Hewlett Packard Enterprise

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Interactive Exploratory Data Analytics (EDA) on Petabytes with Python and Arkouda, Powered by Chapel

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Arkouda Enables HPC from Python

Interactive Rates

Operations run in seconds

Massive Scales

100s of TBs using 1000s of nodes

Python Interface for Client

Familiar, interactive, Jupyter-ready

Chapel-powered Server

Runs on supercomputer, cluster, cloud

Modules for Different Uses

Graphs, visualizations, and more

Open-Source

Developed under MIT License

No other tool provides Exploratory Data Analysis (EDA) at these scales

Arkouda Demo

Client

- Jupyter on laptop

Server

- Running on 8 nodes of Cray XC

Dataset

- Too large for a laptop

Operations

- Histogram
- Group-by
- Visualization w/ matplotlib

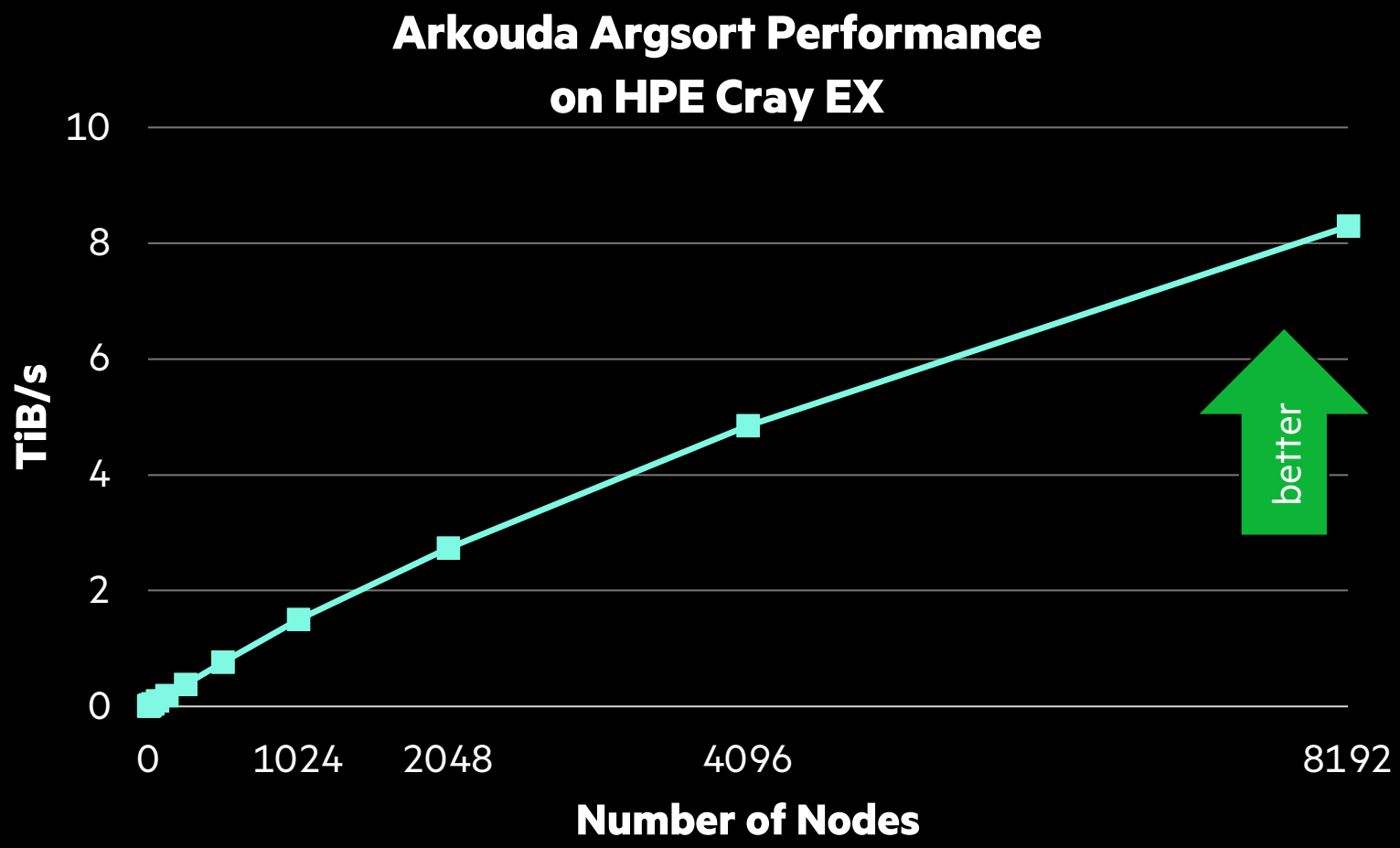
Radix Sort in Arkouda Scaling to 8 TiB/s on 8K Nodes

