Incorporating High Performance Computing in a Physics Curriculum

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Incorporating HPC in a Physics Curriculum
Much of science and industry now has a substantial HPC component
- Physics is now an experimental and a computational science
- HPC is often a destination of Physics students
- School students: if I study Physics what job will I get? The world would be a better place if run by physics graduates 😊

HPC is rarely taught to science and engineering students:
- Who will teach it?
- What to take out to make room for HPC?
- How to start, and ensure a common background for interested students?
Introduction

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  - What to take out to make room for HPC?
  - How to start, and ensure a common background for interested students?
Who will teach HPC?

Presently, many students teach themselves using resources provided by HPC Centers
- Online workshops
- GPU Hackathons
- SIGHPC Education resources a great place to start
- Impressive collaboration of HPC Centers in education

Access to HPC Centers may be problematic
- On-line portals being developed, e.g. AMP Gateway
- In-house expertise rarely spans the full range of HPC
  - A mix of in-house champions with HPC access seems a necessary requirement
  - Physics culture ideal for HPC education
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We have to be driven by what is best for the students

Success metric: career diversity of physics graduates

Physics students: “Jacks of all trades and masters of one” 😊

Many students, one physics major; compromise (optimisation) inevitable

Statements like “You can’t have a physics major without X” have to be addressed.

Allowing for an HPC option may work at larger universities
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How to start?

- Need to have some computing courses in the early years of a physics major
- Can incorporate computation into existing courses:
  - “Advanced Computational Quantum Mechanics”
  - Ask mathematicians to add numerical computation
- Only then can HPC education be considered
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Western Australia is home to **ASKAP**, **MWA**, and **SKA**, and hence the **Pawsey Supercomputer Centre**.

- Physics at Curtin University is multicultural:
  - Mathematics
  - Computing
  - Physics: theoretical, computational and experimental

- Physics students have the background for HPC
  - Object Oriented Program Design
  - Unix and C Programming
  - Data Structures and Algorithms
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Taught as an Honours subject over 12 weeks
- 2 hours/week content delivery
- 2 hours/week practical implementation
- 4 assignments, no exam

Taken by Computing, Mathematics, Physics and Engineering students

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HPC content

- Supercomputer architecture (one week)
- Serial optimisation (one week)
- MPI (four weeks)
- OpenMP (one week)
- GPU acceleration with CUDA, OpenAcc and OpenMP (two weeks)
- Large-scale I/O and Python in HPC (one week)
- Containers and Workflows (one week)

Ran for the first time in 2020, and here to stay!

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