Performance Results

Chapel Team, Cray Inc.
Chapel version 1.17
April 5, 2018
This presentation may contain forward-looking statements that are based on our current expectations. Forward looking statements may include statements about our financial guidance and expected operating results, our opportunities and future potential, our product development and new product introduction plans, our ability to expand and penetrate our addressable markets and other statements that are not historical facts. These statements are only predictions and actual results may materially vary from those projected. Please refer to Cray's documents filed with the SEC from time to time concerning factors that could affect the Company and these forward-looking statements.
Summary

- Generally speaking, performance has improved with 1.17

- Previous slide decks have shown performance changes:
  - ...due to task-spawning improvements
  - ...due to compiler and library optimizations
  - ...due to runtime optimizations

- These slides contain additional 1.17 performance results
  - not tied to any specific effort, just comparisons across releases
Outline

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

● **Hardware:**
  ● 24-core, 128GB RAM
    ● (2) 12-core "Haswell" 2.6 GHz processors

● **Software:**
  ● SLES 12
  ● GCC 6.3
  ● Chapel 1.15.0, 1.16.0, 1.17.0
Single-Locale Performance

- No major --local performance changes
- Minor improvements and regressions

![fannkuchredux: Chapel Local versus No-local](image1)
![fasta: Chapel Local versus No-local](image2)

![Chapel Local Versus No-local Timing: MG Size B](image3)
![Chapel Local Versus No-local Timing: miniMD](image4)
Single-Locale Performance

- Some significant --no-local performance improvements
- For sparse codes

![Chapel Local Versus No-local Timing: LULESH](image)

![Chapel Local Versus No-local Timing: CG Size A](image)
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 processors

● Software:
  ● CLE6
  ● GCC 6.3
  ● Chapel 1.15.0, 1.16.0, 1.17.0
Multi-Locale Performance

- Significant multi-locale performance improvements
- Performance graphs (up is better)
Multi-Locale Performance

- Significant multi-locale performance improvements
- Time graphs (down is better)
Multi-Locale Performance

- **Known regression for elegant ISx**
  - However, performance improved for optimized version
  - (changes will be propagated to elegant version)
Multi-Locale Performance

- A few regressions from ugni dynamic registration
  - Underlying root cause not identified yet, still need to investigate

![Graphs showing performance metrics](image-url)
Scalability Trends
Scalability Configuration

- **Hardware**: Up to 256 nodes of a Cray XC
  - 36-core, 128 GB RAM
  - (2) 18-core "Broadwell" 2.1 GHz processors

- **Software**:  
  - CLE6
  - GCC 6.3
  - Chapel 1.16.0, 1.17.1
Scalability

- Significant scalability improvements
  - Reduction efficiency significantly improved

![Efficiency of Reductions Graph]

% Efficiency (scaled from 0.25s)

Locales

1.16  1.17.1
**Scalability**

- **Significant scalability improvements**
  - Stream Global scalability and performance approaching EP
  - (EP slightly behind reference because of hugepage usage)
Significant scalability improvements
PRK Stencil scalability and performance approaching reference
**Scalability**

- **Significant scalability improvements**
  - ISx scalability on par with reference
    - (raw performance is still ~25% behind, but scaling well)
Performance Priorities and Next Steps
Performance Priorities and Next Steps

● Continue benchmark-driven improvements
  
  ● Scalability:
    ● Add a bulk-spawning mechanism for more scalable task-spawning
    ● Add a cleaner user-facing scalable barrier to compliment allLocalesBarrier
    ● Run scalability tests at higher scales
  
  ● Multi-locale:
    ● focus on ISx, PRKs, MiniMD/CoMD, LULESH, and other DOE proxy apps
    ● reduce unnecessary communication
    ● improve task-affinity between consecutive foralls
  
  ● Single-locale:
    ● improve performance for shootouts (requires better vectorization)
Legal Disclaimer

Information in this document is provided in connection with Cray Inc. products. No license, express or implied, to any intellectual property rights is granted by this document.

Cray Inc. may make changes to specifications and product descriptions at any time, without notice.

All products, dates and figures specified are preliminary based on current expectations, and are subject to change without notice.

Cray hardware and software products may contain design defects or errors known as errata, which may cause the product to deviate from published specifications. Current characterized errata are available on request.

Cray uses codenames internally to identify products that are in development and not yet publically announced for release. Customers and other third parties are not authorized by Cray Inc. to use codenames in advertising, promotion or marketing and any use of Cray Inc. internal codenames is at the sole risk of the user.

Performance tests and ratings are measured using specific systems and/or components and reflect the approximate performance of Cray Inc. products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance.

The following are trademarks of Cray Inc. and are registered in the United States and other countries: CRAY and design, SONEXION, and URIKA. The following are trademarks of Cray Inc.: ACE, APPRENTICE2, CHAPEL, CLUSTER CONNECT, CRAYPAT, CRAYPORT, ECOPHLEX, LIBSCI, NODEKARE, THREADSTORM. The following system family marks, and associated model number marks, are trademarks of Cray Inc.: CS, CX, XC, XE, XK, XMT, and XT. The registered trademark LINUX is used pursuant to a sublicense from LMI, the exclusive licensee of Linus Torvalds, owner of the mark on a worldwide basis. Other trademarks used in this document are the property of their respective owners.