Isambard:

The World's First Large-Scale Production 64-Bit ARM Supercomputer

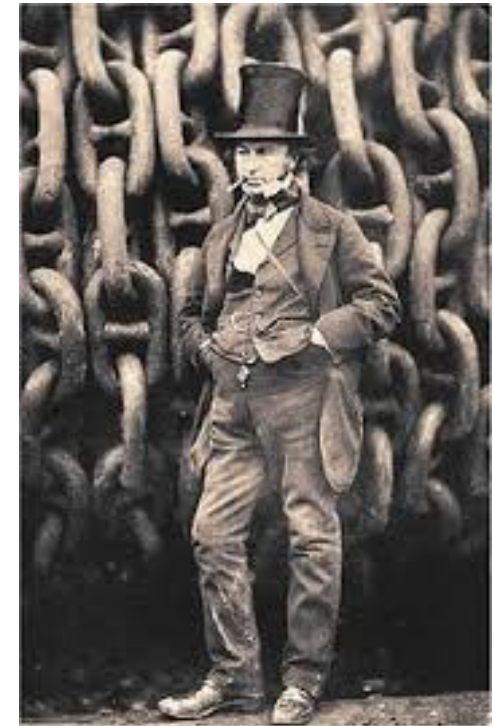Prof Simon McIntosh-Smith

University of Bristol, UK

Recent trends in HPC:

- Most of the world's supercomputers are large collections of servers based on **commodity processors**, typically Intel's x86 CPUs

- **New computer architectures** are just starting to emerge, exploring diverse ways to provide the next jump in performance

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Why explore ARM-based supercomputers?

- The architecture development is driven by the *fast-growing mobile space*

- Multiple vendors of ARM-based CPUs:
  - Greater **competition**
  - More **choice**
  - Exciting **innovations**, e.g. in vector instruction set

- **MONT-BLANC** proved the approach is feasible

'Isambard', a new Tier 2 HPC service from GW4.
Named in honour of Isambard Kingdom Brunel

I.K.Brunel 1804-1859

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Tier 0: international

The tiered model of HPC provision

Tier 1: national

Tier 2: regional

Tier 3

TIER 2 HPC CENTRES

Edinburgh · Cambridge · University College, London
Loughborough · Bristol · Oxford

EPSRC's new Tier 2 HPC centres:

- Funded with a £20m capital investment

- 6 new centres created

- Aim is to explore **architectural diversity**:

  - **Processors**: GPUs, Xeon Phi, ARM

  - **Interconnect**: Infiniband, Omnipath, Cray

  - **Storage**: burst buffers, fast non-volatile memories

Archer: The UK's national HPC service (£43m)

Top 10 codes by core hours used:
VASP, CP2K, GROMACS, CASTEP, HiPSTAR, UM, ONETEP, LAMMPS, WRF, Oasis

2 research councils:

Hardware:
- Cray XC30
- 118,080 x86 cores
- 4,920 nodes
- Cray Aries interconnect

Science:
- ~1,500 users
- Materials science
- CFD
- Climate/ocean modelling

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Isambard system specification:

- Cray system
- **10,000+** ARMv8 cores
- Cray software tools
  - Compiler, math libs, tools…
- Technology comparison:
  - x86, Xeon Phi, Pascal GPUs
- Phase 1 installed March 2017
- The ARM part arrives early 2018
  - Early access nodes from Sep
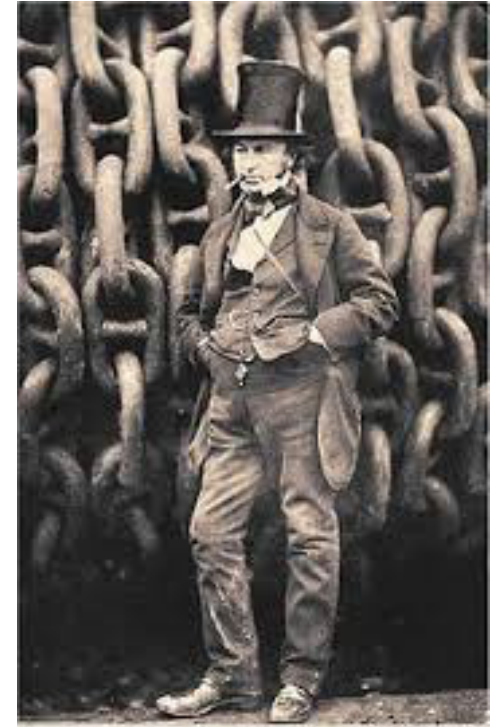
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Isambard's mission:

To provide an open service for UK* science and industry to evaluate ARM in a **production HPC environment**.

The project employs several staff to help port and optimise codes to ARM

* and beyond!

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Some results:

- My team has had remote access to Cavium ThunderX2 early silicon for ~10 days

- Have already managed to compile and run lots of real codes "out of the box"
  - List on next slide

- Using GNU and Clang/LLVM

- Performance very promising!
  - Happy to share the numbers under NDA

- CloverLeaf (2D / 3D)

- TeaLeaf (2D / 3D)

- SNAP

- BookLeaf

- GROMACS

- CP2K

- The Unified Model (UM)

- STREAM

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Also going to be working on:

- The top 10 most heavily used codes on Archer:
  - VASP, CP2K, GROMACS, CASTEP, HiPSTAR, UM, ONETEP, LAMMPS, WRF, Oasis
  - Note 8 of these 10 codes is written in **FORTRAN**

- Additional codes relevant to Isambard project partners:
  - OpenFOAM, OpenIFS, …

- Want to collaborate wherever possible!
  - Let's avoid duplicating effort

Exciting times ahead!

- **In the near term**: greater choice, competition, innovation, …

- **In the longer term**: potential for disruptive change to significantly impact scientific software development

- We need to be ready to exploit next generation technologies to deliver new science!

For more information:

- http://gw4.ac.uk/isambard/

- https://www.epsrc.ac.uk/blog/isambardhpc/

- Twitter: @simonmcs

- Please get in touch to collaborate on optimising applications: simonm@cs.bris.ac.uk

- Bristol is hiring faculty staff in CS to focus on HPC