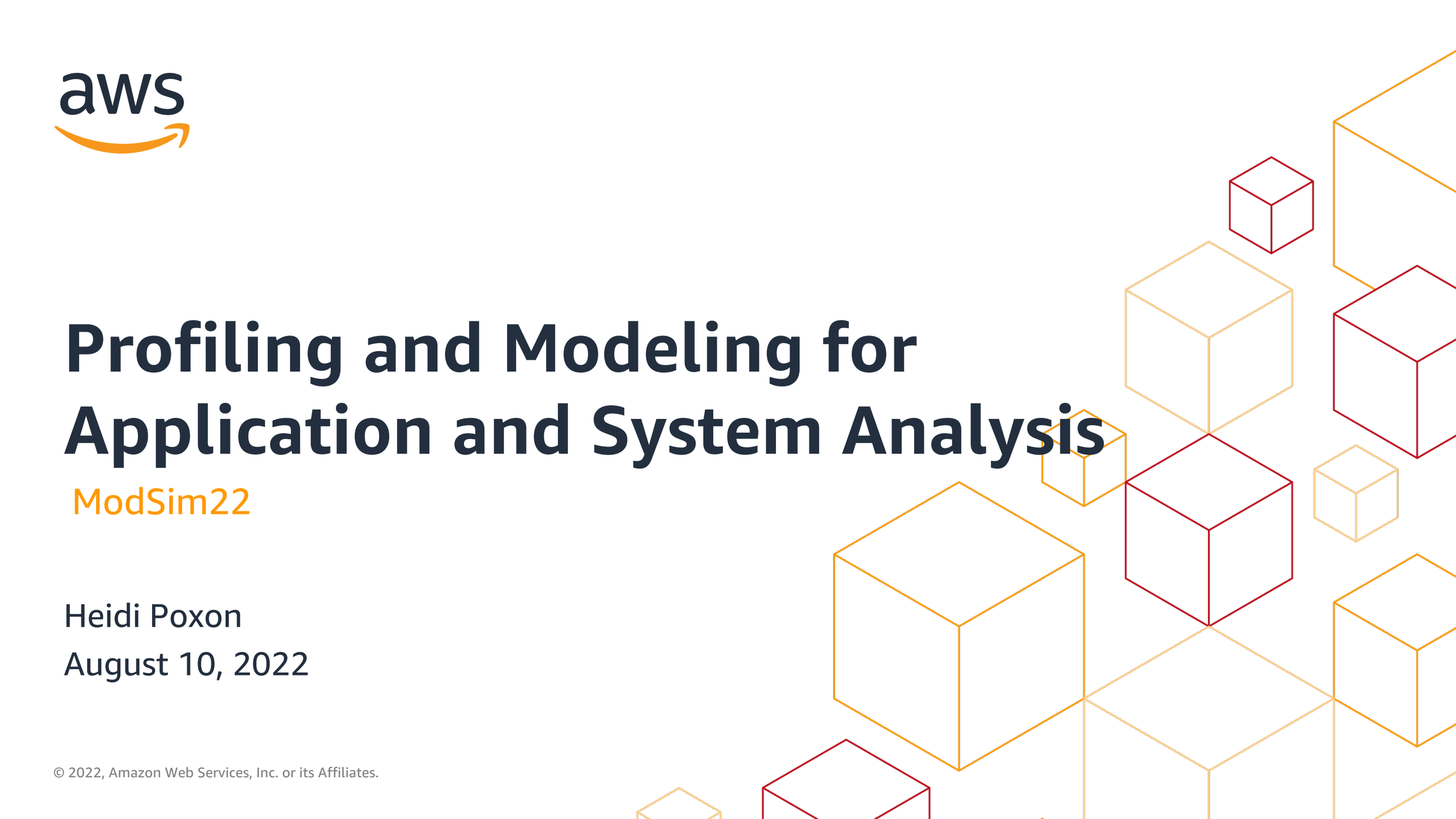

Profiling and Modeling for Application and System Analysis

ModSim22

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Topics

- Profiling and modeling to assess application behavior
- Lessons learned
- How these approaches transfer to cloud when analyzing performance
- What’s needed in the future?

Filesystem

Processor

Node Architecture

Memory

Accelerator

What Impacts Performance?

