LU Decomposition on a GPU

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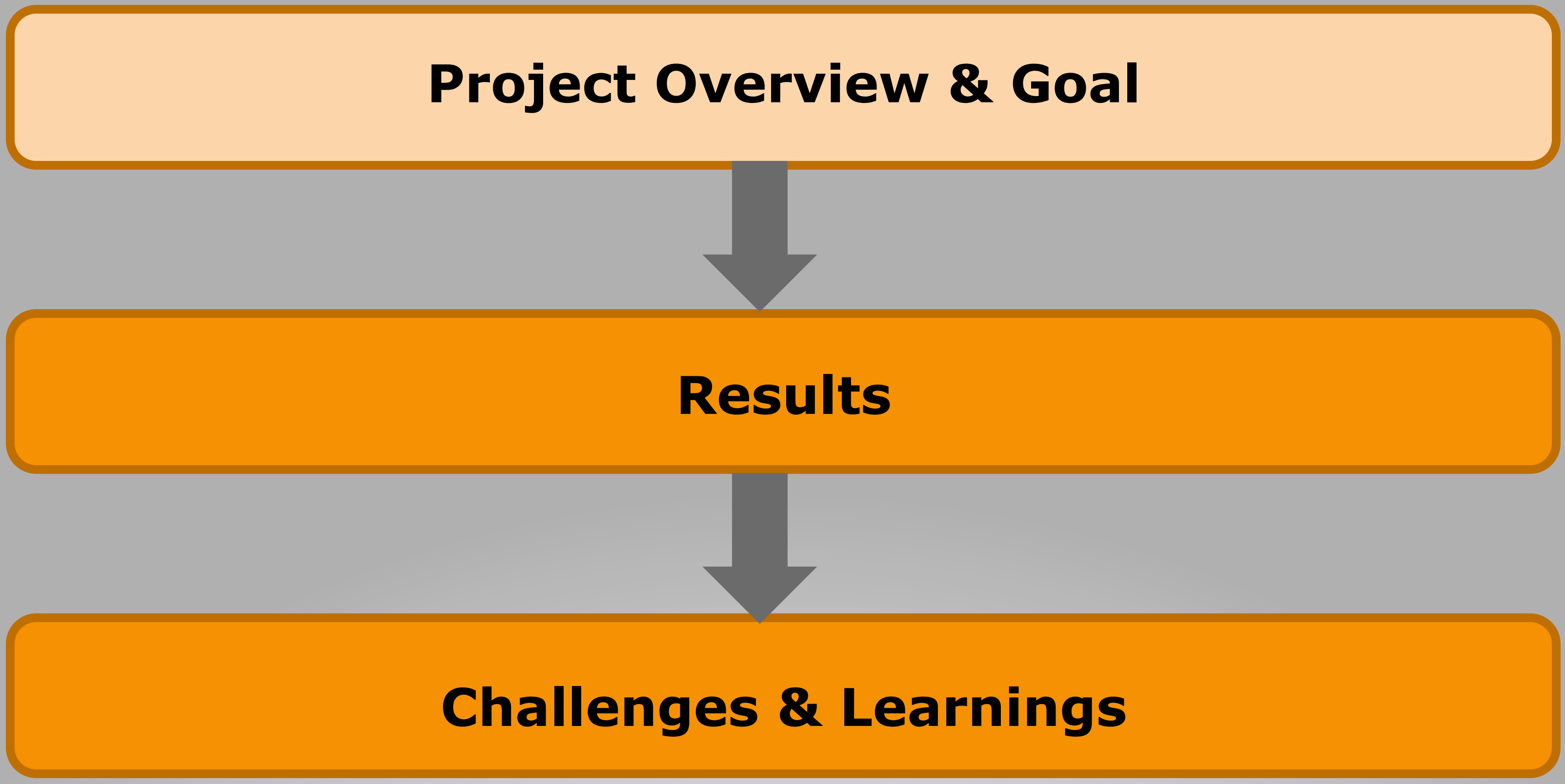
AGENDA



Project Overview & Goal

Results

Challenges & Learnings

Project Overview & Goal

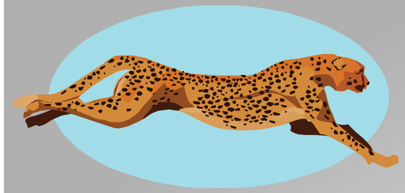
The Project Goal is to factor a matrix into a LU Decomposition using parallel techniques on a graphics-processing unit (GPU) at an optimal speed.

