Programme Specification ARO 034a

This specification provides a concise summary of the main features of the programme and of the learning outcomes that a typical student might reasonably be expected to achieve if they take full advantage of the learning opportunities provided.

This document is published on the University website and will be a publicly available record of the named programme.

The information contained in this form should be included in the Programme Handbook, either as presented below or in a format determined by the Faculty.

Section 1 Key Facts

<table>
<thead>
<tr>
<th>Awarding Body</th>
<th>University of Stirling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partner Institution</td>
<td></td>
</tr>
<tr>
<td>Programme Name</td>
<td>Professional Doctorate Big Data Science</td>
</tr>
<tr>
<td>Award</td>
<td>PhD</td>
</tr>
<tr>
<td>Faculty</td>
<td>Natural Sciences</td>
</tr>
<tr>
<td>Division (if applicable)</td>
<td>Computing Science and Mathematics</td>
</tr>
<tr>
<td>UCAS Code (UG only)</td>
<td></td>
</tr>
<tr>
<td>Programme Code</td>
<td>DXX70-BIG</td>
</tr>
<tr>
<td>Mode of Study</td>
<td>Full Time ☒ Part Time ☒ (if both please provide two Degree Programme Tables in the Outline Programme Structure)</td>
</tr>
<tr>
<td>Location/Method of Study</td>
<td>On Campus – UK ☒ International ☐ Where: Online ☐ Blended ☒</td>
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<tr>
<td>Admission Points</td>
<td>September ☒ January ☐ Other 2nd year entry</td>
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<tr>
<td>(if more than one entry point please provide a Degree Programme Table for each in the Outline Programme Structure)</td>
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<tr>
<td>Length of Programme</td>
<td>36 months (ft) 72 months (pt)</td>
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<tr>
<td>SCQF Level</td>
<td>12</td>
</tr>
<tr>
<td>Total Credit Value</td>
<td>540 (120 at level 11, 420 at level 12)</td>
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<tr>
<td>ECTS Credit Value</td>
<td>270</td>
</tr>
<tr>
<td>Relevant QAA Subject Benchmark</td>
<td>Masters in Computing (year 1)</td>
</tr>
<tr>
<td>Professional Body Accreditation (all relevant accreditations to be listed)</td>
<td>Name of accrediting body: N/A Required for programme: No</td>
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Section 2 Overview

PROGRAMME SUMMARY

A comprehensive summary of the programme.

Big Data skills are in high demand and they attract high salaries. Our Professional Doctorate in Big Data is the first industrial doctorate of its kind, and is supported by The Data Lab.

The programme builds on Stirling’s highly successful taught MSc Big Data to equip you with a range of cutting-edge, interdisciplinary research and practical skills and tools, that will lead to an industry job in Big Data Science or data analytics. There is a taught component (the MSc modules) and a research component (research project and thesis).

In addition to enhancing students’ employability through work-based learning, the professional doctorate prepares you to undertake interdisciplinary Big Data research, jointly supervised by world-leading Stirling academics and Big Data industry experts.

Key Features of the Programme (including what makes it distinctive)

The first year of the programme follows the taught syllabus of the highly successful Big Data MSc. The course covers Big Data technology, advanced analytics and industrial and scientific applications. The syllabus includes:

- Mathematics and Statistics for Big Data
- Python scripting
- Business and scientific applications of Big Data
- Big databases and NoSQL including MongoDB, Cassandra and Neo4J
- Analytics, machine learning and data visualisation using Weka, R and ScikitLearn
- Cluster computing with Hadoop, Spark, Hive and MapReduce
- Student projects including possible paid internships

The course is also proudly part of the DataLab MSc, which supports our students with funding, networking and routes into employment.

At the end of the taught part of the programme you will have developed a thesis plan for your 2 years of interdisciplinary research. This period of independent study, guided by a supervisor, concludes with submission of a thesis and an oral viva.

PROGRAMME AIMS

Overarching Programme Aims

On successful completion of this programme, you will be able to:

1. Employ the required multi-disciplinary skills, and underlying theoretical, practical and transferable knowledge, in undertaking professional practitioner-oriented, impact-led research in Big Data Science.
2. Demonstrate relevant practical, investigative, analytical and generic skills required for research in the area of Big Data Science.

