Online MSc DPTs and notes

These proposals are for the creation of online part-time intermittent versions of the existing MSc programmes (to include PGDip, PGCert and PPD entry routes) in High Performance Computing (HPC) and High Performance Computing with Data Science with admissions for the first intake to open on 01 October 2019 for first entry in September 2020 (Academic Year 2020/21).

The only differences at present between the on-campus programmes and the suggested online variant are that:

- The on-campus compulsory 10 credit courses INFR11176 – Fundamentals of Data Management and INFR11171 – Data Analytics with High Performance Computing are replaced by their direct equivalent, the 20 credit INFR11183 – Practical Introduction to Data Science
- The 10 credit course INFR11175 HPC Architectures course will not have a direct equivalent as much of its material already exists within the 20 credit online course INFR11184 - Practical Introduction to High Performance Computing (a course which will serve to prepare students for other core courses to follow or take alongside the Semester 2 material, where on-campus students take HPC Architectures alongside other such core courses).
- Due to the broader-based nature of course INFR11184 - Practical Introduction to High Performance Computing it will be compulsory for online HPC with Data Science students, where HPC Architectures is not (but remains a strongly recommended course).
- At present two on-campus optional courses: INFR11174 – Numerical Algorithms for High Performance Computing and INFR11169 – Advanced Message-passing Programming are not proposed: the on-campus courses are primarily minority optional courses. These courses may be proposed for online learning in future, but are not planned before 2022 at earliest and their introduction may depend on student interest.

The programmes will be formed around the existing online courses:

- INFR11184 - Practical introduction to High Performance Computing (compulsory for both programmes) – 20 credits
- INFR11183 - Practical Introduction to Data Science (compulsory for MSc in HPC with Data Science) – 20 credits

Further courses listed on the DPTs below are to be created and launched to the following schedule (as required for the DPT); all courses below except Project Preparation and the Dissertation courses are expected to be offered to the DSTI DPT as optional courses as well:

September 2019 (See attached proposals – courses not required until September 2020, but desire to launch in January 2019 to be offered to DSTI students in Academic year 2019/20 so that material has already been subject to a run before the first year of the programme):

- Message-passing Programming – 10 credits (compulsory) to run in Semester 2
- Threaded Programming – 10 credits (compulsory) to run in Semester 2

By **David Henty & Ben Morse (EPCC) 14/02/2019**

September 2020 (Full course proposals to follow, but suggested as online versions of their existing on-campus equivalents INFR11177 and INFR11172):
- Programming Skills – 10 credits (compulsory for PGDip and MSc) to run in Semester 1
- Software Development – 10 credits (compulsory for PGDip and MSc) to run in Semester 1

September 2021 (or earlier, full course proposals to follow, but suggested as online versions of their existing on-campus equivalents: INFR11173, INFR11167, INFR11168, INFR11170, INFR11179):
- Project Preparation – 10 credits (compulsory for MSc, optional for PGDip but only for students approaching end of PGDip who wish to keep options open for, intending to, or in the process of applying for transfer to the MSc programme, not offered for PGCert) to run in Semester 2
- Performance Programming – 10 credits (optional for all programmes) to run in Semester 1
- Parallel Design Patterns – 10 credits (optional for all programmes) to run in Semester 1
- Advanced Parallel Techniques – 10 credits (optional for all programmes) to run in Semester 2
- Design and Analysis of Parallel Algorithms – 10 credits (optional for all programmes) to run in Semester 2

September 2022 (or earlier, full course proposals to follow, but suggested as online versions of their existing on-campus equivalents: INFR11164, INFR11166):
- Dissertation (High Performance Computing) – 60 credits (compulsory for MSc in HPC) to run over 12 months (September-August)
- Dissertation (High Performance Computing with Data Science) – 60 credits (compulsory for MSc in HPC with Data Science) to run over 12 months (September-August)

MSc in High Performance Computing Degree Programme Table Requirements
Compulsory Courses: Practical Introduction to High Performance Computing, Message-passing Programming, Threaded Programming, Programming Skills, Software Development, Project Preparation, (70 credits).
Students must take at least 30 Credits of options from: Parallel Design Patterns, Performance Programming, Advanced Parallel Techniques, Design and Analysis of Parallel Algorithms. Further courses to enhance this list may be added for launch after the 2020/21 academic year.
Further optional courses: Practical Introducton to Data Science (20 credits), Introductory Applied Machine Learning (20 credits). Further courses to enhance this list may be added as they become available in the Online Learning ecosystem.

