

MPI-based decentralized learning framework for large-scale networks

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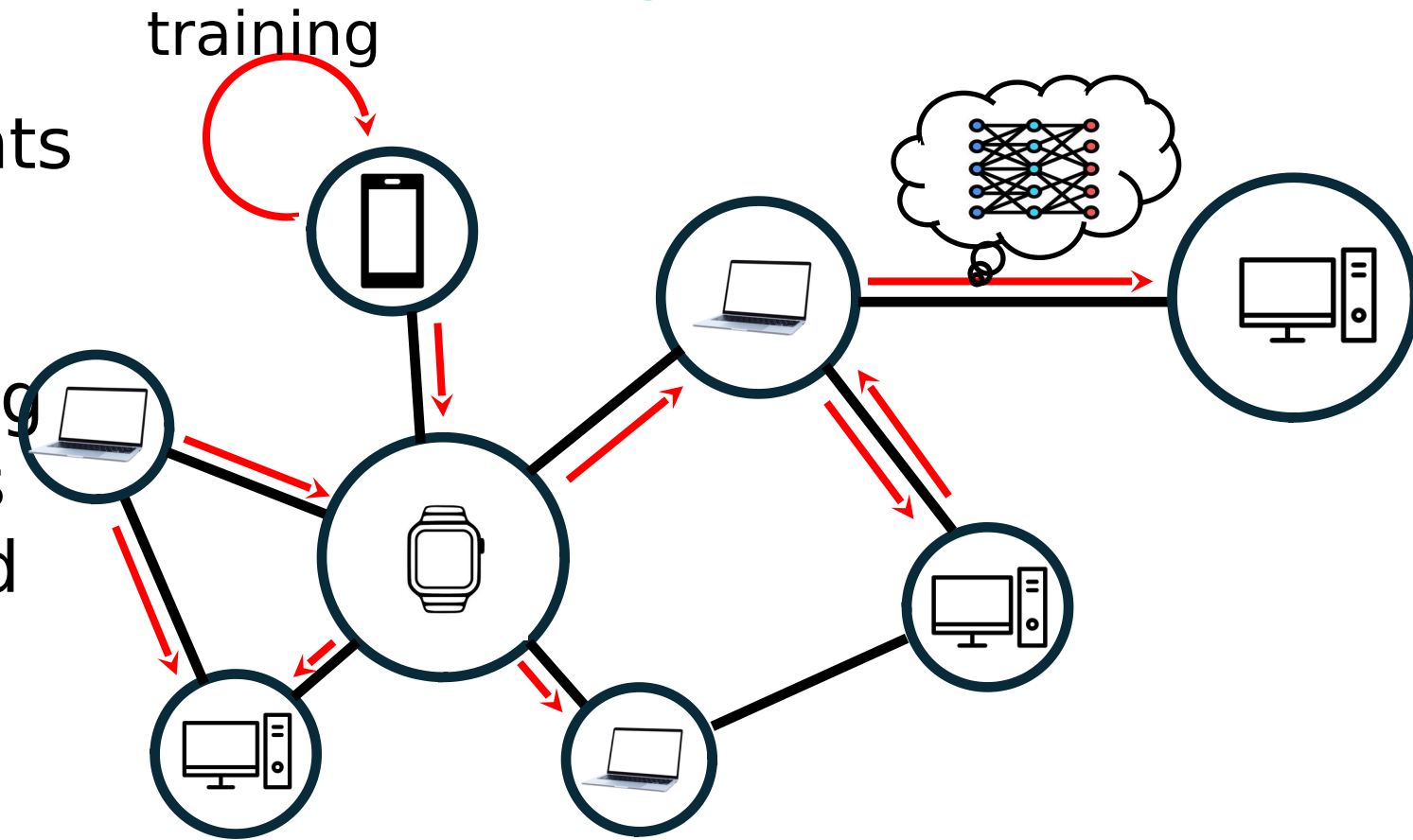
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What is decentralized learning?