3. Show how you have tackled a wide range of Big Data challenges and applications across a wide range of areas, such as Business, Healthcare and Scientific disciplines.

4. Demonstrate independent learning ability to plan, undertake and prepare publication quality research.

**WHAT WILL I BE EXPECTED TO ACHIEVE?**

*Detailed Learning Outcomes*

On successful completion of this programme, you will be able to:

Knowledge and Understanding:
1. Demonstrate in depth knowledge and understanding of Big Data theory based on data manipulation and representation, mathematical and statistical analysis, machine learning and data mining techniques.
2. Apply this knowledge to real world problems, and create new solutions in response to those problems.
3. Show awareness of the emergence and role of next generation technologies in data science and contextualise your solutions to real world problems.
4. Show awareness of career and funding opportunities in data science.

Intellectual, Practical and Transferable Skills and other graduate attributes:

Critical reasoning and its application to the design and review of research
1. Critically analyse and synthesise information from a variety of sources
2. Understand the research pathway from initial concept to final output.
3. Plan, execute and report an original research project in the field of data science
4. Devise research projects for both teams and individuals to different specifications and budgets
5. Derive useful information from large data sets using a range of appropriate data science methodologies and software tools
7. Report the results of investigations with appropriate referencing of sources of information
8. Synthesise findings and present results to an audience.

Generic skills (e.g. information skills, communication skills, critical, analytical and problem solving abilities) and other attributes
1. Prepare communications (manuscript and poster and verbal)
2. Work in a team including task analysis and allocation
3. Use internet, bibliographic databases and other electronic information sources
4. Liaise with individuals, public and private bodies to elicit background information for research

Values and Attitudes:
1. Demonstrate knowledge of research ethics and the development of safe and robust working practices in project planning and reporting
2. Work with large data sets in accordance with privacy and security needs
3. Liaise with, and understand the needs of, end-users/stakeholders, for example to gather data from individuals, organisations and databases
HOW WILL I LEARN?
Outline of the teaching methods and approach to be used on the programme.

The programme has two parts:

Taught component (year 1, 180 credits)

Applied Research (years 2 and 3, 360 credits)

In the taught component (MSc with a research-oriented dissertation):

- Students will undertake a number of taught modules to equip them with the skills required for Big Data Science research. These modules are taught through lectures, practicals and small group work and are assessed through a variety of course work and exams. This is the existing MSc in Big Data. The taught modules are exactly the same as for the MSc in Big Data.

- To prepare for the professional doctorate, an independent research project (60 credits at SCQF level 12) will include a systematic review of an appropriately challenging applied research topic/area, and development of a full Doctorate research proposal as outputs – assessed through an oral viva exam and research poster presentation. This is the point at which the professional doctorate programme diverges from the MSc Big Data. Note: you will be able to graduate with the MSc Big Data following this project (assuming you have obtained sufficient credits in the taught modules) if you decide not to continue with the professional doctorate.

Following this taught component the student will undertake a period of research (360 level 12 credits) by working with experienced academic and industrial supervisors on original piece(s) of applied research. This could either be a single long project or a portfolio of data-centric projects, depending on the industrial organization’s strategic priority needs. Outcomes will be presented in a doctoral dissertation assessed through a viva by internal and external examiners.

WHAT TYPES OF ASSESSMENT AND FEEDBACK CAN I EXPECT?
Outline of the assessment methods and approach to be used on the programme.

Assessment and Assessment Criteria
In the taught component (MSc with a research-oriented dissertation) you will be assessed through a variety of course work and exams. The applied research project (years two and three) will be assessed through a dissertation, oral viva exam and research poster presentation.

Your doctoral research work will be assessed by a viva by internal and external examiners, following submission of a written thesis.

Feedback on Assessment
In the taught part of the programme you will receive feedback on coursework within 3 weeks of completion of the assessment. Feedback is usually provided electronically on formal coursework. Feedback and Guidance sessions with teaching staff are available on all modules. These provide regular opportunities to discuss feedback further. More information about feedback on assessment can be found here; http://www.stir.ac.uk/academicpolicy/handbook/assessment/

In the research part of the programme you will receive regular feedback through supervisory meetings.

