Programme Specification

Masters by Research (MRes) in Big Data Biology 2020-21

This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities that are provided.

Awarding Institution	University of Southampton (UoS)
Teaching Institution	University of Southampton
Accreditation details	NA
Final award	Master of Research (MRes) (Masters of Science by Research)
Name of award	Big Data Biology
Interim Exit awards	Postgraduate Diploma Postgraduate Certificate
FHEQ level of final award	Level 7
QAA Subject Benchmark or other external reference	QAA: Master's degree characteristics (2015) QAA Framework for Higher Education Qualifications (FHEQ) of UK Degree Awarding Bodies
Programme Coordinators	Dr Rob Ewing and Dr Paul Skipp
Date specification was written	17/10/2019

Programme Overview

Biological sciences is entering an era in which new technologies that allow the large-scale measurement of biological processes are being coupled to quantitative and computational approaches to model biological systems. Understanding how whole biological systems work or how they respond to their environment is the goal of research in this area, and this is impacting both fundamental biological research and areas such as healthcare and drug development. At the same time, advances in data science, artificial intelligence and the growth and rate of accumulation of large-scale "big data" are enabling new data-driven approaches to biomedical and biological sciences.

The marriage of computational and quantitative thinking in the context of biological integration is a foundational principle of this programme and as a student on this programme you will interact and learn from colleagues from across the spectrum of biological science, computer science, mathematics and engineering. The programme is designed for graduates of biological science programmes who are seeking to develop skills in quantitative and computational biology as well as graduates of quantitative or computational disciplines who wish to develop and apply their quantitative skills in the area of large-scale biology. Recognizing that many of the advances in the life sciences are now coming from interdisciplinary teams of scientists, students on this programme will interact and learn from colleagues from across the spectrum of the life sciences, including experimental biologists, computer scientists, mathematicians and engineers.

Learning and teaching

Several teaching methods will be used to develop your skills and knowledge:

- You will attend skills-based workshops at the start of the programme focusing on understanding large-scale molecular techniques and computational approaches in biology
- You will attend a programme of seminars by world-renowned researchers that will broaden your knowledge and understanding of biological sciences
- You will undertake an extended research project in conjunction with a supervisory team with leading and cutting-edge research experience in that area
- You will also be a member of a research project team comprised of students and academic staff that will that will enable you develop the necessary skills to work in a team science environment. This will allow you to develop the key skills in modern biology of working across disciplines and of communicating and discussing your work with colleagues
- Throughout the programme you will undertake independent reading both to supplement and consolidate taught material and to broaden your knowledge and understanding

Assessment

The programme will be assessed though course-work assignments based on skills learned in workshops, scientific comprehension of seminars and through the research project. The research component will be assessed on the practical outcomes of the project work and the ability to communicate these and background understanding in a scientific dissertation, oral presentation and poster presentation. The final dissertation will be assessed independently by a University of Southampton academic in addition to the supervisors.

Educational Aims of the Programme

The Masters by Research in Big Data Biology is highly research-focussed with the goal of preparing students to enter full-time research as a career or through a higher-degree. Reflecting the interdisciplinary nature of the programme, you will interact, learn from, and work alongside academic staff from multiple faculties at the University of Southampton. The programme is based in the School of Biological Sciences but draws on the expertise and research of faculty members from Medicine, Electronics and Computer Science and Mathematics, By the end of your programme you will have significantly extended your subject-specific and employability skills beyond the level of your undergraduate degree. A Master of Research programme differs from a conventional MSc programme in the balance between teaching and research. As an MRes student you will spend more time on the research project and correspondingly less time will be devoted to formal teaching.

