A Computation-Driven Introduction to Parallel Programming in Chapel

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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!)

Final Notes

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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