Two techniques are used for the factorization and their performance results are compared with the corresponding sequential versions.

- ***LU decomposition*** without pivoting using a loop unrolling technique.
- ***LU decomposition*** with partial pivoting using a block algorithm.

What are the Benefits of LU Decomposition on a GPU?

It's useful for many applications, such as solving Linear Equations…..and most importantly it needs to be fast!



Project Approach

Algorithms without Pivoting

- Sequential
- Parallel

Algorithms with Partial Pivoting

- Sequential
- Unblocked vs. Blocked
- Parallel

Optimize Parallel Approaches

- Hybrid CPU/ GPU

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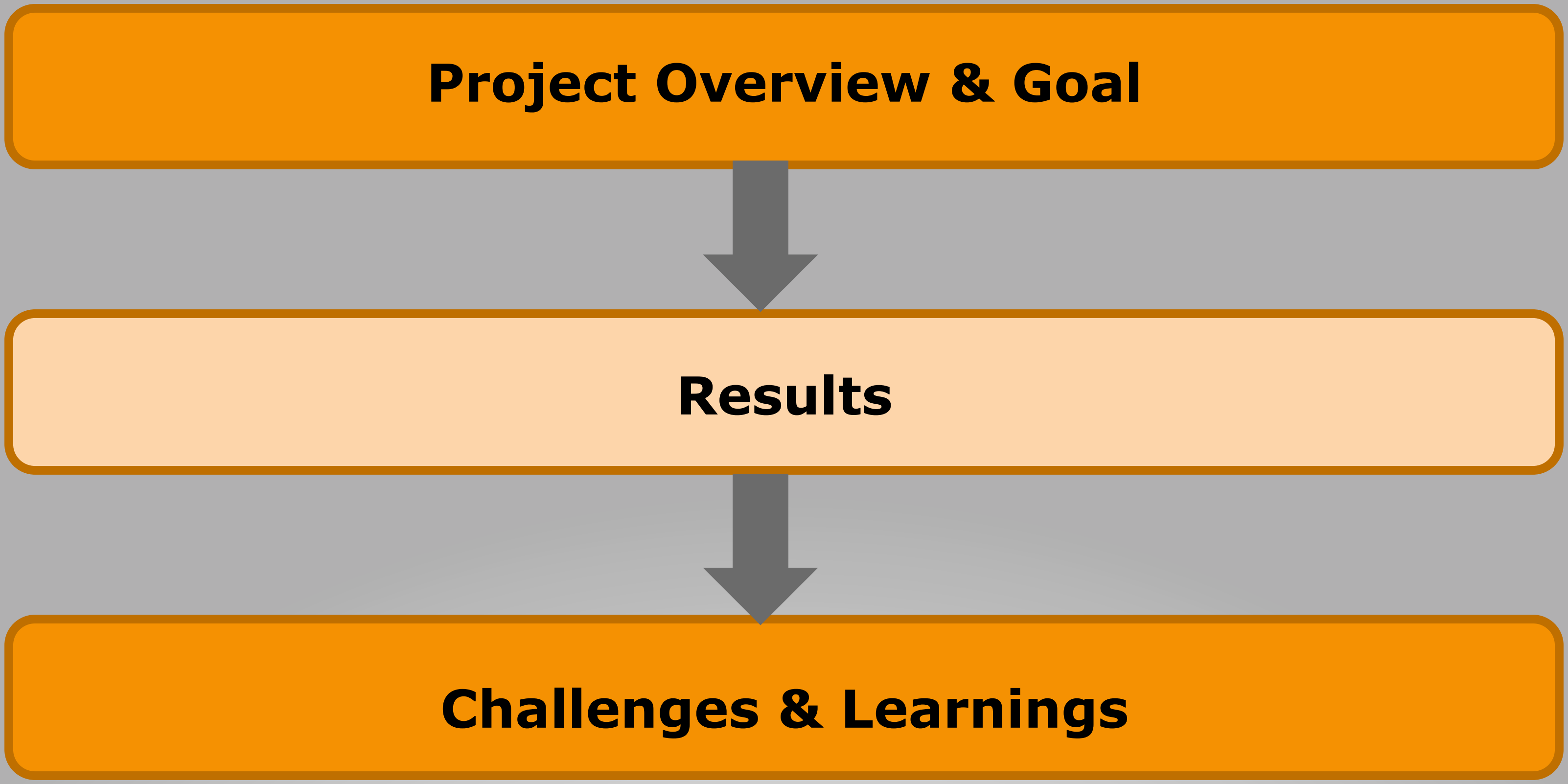