The aims of the programme are to:

- Provide the means to carry out an extensive scientific research project utilising the concepts, tools and techniques of big data biology
- Provide advanced, and in-depth knowledge in a specific area of research
- Provide an opportunity to work in a research environment with state of the art laboratories and computational resources
- Provide a stimulating, informed environment through a range of modules;
- Provide an opportunity to develop a range of highly transferable skills (written and oral communication, time management, project management, team working, information and communication technology, data collection and analysis);
- To develop skills and aptitudes for working in interdisciplinary teams of scientists
- Provide a sound and suitable qualification that would enable you to proceed to a more specialist higher degree at the PhD level or a career in areas such as biological/biomedical sciences, bioinformatics or data science

Programme Learning Outcomes

Knowledge and Understanding

Having successfully completed this programme you will be able to demonstrate:

1. Knowledge and understanding of the scientific and technological principles underlying the chosen research specialisation;
2. An understanding of how to design and test scientific hypotheses;
3. An ability to address and develop strategies to resolve a research problem in the chosen specialist area;
4. Skills in critical evaluation of primary and review scientific literature and the ability to develop this knowledge and understanding in relation to the chosen area of research;
5. Experience in presenting scientific information;
6. An ability to collect, record and critically evaluate large-scale biological data;
7. Knowledge of general IT methodology relating to the area to find relevant information.

Teaching and Learning Methods

Learning and teaching methods will include:

- Independent (supported) project work on a research problem that could lead to results publishable in the peer reviewed literature;
- Regular meetings about research work with the supervisory team, with the lead academic as the key provider of guidance;
- Staff-led lectures, tutorials, seminars and demonstrations;
- Directed reading of the primary scientific literature;
- Student-led seminars and presentations (verbal and poster) and contributions to regular research group meetings;

For the research-based component you will carry out an extensive project on a topic related to the specialised area. You will plan the project with the support of your academic research supervisor. Initially you will carry out a preliminary review of the literature in the area of research to help you plan the overall objectives and build on the current level of knowledge in the area of research. This will give you the opportunity of producing results that would be of a standard to publish in peer reviewed journals. You will present an overview containing these elements at an early stage to your project supervisor and then have regular contact throughout the remainder of the project. This will include providing a regular summary of research finding to the supervisor. A detailed plan of the final dissertation will be presented to the supervisor three quarters of the way through the project, and feedback will be provided by the supervisor in how to structure the final dissertation.

Assessment methods

<u>Taught component</u>

The taught component will primarily be assessed through coursework assignments such as data analysis projects, writing critiques of scientific papers and summaries of seminars and discussions of methodology. According to which of the optional modules is selected, assessment may also be through computer exams or written exam. All skills-centred learning is taken at FHEQ Level 7.

<u>Research component</u>

The research component will be assessed on the basis of the practical outcomes of the project work, ability to communicate these and also the understanding of background literature, all of which is judged through the production of a scientific dissertation. This will be assessed independently by an internal examiner within the University of Southampton in addition to the supervisor.

Subject Specific Intellectual and Research Skills

Having successfully completed this programme you will be able to:

1. Apply (and potentially develop) advanced computational techniques to analyse large-scale biological data and determine their importance and validity;
2. Develop research strategies for solving problems in the chosen research area;
3. Formulate and test hypotheses by planning, conducting and reporting a significant programme of biological sciences research;
4. Find, read, understand and explain scientific publications related to the chosen area of research;
5. Undertake scientific investigations in a responsible and safe manner, paying due attention to risk assessment and relevant health and safety regulations;
6. Have the potential to play a strong part as a researcher in a team in biological sciences-based industry;
7. Be able to progress to a higher degree in the relevant area.

Teaching and Learning Methods

Learning and teaching methods will include:

- Staff-led lectures, tutorials, seminars and demonstrations;
- Directed reading of the primary scientific literature;
- Student-led seminars and presentations (verbal and poster) and attendance at regular research group meetings;
- Independent (supported) project work in the research environment on a research problem that could realistically lead to results publishable in the peer reviewed literature;
- Regular meetings about research work with the supervisory team, with the lead academic as the key provider of guidance;
- Engagement with written assignments and other activities associated with the coursework component of the taught modules;
- Regular meetings about research work with the supervisory team, with the lead academic as the key provider of guidance.

Assessment methods

The taught component will be assessed by a combination of coursework and examinations at the end of each semester.
The research component will be assessed on the practical outcomes of the project work and the ability to communicate these and background understanding in a scientific dissertation. See above for more detail on these.

Transferable and Generic Skills

The transferable skills you will develop during your degree are those that will improve your employability and will be of use to you in your future career.

