EPCC HPC programming teaser

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Who we are

- EPCC is a High-Performance Computing (HPC) **centre of excellence** at the University of Edinburgh, UK.
- Typically ranked in the **top 20** universities in the world, **#15** as of 2023[1].

During ISC, you can find us at booth **G715**, and our student cluster competition team at booth **A116**.

[1] https://www.topuniversities.com/universities/university-edinburgh

What we do #1: education

Based on 30 years of HPC experience, EPCC offers two well established **Master's degrees**:

- MSc[2] in HPC: on-campus / online
- MSc in HPC with Data Science: on-campus / online

Full-time vs part-time:

- Our **on-campus** Master's degrees are available both full-time, 1 year, and part-time, 2 years minimum, 3 years maximum.
- Our **online** Master's degrees are available part-time, 3 years minimum, 6 years maximum.

[2] Master's of Science

What we do #1: education

Here is an partial list of the modules you can find in our master's degrees, such as our MSc in HPC:

- Threaded Programming
- Message-Passing Programming
- Advanced Message-Passing Programming
- HPC Architectures
- Numerical Algorithms for HPC
- Performance Programming
- Design and Analysis of Parallel Algorithms
- Parallel Design Patterns
- High Performance Data Analytics
- Advanced Parallel Techniques

What we do #2: supercomputers

- We also host, run, and provide training for the UK's national supercomputer ARCHER2, made up of **750,000 cores**.
- ARCHER2, along the other clusters and supercomputers we manage, forms a **£1 billion** HPC ecosystem at our Advanced Computing Facility (ACF).

What we do #3: industrial collaboration

EPCC has a proven track record of commercial projects with numerous companies and organisations, including but not limited to:

- Alpine F1 team
- Rolls-Royce
- McLaren
- Royal Bank of Scotland
- Met Office
- BAE systems

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Motivation

In HPC, there are two main levels of parallelism:

intra-node using multiple cores[3] on a given node, by leveraging **shared-memory** programming.

inter-node using multiple nodes together, by leveraging **distributed-memory** programming.

[3] We do not dive into heterogeneous computing as part of this programming teaser, though we definitely do as part of our MSc.

Motivation

Two standards have proven themselves for over two decades:

OpenMP standing for **Open** **M**ulti-**P**rocessing, the reference in shared-memory programming.

MPI standing for **M**essage-**P**assing **I**nterface, the reference in distributed-memory programming.

In this teaser, we are going to **scratch the surface** of each, for you to see how far you can go :)

Motivation

You will find two directories on the USB flashdrive:

- `OpenMP`
- `MPI`

They contain nearly thirty **short source codes**, each one illustrates the use of a particular technique or feature.

Feel free to do the ones you want, in the order you want.[4]

[4] Note: they *tend* to get more difficult as you progress.

What if I need help?

If you get stuck, **solutions are available**, simply:

- come back to our booth **G715**, or
- contact us

Of course, you can also compare your code with other students and discuss your approaches.

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Contact us

- You are stuck on an exercise?
- You have questions or feedback?
- You would like to discuss further?

You are welcome to! Simply let us know.

Stay tuned!

We hope you enjoyed this HPC programming teaser. This is our **first edition**, so any feedback is welcome :)

If you are interested in learning more about EPCC, keep an eye on what we do, we are present in numerous instances, including but not limited to:

- Our MSc in HPC: on-campus / online
- Our MSc in HPC with Data Science: on-campus / online
- The International HPC Summer School.
- The EPCC HPC Summer school.
- The MPI forum
- The OpenMP language committee.