Differences for PGDip: Project Preparation non-compulsory and should only be taken as optional during Semester 2 of expected final year on PGDip by students considering or in the process of transferring to the MSc.

Differences for PGCert: Project Preparation not available, Programming Skills and Software Development non-compulsory. Students take a maximum of 20 non-compulsory credits.

By **David Henty & Ben Morse (EPCC) 14/02/2019**

MSc in High Performance Computing with Data Science Degree Programme Table Requirements:
Compulsory Courses: Practical Introduction to High Performance Computing, Practical Introducton to Data Science, Message-passing Programming, Threaded Programming, Programming Skills, Software Development, Project Preparation, (90 credits).

Students must take at least 10 Credits (20 credits recommended) of options from: Parallel Design Patterns, Performance Programming, Advanced Parallel Techniques, Design and Analysis of Parallel Algorithms. Further courses to enhance this list may be added for launch after the 2020/21 academic year.

Relevant further optional courses: Introductory Applied Machine Learning (20 credits), Image and Vision Computing, Advanced Vision. Further courses to enhance this list may be added as they become available in the Online Learning ecosystem.

Differences for PGDip: Project Preparation non-compulsory and should only be taken as optional during Semester 2 of expected final year on PGDip by students considering or in the process of transferring to the MSc.

Differences for PGCert: Students only take compulsory courses: Practical Introduction to High Performance Computing, Practical Introducton to Data Science, Message-passing Programming, Threaded Programming
MSc in High Performance Computing Degree Programme Table Draft:
MSc Students must complete exactly 120 taught credits including all compulsory courses (Practical Introduction to High Performance Computing, Message-passing Programming, Threaded Programming, Programming Skills, Software Development, and, Project Preparation) before progression to the Dissertation (must occur before the end of year 5 of the programme).

Students are not recommended to take more than 60 credits during a year of the programme. Students are recommended to take a maximum of 30 credits per Semester.

Year 1
Compulsory:
Practical Introduction to HPC

Group A – Choose a minimum of 0 and a maximum of 40 credits from:
Students are recommended to take any additional credits in Year 1 from Group A1
Group A1 – Choose a minimum of 0 and a maximum of 40 credits from:
Message-passing Programming
Threaded Programming
Programming Skills
Software Development

AND

Group A2 – Choose a Minimum of 0 and a maximum of 20 credits from:
Practical introduction to Data Science
Design and Analysis of Parallel Algorithms

By **David Henty & Ben Morse (EPCC) 14/02/2019**

Year 2
Compulsory:
Practical Introduction to HPC
Message-passing Programming
Threaded Programming
Programming Skills
Software Development
Project Preparation

Group A – Choose a minimum of 0 and a maximum of 60 credits from:
Students are recommended to prioritise taking any compulsory courses not taken during
Year 1 before undertaking any courses listed in Group A.
Group A1 – Choose a minimum of 0 and a maximum of 40 credits from:
Parallel Design Patterns
Performance Programming
Advanced Parallel Techniques
Design and Analysis of Parallel Algorithms
AND
Group A2 – Choose a Minimum of 0 and a maximum of 20 credits from:
Practical introduction to Data Science
Introductory Applied Machine Learning

Years 3, 4 and 5
Compulsory:
Practical Introduction to HPC
Message-passing Programming
Threaded Programming
Programming Skills
Software Development
Project Preparation

Group A – Choose a minimum of 10 and a maximum of 60 credits from:
Students are recommended to prioritise taking any compulsory courses not taken during
Years 1 or 2 before undertaking any courses listed in Group A.
Group A1 – Choose a minimum of 10 and a maximum of 40 credits from:
Parallel Design Patterns
Performance Programming
Advanced Parallel Techniques
Design and Analysis of Parallel Algorithms

AND

Group A2 – Choose a Minimum of 0 and a maximum of 20 credits from:
Practical introduction to Data Science
Introductory Applied Machine Learning

OR

Group B – Choose exactly 60 credits from:

