A Computation-Driven Introduction to Parallel Programming in Chapel

Brad Chamberlain, Greg Titus, Sung-Eun Choi
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What is Chapel?

- **An emerging parallel programming language**
  - Design and development led by Cray Inc.
    - in collaboration with academia, labs, industry; domestically & internationally

- **A work-in-progress**

- **Goal:** Improve productivity of parallel programming
What does “Productivity” mean to you?

Recent Graduates:
“something similar to what I used in school: Python, Matlab, Java, …”

Seasoned HPC Programmers:
“that sugary stuff that I don’t need because I was born to suffer”
want full control to ensure performance”

Computational Scientists:
“something that lets me express my parallel computations without having to wrestle with architecture-specific details”

Chapel Team:
“something that lets computational scientists express what they want, without taking away the control that HPC programmers need, implemented in a language as attractive as recent graduates want.”
Chapel's Implementation

- Being developed as open source at GitHub
  - Licensed as Apache v2.0 software

- Portable design and implementation, targeting:
  - multicore desktops and laptops
  - commodity clusters and the cloud
  - HPC systems from Cray and other vendors
  - in-progress: manycore processors, CPU+accelerator hybrids, …
Today’s Goals

- Provide context for Chapel
- Introduce you to Chapel via sample computations
  - base language
  - data parallelism
  - task parallelism
  - locality control
- Demonstrate the Chapel compiler interactively
- Point you toward resources for future reference
- Get your feedback on Chapel
Format of This Tutorial

● In past years, our tutorials have been very pedagogical
  ● “Here are Chapel’s types, variables, parallel features, etc.”
  ● Somewhat of a forced march through the language specification
    ● Zzzzzz…
    ● Examples were where people perked up

● So, this year, we’re taking an example-oriented approach
  ● Goal: cover similar material in a more interesting way
  ● (Please forgive any growing pains due to change of format)

● Also, this was intended as a full-day tutorial
  ⇒ no hands-on session and less time to get through the material
  ⇒ help me throttle pace to cover material well rather than sprinting to get through it all

● Slides have improved since SC14’s print-run deadline
  ● final slides available at: http://chapel.cray.com/tutorials/SC14
Ground Rules

● Please feel encouraged to ask questions as we go
  ● not to mention during the break and afterwards

● Feel free to ask to see features demonstrated

● Please fill out surveys afterwards
  ● We have a paper one for feedback on Chapel and the tutorial
  ● SC14 has a general quality-of-tutorial one as well
Who are you?

Type of Institution?
- Academic, Industry, HPC Lab, Gov’t, …

Role?
- Student, postdoc, faculty, developer, researcher, …

Favorite Languages?
- Fortran, C, C++, Java, Matlab, Python, Perl, C#, …

Parallel Programming Models?
- MPI, OpenMP, UPC, CAF, Pthreads, CUDA, …
Agenda

8:30: Welcome
8:40: Chapel Background and Motivation
9:00: Base Language by Example
9:30: Data Parallelism by Example
10:00: Break
10:30: Task Parallelism by Example
11:00: Locality Control by Example
11:30: Project Status, Next Steps, Demos, …
12:00: Done! (Lunch!)
Surveys

Please take the time to fill out and return the surveys (both ours and SC14’s)

Thanks!

For your interest in Chapel and your feedback
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