Performance Summary

Chapel version 1.19
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Overview

• Generally speaking, performance has improved with 1.19

• Previous slides have shown performance improvements
  … due to communication optimizations
  … due to compiler and module optimizations
  … due to runtime optimizations

• These slides contain overall 1.19 performance results and trends
  • Shows comparisons across releases
Outline

- Single Locale Performance Trends
- Multi-locale Performance Trends
- Scalability Trends
- Priorities and Next Steps
Single Locale Performance
Single Locale Performance

• No major single locale performance changes
  • No known regressions
  • Some improvements from making cstdlib atomics the default
  • Performance efforts are focused on multi-locale and scalability improvements
Multi-locale Performance Trends
Multi-locale Performance Configuration

• Hardware: 16 nodes of a Cray XC
  • 28-core, 128GB RAM
    • (2) 14-core “Broadwell” 2.6 GHz

• Software:
  • CLE 6
  • GCC 8.2.0
  • Chapel 1.17.1, 1.18.0, 1.19.0
Multi-Locale Performance

• Modest multi-locale performance improvements

![Graph showing HPCC: PTRANS Perf (GB/sec) with n=2,000, nb=100](image1)

![Graph showing HPCC: HPL Release Perf (Gflop/s) with n=255, nb=32](image2)
Multi-Locale Performance

- Minor regression for NAS Parallel Benchmarks: EP
  - Has been resolved on master, but not in 1.19 release
  - Regression was minor, not a critical benchmark for us
Multi-Locale Performance

• Discovered PRK-stencil is not on par with reference as previously reported
  • Missed setting OpenMP affinity flags for reference version
  • Remaining gap due to imperfect Chapel task-affinity between trials

![Graph showing PRK: Stencil Optimized Perf (Mflop/s) order=128,000]
Multi-Locale Performance

- Regression for Promoted Stream under GASNet with MPI conduit
  - Not an important configuration, but discovered promoted version has comm
  - Surprising, communication not expected for any stream variants

![Graph showing HPCC: Promoted STREAM Perf (GB/s) with n=5,723,827,200]
Scalability Trends
Scalability Configurations

• 256 Node Configuration:
  • 36-core, 128GB RAM
    • (2) 18-core “Broadwell” 2.1 GHz
  • CLE 7.0 UPO0
    • GCC 8.2.0, cray-mpich/cray-shmem 7.7.7.1, Chapel 1.18.0/1.19.0

• 1024 Node Configuration (Edison):
  • 24-core (48 HT), 64 GB RAM
    • (2) 12-core "Ivy Bridge" 2.4 GHz processors
  • CLE 6.0 UP07
    • GCC 8.2.0, Chapel 1.18.0/1.19.0
Scalability

- Significant scalability improvements
  - 45% improvement for RA using remote-memory-operations
Scalability

- Significant scalability improvements
  - Scans over block distributed arrays scale

Scan Strong Scaling (8MB Total)

- Time (sec)
- Locales (x 36 cores / locale)
- Faster
Scalability

- Significant scalability improvements
  - 4.5x improvement for typical remote task spawns

Task Spawn Time (seconds)
(100,000 `coforall loc in Locales do on loc`)
Scalability

• Significant scalability improvements
  • 8% speedup for Stream Global at 1,024 nodes (~25,000 cores)
Performance Priorities and Next Steps
Performance Priorities and Next Steps

• Continue with Bale-driven optimizations
  • Enable unordered compiler optimization by default
  • Flesh out unordered operation API
  • Port and tune additional Bale applications
  • Start on aggregation library and performance experiments
• Locality oriented improvements
  • Optimize slicing
  • Optimize communication for distributed fields in records/classes
  • Improve bulk transfer for distributed arrays
• Tune comm=ofi performance
Performance Priorities and Next Steps

- Switch to llvm backend by default
  - Provides more consistent and controllable performance
  - Will likely have vectorization improvements
- Eliminate communication for promoted Stream
- Implement a task-resetting policy
- Eliminate remaining memory leaks
- Improve compilation speed
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