Slingshot-11 network (200 Gb/s)

8192 compute nodes

256 TiB of 8-byte values

~8500 GiB/s (~31 seconds)



A notable performance achievement in ~100 lines of Chapel

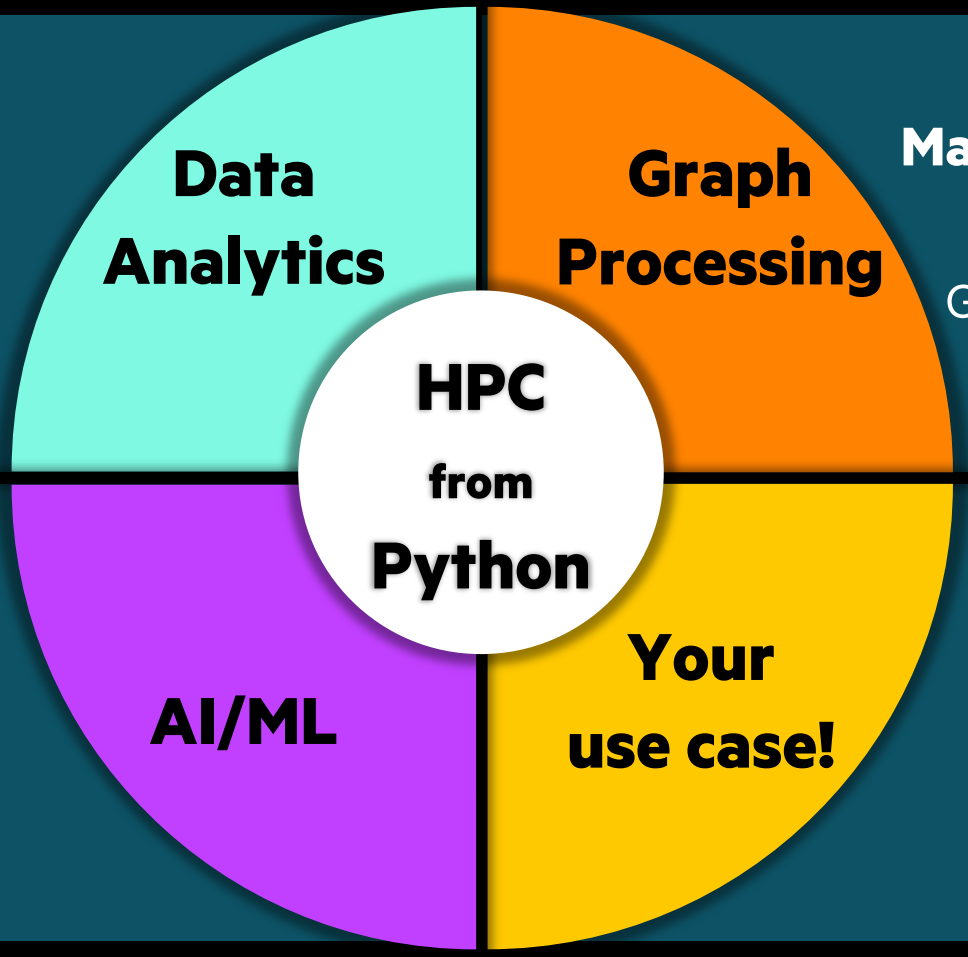
What can Arkouda do?

Scalable Operations

sorting, groupby, stats…

Performant I/O

HDF5, Parquet…



Massive-scale real-world graphs

Arachne: Developed by NJIT

Graph infrastructure for data science

Distributed Inference

Chapel AI Library (ChAI)

Open-source, under development

Coming Soon!