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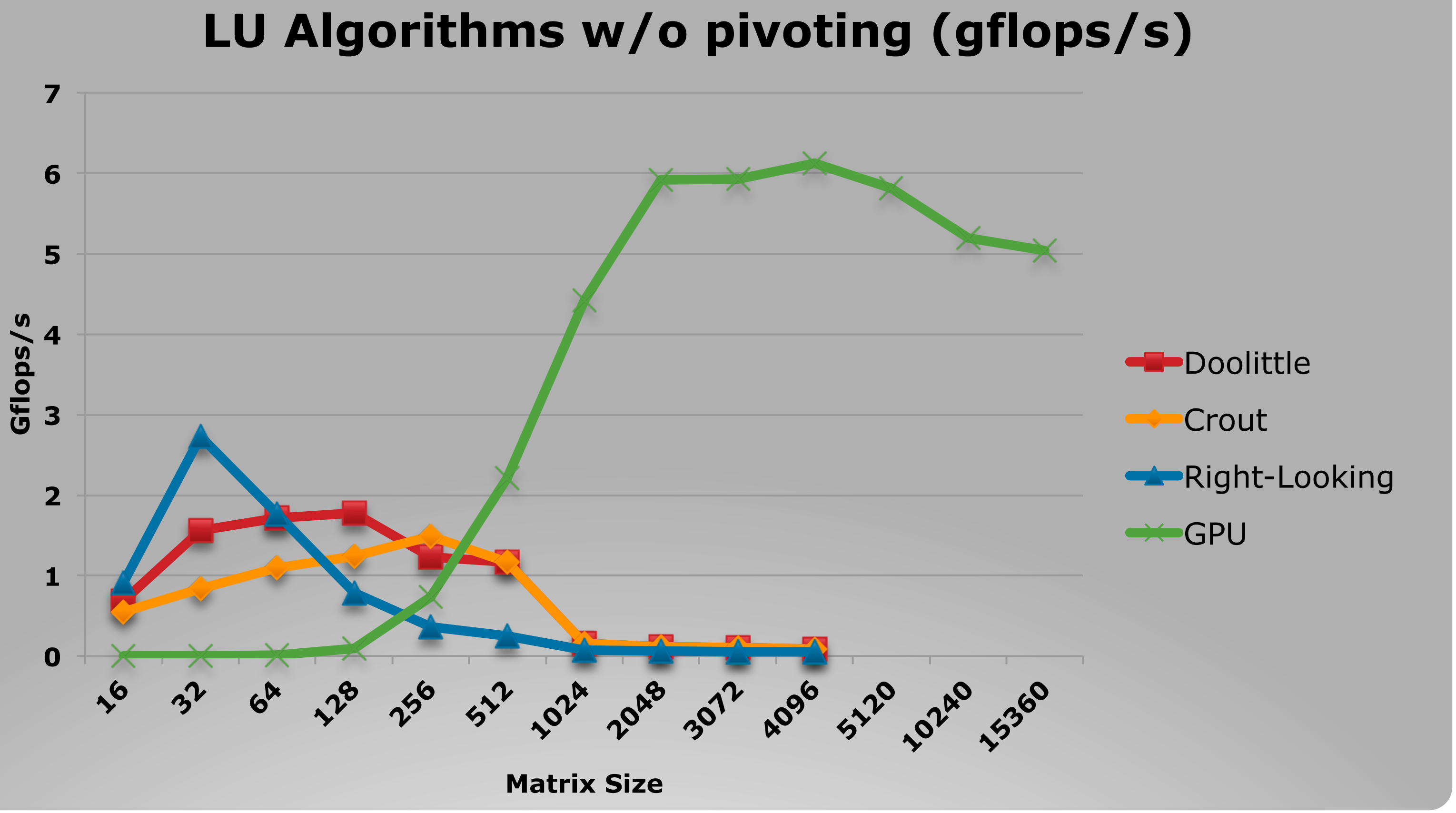
