CS 744: DISTRIBUTED DGL

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Fall 2022
- Midterm grades out!
- Regrade requests (check question numbers)
  - Thu: After class, Roger’s OH
  - Mon: Shivaram’s OH, Roger’s OH
  - Tue: After class

- Course Project: Check in by Nov 23th
EXAMPLE: LINK PREDICTION

Task: Predict potential connections in a social network

Find K-nearest neighbors
EXAMPLE: NODE CLASSIFICATION

Task: Classify papers in a citation graph by subject area

From: https://github.com/lanstonchu/citation-graph
GRAPH EMBEDDING MODELS: DECODER-ONLY

Loss function

Maximize score for edges in graph
Minimize for others (negative edges)

\[ \mathcal{L} = \sum_{e \in G} \sum_{e' \in S_e} \max(f(e) - f(e') + \lambda, 0) \]
Graph Neural Networks: Use neural network to capture neighborhood structure

Input: $h_i^0$ (base node representations)

Model: $h_i^k = AGG(h_i^{k-1}, \{h_u^{k-1}: u \in N_i\})$

$N_i$ one-hop neighborhood of $i$

$AGG$ parameterized aggregation func

$h_W^1 = AGG(h_W^0, \{h_i^0, h_M^0\})$

$N_i$ one-hop neighborhood of $i$
\( h_v^k \leftarrow \sigma(W \cdot \text{MEAN}(\{ h_{v}^{k-1} \} \cup \{ h_{u}^{k-1}, \forall u \in N(v) \})) \)
DISTDGL: DEEP GRAPH LIBRARY

Distributed system for training GNNs
  KVStore
  Mini-batch sampler
  Trainer

System Design
Key techniques
  Partitioning heterogeneous graphs
  Async mini-batch sampling
DISTDGL SYSTEM SETUP

Machine-0

Machine-1

- KVStore Server
- Sampler Server
- Trainer Process
- Sampler Process

Shared-memory

RPC Request
GRAPH PARTITIONING: METIS

Hierarchical METIS

Apply METIS to partition graph across machines

Re-apply METIS to partition within a machine

A fast and high quality multilevel scheme for partitioning irregular graphs

George Karypis and Vipin Kumar
for batch in training_examples:
    sample_neighbors(batch)
    load_representations(batch)
    transfer_to_GPU(batch)
    loss = model(batch)
    transfer_to_CPU(batch)
    update_parameters(batch)
MINIBATCH SAMPLING FOR GNNS
Async mini-batch sampling with sync training
Graph NN: capture the structure of

DistDGL: Distributed GNN training
  Partition graphs using METIS
  Pipelining to use CPU, GPU for sampling
DISCUSSION

https://forms.gle/Dp8qtqdpWuoVey67
If you wished to extend the design of Marius to support GNNs, how would you do that? What would be some challenges?
Next steps

Next class: Serverless computing
Project check-ins by Nov 23th