By **David Henty & Ben Morse (EPCC) 14/02/2019**

Only to be undertaken by students who have fulfilled all progression requirements and had their progression to the dissertation confirmed:
Dissertation (High Performance Computing)

Year 6:
Compulsory:
Dissertation (High Performance Computing)

PGDip in High Performance Computing
Year 1
Compulsory:
Practical Introduction to HPC

Group A – Choose a minimum of 0 and a maximum of 40 credits from:
Students are recommended to take any additional credits in Year 1 from Group A1
Group A1 – Choose a minimum of 0 and a maximum of 40 credits from:
Message-passing Programming
Threaded Programming
Programming Skills
Software Development
AND
Group A2 – Choose a Minimum of 0 and a maximum of 20 credits from:
Practical introduction to Data Science
Design and Analysis of Parallel Algorithms

Year 2
Compulsory:
Practical Introduction to HPC
Message-passing Programming
Threaded Programming
Programming Skills
Software Development

Group A – Choose a minimum of 0 and a maximum of 60 credits from:
Students are recommended to prioritise taking any compulsory courses not taken during Year 1 before undertaking any courses listed in Group A.
Group A1 – Choose a minimum of 0 and a maximum of 50 credits from:
Project Preparation should only be taken by students enrolled on the PGDip who intend to or are in the process of applying to transfer to the MSc programme.
Parallel Design Patterns
Performance Programming
Advanced Parallel Techniques
Design and Analysis of Parallel Algorithms
Project Preparation

AND

Group A2 – Choose a Minimum of 0 and a maximum of 20 credits from:
Practical introduction to Data Science
Introductory Applied Machine Learning

By **David Henty & Ben Morse (EPCC) 14/02/2019**

Years 3 and 4
Compulsory:
Practical Introduction to HPC
Message-passing Programming
Threaded Programming
Programming Skills
Software Development

Group A – Choose a minimum of 10 and a maximum of 50 credits from:
Students are recommended to prioritise taking any compulsory courses not taken during Year 1 before undertaking any courses listed in Group A.
Group A1 – Choose a minimum of 10 and a maximum of 50 credits from:
Project Preparation should only be taken by students enrolled on the PGDip who intend to or are in the process of applying to transfer to the MSc programme.
Parallel Design Patterns
Performance Programming
Advanced Parallel Techniques
Design and Analysis of Parallel Algorithms
Project Preparation

AND

Group A2 – Choose a Minimum of 0 and a maximum of 20 credits from:
Practical introduction to Data Science
Introductory Applied Machine Learning
PGCert in High Performance Computing
Year 1
Compulsory:
Practical Introduction to HPC

Group A – Choose a minimum of 0 and a maximum of 40 credits from:
Students are recommended to take any additional credits in Year 1 from Group A1
Group A1 – Choose a minimum of 0 and a maximum of 40 credits from:
Message-passing Programming
Threaded Programming

AND

Group A2 – Choose a Minimum of 0 and a maximum of 20 credits from:
Practical introduction to Data Science
Design and Analysis of Parallel Algorithms
Programming Skills
Software Development

Year 2
Compulsory:
Practical Introduction to HPC
Message-passing Programming
Threaded Programming
By **David Henty & Ben Morse (EPCC) 14/02/2019**

Group A – Choose exactly 20 credits from:
Students are recommended to prioritise taking any compulsory courses not taken during Year 1 before undertaking any courses listed in Group A.
Group A1 – Choose a minimum of 0 and a maximum of 20 credits from:
Project Preparation should only be taken by students enrolled on the PGDip who intend to or are in the process of applying to transfer to the MSc programme.
Parallel Design Patterns
Performance Programming
Advanced Parallel Techniques
Design and Analysis of Parallel Algorithms

AND

Group A2 – Choose a Minimum of 0 and a maximum of 20 credits from:
Practical introduction to Data Science
Introductory Applied Machine Learning
Programming Skills
Software Development

MSc in High Performance Computing with Data Science Degree Programme Table Draft:
MSc Students must complete exactly 120 taught credits including all compulsory courses (Practical Introduction to High Performance Computing, Practical Introduction to Data Science, Message-passing Programming, Threaded Programming, Programming Skills, Software Development, and, Project Preparation) before progression to the Dissertation (must occur before the end of year 5 of the programme).