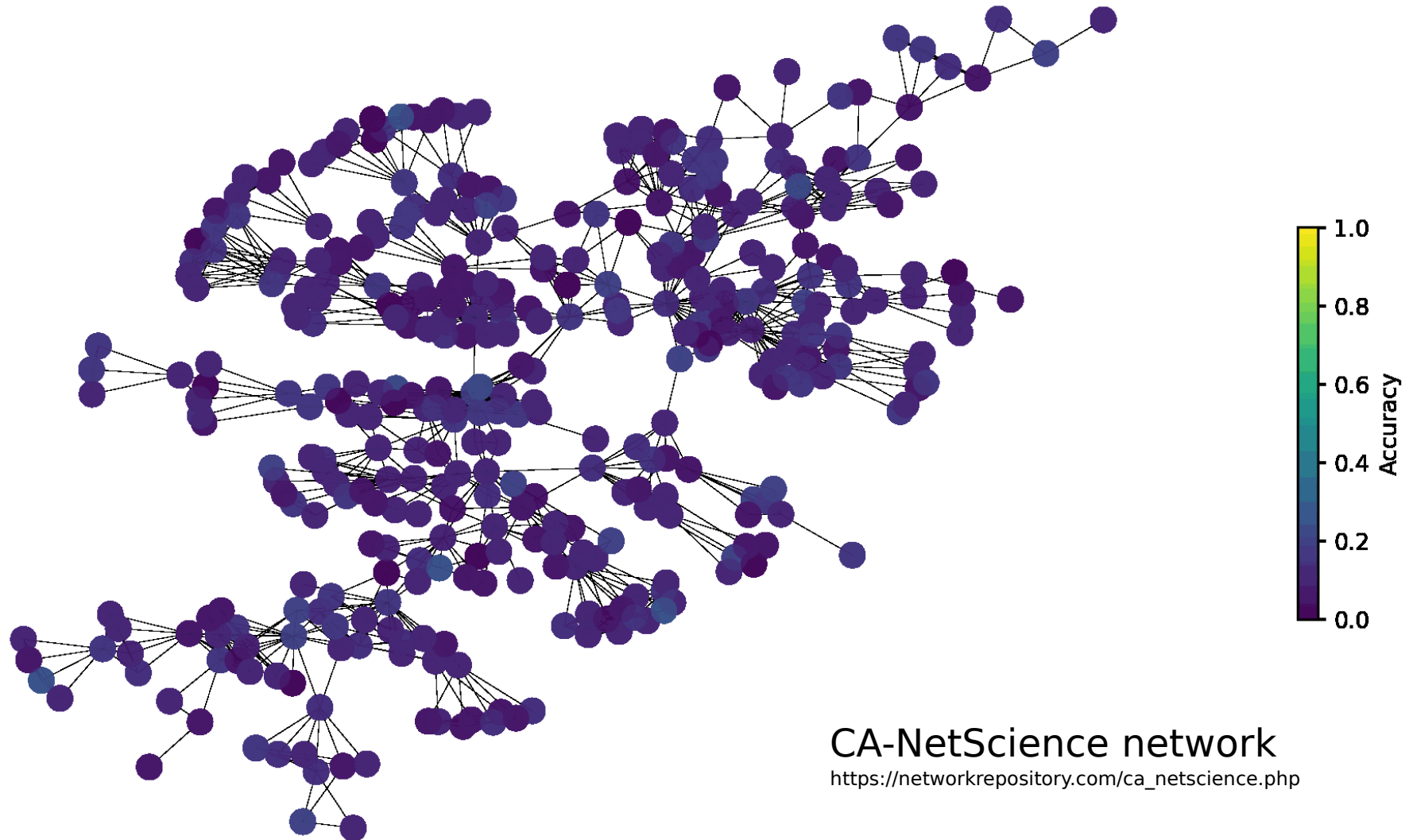
1. Share model weights

2. All nodes perform training and sharing models with others simultaneously and asynchronous

