

# LAGraph: A Graph Algorithm and Network Analysis Library for GraphBLAS

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**Abstract**—design decisions, easy mode/expert mode, GAP algorithms, ...

**Index Terms**—Graph Processing, Graph Algorithms, Graph Analytics, Linear Algebra, GraphBLAS

## I. INTRODUCTION

LAGraph is a library of Graph Algorithms based on the GraphBLAS

Key contributions:

- document design decisions for LAGraph
- present a concise notation for GraphBLAS algorithms
- algorithms of the GAP benchmark suite [3] used in the IISWC benchmark paper [2]
- improve data ingestion performance, e.g. using SIMD techniques [10]

Recently, numerous graph-specific have targeted GPUs such as Gunrock [15] and GraphBLAST [17], and FPGAs [4].

However, in the near future we expect even more heterogeneous hardware architectures including graph-specific hardware based on the Programmable Integrated Unified Memory Architecture (PIUMA) [1]. Additionally, graph processing workloads can be offloaded to machine learning accelerators, e.g., Tensor Processing Units (TPUs) [9], systolic arrays using reconfigurable dataflow architecture [7], sparse linear algebra-based deep learning accelerators [11].

Previous GraphBLAS design papers: theory [12], C API [14], C++ API [6], distributed API [5], LAGraph [13]

```
int main() {  
    return 0; // return zero  
}
```

Listing 1: Example

1

## II. DESIGN DECISIONS

Jim

We investigate the following design questions:

- easy/expert mode or standard/advanced more
- multi-threadable
- data structure for representing a graph/matrix
- error handling
- opacity of LAGraph

<sup>1</sup>A non peer-reviewed comparison of 6 popular graph algorithms libraries is available at <https://www.timlrx.com/blog/benchmark-of-popular-graph-network-packages-v2>.

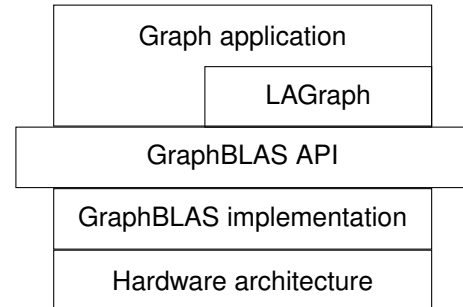


Fig. 1: Separation of concerns using the GraphBLAS API.

- how to work around typecasting being expensive in GraphBLAS
- terminology: properties (parameters? features?)

## III. NOTATION

## IV. ALGORITHMS

GAP algorithms: BFS, SSSP, TC, BC, PR. Not sure whether CC should be included.

### A. BFS

push/pull [16]

GraphBLAST stores both directions and picks automatically [17]

### B. Betweenness Centrality

also does push/pull

### C. PageRank

### D. SSSP

### E. Triangle Count

(Not too interesting from an API design point of view.)

### F. Connected Components

Needs a few GxB extensions.

## V. EVALUATION

Tim D

### A. SuiteSparse Extensions

SuiteSparse performance figures: lazy sort, bitmap, ...

### B. Performance Results

Benchmark environment (DGX), 2x6x5

## VI. UTILITY FUCTIONS

sort, diag/invdiag (?), equal

## VII. CONCLUSION

Future work - ideas:

- Create a Python wrapper for LAGraph
- Implement the LDBC Graphalytics benchmark [8]
- Improve data ingestion performance using e.g., SIMD instructions [10]

## ACKNOWLEDGEMENTS

add acks

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