1. Good communication skills with some experience in giving scientific presentations;
2. High proficiency in general data science skills including data processing, analysis, integration, visualization
3. The compilation of knowledge and understanding through critical reading of material: learn independently through critical reading;
4. The application of such knowledge and understanding to problems in biological research;
5. Communication of specialist technical information in written form;

6. The ability to work with, and within, a group towards defined outcomes: the ability to balance the need for independent research with the importance of making effective contributions to the work of the scientific team;
7. The ability to develop and apply technical skills in the independent resolution of theoretical problems;
8. The ability to identify and work towards targets for personal, academic and career development;
9. Management of resources and time;
10. Awareness of good laboratory practice and safety issues in a modern research laboratory.

Teaching and Learning Methods

You will be helped to acquire these skills through aspects of the formal teaching programme and while carrying out your research project and includes the following

- Staff-led lectures, tutorials, seminars and demonstrations;
- Directed reading of the primary scientific literature, technical reports, websites;
- Student-led seminars and presentations (verbal and poster) and attendance at regular research group meetings;
- Regular meetings with supervisory team and appropriate technical team.

Assessment methods

This will be assessed by:

- The production of a dissertation at the end of the study and an oral presentation during the course of the project;
- The completion of coursework tasks as part of the taught component or exams (depending on module choice)
- The ability to produce appropriate risk assessments for all aspects of the practical work and completion of the appropriate safety inductions.

Programme Structure

The programme is 12 months in duration and the research component features throughout this period while the taught part of the programme is primarily confined to the first semester (Oct to Jan). The programme requires an accumulation of 90 ECTS* composed of a research project leading to a dissertation (60ECTS) and a taught component (30 ECTS).

* ECTS = European Credit Transfer System

A taught module on this programme is worth 7.5 ECTS credits which equates to 150 hours of study. For example a 7.5 ECTS credits module would normally comprise up to 25 hours contact teaching (workshops, seminars, lectures, tutorials, etc.) with the remainder of the time for your own independent study. Four of these modules will be taken in total.

The taught component involving the modules will be confined to the two teaching semesters mentioned above. The optional modules chosen by the student (with guidance from academic supervisor) will be selected as most relevant to the research project being undertaken. For students from computational and quantitative disciplines with more limited knowledge of the biological sciences, the academic supervisor may recommend them to take a module from the BIOL* selection (see examples above).

In addition to the modules listed above, students will have the opportunity to participate in Data Carpentry workshops that are run by the Research Software Group at the University of Southampton

(https://rsgsoton.net/training/). These workshops in R and Python Programming and Relational Databases and SQL are offered at different levels and will therefore be appropriate for those students entering with good computer science and quantitative skills or those who need to develop those skills.

Choice of modules will be guided by discussion with the Programme leaders and the student's supervisors. It is anticipated that students will join this programme from two broad areas of undergraduate study: biological or life sciences and quantitative/computational disciplines. Students with quantitative backgrounds but no or limited biological science background will be provided with remedial training in the Biological Sciences. Basic principles (e.g. molecules of life, information flow in biological systems and biochemical processes) will be offered through existing BIOL* modules. All BIOL* content is available via Panopto, and the student's supervisor will guide the student to the most appropriate resources and follow up with them in one-on-one tutorials.

Where specific types of data are to be used in the research project, students will be guided to modules that explain how the experiments are performed and the data is acquired. For example, the module BIOL6074 Bioinformatics and Systems Biology includes in-depth sessions on the major types of 'omics data' that the students may encounter as well as sessions on omics data interpretation and analysis as well as key resources.

The practical phase of the research project will be completed from October until July/August of the following year. During this period there will be preparation of the dissertation with the majority of August and September involving a concentrated period of dissertation preparation. You will also be encouraged to attend research seminars, which in the School of Biological Sciences are run at a variety of different levels. In particular, you will be encouraged to attend key seminars from leading visiting scientists. You will also be able to be part of the School of Biological Sciences' weekly journal clubs, which includes presentations from PhD students and academic staff, and discussions on new or seminal research.

