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POSTER: Optimizing GPU Programs By Partial Evaluation

Aleksey Tyurin, Daniil Berezun, **Semyon Grigorev**

JetBrains Research, Programming Languages and Tools Lab
Saint Petersburg University

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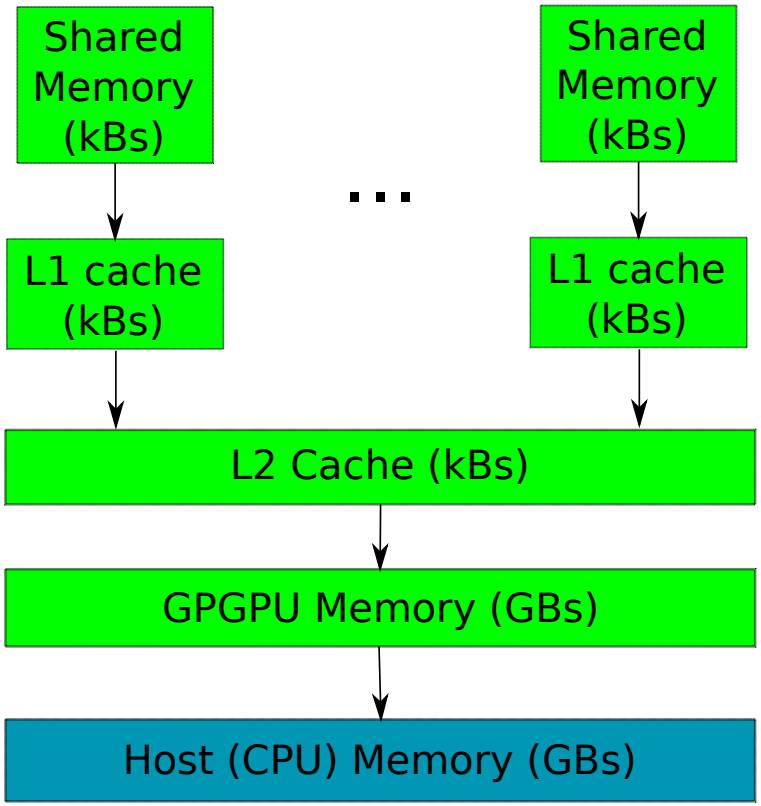
GPGPU Architecture

GPGPU memory hierarchy



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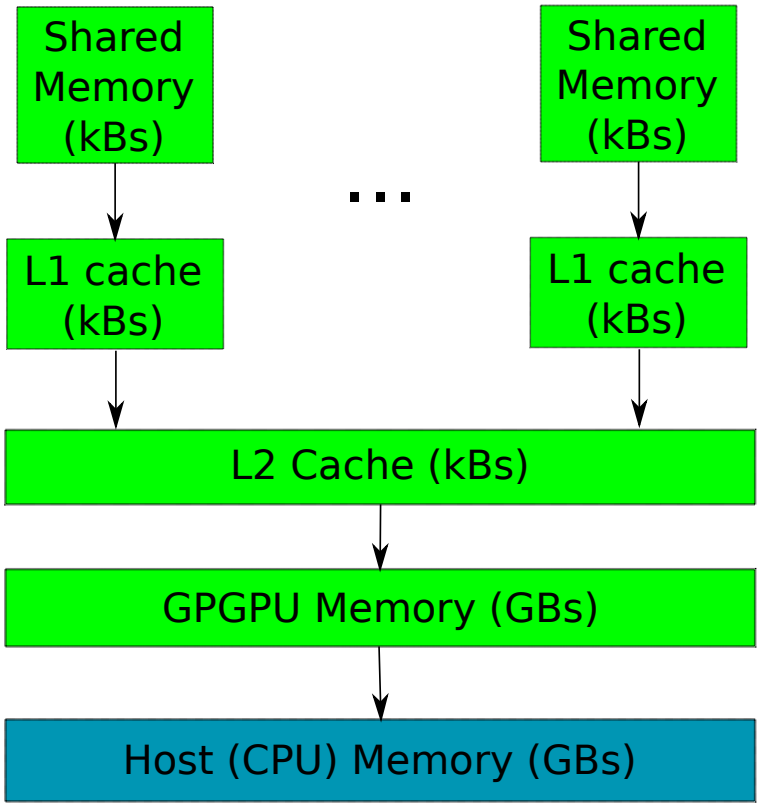

