Gospel - High-performance graph analytics

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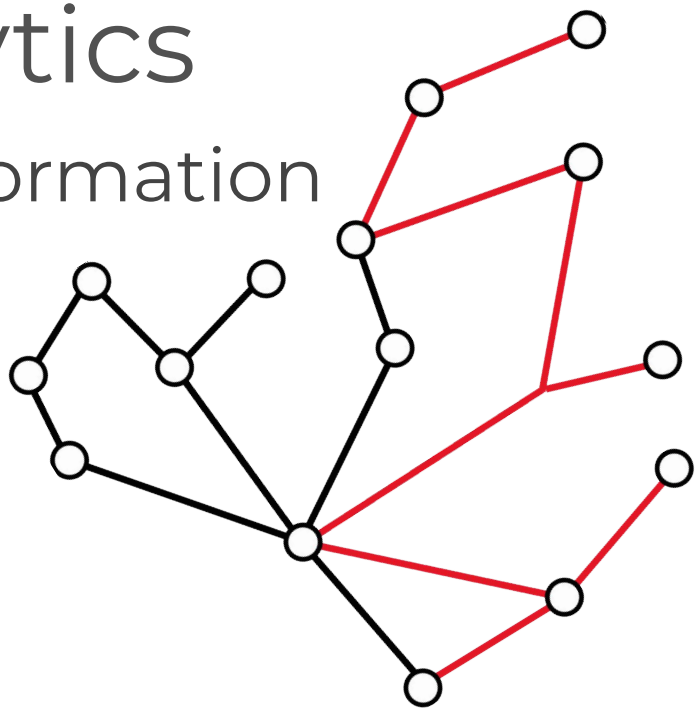
High-Performance Graph Analytics