Each student will work on an independent research project guided by his or her supervisor. However, a goal of this programme is to prepare students for the team science environment: interdisciplinary teams of scientists focused on addressing specific biological or biomedical problems. Each student will therefore be part of a supervisory team comprised of at least 2 students and their supervisors. This will promote Team Science working, and where possible students will be grouped together who have different undergraduate backgrounds. For example, a project team might consist of a biological science student and a computational science student who would work on different aspects of the same larger problem. Exchange of ideas, peer-to-peer learning and collaboration with others will be strongly encouraged in these project teams.

Module	Module Code	Credits	Type	Level
Current Research 2020-21	BIOL6053	15	Compulsory	Level 7
Advanced Research Project 2020-21	BIOL6013	60	Core	Level 7

Bioinformatics and Systems Biology 2020-21	BIOL6074	15	Optional/Core	Level 7
Quantitative Cell Biology 2020-21	MEDI6227	20	Optional/Core	Level 7

Part I Optional (Biological Sciences)

Choose 2 optional modules from these clustered groups

Module	Module Code	Credits	Type	Level
Cancer Chromosome Biology 2020-21	BIOL6071	15	Optional	Level 7
Cellular and Molecular Neuroscience 2020-21	BIOL6035	15	Optional	Level 7
Molecular Cell Biology 2020-21	BIOL6030	15	Optional	Level 7
Molecular Recognition 2020-21	BIOL6032	15	Optional	Level 7
Plant Cell Biology 2020-21	BIOL6044	15	Optional	Level 7
Systems Neuroscience 2020-21	BIOL6034	15	Optional	Level 7

Part I Optional (Computational/Quantitative)

You must consult with your supervisor and the module lead if wanting to take option modules outside of the School of Biological Sciences (dependent on availability)

Module	Module Code	Credits	Type	Level
Foundations of Machine Learning (MSc) 2020-21	COMP6245	15	Optional	Level 7
Genomic Technologies and Basic Informatics 2020-21	MEDI6237	20	Optional	Level 7
Machine Learning 2020-21	MATH6168	15	Optional	Level 7
Structure and Dynamics of Networks 2020-21	MATH6140	15	Optional	Level 7

Programme details

Details of the modules (i.e. module profiles) can be downloaded from the School of Biological Sciences website (www.southampton.ac.uk/biosci)

We will take a flexible and inclusive approach to enable those students with additional requirements to access the curriculum and achieve the intended learning outcomes of their programme. We will do this by working with you and the University's Enabling Services to assess your individual requirements.

Progression Requirements

The University regulations governing progression, determination and classification of results for standalone masters can be found in the University Calendar (Section IV – General Regulations) http://www.calendar.soton.ac.uk/sectionIV/progression-regs-standalonemasters.html

The Academic Regulations for this programme can be found at: http://www.calendar.soton.ac.uk/sectionIX/sectIX-index.html

The final award is awarded by Senate on the recommendation of the Faculty Programmes Committee to candidates who have satisfactorily completed an approved course of study and have satisfied the assessment requirements.

All processes and procedures governing teaching and research programmes in the University are described in the Quality Handbook which is available online at:

https://sharepoint.soton.ac.uk/sites/ese/quality_handbook/Handbook/Index.aspx

Intermediate exit points

You will be eligible for an interim exit award if you complete part of the programme but not all of it, as follows:

Qualification	Minimum overall credit in ECTS credits	Minimum ECTS credits required at level of award	
Postgraduate Diploma	at least 60	45	
Postgraduate Certificate	at least 30	20	

Support for student learning

There are facilities and services to support your learning some of which are accessible to students across the University and some of which will be geared more particularly to students in your particular Faculty or discipline area. The University provides or hosts a wide range of specialist academic and pastoral support services. These include the Library, Computing Services, Careers Destinations, Student Union Advice and Information Service, Student Loans Office, Hardship Fund, Accommodation Office, University Health Service, University Counselling Service, Disability and Learning Support, mature student support, day nursery, language support, and international student support. Electronic details about these services may be found on the University web site at http://www.southampton.ac.uk/postgraduate/servicesforstudents/index.shtml the majority of them are co-located in the Student Services Centre on the Highfield Campus. Academic Skills support can be obtained from http://www.academic-skills.soton.ac.uk and the student portal at http://www.sussed.soton.ac.uk (requiring your personal ID for access).