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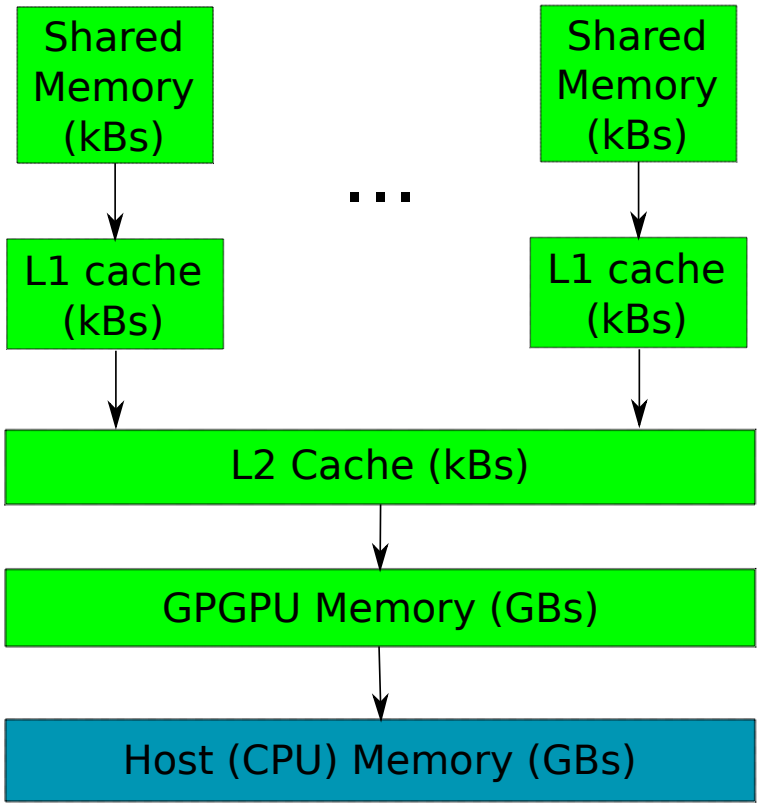

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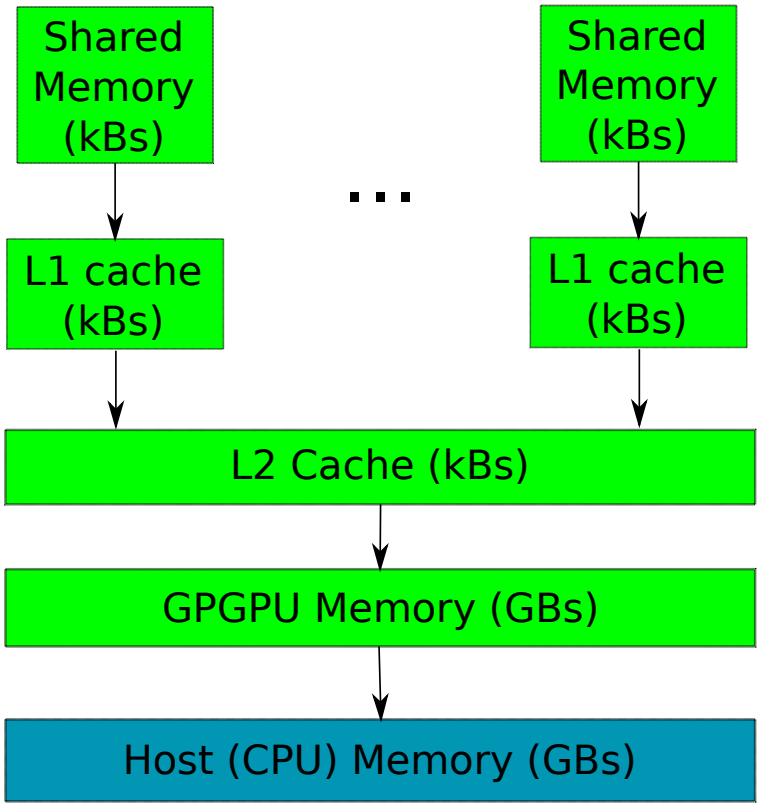