Students are not recommended to take more than 60 credits during a year of the programme. Students are recommended to take a maximum of 30 credits per Semester.

Year 1
Compulsory:
Practical Introduction to HPC
Practical introduction to Data Science

Group A – Choose a minimum of 0 and a maximum of 20 credits from:
Students are recommended to take any additional credits in Year 1 from Group A1
Group A1 – Choose a minimum of 0 and a maximum of 20 credits from:
Students are recommended to take Programming Skills before Software Development and are advised that Message-passing Programming allows a wider variety of optional courses to be taken in year 2 than Threaded Programming
Message-passing Programming
Threaded Programming
Programming Skills
Software Development

Year 2
Compulsory:
Practical Introduction to HPC
Practical introduction to Data Science
Message-passing Programming
Threaded Programming
Programming Skills
Software Development
Project Preparation

Group A – Choose a minimum of 0 and a maximum of 60 credits from:
Students are recommended to prioritise taking any compulsory courses not taken during Year 1 before undertaking any courses listed in Group A.
Group A1 – Choose a minimum of 0 and a maximum of 40 credits from:
Parallel Design Patterns
Performance Programming
Advanced Parallel Techniques
Design and Analysis of Parallel Algorithms
AND
Group A2 – Choose a Minimum of 0 and a maximum of 20 credits from:
Introductory Applied Machine Learning
Image and Vision Computing
Advanced Vision

By **David Henty & Ben Morse (EPCC) 14/02/2019**

Years 3, 4 and 5
Compulsory:
Practical Introduction to HPC
Practical introduction to Data Science
Message-passing Programming
Threaded Programming
Programming Skills
Software Development
Project Preparation

Group A – Choose a minimum of 10 and a maximum of 60 credits from:
Students are recommended to prioritise taking any compulsory courses not taken during Years 1 or 2 before undertaking any courses listed in Group A.
Group A1 – Choose a minimum of 10 and a maximum of 40 credits from:
Parallel Design Patterns
Performance Programming
Advanced Parallel Techniques
Design and Analysis of Parallel Algorithms

AND

Group A2 – Choose a Minimum of 0 and a maximum of 20 credits from:
Introductory Applied Machine Learning
Image and Vision Computing
Advanced Vision

OR

Group B – Choose exactly 60 credits from:
Only to be undertaken by students who have fulfilled all progression requirements and had their progression to the dissertation confirmed:
Dissertation (High Performance Computing with Data Science)

Year 6:
Compulsory:
Dissertation (High Performance Computing with Data Science)

PGDip in High Performance Computing with Data Science
Year 1
Compulsory:
Practical Introduction to HPC
Practical introduction to Data Science

Group A – Choose a minimum of 0 and a maximum of 20 credits from:
Students are recommended to take any additional credits in Year 1 from Group A1.
Group A1 – Choose a minimum of 0 and a maximum of 20 credits from:
Message-passing Programming
Threaded Programming
Programming Skills
Software Development

By **David Henty & Ben Morse (EPCC) 14/02/2019**

Year 2
Compulsory:
Practical Introduction to HPC
Practical introduction to Data Science
Message-passing Programming
Threaded Programming
Programming Skills
Software Development

Group A – Choose a minimum of 0 and a maximum of 40 credits from:
Students are recommended to prioritise taking any compulsory courses not taken during Year 1 before undertaking any courses listed in Group A.
Group A1 – Choose a minimum of 0 and a maximum of 40 credits from:
Project Preparation should only be taken by students enrolled on the PGDip who intend to or are in the process of applying to transfer to the MSc programme.
Parallel Design Patterns
Performance Programming
Advanced Parallel Techniques
Design and Analysis of Parallel Algorithms
Project Preparation

AND

Group A2 – Choose a Minimum of 0 and a maximum of 20 credits from:
Introductory Applied Machine Learning
Image and Vision Computing
Advanced Vision

Years 3 and 4
Compulsory:
Practical Introduction to HPC
Practical introduction to Data Science
Message-passing Programming
Threaded Programming
Programming Skills
Software Development