Assessment Regulations
If you would like to know more about the way in which assessment works at the University of Stirling, please see the full version of the assessment regulations at:
Postgraduate – Taught (year one)
Postgraduate - Research (years two and three)
WHAT WILL I STUDY?

Outline Programme Structure

The list below shows compulsory and option modules for this programme. Option modules are revised over time and, in some cases, will be dependent upon pre-requisite and/or co-requisites being taken. More information about these requirements can be found in the relevant Module Descriptors. The options available each year can be subject to change due to student demand and availability of teaching staff.

- Where an “Option list” is specified, you have a choice of which module to take at this point in the degree programme and these choices are listed below.

Year 1

Total year 1 credit value = 180
Compulsory credits = 120
Option credits = 60

Compulsory Modules

<table>
<thead>
<tr>
<th>Module Title</th>
<th>Module Code</th>
<th>Credit</th>
<th>Semester</th>
<th>SCQF Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical Foundations</td>
<td>ITNPBD1</td>
<td>10</td>
<td>Autumn</td>
<td>11</td>
</tr>
<tr>
<td>Statistics for Data Science</td>
<td>MATPMD1</td>
<td>10</td>
<td>Autumn</td>
<td>11</td>
</tr>
<tr>
<td>Representing and Manipulating Data</td>
<td>ITNPBD2</td>
<td>20</td>
<td>Autumn</td>
<td>11</td>
</tr>
<tr>
<td>Commercial and Scientific applications</td>
<td>ITNPBD4</td>
<td>20</td>
<td>Autumn</td>
<td>11</td>
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<tr>
<td>Relational and non-relational databases</td>
<td>ITNPBD3</td>
<td>20</td>
<td>Spring</td>
<td>11</td>
</tr>
<tr>
<td>Data Analytics</td>
<td>ITNPBD6</td>
<td>20</td>
<td>Spring</td>
<td>11</td>
</tr>
<tr>
<td>Cluster Computing</td>
<td>ITNPBD7</td>
<td>20</td>
<td>Spring</td>
<td>11</td>
</tr>
<tr>
<td>Research Dissertation project</td>
<td>ITNPMR9</td>
<td>60</td>
<td>Summer</td>
<td>12</td>
</tr>
</tbody>
</table>

Note: if you decide the professional doctorate is not for you, you may choose instead to take the MSc dissertation project. Either project module (ITNPMR9 or ITNPBD5) will permit you to graduate with the MSc Big Data (assuming you have met the regulations on credits).

<table>
<thead>
<tr>
<th>Module Title</th>
<th>Module Code</th>
<th>Credit</th>
<th>Semester</th>
<th>SCQF Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation project</td>
<td>ITNPBD5</td>
<td>60</td>
<td>Summer</td>
<td>11</td>
</tr>
</tbody>
</table>

Year 2

Total year 2 credit value = 180
Compulsory credits = 180
Optional credits = 0

There are no modules in this part of the programme. You are expected to undertake independent research study, embedded in a professional setting. Progress each year will be assessed by a formal review: usually a short written report and an oral viva.

Year 3

Total year 3 credit value = 180
Compulsory credits = 180
Optional credits = 0

There are no modules in this part of the programme. You are expected to undertake independent research study, embedded in a professional setting. You are expected to submit your thesis at the end of this year, to be assessed by oral viva.

**Part Time**

You may study the taught part of the programme part time over two years. There are no pre-requisites, so you may choose any modules each semester subject to the following constraints: you must study a minimum of 30 and a maximum of 40 credits per semester (Spring and Autumn). By the end of the second year you must have completed 60 credits in Autumn modules and 60 credits in Spring modules. The dissertation project must be completed over one summer period, in the summer of year two.

The doctoral work may also be completed part time.

**READING LIST**

Required and Recommended Reading for the Programme
The reading lists will be given online per module.
How to get a PhD, Estelle Phillips.
International journals in Big Data will provide a broad view of research in your field. See e.g. Big Data Analytics, International Journal of Data Science and Analytics, Journal of Big Data.

