

The unified GraphIt compiler framework (UGF) for novel architectures

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Abstract

We augmented the Graphlt compiler that is a domain-specific language (DSL) for graph applications to achieve portability by decoupling the architecture independent algorithm from the architecture-specific schedules. We demonstrated that high performance can be achieved on four different platforms: CPUs, GPUs, the Swarm hardware accelerator, and Hammerblade.

Introduction

- Graph applications are everywhere, but achieving performance, programmability, and portability is very challenging
- GraphIt: a domain specific language (DSL) for graph applications. GraphIt decouples algorithms (what to compute) and schedules (how to compute)
- But, with GraphIt, hard to achieve portability







Hammerblade Manycore

Swarm

GPUs

Results

- UGF pvodies up to 87x speedup over usersupplied baseline code

| | Pγ | ç | BCS | SSp | BFS | | Pγ | ç | BC S | 'azz | BFS | | Pγ | ç | BCS | ssp ' | BFS | |
|------|-------|------|------|------|-------|------|------|------|-------|-------|-------|-------------|------|------|------|-------|------|----|
| HW - | 9.59 | 1.27 | 3.43 | 1.00 | 22.31 | HW - | 2.34 | 2.63 | 7.09 | 6.86 | 13.41 | HW - | 4.96 | 4.69 | 4.45 | 1.53 | 1.84 | HW |
| LJ - | 6.74 | 1.27 | 1.80 | 1.16 | 8.62 | Ц - | 3.04 | 5.09 | 4.40 | 4.60 | 20.14 | Ц- | 1.11 | 2.40 | 2.39 | 1.19 | 2.33 | IJ |
| PK - | 5.42 | 1.16 | 1.58 | 1.15 | 6.34 | PK - | 2.31 | 4.54 | 2.80 | 3.32 | 11.10 | PK - | 1.23 | 1.44 | 4.20 | 1.49 | 1.60 | PK |
| RC - | 1.53 | 1.15 | 1.00 | 6.89 | 3.38 | RC - | 2.11 | 2.20 | 1.00 | 1.97 | 1.45 | RC - | 1.02 | 1.07 | 1.07 | 2.18 | 2.32 | RC |
| RN - | 1.45 | 1.09 | 1.01 | 6.43 | 3.79 | RN - | 1.00 | 1.11 | 1.00 | 2.16 | 2.62 | RN - | 1.08 | 1.13 | 1.31 | 2.52 | 2.08 | RN |
| RU - | 1.23 | 1.23 | 1.07 | 3.03 | 3.64 | RU - | 1.00 | 1.78 | 1.00 | 2.20 | 3.65 | RU - | 1.05 | 1.00 | 1.12 | 2.37 | 2.38 | RU |
| OK - | 7.58 | 1.32 | 4.53 | 1.00 | 42.38 | OK - | 3.13 | 5.09 | 5.62 | 6.52 | 52.74 | OK - | | | | | | ОК |
| IC - | 12.77 | 1.20 | 1.41 | 1.23 | 5.47 | IC - | 3.92 | 8.18 | 33.99 | 14.79 | 6.24 | IC - | | | | | | IC |
| TW - | 16.05 | 2.44 | 2.40 | 1.00 | 14.32 | TW - | 4.43 | 5.90 | 10.66 | 11.59 | 40.61 | TW - | | | | | | тw |
| SW - | 38.56 | 6.35 | 8.34 | 1.06 | 42.73 | SW - | 3.03 | 2.94 | 2.54 | 3.57 | 5.71 | SW - | | | | | | SW |
| CPU | | | | | | | GPU | | | | | Hammerblade | | | | | | |

Conclusion

- Right Domain Specific Abstractions and Compilers are a powerful way for programming and optimizing upcoming accelerators Domain Specific Intermediate
- Representations allow decoupling hardware dependent and independent optimizations allowing maximum reuse!
- UGC is available open source at https://graphit-lang.org

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