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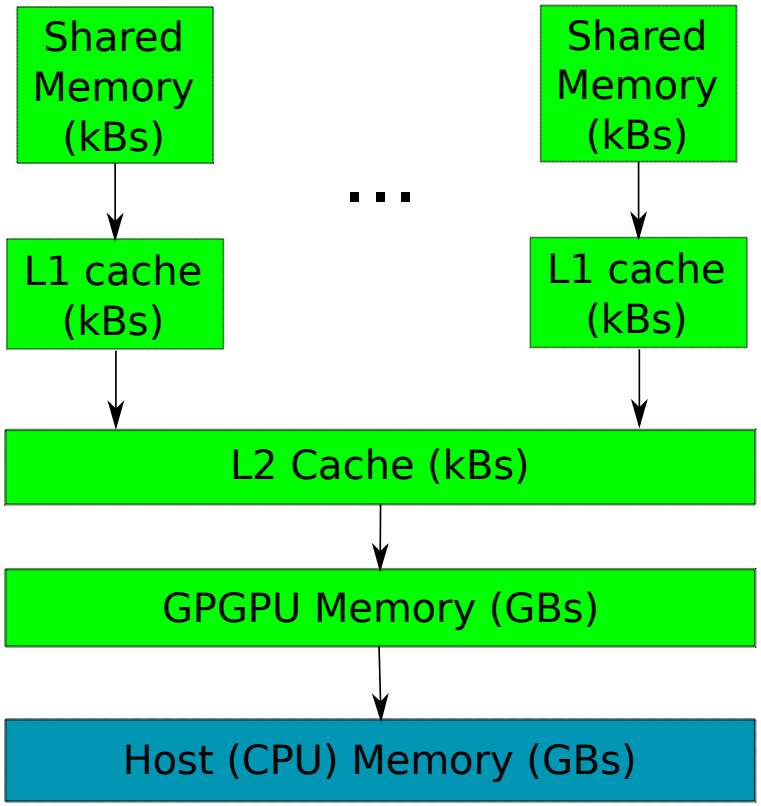

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- **Memory traffic is a bottleneck**

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How can we use this fact to optimize our procedure?

Partial Evaluation or Specialization

$$[\![\underbrace{handleData}_{handleData}]\!][filterParams, data] = [\![\underbrace{[\![mix]\!][handleData, filterParams]}_{handleData_{mix}}]\!][data]$$

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handleData (filterParams, data)
{
  res = new List()
  for d in data
     for e in filterParams
        if d % e == 0
        then res.Add(d)
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- AnyDSL framework for specialization
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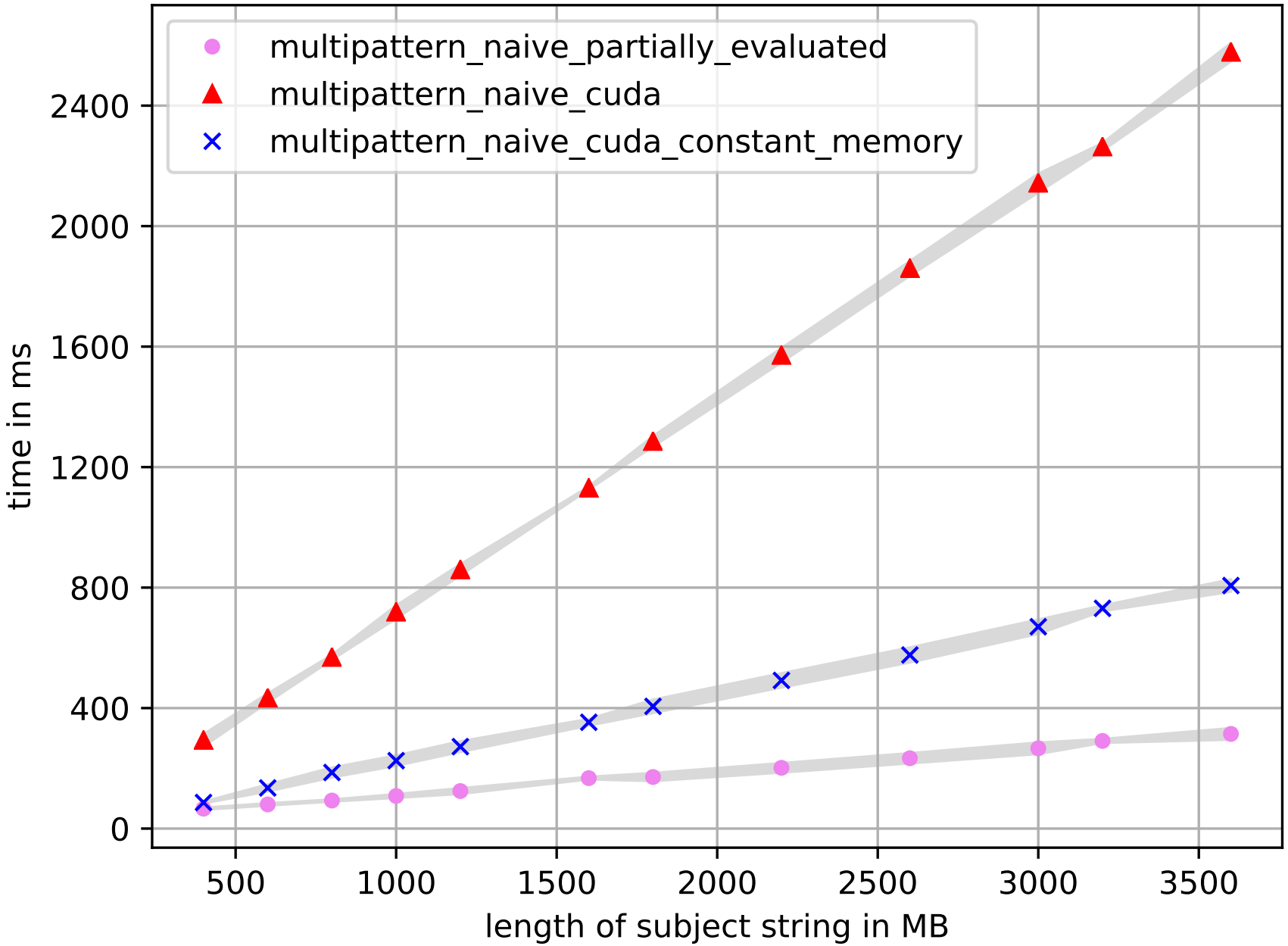
Evaluation: Data Curving