Graphs are a gold mine of information

- Social Networks
- Financial transactions
- Recommender Systems

Real graphs are enormous

- Facebook: 2B users, Wikipedia: 200M links

We need high-performance and scalable ways to process graphs

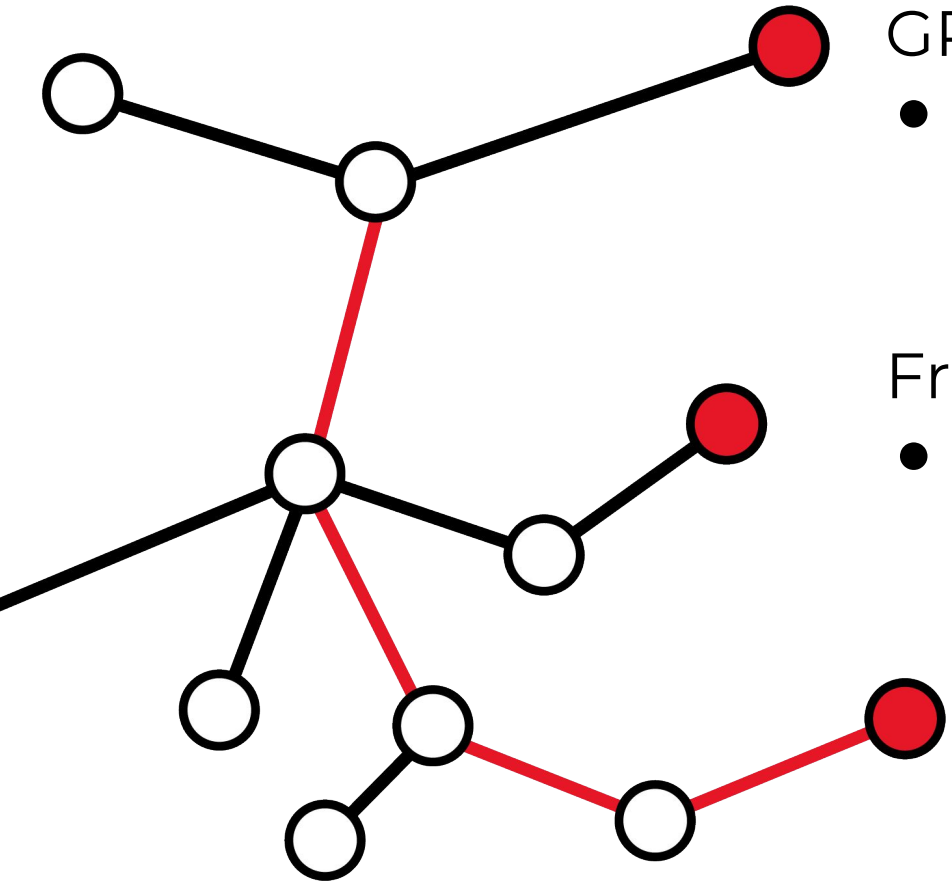
Introducing Gospel

- High-performance heterogeneous architectures for graph analytics
- Make graph processing faster and readily available to researchers and industry

Quick examples:

1. Single-GPU PageRank on Wikipedia in **0.2 sec**
2. Real-time Entity Linking with **>80% accuracy**

The Gospel Graph



GPU Algorithm Acceleration

- PageRank, Graph Visits, Embeddings

Framework/DSL extension

- Green-Marl by Oracle Labs

Embeddings & ML apps

- Entity Linking

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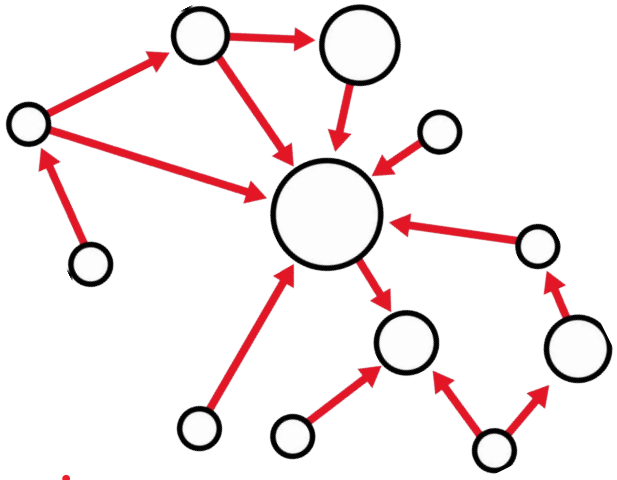
Approximating PageRank on GPU

- The original workhorse of Google's search
- Computation time is a bottleneck, even with GPUs
- No need for 100% accuracy
  - The ranking is what matters!
- Leverage approximate computing
  - Low precision arithmetic, loop perforation, numerical tricks

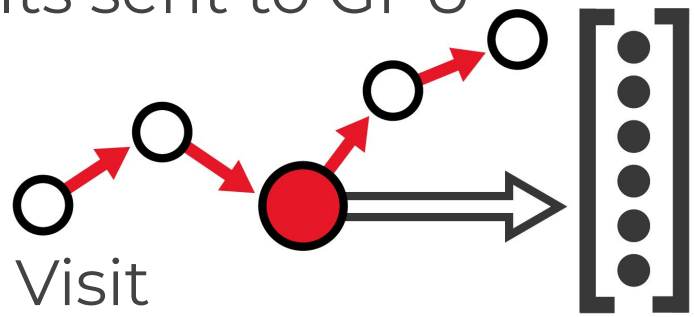


PageRank on graphs larger than GPU memory

- Most real-world graphs are larger than GPU memory (*e.g. the web!*)
- Adapt PR to work in these cases
  - Graph partitioning
  - Data compression
  - Double buffering and pipelining
- These techniques can be adapted to many algorithms, and to a multi-GPU scenario

Accelerating embeddings primitives on GPU

- Vertex embeddings are key to perform machine learning on graphs
- Most algorithms have the same primitives: *random walks*, *vertex sampling*, *etc*...
  - Often done on CPU, and results sent to GPU
- Our direction:
  - Do everything on GPU, using modified Breadth-First Visit