The University provides:

- A dedicated computer for use during the programme;
- library resources, including e-books, on-line journals and databases, which are comprehensive and up-to-date; together with assistance from Library staff to enable you to make the best use of these resources;
- computer accounts on the University of Southampton High-Performance Computing platforms (Lyceum, Iridis4 or Iridis5 as appropriate)
- high speed access to online electronic learning resources on the Internet from dedicated PC Workstations onsite and from your own devices (laptops, smartphones and tablet PCs) via the Eduroam wireless network. There is a wide range of application software available from the Student Public Workstations;
- computer accounts which will connect you to a number of learning technologies for example, the Blackboard virtual learning environment (which facilitates online learning and access to specific learning resources);
- standard ICT tools such as Email, secure filestore and calendars;
- access to key information through the MySouthampton Student Mobile Portal which delivers timetables, Module information, Locations, Tutor details, Library account, bus timetables etc. while you are on the move;
- IT support through a comprehensive website, telephone and online ticketed support and a dedicated helpdesk in the Student Services Centre;
- Enabling Services offering assessment and support (including specialist IT support) facilities if you have a disability, dyslexia, mental health issue or specific learning difficulties;
- the Student Services Centre (SSC) to assist you with a range of general enquiries including financial matters, accommodation, exams, graduation, student visas, ID cards;

- Career Destinations, advising on job search, applications, interviews, paid work, volunteering and internship opportunities and getting the most out of your extra-curricular activities alongside your degree programme when writing your CV;
- a range of personal support services: mentoring, counselling, residence support service, chaplaincy, health service;
- a Centre for Language Study, providing assistance in the development of English language and study skills for non-native speakers;

The Students' Union provides

- an academic student representation system, consisting of Course Representatives, Academic Presidents, Faculty Officers and the Vice-President Education; SUSU provides training and support for all these representatives, whose role is to represent students' views to the University;
- opportunities for extracurricular activities and volunteering;
- an Advice Centre offering free and confidential advice including support if you need to make an academic appeal;
- Support for student peer-to-peer groups, such as Nightline.

Associated with your programme you will be able to access support within Southampton Biological Sciences:

In Southampton Biological Sciences you will:

- receive an induction that will introduce you to all our teaching and learning resources you will interface with during your degree as well as ensuring you understand the regulations which govern your study;
- have a personal research supervisor who will advise on choice of taught modules and can provide pastoral support (this is the primary source of support for your research);
- have an allocated academic advisor who can provide an alternative and independent view on your progress. This member of staff will also be your internal examiner at the end of the research programme;
- receive individually tailored guidance from academic staff delivering the taught components of your programme. Each module has an academic coordinator who would be the first point of contact in the event of needing academic support;
- be able to obtain additional support from the senior staff involved in the programme; have a base in a research laboratory proximate to the other team members of your research group – an invaluable source of peer to peer support;
- have a personal e-mail account, web access, and IT support from the University i-Solutions team;
- have access to writing space for writing up your MRes research project;
- attend group meetings in the selected research grouping and research seminars given by visiting speakers;
- The opinions of the MRes students are heard through a number of different forums. Termly meetings are convened by the Director of the Masters programmes who ensures that teaching related issues are diverted to the Staff Student Liaison Committee and that research related issues are directed to the Graduate School;
- There are systems for the support of student learning in Biological Sciences as well as available from central University facilities. Throughout the degree, students with special learning requirements are supported and their ability to complete the degree in full is managed by making appropriate reasonable adjustments to our infrastructure and methods of delivery and assessment.