**Section 3 Student Support**

**SUPPORT FOR STUDENT LEARNING**

**Induction**

There is an induction lecture on the first day of Autumn semester, which is recorded for those who miss it. Students are also provided with a detailed student handbook that covers everything they need to know about the procedures and regulations of taking a degree at Stirling. Each student is assigned a personal tutor who is available throughout their studies to offer help, support and advice. For the research part of the programme, you will follow the research student handbook, and your supervisor will act as your personal tutor. The director for Research Students is also available for more general help, support and advice. PG Tips is a group for research students, run by research students. You must attend their meetings and you will find them a great source of information about research study from the student point of view.

**Study Skills Support**

Student Learning Services (SLS) are committed to providing comprehensive guidance on all aspects of effective and efficient learning. The ultimate aim of the service is to enable you to make the most of your academic studies at the University and for you to become an independent, successful learner during your time at the University of Stirling. This is facilitated through collaborative work with experienced tutors and by offering a variety of courses, workshops and tutorials.

All students, whatever stage of their academic studies, are welcome to use Student Learning Services. However the service may be particularly beneficial:

- In your first two years of study.
- If you are making the transition from college to Higher Education.
- If you have been out of education for some time.
What SLS are able to do:

- Advise you on academic skills relevant to your studies at University.
- Help you consolidate your previous learning and develop new learning strategies.
- Advise on action-plans to potentially improve grades.
- Suggest practical solutions if you feel overwhelmed by assignment work.
- Help you gain confidence in the transition to Higher Education.

More information can be found here: http://www.stir.ac.uk/campus-life/learning-support/student-learning-services/

STEER
STEER is a University-wide peer support scheme linking in returning student "Captains" with new undergraduate or taught post-graduate "Crew" during their first year at Stirling.

The scheme aims to help you make the most of your time at the University, help new students - the Crew - settle in and realise the opportunities available to them. You can find out more information here: https://www.stirlingstudentsunion.com/representation/studentsupport/steer/

Stirling Graduate School
For Research Postgraduate Students the Stirling Graduate School as well as your own faculty will provide support. More information can be found here: http://www.stir.ac.uk/graduateschool/current-pg-students/skills-development/

Academic and Pastoral Support
Advisor of Studies: Advisers have an important role to play in enhancing your academic and personal development and are essential to ensuring you make the most of your time at university. Advisers provide a personalised point of contact for you to discuss academic concerns or queries within the academic community. The general purpose of the role is to provide more in-depth advice on the academic options available to you and on the academic policies and regulations within the University. More information can be found here: http://www.stir.ac.uk/registry/advisers/

Personal Tutor: The role of a personal tutor is to help you feel part of the University community. They are a specific and consistent source of guidance, information and support for you throughout your studies. The tutor should be the your first formal point of contact for general academic guidance and pastoral support. More information can be found here: http://www.stir.ac.uk/tse/personal-tutor/

Support and Wellbeing: At university you may face non-academic issues where you need some expert help or guidance. There are lots of ways we can help you in your day-to-day life at University. Student Support Services provide a range of high-quality services to assist you during the course of your studies, help prepare you for life after graduation. We aim to enhance the student experience and help you to get the most out of your time at University. More information can be found here: http://www.stir.ac.uk/campus-life/support-and-wellbeing/

Student Union: you can also access support through the Students’ Union, more information can be found here: https://www.stirlingstudentsunion.com/representation/studentsupport/

Accessibility and Inclusion (A&I)
A&I are committed to offering a service which is welcoming and supportive of the needs of all students. Our service takes into account the full range of needs you may have, in a wide variety of circumstances including - physical and mobility difficulties, sensory impairments, specific learning difficulties including dyslexia and autistic spectrum disorder as well as medical conditions and mental health difficulties. A&I can also support you if you have short-term, temporary impairments or other difficulties as a result of an accident, injury, illness or surgery. More information can be found here: http://www.stir.ac.uk/student-support/accessibility-&-inclusion-service/
Learning Resources
You can find out more about the resources available to support your learning here:
http://www.stir.ac.uk/campus-life/learning-support/