Earth sciences with Pangeo

Supercomputer telemetry

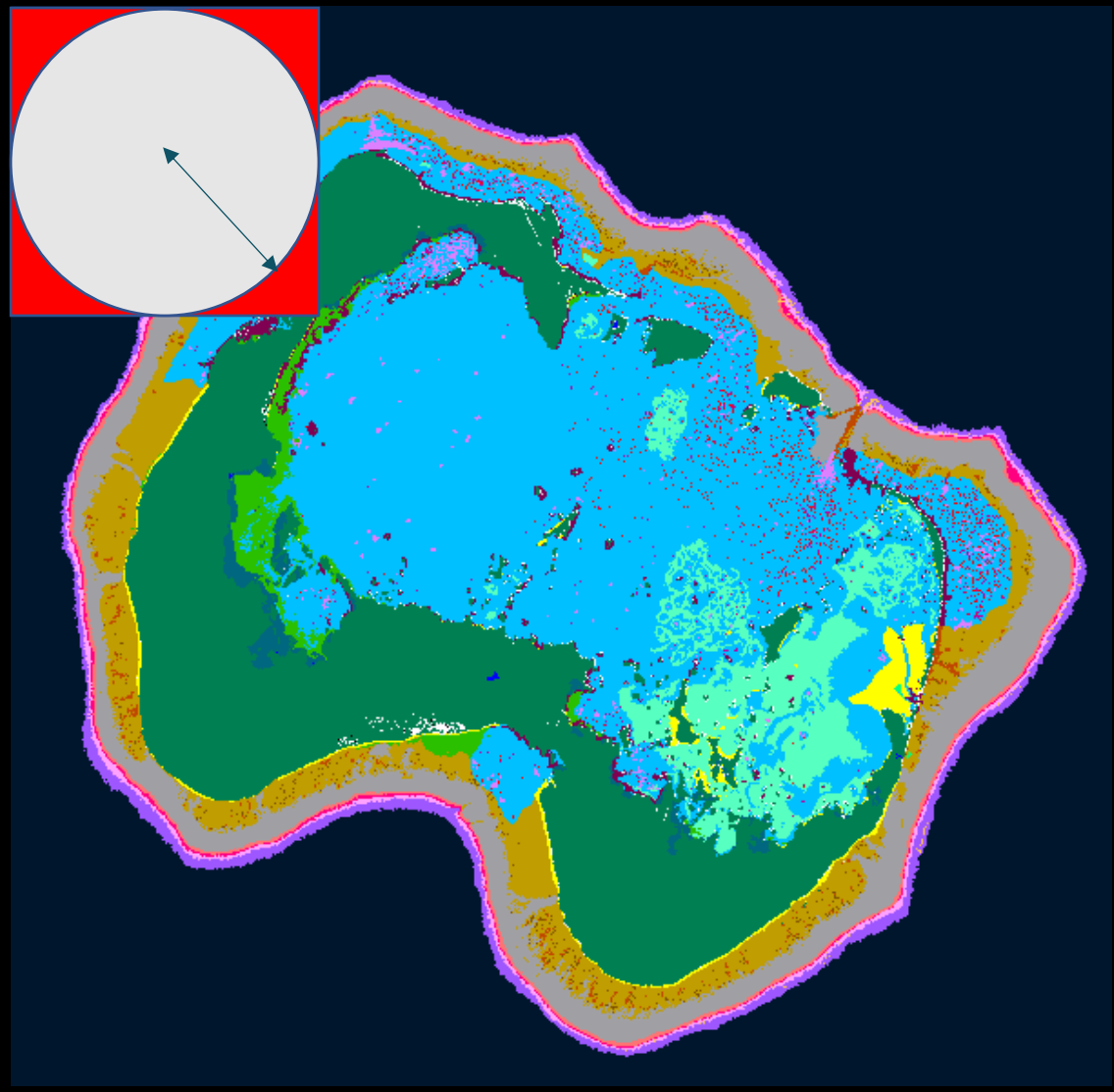
Powered by the Chapel Parallel Programming Language

Chapel is a language designed for productive parallel programming, particularly on large-scale systems. Chapel is …

Easy to Use	"*We ask students at the master's degree to do stuff that would take 2 years and they do it in 3 months.*" Eric Laurendeau, Professor of Mechanical Engineering
Portable	HPE Cray EX, HPE Apollo, Cray XC, *nix systems, Mac, NVIDIA and AMD GPUs
Fast & Scalable	Achieved 8,500 GiB/s when sorting 256 TiB in 31 seconds on 8192 HPE Cray EX Nodes
GPU-Ready	Real-world applications were ported on GPUs with few changes, and run on leadership-class systems such as Frontier and Perlmutter
Open source	Team at HPE actively interacts with Chapel community at chapel-lang.org