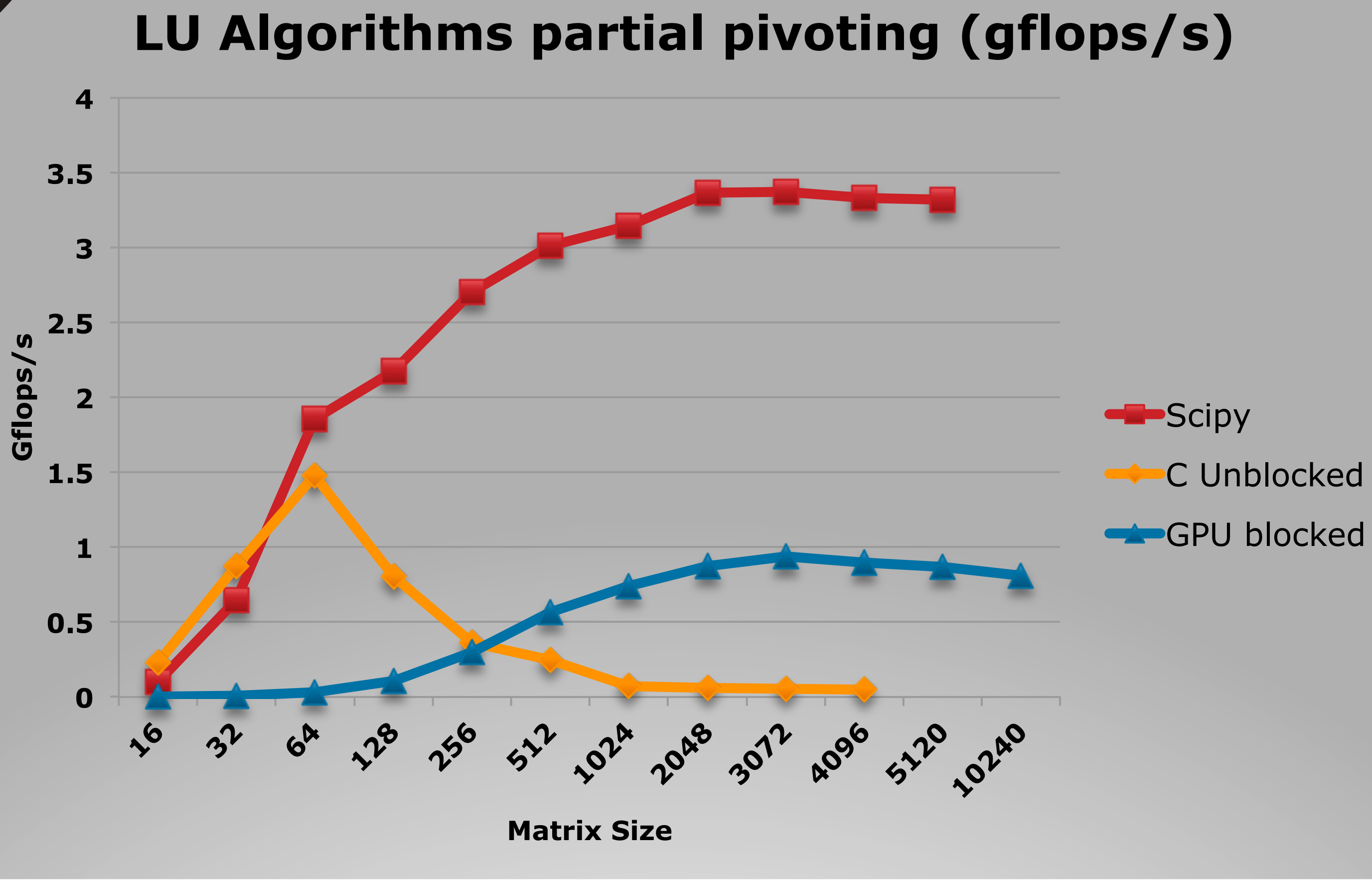
Results without Pivoting