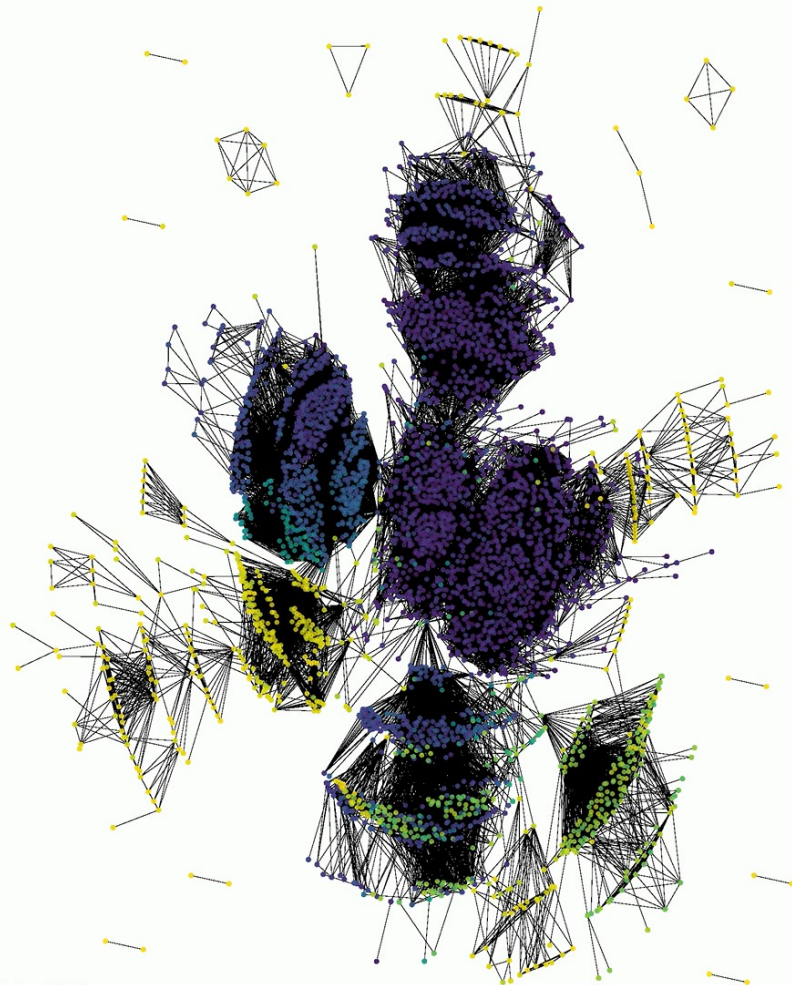
3. This system allows us to investigate how a good model is propagated in a network



Why do we investigate the model propagation?