Limitations

[RDF]

- The set of the real-world RDF files (ontologies)
- Queries:
  $G_4 : s \rightarrow SCOR\ s\ SCO \mid TR\ s\ T \mid SCOR\ SCO \mid TR\ T$
  $G_5 : s \rightarrow SCOR\ s\ SCO \mid SCO$

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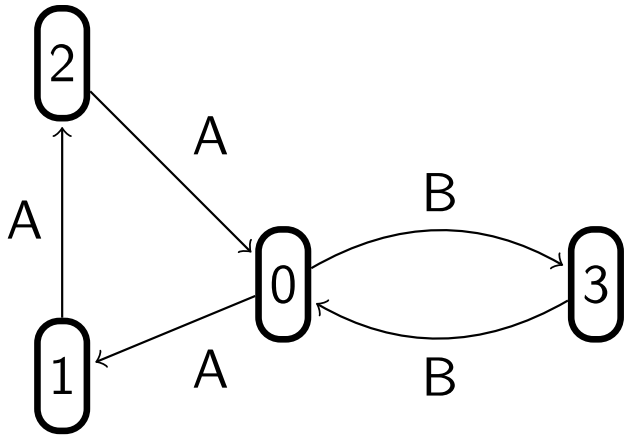
[Worst]

- The input graph is two cycles of coprime lengths with one shared vertex



- Query: $G_1 : s \to A\ s\ B \mid A\ B$

Dataset

[Full]

- The input graph is sparse, but the result is a full graph
- Queries:
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[Full]

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[Sparse]

- Sparse graphs are generated by GTgraph
- Query: $G_1 : s \to A\ s\ B \mid A\ B$

Conclusion

- Just In Time speciaization
-
-
-

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  - LLVM.mix: partial evaluator for LLVM IR
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- Integrete with shared memory register spilling
  - "RegDem: Increasing GPU Performance via Shared Memory Register Spilling" (Putt Sakdhnagool et.al. 2019)
- Evaluate on real-world examples

Contact Information

- Semyon Grigorev:
  - s.v.grigoriev@spbu.ru
  - Semen.Grigorev@jetbrains.com
- Aleksey Tyurin: alekseytyurinspb@gmail.com
- Daniil Berezun: daniil.berezun@jetbrains.com

- Dataset and algorithm implementations: https://github.com/SokolovYaroslav/CFPQ-on-GPGPU

Thanks!