Results with Partial Pivoting



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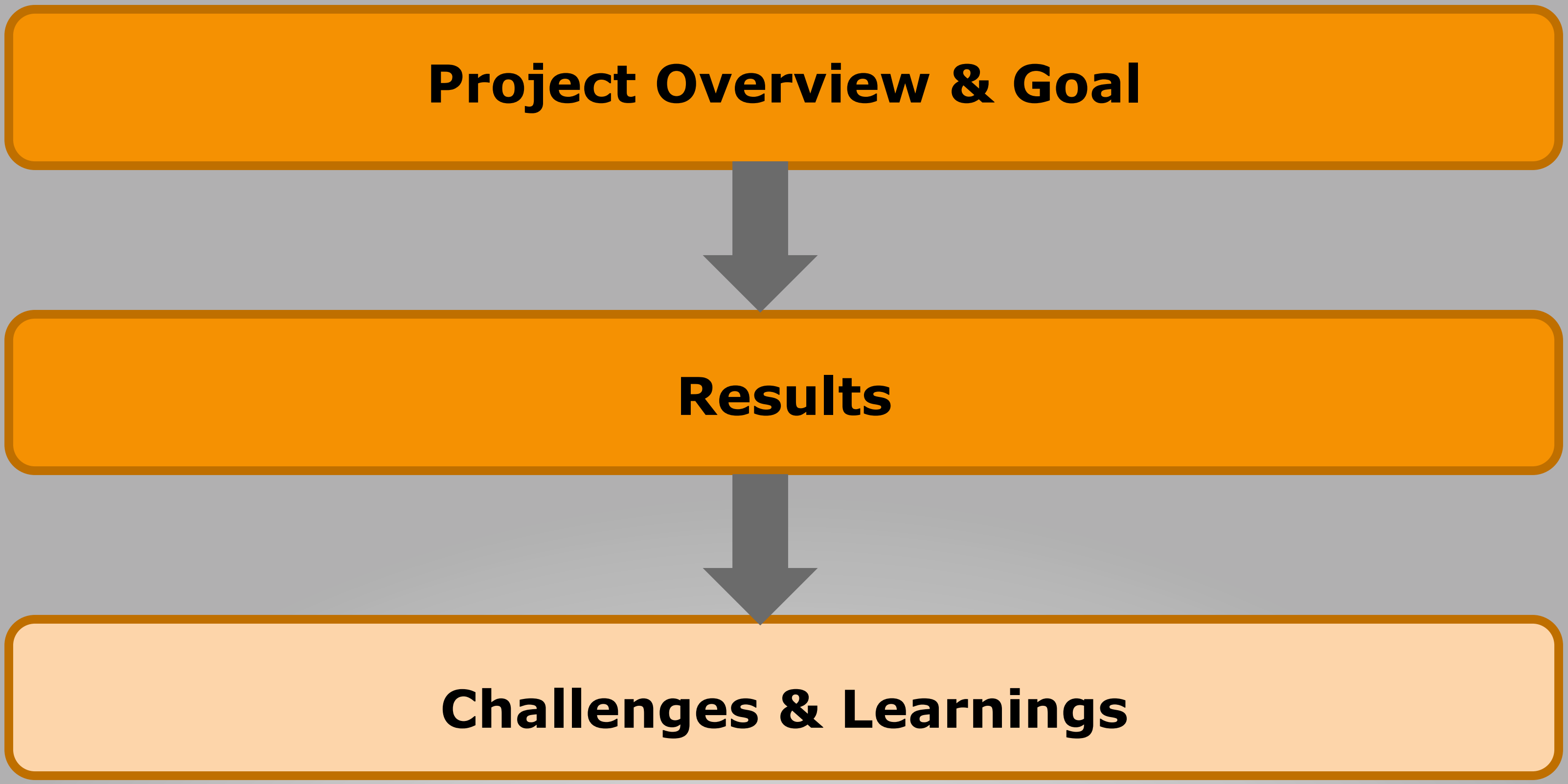

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Summary of Challenges & Learnings