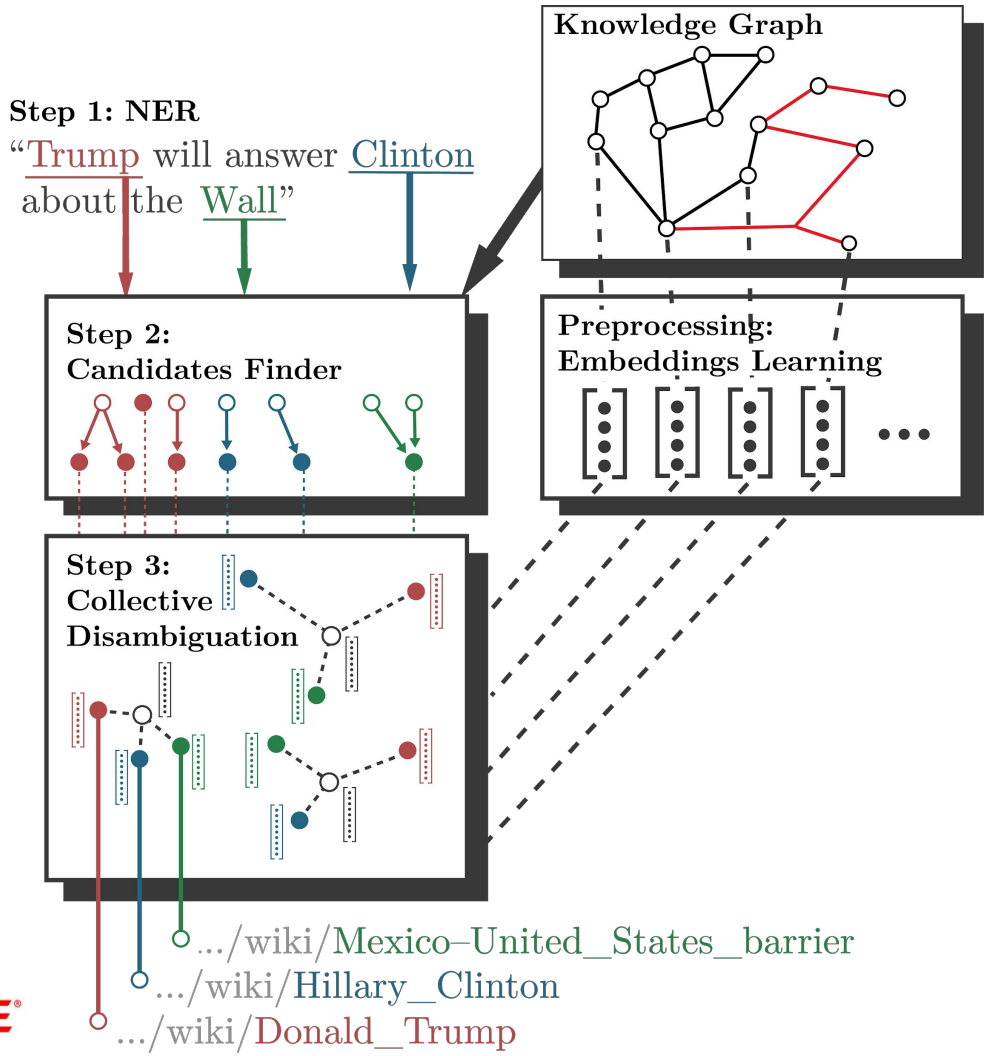
Fast Entity Linking via Graph Embeddings (1/2)

- Entity Linking (EL): connect Named Entities to unique identities (e.g. Wikipedia Page)

- Lots of applications: search engines, recommender systems, chat bots

Fast Entity Linking via Graph Embeddings (2/2)

- The first EL algorithm to leverage graph embeddings
- SoA results (**>80% accuracy**) with real-time latency (30 names / sec)



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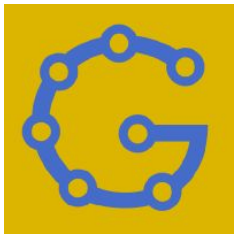
Automatic GPU code generation from graph DSL

- Writing high-performance GPU graph algorithms is difficult
- We can extend Green-Marl, a graph DSL developed by Oracle Labs
  - Graph computation as linear algebra kernels
  - We leverage GraphBlast, GPU library from the authors of Gunrock
  - 2x-10x speedup w.r.t. 56-threads CPU



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- PageRank on graphs larger than GPU memory
- Accelerating embeddings primitives on GPU
- Fast Entity Linking via Graph Embeddings
- Automatic GPU code generation from Graph DSL

Thank you!

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