Group A – Choose a minimum of 10 and a maximum of 40 credits from:
Students are recommended to prioritise taking any compulsory courses not taken during Year 1 before undertaking any courses listed in Group A.
Group A1 – Choose a minimum of 10 and a maximum of 40 credits from:
Project Preparation should only be taken by students enrolled on the PGDip who intend to or are in the process of applying to transfer to the MSc programme.
Parallel Design Patterns
Performance Programming
Advanced Parallel Techniques
Design and Analysis of Parallel Algorithms
Project Preparation

By **David Henty & Ben Morse (EPCC) 14/02/2019**

AND

Group A2 – Choose a Minimum of 0 and a maximum of 20 credits from:
Introductory Applied Machine Learning
Image and Vision Computing
Advanced Vision

PGCert in High Performance Computing with Data Science
Year 1
Compulsory:
Practical Introduction to HPC
Practical introduction to Data Science

Group A – Choose a minimum of 0 and a maximum of 20 credits from:
Students are recommended to take any additional credits in Year 1 from Group A1
Group A1 – Choose a minimum of 0 and a maximum of 20 credits from:
Message-passing Programming
Threaded Programming

Year 2
Compulsory:
Practical Introduction to HPC
Practical introduction to Data Science
Message-passing Programming
Threaded Programming

Possible routes through the taught component of degrees:
This DPT has been designed with a clear balance in mind between the needs of a student's journey through the taught curriculum over as little as two and as many as five (or more, by concession) years with most MSc/PGDip students expected to complete the taught component over three years. Students will generally be advised to take a maximum of 30 credits per Semester, although in individual cases 40 credits in one Semester of a year may be permissible (e.g. due to work commitments).

The models below illustrate how this would be possible over two and three years assuming even credit load (which cannot always be assumed for a part-time intermittent student), however the design of the DPT means that students with limited time in their first year (or first Semester of first year) will still have options available to them.

MSc in HPC:
Completing taught component in 2 years:

Year 1		Year 2	
Semester 1	Semester 2	Semester 1	Semester 2
Compulsory: Practical introduction to HPC		Optional: Practical Introduction to Data Science or 20 credits of outside courses	
Compulsory: Software Development	Compulsory: Threaded Programming	Optional: Parallel Design Patterns	Compulsory: Project Prep
Compulsory: Programming Skills	Compulsory: Message-passing Programming	Optional: Performance Programming	Optional: Advanced Parallel Techniques or Design and Analysis of Parallel Algorithms

Completing Taught Component in 3 years:

Year 1		Year 2		Year 3	
Semester 1	Semester 2	Semester 1	Semester 2	Semester 1	Semester 2
Compulsory: Practical introduction to HPC		Optional: Practical Introduction to Data Science		Optional: Parallel Design Patterns	Compulsory: Project Prep
Compulsory: Programming Skills	Compulsory: Message-passing Programming	Compulsory: Software Development	Compulsory: Threaded Programming	Optional: Performance Programming	Optional: Advanced Parallel Techniques

By **David Henty & Ben Morse (EPCC) 14/02/2019**

MSc in HPC with Data Science

Completing taught component in 2 years:

Year 1		Year 2	
Semester 1	Semester 2	Semester 1	Semester 2
Compulsory: Practical Introducton to Data Science		Compulsory: Software Development	Compulsory: Threaded Programming
Compulsory: Practical Introduction to HPC		20 credits of options:	Compulsory: Project Prep
Compulsory: Programming Skills	Compulsory: Message-passing Programming	Performance Programming and/or Performance Programming and/or Image and Vision Computing or Introductory Applied Machine Learning	Optional: Design and Analysis of Parallel Algorithms or Advanced Vision

Completing Taught Component in 3 years:

Year 1		Year 2		Year 3	
Semester 1	Semester 2	Semester 1	Semester 2	Semester 1	Semester 2
Compulsory: Practical Introducton to Data Science		Compulsory: Software Development	Compulsory: Threaded Programming	20 credits of options: Performance Programming and/or Performance Programming and/or Image and Vision Computing or Introductory Applied Machine Learning	Compulsory: Project Prep
Compulsory: Practical introduction to HPC		Compulsory: Programming Skills	Compulsory: Message-passing Programming		Optional: Advanced Parallel Techniques or Design and Analysis of Parallel Algorithms or Advanced Vision