Another Chapel Use Case: Image Processing for Coral Reef Biodiversity

- **Analyzing images for coral reef biodiversity**
- **Algorithm implemented productively**
  - Add up weighted values of all points in a neighborhood
  - Developed by Scott Bachman, NCAR scientist
  - Scott …
    - started learning Chapel in Sept 2022,
    - started Coral Reef app in Dec 2022, and
    - had collaborators presenting results in Feb 2023.
  - In July, changed ~5 lines in a variant to run on GPU
- **Performance**
  - Less than 300 lines of Chapel code scales out to 100s of processors on Cheyenne (NCAR)
  - Full maps calculated in **seconds**, rather than days
    - **10,000 times faster than the MATLAB version**



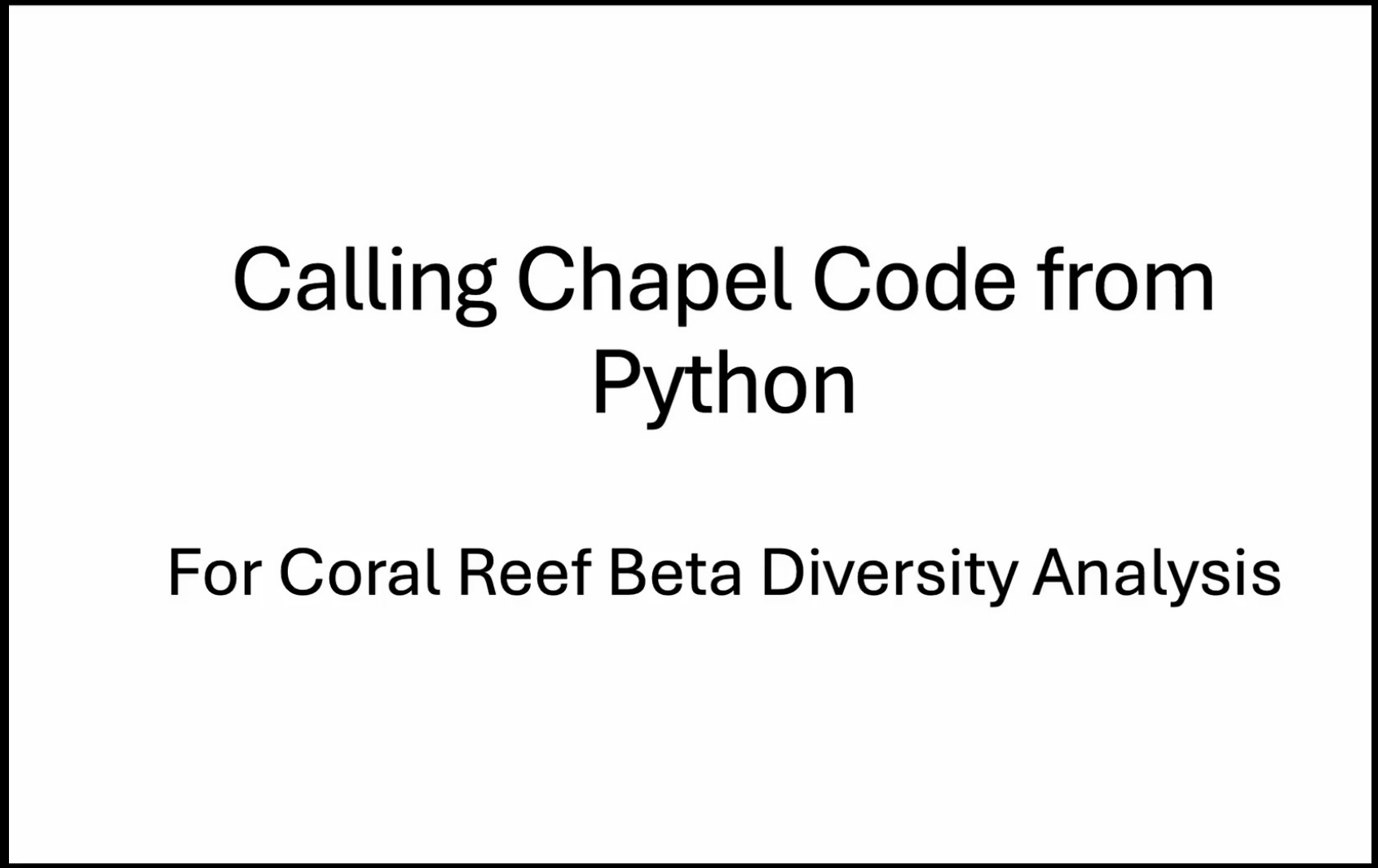
Calling the Coral Reef Chapel Code from Within Python

