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CUSMART: effective parallelization of string matching algorithms using GPGPU accelerators

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Key words: String matching; Parallel computing; GPU programming; GPGPU; NVIDIA; CUDA; SMART

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Motivation & Main Idea

Motivation

- String matching is essential in fields like bioinformatics, security, and text processing.
- Serial string matching algorithms are not efficient for large data.
- Previous GPU implementations focus on individual algorithms.

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Main Idea

Develop a GPU-based parallel string matching library (CUSMART) with 64 optimized CUDA-based algorithms.

Method

- Based on the SMART library (serial implementations).
- Implement 64 parallel versions using CUDA.
- Apply intra-task parallelism, kernel optimization, and memory techniques.
- Use dynamic memory, modular wrappers, and helper functions for scalability and ease of testing.

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Major Results

- Speedup up to 51× (e.g., Turbo Boyer–Moore on short patterns).
- Performance influenced by pattern length, alphabet size, and dataset type.
- Overlapping transfer and pinned memory usage achieved up to 62% extra performance gain.

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Conclusions

- Parallelization significantly boosts string matching performance.
- CUSMART supports 64 algorithms with unified testing and benchmarking.
- Match position tracking and memory-efficient execution are included.
- Limitations: Some algorithms are not parallelizable; some GPU features are not universally beneficial.

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Summary

- CUSMART addresses the gap in parallel GPU-based string matching libraries.
- Open-source, extensible: https://github.com/adnanozsoy/CUSMART
- Support high-performance computing needs in various domains.
- Future directions: mobile platform benchmarking, energy efficiency, and new features.

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