst\_users\_items = {k: sort\_date(k, v) for k, v in users\_items.items()}  onehot\_film = MultiLabelBinarizer()  onehot\_film.fit([list\_film\_id])  pred = []  # print(hst\_users\_items)  print("Length User: ", len(list(hst\_users\_items.keys())))  with torch.no\_grad():  for idx, key in enumerate(hst\_users\_items.keys()):  # print(i)  if idx > 200:  break  pred\_key = []  hst\_films\_key = hst\_users\_items[key]  ccai\_embedding = get\_ft\_user(key)  if ccai\_embedding is None:  continue  ccai\_embedding = torch.cat(length\_list\_ft\_film \* [ccai\_embedding.unsqueeze(0)], 0)  fe\_hst\_items = []  list\_rating = []  for (film\_id, partition, watch\_duration) in hst\_films\_key:  batch\_fe\_item = []  fe\_item = dict\_fe\_item[film\_id]  for i in range(8):  ft\_i = torch.cat(length\_list\_ft\_film \* [fe\_item[i]], 0)  batch\_fe\_item.append(ft\_i)  if watch\_duration > opt.duration\_threshold:  rating = 1  else:  rating = watch\_duration / opt.duration\_threshold  # if watch\_duration > dict\_film\_durations[int(film\_id)][0]:  # rating = 1  # else:  # rating = watch\_duration/dict\_film\_durations[int(film\_id)][0]  # print(rating)  rating = torch.cat(length\_list\_ft\_film \* [torch.tensor([rating])], 0)  list\_rating.append(rating)  fe\_hst\_items.append(batch\_fe\_item)  list\_ft\_film1 = deepcopy(list\_ft\_film)  inputs = (fe\_hst\_items, list\_ft\_film1, ccai\_embedding, list\_rating)  # print(summary(model, inputs))  # print(model)  outputs = model(inputs)  outputs = outputs[:, 0].detach().cpu().numpy()  indexs = bn.argpartition(-np.array([outputs]), args.top\_k, axis=1)  sort\_idx = indexs[:, :args.top\_k]  sort\_idx = sorted(sort\_idx[0], key=lambda x: outputs[x], reverse=True)  outputs\_film = [list\_film\_id[idx] for idx in sort\_idx]  print("---------------------")  print(outputs\_film)  pred.append(outputs\_film)  pred = np.array(pred)  print(pred.shape) |
| --- |

## 