



Graph analysis

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Research areas

- High-performance graph analysis
- Path problems with constraints
- Graph databases

- Semyon Grigorev (Lead)
 - ▶ PhD (2016)
 - ▶ Associate professor (2016, SPbSU)
 - ▶ s.v.grigoriev@spbu.ru
 - ▶ High-performance graph analysis
 - ▶ Graph databases
 - ▶ dblp: <https://dblp.org/pid/181/9903.html>
- Ekaterina Shemetova
 - ▶ PhD student
 - ▶ Path problems with constraints
 - ▶ Fine-grained complexity
 - ▶ Dynamic graph problems
- Rustam Azimov
 - ▶ PhD student
 - ▶ Linear algebra based graph analysis
 - ▶ GraphBLAS API
 - ▶ Algebraic path problem

Team: Master Students

- Alexandra Istomina
 - ▶ Master student
 - ▶ Fine-grained complexity
 - ▶ Path problems with constraints
 - ▶ Algebraic path problem
- Vladimir Kutuev
 - ▶ Master student
 - ▶ Linear algebra based graph analysis
 - ▶ GraphBLAS API
 - ▶ Parallel programming
- Julia Susanina
 - ▶ Master student
 - ▶ Linear algebra based graph analysis
 - ▶ Probabilistic graph analysis
 - ▶ GPGPU programming

High-Performance Graph Analysis

- Linear algebra based algorithms for graph analysis
 - ▶ Parallel algorithms on CPU and GPGPU
 - ▶ Sparse linear algebra for graph analysis
 - ▶ GraphBLAS API¹

¹<https://graphblas.org/>

High-Performance Graph Analysis

- Linear algebra based algorithms for graph analysis
 - ▶ Parallel algorithms on CPU and GPGPU
 - ▶ Sparse linear algebra for graph analysis
 - ▶ GraphBLAS API¹
- Research directions
 - ▶ GraphBLAS-based algorithms design, implementation and evaluation
 - ▶ Portable multi-GPGPU implementation of GraphBALS-like API
 - ▶ GraphBLAS API analysis

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Path Problems With Constraints: Algebraic Path Problems

- Semiring-like structures to specify constraints on paths
 - ▶ Reachability — boolean semiring
 - ▶ Shortest paths — tropical semiring
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 - ▶ Transitive closure using matrix-matrix multiplication
 - ▶ APSP using matrix-matrix multiplication
 - ▶ BFS-like traversals using matrix-vector multiplication
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- Compositionality
 - ▶ Having two semirings one can create a new one
 - ▶ Single solution for similar problems
 - ★ Generic solution
 - ★ Configurable solution

Formal Language Constraint Path Querying

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- Research directions
 - ▶ New algorithms development
 - ▶ Complexity analysis
 - ▶ New classes of languages investigation
 - ▶ High performance algorithms implementation and evaluation

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Our Results

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- ▶ LDBC Graphalytics extension for evaluation of formal language constrained path querying
- ▶ GLL4Graph: CFPQ for Neo4j
- ▶ CFPQ for RedisGraph

- Papers (> 10)

- ▶ SPbLA: The Library of GPGPU-Powered Sparse Boolean Linear Algebra Operations (GrAPL@IPDPS)
- ▶ Evaluation of the context-free path querying algorithm based on matrix multiplication (GRADES-NDA@SIGMOD)
- ▶ Multiple-Source Context-Free Path Querying in Terms of Linear Algebra (EDBT, Core A)
- ▶ Context-free path querying by matrix multiplication (GRADES-NDA@SIGMOD)

Possible Ways for Collaboration

- Algebraic Path Problem framework applicability for network analysis
 - ▶ Which constraints can be specified in terms of semirings?
 - ★ Length minimality
 - ★ Nodes to visit
 - ★ ...
 - ▶ Is it flexible enough?
- High-performance network analysis
 - ▶ GraphBLAS-based solution
 - ▶ Algorithms development and analysis
 - ▶ Algorithms implementation and evaluation