

Spring '25: Newton's Method and ADMM on cellular sheaves

Getting to a paper

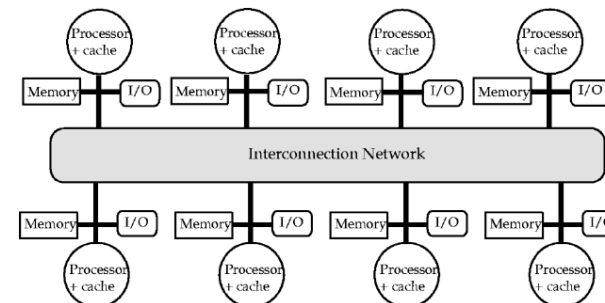
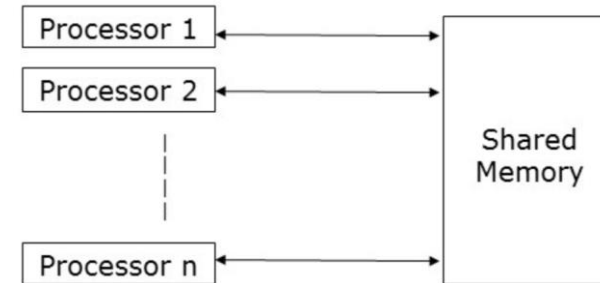
Samuel Cohen



Progress so far

- MatrixSheaf
 - Model using large sparse arrays and shared memory
- ThreadedSheaf
 - Model using nodes, channels, and shared memory
- DistributedSheaf
 - Model using nodes, remote channels, and distributed memory

$$A := \begin{bmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 \\ 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 \\ 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 \\ 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 \\ 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \end{bmatrix}$$



A blurred, black and white photograph of a group of people in a meeting or conference room. The people are standing and appear to be engaged in a discussion. The background is out of focus, showing some architectural elements and other people in the distance.

Distributed memory and HiPerGator

Sheaf optimization

A blurred background image of an office interior. Two people are visible in the foreground, their silhouettes and forms softened by a shallow depth of field. They appear to be in a meeting or collaborative work environment. The background shows office furniture, including desks and chairs, and some greenery. The lighting is warm and ambient, with soft bokeh effects from office lights.