System and Developer Software

System Size

Application

Network

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Analysis Considerations

Learn how an application performs the way it does and why

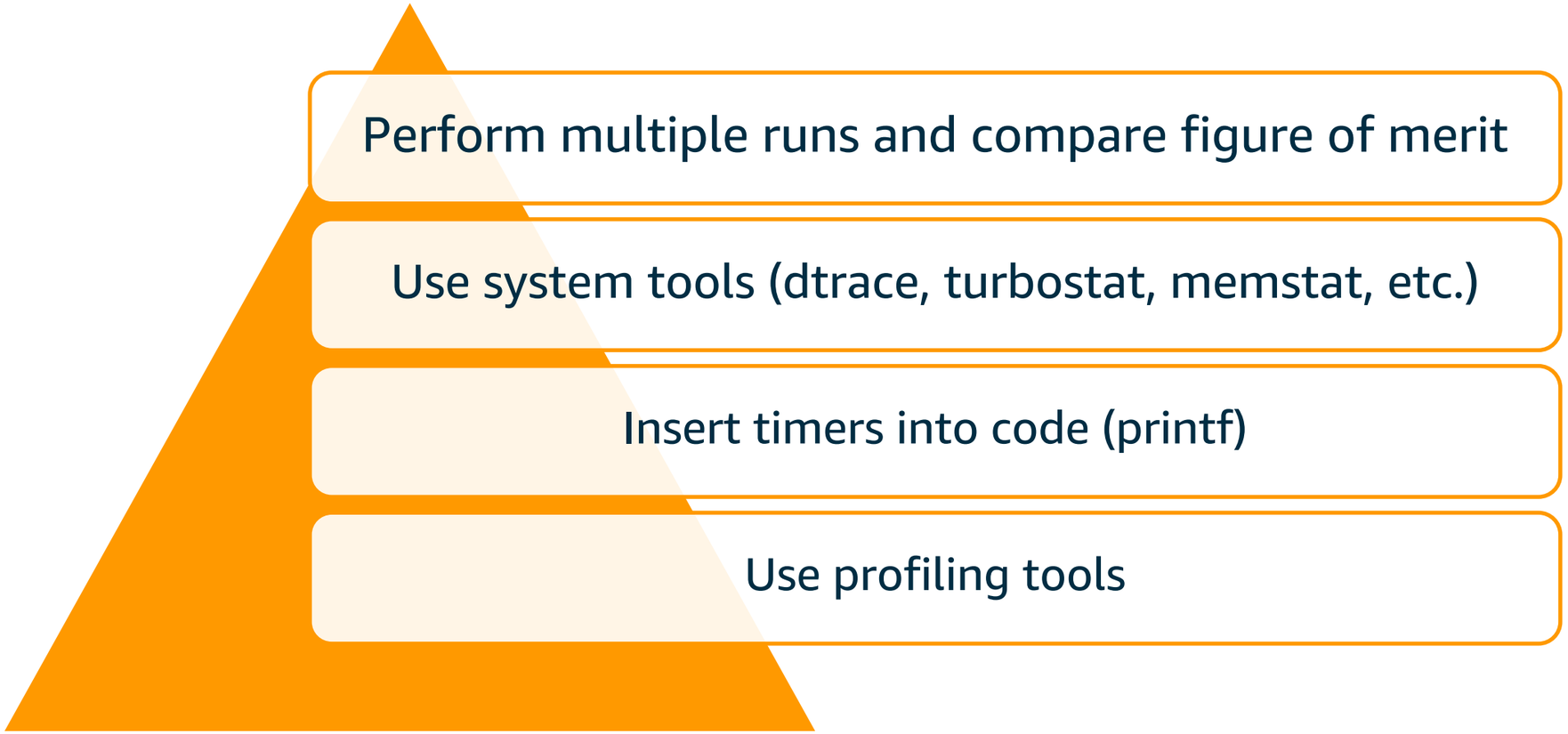
- Analyze whole program, single node, code segment
- Run in dedicated or loaded environment
- Perform static code analysis, roofline, impairment, or sensitivity studies

Modeling Application Behavior

Learn how an application reacts to different architectural characteristics or in different environments

- Run or profile and see what you get, then extrapolate
- Create equations (simple or complex) to evaluate behavior
- Imitate application or hardware behavior
- Feed traces or applications through performance simulators
- Combine profiling and modeling to increase modeling effectiveness

Performance Assessment Approaches



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What Makes a Profiling Tool Effective?

- Reduces time investment to port and tune applications
- Analyzes whole-program at scale for bottlenecks
- Provides simple interfaces with capability to target complex HPC applications
- Offers actionable guidance

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Challenges

- Periodic use
- No one tool fits all needs
- Those elusive performance counters
- Profiling-ready applications

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Lessons Learned from a Tool User Perspective

- Choose tool to fit the goal (2x vs 3% speedup, evaluating new architecture)
- Consider the investment
- Understand the why, not just the what
- Analyze the job size and problem size you intend to run
- Aggregated data is good, but need the ability to break it down too
- Understand how data is aggregated by a tool

Lessons Learned from a Tool Developer Perspective

- Offer simple steps to obtaining performance results
- Both high level summaries and details are important
- Choosing the most meaningful information for a single run is difficult
- Sometimes the simplest solutions can be the most effective
- Aggregate data, derive metrics, but also provide the ability to review non-aggregated data
- Describe how data is aggregated
- Balance overhead injection with insight
- Providing more data is not necessarily better

Cloud – a New Performance Capture Environment

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Continuity Between Cloud and Local Data Centers

- Another set of resources for computing and data analytics
- Application and system performance still matters!
- Yes, you can use performance counters (but not quite as many)
- You have access to dedicated, high performance resources
- System tools, timers, profilers, modeling are available

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Example Differences

- Virtual environments and hypervisors
- Technology choice with more frequent uplifts
- You become the administrator
- Topology details and some controls are not available

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Bringing it Together to Address Common Problems

- Tool platform portability
- Profiling interfaces for programming layers (libfabric, RAJA, Kokkos, DPC++)
- Data explosion due to large scale systems and converged workloads
- Profiling and modeling require expertise
    - Simplicity and familiarity for wider adoption
    - Performance teams or “Centers of Excellence” for profiling goals, methodology, consistency, knowledge transfer

Thank you!

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