Investigate the knowledge propagation in a network



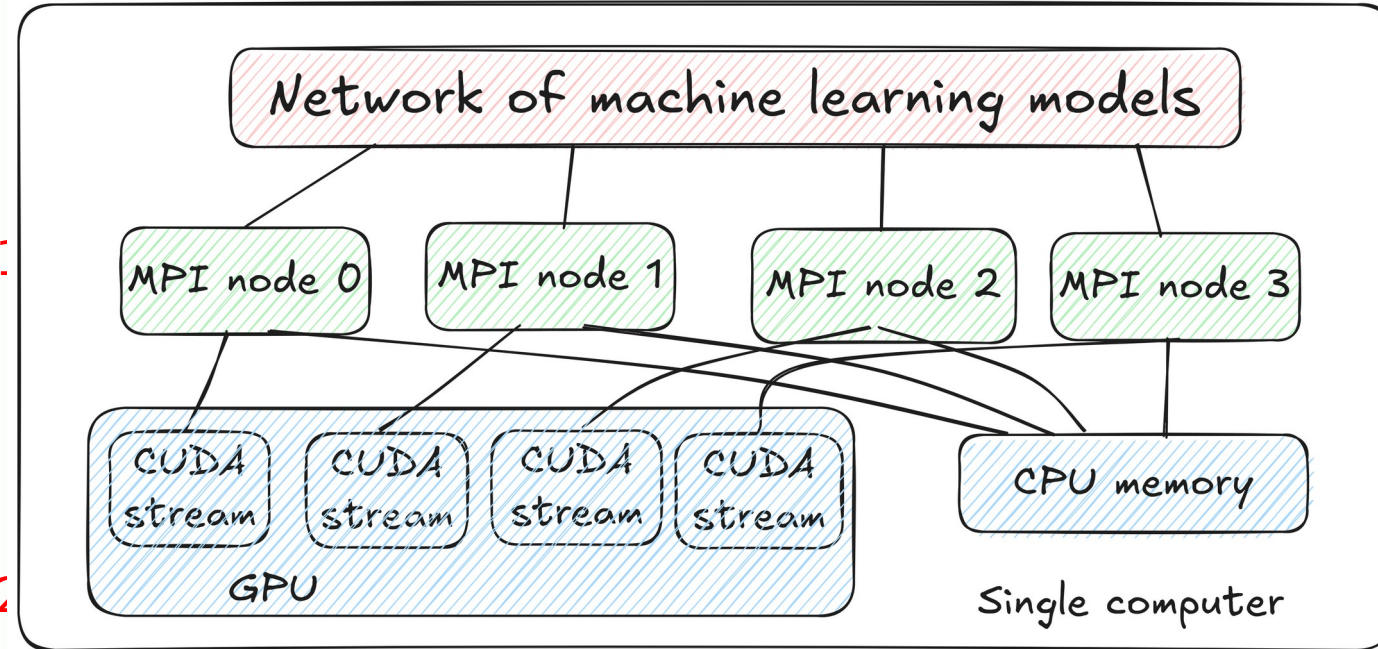
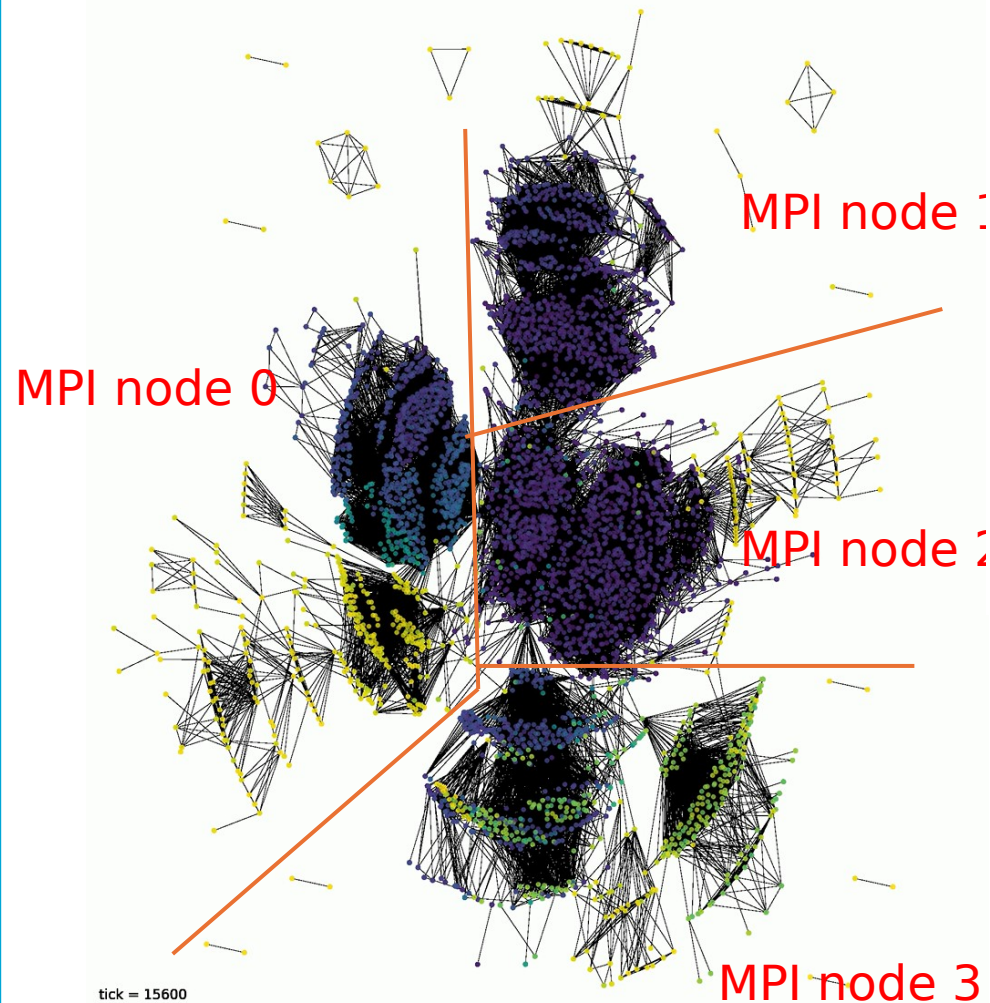
GPU memory size becomes the major bottleneck for large scale networks.