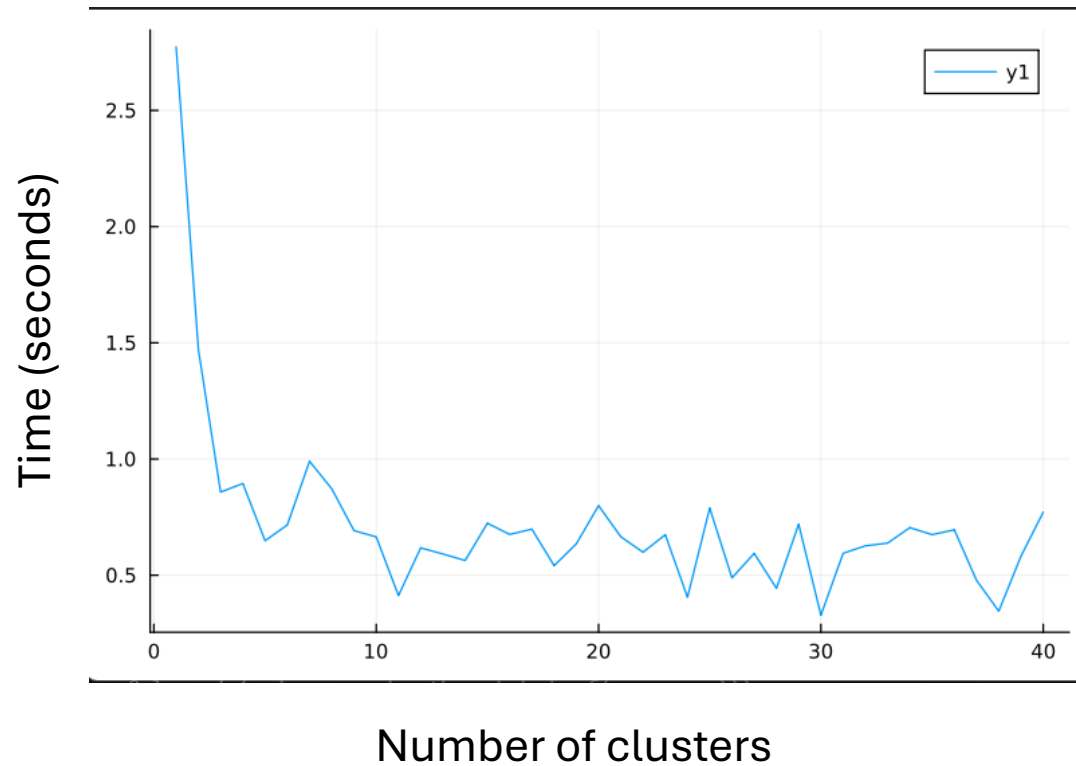
Shared memory and HiPerGator

Sheaf optimization

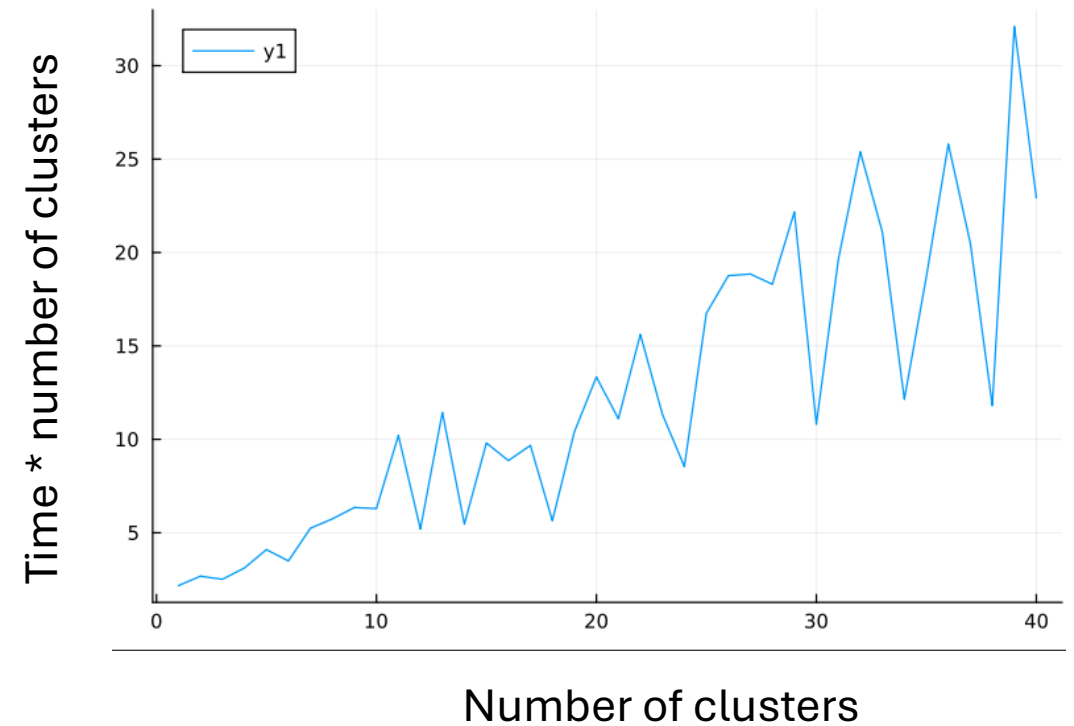
Progress so far

- Benchmarks on my laptop
 - 20 threads

Laplacian iterated on a ThreadedSheaf



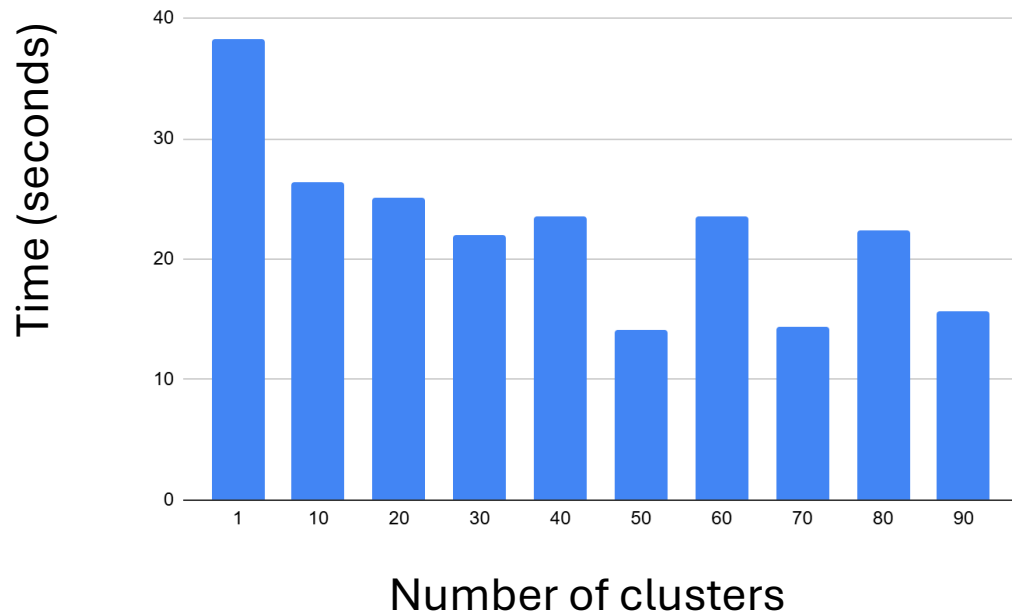
Laplacian iterated on a ThreadedSheaf



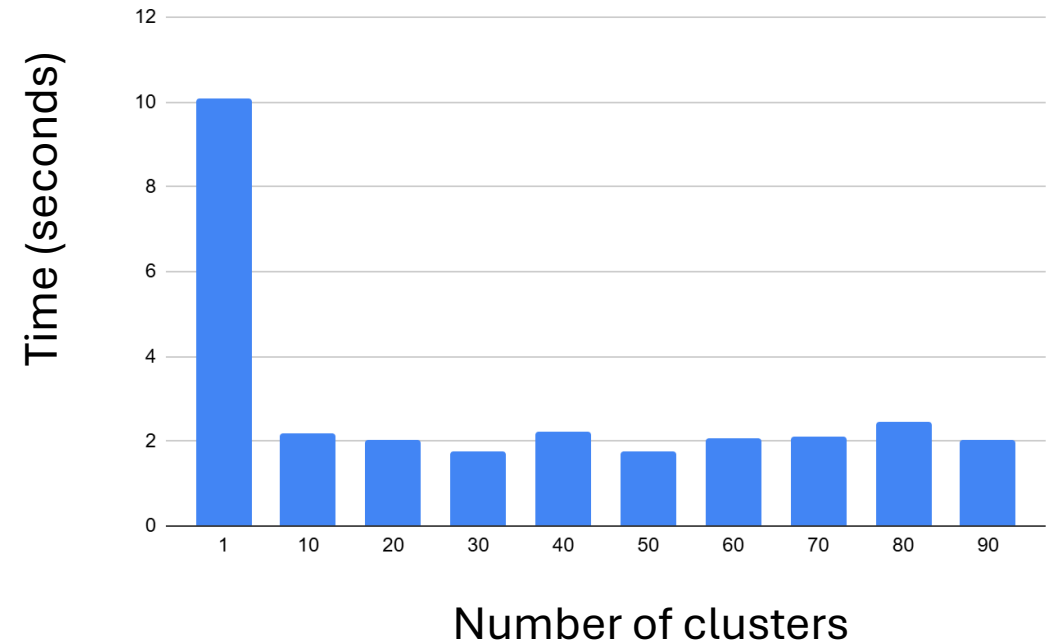
Progress so far

- Benchmarks on HiPerGator
 - 64 threads

Laplacian iterated on a ThreadedSheaf
Density = 0.8



Laplacian iterated on a ThreadedSheaf
Density = 0.1



What's next

- Implement Newton's Method and ADMM on ThreadedSheaf and MatrixSheaf
- Benchmark on HiPerGator for various datasets, graphs, sparsity patterns, clusterings, restriction map matrix types, and sheaf implementations
- Write up background from the Hansen & Ghrist paper
- Machine learning application
- Documentation
- Submit to ____ by ____
 - NeurIPS by May pending good ML application

Thanks for listening!