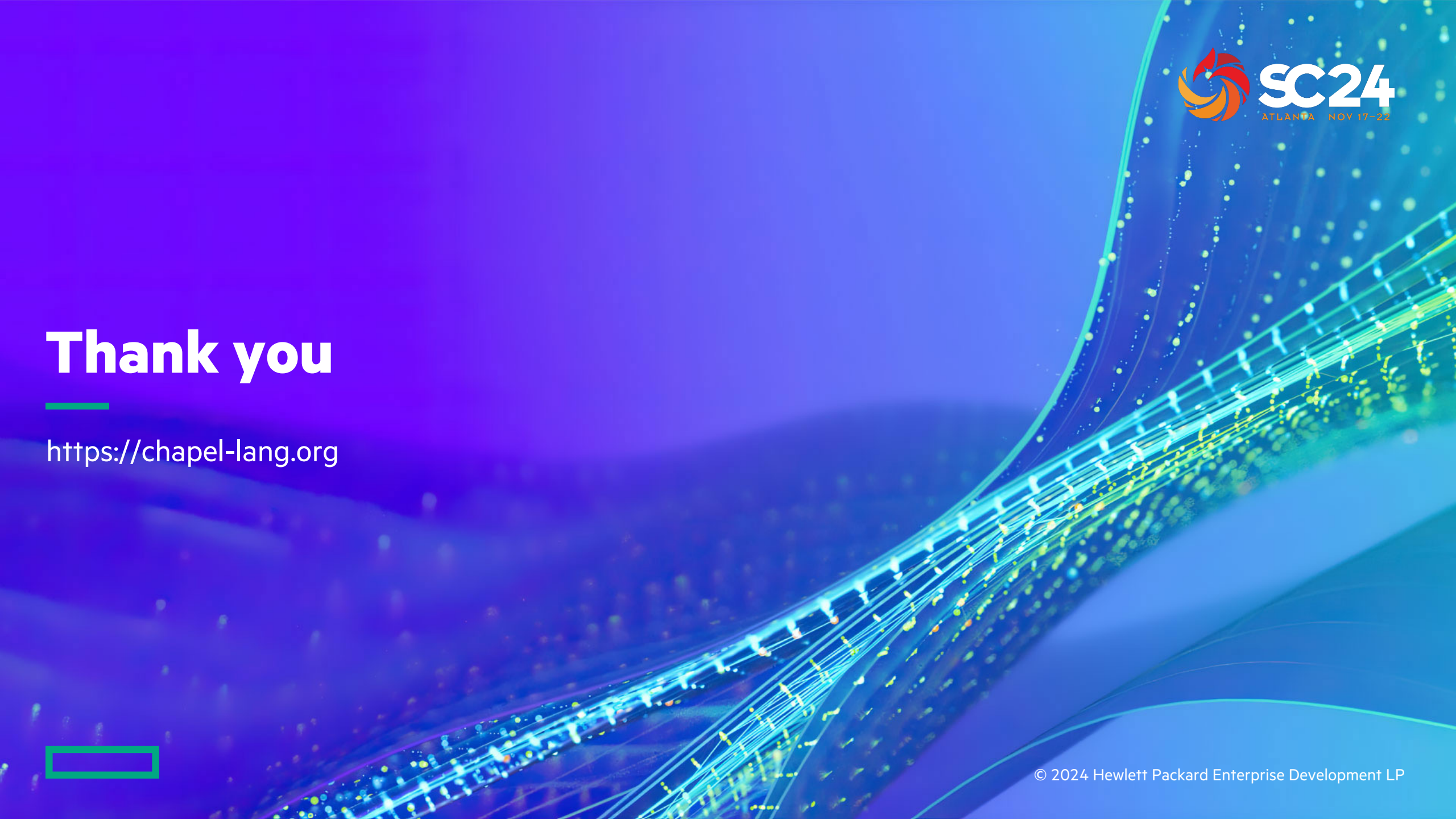
Runs on a Laptop

- Same code ran on supercomputer

Runs Interactively

- From within Python interpreter
- Calling the fast Chapel code





Thank you

https://chapel-lang.org