We have to use larger but slower CPU memory.

Facebook network

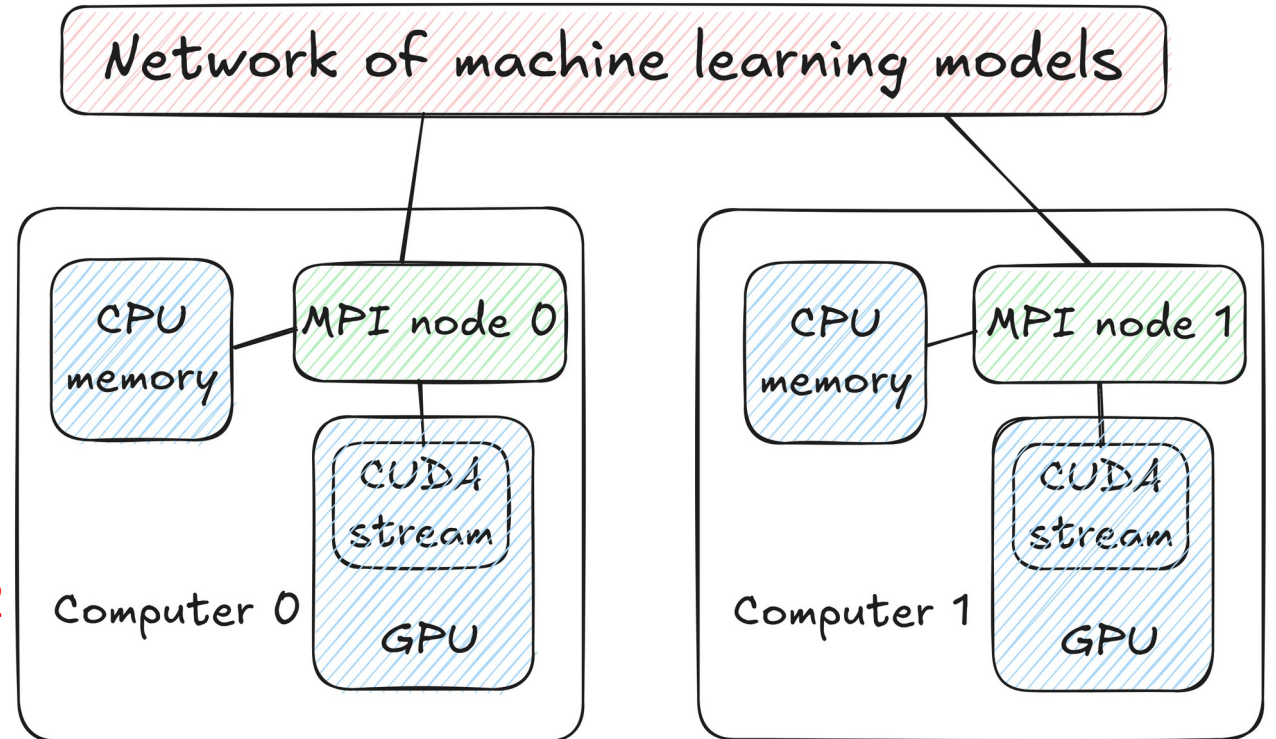
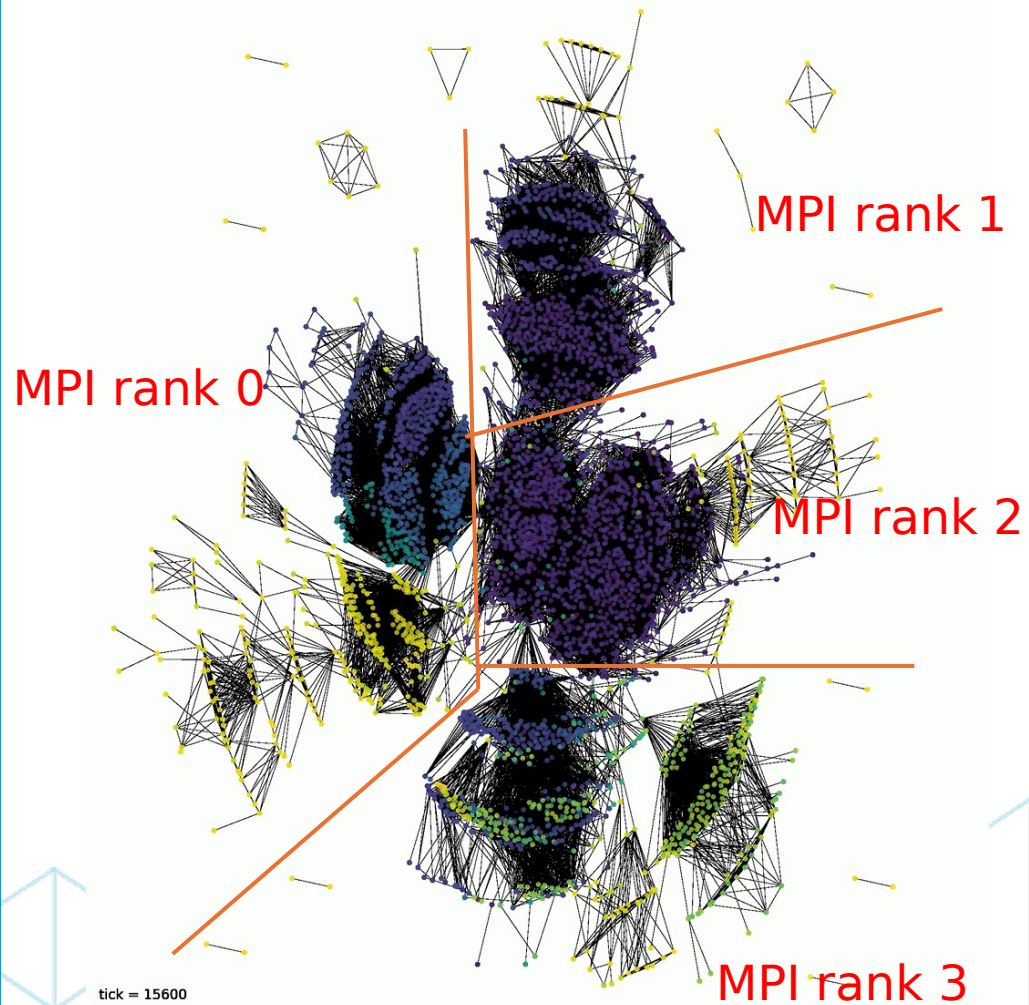
<https://snap.stanford.edu/data/ego-Facebook.html>

Simulator for large scale networks



In a single computer environment
To reduce the memory copying overhead, we usually allocate >1 MPI process on a single computer to overlap the memory copying time and kernel execution time.

Simulator for large scale networks



In a cluster environment

Memory consumption

Memory consumption	LeNet5 + MNIST	Resnet18 + CIFAR10
Optimizer	SGD with momentum	Adam optimizer
Batch size	64	128
50 nodes		30GB
500 nodes		280GB
10,000 nodes	94GB	
100,000 nodes	710GB	

All experiments are performed on a system with 1TB of memory and a single 2080ti 11GB GPU

The test network is a random regular network with an average degree of 8.

Computation performance

We test the scaling performance on a single computer with 2080Ti.

Train a single ResNet18 without MPI: **168ms / iteration**

1. Train a network composed of 50 ResNet18 nodes with MPI rank 4: **9.348s / iteration**

2.