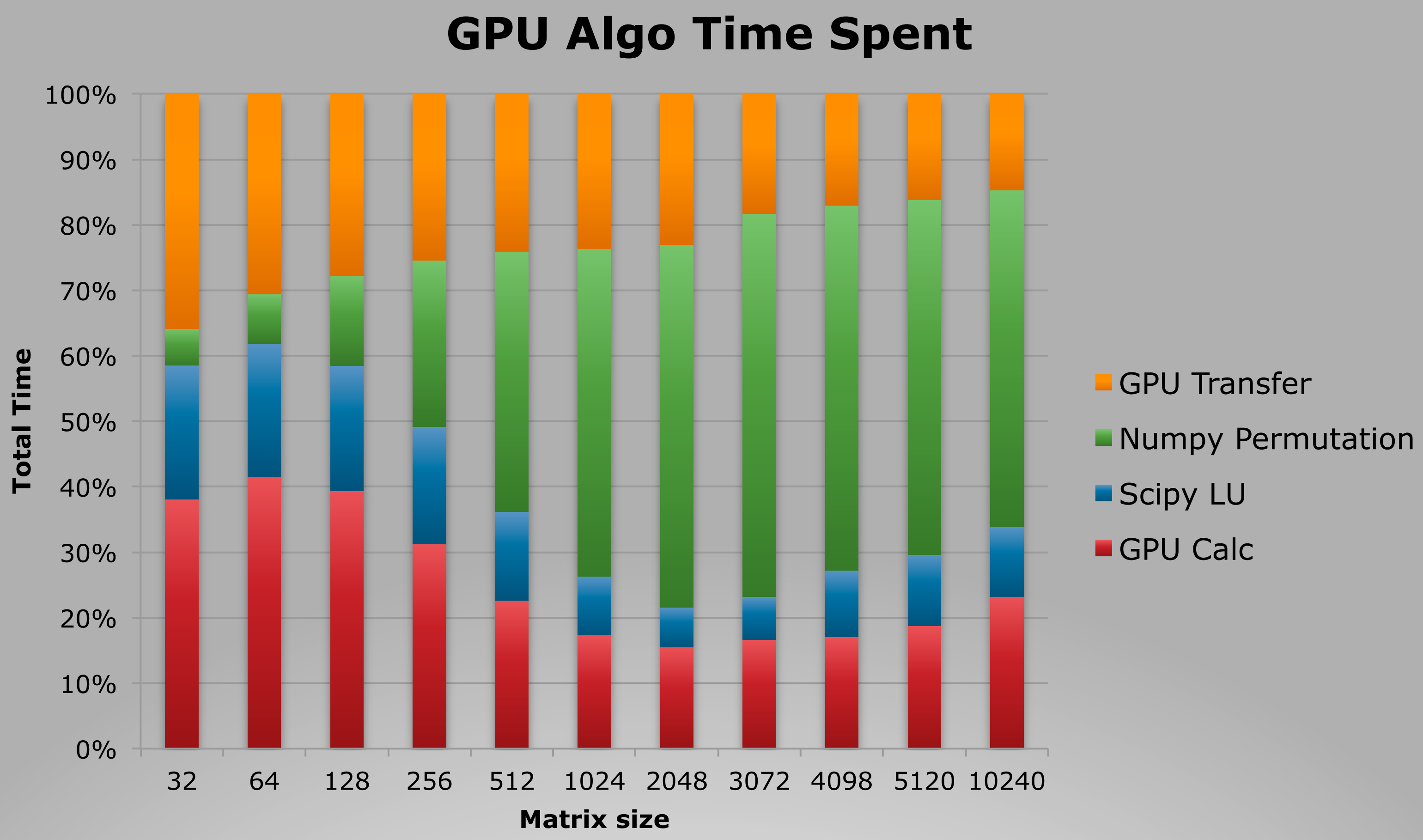
1. Review performance of individual components

2. Memory transfer from host to device

3. Working with external libraries

4. When in doubt…write/run the code

Review Individual Component Performance



Memory Transfer from host to device

- Try to minimize transfer
- Sometimes better to do trivial work on GPU than to transfer back and forth
- CPU/GPU hybrid algorithm –difficult to reduce transfers

Working with External Libraries

- Can be excellent tools for quick development
- But…don’t take performance for granted!
- Analyze performance of external libraries as well as your own code

When in Doubt…Write/Run the Code

- GPUs kernels can be difficult to visualize
- Example: Memory access
- Write different access types and measure the performance gains

QUESTIONS?