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 algorihms
- 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
- how to work around typecasting being expensive in GraphBLAS

[1]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.

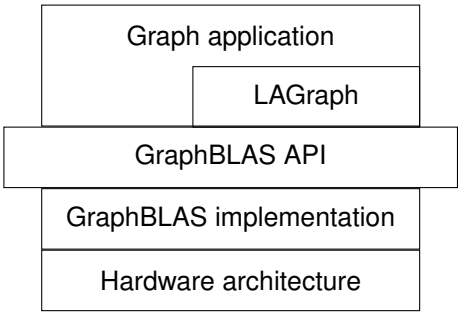

Fig. 1: Separation of concerns using the GraphBLAS API.

III. Notation

IV. Algorithms

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

push/pull [16]

V. Evaluation

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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]

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