Award #: 1740333

CSSI Element: SI2-SSE: Gunrock: High-Performance GPU Graph Analytics

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Project Goal

Develop the "Gunrock" programmable, high-performance graph analytics library for programmable graphics processors (GPUs) from a working prototype to a robust, sustainable, open-source component of the GPU computing ecosystem

External Collaboration

- **DARPA HIVE**: Used as benchmark for next generation parallel processor design (red team)
- **NVIDIA**: Incorporating into RAPIDS.ai, open source ML initiative
- **MIT GraphIt**: DSL that outputs Gunrock

gunrock v1.0 | build passing | license Apache-2.0 | issues 87 open | codecov 64% | nvidia accelerated library | rapids contributor

https://gunrock.github.io

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Brief Stats

- **Downloads / Clones**: 1429 (only 2 week snapshot as of July 2019)
- **Issues**: 89 open, 379 closed
- **Pull Requests**: 3 open, 218 closed
- **Lines of Code:** 229,000
- **Gunrock citations**: 367 across 7 papers

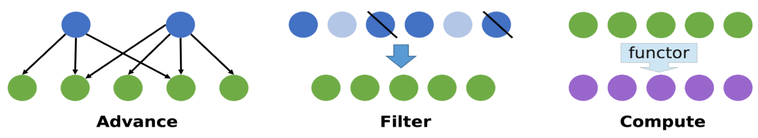
Overview

Gunrock is the state-of-the-art CUDA based library specifically designed for GPU graph analytics. One framework that works on single node single GPU and multi-GPU. Gunrock offers:

- a high-level, bulk-synchronous, data-centric model
- a balance between performance and expressiveness
- A wide range of over 20 graph applications
- High-level programming model to simply GPU development

Data-Centric Abstraction

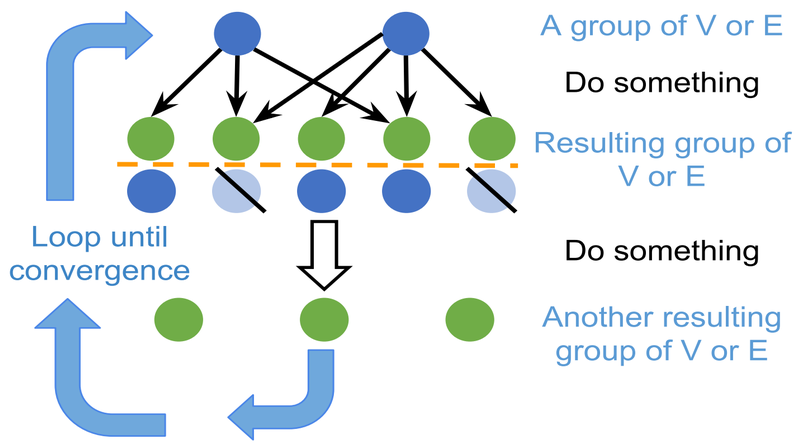
- **Frontier**: is a compact queue of nodes or edges
- Manipulation of frontiers is an **operation**



- **Advance:** Generates new frontier by visiting the neighbors
- **Filter:** Chooses a subset of current frontier as the new front
- **Compute:** Applies an arbitrary lambda function to all elements in the input frontier
- **Intersection:** Generates a new frontier from the intersection of two input frontiers

Bulk-Synchronous Programming

- Series of parallel operations separated by **global barriers**



Road Map

We have three principal near-term priorities for Gunrock development (as of June 2019):

- Gunrock's 1.0 release focused on single-GPU performance. We expect to target single-node multi-GPU support in a near-term future release.
- We believe dynamic (mutable) graphs are a practically interesting area of graph analytics that has not been a focus of the GPU graph analytics research community.
- We will ensure that Gunrock will integrate with NVIDIA's RAPIDS suite of software libraries to accelerate data science workloads on GPUs.