Methods for evaluating the quality of teaching and learning

You will have the opportunity to have your say on the quality of the programme in the following ways:

- Completing student evaluation questionnaires for each module of the programme (relevant to the taught part of the MRes);

    - Acting as a student representative on various committees serving as a student representative on the SoBS Graduate School Committee
- Serving as a student representative on Faculty Scrutiny Groups for programme validation;
- Taking part in programme validation meetings by joining a panel of students to meet with the Faculty Scrutiny Group

The ways in which the quality of your programme is checked, both inside and outside the University, are:

- Regular module and programme reports which are monitored by the Faculty;
- Programme validation, normally every five years;
- External examiners, who produce an annual report;
- A national Research Assessment Exercise (our research activity contributes directly to the quality of your learning experience);
- Institutional Review by the Quality Assurance Agency

Criteria for admission

University Commitment

The University will at all times seek to operate admissions regulations that are fair and are in accordance with the law of the United Kingdom, and the University's Charter, Statutes, Ordinances and Regulations.

This includes specific compliance with legislation relating to discrimination (e.g. Equality Act 2010) and the University's Equal Opportunities Policy Statement. This includes a commitment that the University will:

- actively assist groups that experience disadvantage in education and employment to benefit from belonging to the University;
- actively seek to widen participation to enable students that do not traditionally participate in Higher Education to do so;
- ensure that admission procedures select students fairly and appropriately according to their academic ability and that the procedure is monitored and regularly reviewed.

Entry Requirements

The University's general admission requirements, including information for overseas/European applicants can be viewed on the web page: www.calendar.soton.ac.uk/sectionIV/admissions.html

The normal entry requirement is at least an upper second class honours degree in a quantitative subject (e.g. Maths, Computer Science or Statistics) or in a Biological Sciences related degree with evidence of training in quantitative methods. Non-UK applicants will usually have completed 4 years or more in higher education. Students who are of lower second honours degree standard will only be admitted in exceptional circumstances. A key feature of your first degree studies is that they must demonstrate achievement of learning outcomes (both content and level) that will ensure that you can integrate into our teaching and research experience.

The selection process will involve close scrutiny of your academic credentials in a process that will include both the academic researcher you identified as being of interest to you and the Post Graduate Admissions Tutor. Typically the process will involve an interview (via Skype for students not available to come to Southampton). The whole process is supported by a Post Graduate Admissions Administrator who remains in touch with students throughout the application process.

A minimum standard of English Language is required for admission to the programme which is identified as a standard against a number of internationally recognised language tests. A list of these may be found at

http://www.southampton.ac.uk/international/entry_reqs/english_language.shtml

The decision of whether to offer a place is one made by the academic supervisor, their research manager and the Post Graduate Admissions Tutor. The latter will make the formal offer of a place to you if this is the appropriate course of action.

Students are expected to prepare themselves for the course by private study prior to the start of the course. A reading list will be made available through contact with the nominated research supervisor

International Students and ATAS

International applicants to some undergraduate programmes are required to apply to the Foreign and Commonwealth Office's (FCO) Academic Technology Approval Scheme (ATAS) for clearance to study this programme in the UK before an application for a Tier 4 visa can be made

An ATAS certificate, once issued, is valid for the purpose of making a visa application for a period of six months from the date of issue. You need only hold a conditional offer when making an application for ATAS. You must ensure that you have received ATAS clearance before making your application for a Tier 4 student visa or your visa application will be refused. The FCO normally takes between four and six weeks to issue ATAS clearance, although it can sometimes take longer.

More information regarding ATAS and the process can be found at:

http://www.southampton.ac.uk/studentadmin/admissions/atas/

Career Opportunities

A range of career opportunities are open to you having completed your MRES:

- Biotechnology, pharmaceutical, bioinformatics or data-science related industry
- Postgraduate research training
- Scientific officer in research / computational environment
- Teaching
- Forensic science
- Legal profession
- Business management

External Examiners(s) for the programme

Name
Institution

Students must not contact External Examiner(s) directly, and external examiners have been advised to refer any such communications back to the University. Students should raise any general queries about the assessment and examination process for the programme with their Course Representative, for consideration through Staff: Student Liaison Committee in the first instance, and Student representatives on Staff: Student Liaison Committees will have the opportunity to consider external examiners' reports as part of the University's quality assurance process.
External examiners do not have a direct role in determining results for individual students, and students wishing to discuss their own performance in assessment should contact their personal tutor in the first instance.

Please note: This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities that are provided. More detailed information can be found in the programme handbook (or other appropriate guide) or online at www.sussed.soton.ac.uk