Section 4 Programme Evaluation and Enhancement

**METHODS FOR EVALUATING AND IMPROVING THE QUALITY AND STANDARDS OF TEACHING AND LEARNING**

**Module Evaluation**
Module evaluations are carried out each year and are an important way of getting student feedback on the modules we teach. We aim to evaluate every module we teach in every semester. You can find out more here: http://www.stir.ac.uk/registry/studentinformation/moduleevaluation/

**Programme Review**
Programmes are reviewed annually and on a 5 yearly cycle. You can get involved in a variety of different ways; by completing module evaluations, becoming a programme representative and attending Student Staff Feedback Committees, or participating in the review process itself. You can find out more here: http://www.stir.ac.uk/academicpolicy/handbook/review-and-monitoring/

**External Examiner(s)**
Name of External Examiner: Dr Dharini Balasubramanian, University of St Andrews, is the external examiner for the taught part of the programme. Your thesis will be examined by an individually-appointed external examiner specifically chosen for you based on the content of your thesis.

Section 5 My Future

**WHAT KIND OF CAREER MIGHT I GO ON TO?**
*What career avenues does this qualification open up to the student?*
A professional doctorate in Big Data Science opens up a career as a data scientist across many different application areas, such as health, in finance, in marketing, and in sport.

How does this programme facilitate your development of the Graduate Attributes? The programme will:

**Connected**
- connect you with data science knowledge, understanding and skills as applied to complex real-world problems.
- connect you with private, public and third sector representatives via external teaching contributions, placement opportunities and employer-engagement events.
- enable you to work with staff, students and external organisations, including the Data Lab, as part of an inclusive learning community.
- teach you to communicate effectively through a range of digital and other media. You will be expected to write up your research for presentation at international conferences and in journals, connecting you with the international data science community.

**Innovative**
- encourage you to innovate through participation in active and ethical, world-leading research into data science, solving problems in industrial or third sector settings.
- train you in independent critical and reflective thinking around data science issues.
teach you to identify opportunities for improvement in your own learning and to take action.

Transformative
- transform your intellectual passion and excellence with regards to data science issues and solutions.
- help you share new perspectives and broaden your horizons via in-class discussions and work with your research supervisor and the Data Science research group.
- provide training in professionalism, allowing you to develop as an adaptable and resilient data scientist, equipped to succeed in the global data science jobs market.

WHAT STUDY ABROAD OPPORTUNITIES ARE AVAILABLE?
There are no formal study abroad opportunities.

WHAT PLACEMENT OPPORTUNITIES ARE AVAILABLE?
The three month summer dissertation project may be carried out as a placement with a company. The division of Computing Science and Mathematics have had a good level of success placing students in placements in the current MSc Big Data programme and we expect this to continue. Many of the contacts come via the Data Lab; however professional doctorate applicants are likely to already be professionally employed and will continue to work with their employer during their research work.

WHAT FURTHER STUDY OPTIONS ARE AVAILABLE TO ME?
What programmes of study could the student go on to after successfully completing this one?
Data science is a continuously developing landscape with new software and algorithms being developed all of the time. Therefore there will be plenty of opportunity to continue to develop skills and continue to train once the doctorate is complete.

WHAT OTHER INFORMATION DO I NEED TO KNOW?
If you have any questions, contact the programme director. They will be able to answer your questions and to direct you to specific preparatory reading for the course, based on your previous experience.

Section 6 Admissions

HOW DO I ENTER THE PROGRAMME?
Admissions Criteria
Students applying may have a variety of backgrounds including:
- numerate and computational degrees (Computing, Mathematics, Physics, Engineering)
- medical/clinical, business, marketing or economics background, plus some relevant work (industrial or commercial) experience

Students may also come from other Science or Engineering backgrounds, to gain applied research and analytical skills that are in high demand in the Scottish job market.

Students with suitable research-oriented Masters degrees in numerate and computational disciplines (Computing, Mathematics, Physics, Engineering), will be considered for direct entry to the second year of the Doctoral Training Component, on a case by case basis.