A practical introduction to MLIR for HPC using Python

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Motivation

- Compilers and associated tooling are crucial to our workloads in HPC
  - If you are an applications developer, you use these things every day
  - If you are a tools developer, you integrate with the technologies
  - If you are a hardware designer, you will need to support these tools so your users can use your hardware

- MLIR is revolutionising the field of compiler design by providing standardisation and reusability
  - In the hands on we will see just how powerful this is in enabling us to achieve significant results in a short period of time and run these on a supercomputer

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Learning objectives

- This tutorial is open to everybody, regardless of experience with compilers
  - We have designed the hands on activities to walk people through the material and not prescribe when a specific exercise should be finished

1. To demystify MLIR and LLVM, providing an overview of technologies that are both commonly discussed in the HPC community and highly topical so that attendees know what these are and what they do.
2. Provide attendees with an understanding of how the MLIR, xDSL, and LLVM technologies can be leveraged for an end-to-end compilation flow on a supercomputer, starting with source code all the way to binary execution on a compute node.
3. Illustrate how these can be extended and used in production via developing new dialects and transformations to support new languages, constructs, or target platforms.
4. For more advanced attendees we aim to provide an underlying foundation and examples that they can then use in porting their own code translation tools to MLIR.

Session plan

Time	Details	Type
8:30 - 8:35	Introduction, welcome and objectives	Presentation
8:35 - 8:55	An overview of MLIR and LLVM	Presentation
8:55 - 9:20	The xDSL framework	Presentation
9:20 - 9:25	Introduction to the hands-on activity	Presentation
9:25 - 10:00	Logging into ARCHER2 and hands-on practical activity	Hands-on
10:00 - 10:30	Morning break	
10:30 - 10:35	Welcome back and overview of second part	Presentation
10:35 - 11:45	Hands-on practical activity	Hands-on
11:45 - 11:55	Wash up from practical activities, highlighting key take-away points	Presentation
11:55 - 12:00	Conclusions & next steps to continue working with the technologies	Presentation

More about the hands on activities in about 50 minutes!

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Materials and the xDSL community

- We will remind people as we progress through the session
- All materials for this tutorial can be found at
  - https://github.com/xdslproject/training-intro
- More generally if you wish to continue exploring this after the tutorial finishes:
  - https://xdsl.dev/
  - https://xdsl.zulipchat.com/