Programme Specification (PG)

Awarding body / institution:	Queen Mary University of London
Teaching institution:	Queen Mary University of London
Name of final award and title:	MSc Cancer Genomics and Data Science
Name of interim award(s):	MSc / PG Diploma
Duration of study / period of registration:	12 months (FT); 24 months (PT)
Queen Mary programme code(s):	PSCDS
QAA Benchmark Group:	NA
FHEQ Level of Award:	Level 7
Programme accredited by:	NA
Date Programme Specification approved:	7 Feb 2023
Responsible School / Institute:	Barts Cancer Institute

Schools / Institutes which will also be involved in teaching part of the programme:
William Harvey Research Institute

Collaborative institution(s) / organisation(s) involved in delivering the programme:

Programme outline

Biomedical science is increasingly data driven, as new bioanalytical techniques deliver ever more data about DNA, RNA, proteins, metabolites and the interactions between them, in the whole tissue and single-cell levels. Currently, there is a serious shortage of well-trained bioinformaticians, computational biologists and data analysts who have the relevant skillset and hands-on experience in real world biomedical and cancer data. This course is designed to fill in the gap between research / employment demands and student training, offering up-to-date modules focusing on "big-data" analyses and enabling these through use of high-performance computing, together with cutting edge research projects and practical training using real world cohort data. You will be taught by QMUL academics who are actively engaged in developing bioinformatics and computational tools, and applying them in cancer and medical research areas such as genomics, proteomics, evolution, modelling and biomarker discovery. Guest speakers will be drawn from our extensive network of academic and industrial collaborators around the UK. They may also provide co-supervision of your final project and provide links for potential employment opportunities

Programme highlights include:
- Up-to-date analytic techniques and bioinformatics/computational tools in biomedical and cancer research.
- Designed and delivered by world-class experts in genomics and data science, who actively develop and apply computational tools to address research questions.

- Providing hands-on experience using real world patient and experimental data.
- A substantial individual research project to further expand analytic skills and research experience.
- Providing the skills and experience that employers and PhD supervisors need.
- Flexible modes of study: full time, part time, campus-based or online.

Aims of the programme

Appealing to science and medicine graduates with strong quantitative skills, this programme will provide the cutting edge analytical and computational skills in genomics and data science, which are essential for data driven biomedical/cancer research. Practical and research training will be provided in multi-omics data and real-world clinical settings.

Through this programme, we aim to produce graduates who:

- have strong computational and practical problem solving skills that prepare them for research and employment.
- meet a strong local, national and international need for bioinformaticians and data scientists in biomedical sectors with strong knowledge of genomics, independent thinking, and practical / research experience.
- have all the attributes to pursue a research career in cancer and other biomedical subjects, having learned all the key transferable skills and performed a substantial individual project.
- drive and play an integral role in interdisciplinary research and collaborations.

What will you be expected to achieve?

Student who successfully complete the MSc programme should be able to achieve the following learning outcomes:

Academic Content:	
A 1	Students will have a deep knowledge and understanding of cancer genomics, different omics technologies and their applications in biomedical and cancer research; can work at and with advanced levels of theoretical and/or research knowledge.
A 2	Students will have a deep knowledge of, and proficiency in, existing bioinformatics resources, analytical pipelines and tools for a range of different data types and biomedical / cancer research applications.
A 3	Students can undertake analysis of complex, incomplete or contradictory areas of knowledge and take appropriate action in order that the task may be completed.
A 4	Students will have a deep knowledge of, and proficiency in, the key technical skills required to analyse complex data and produce new cancer bioinformatics and computational resources.
A 5	Students can undertake synthesis of information or ideas and create responses to problems in terms of advanced states of knowledge. This may involve development of new approaches in new situations.

Disciplinary Skills - able to:	
B 1	Students will have a critical awareness of current developments in cancer bioinformatics and data analytics, and critically evaluate new developments as they arise; can evaluate / argue alternative approaches.

B 2	Students can devise solutions to complex research questions and analytical problems using existing pipelines and tools; are confident and autonomous in problem solving. Can isolate, clarify and assess, and manage resolution of most relevant problems.
B 3	Students can maintain and improve analytical practice and pipelines, and produce and interpret the results derived from real-life patient datasets; can justify outcomes of her/his reflective process.
B 4	Students can develop novel software to solve or automate cancer data analysis problems for which suitable existing tools do not exist.

Attributes:	
C 1	Students can engage confidently and communicate relevant concepts and explain data/results to researchers and practitioners from within the cancer bioinformatics community, and from other disciplines that rely on bioinformatics.
C 2	Students can apply a range of personal and professional transferable skills in project design and management, team-working, code / report writing, software development, communication and presentation skills.
C 3	Students can clarify a group task and lead, work with or work within a group towards defined outcomes, making appropriate use of the capacities of the group members. Are able to negotiate and handle conflict with confidence.
C 4	Students are able to apply analytical and transferable skills to investigate unfamiliar problems.

How will you learn?

The course will be taught via lectures and practicals with Mixed Mode Education (MME). All modules will be delivered to students on campus and simultaneously to students present online using Queen Mary's virtual learning environment (QMplus), MS Teams and Zoom. For students, including distance learning (DL) students, who could not attend the real-time lectures and practicals, recorded lectures and practicals are also available on QMPlus.

Lectures are used to impart key concepts and knowledge. These lectures are supported by online materials on QMPlus, including lecture / practical slides, links to relevant resources and further reading. Extensive hands-on practical sessions cement the knowledge from the lectures and allow students to become proficient and confident in the use of bioinformatics tools introduced in the lectures. Individual support from teaching staff is available throughout these practical sessions. Practical coursework assignments are designed to allow students to further hone their skill through private study, with the completed coursework being assessed and detailed individual feedback returned to each student. Separate online Q&A sessions will take place to allow students (including DL) to ask questions, raise concerns, and receive answers / feedbacks, as well as take part in interactive activities. These sessions will be live but recordings will also be available on QMplus. Q&A forum will also be available to students to post messages throughout modules and the course.

During the course, seminars will be organised from active researchers in the fields of cancer genomics and data science within and outside BCI to inform students of cutting-edge science using various omic technologies and computational skills, to better prepare them for employment in academia and industry. Finally, the substantial individual thesis project (60 credits) will offer students the opportunity to select the area(s) they wish to research further, consolidate key transferable skills such as collaboration and improve their own technical and independent research skills.

How will you be assessed?

Continual assessment is used throughout the course, with the specific mode of assessment for each module selected according to the nature of the module content. Assessment will be, but not limited to, short and long answer coursework, multiple choice questions, presentations and research dissertation. Assessment has been designed to develop and assess a broad range of skills that will be essential for students in their future careers

How is the programme structured?

Please specify the structure of the programme diets for all variants of the programme (e.g. full-time, part-time - if applicable). The description should be sufficiently detailed to fully define the structure of the diet.

The modules are intended to impart key knowledge and skills. These are each taught over three weeks, with an intensive combination of lectures and computer-based practicals, as well as self-study, in the first two weeks, followed by a whole week of private study in which to complete a substantive piece of assessed work, except for Module 1&2 (existing WHRI modules), which consists of one teaching week of lectures / seminars and two weeks of private study each.

Finally, each student carries out an individual research project (60 credits). The aim of this project is to apply the technical and transferable skills gained during the taught modules to a pertinent cancer research question involving the management and/or analysis of biological data. In addition to the final thesis, towards the end of the research project, student will also deliver a presentation about their project and what they have achieved.

The course will be structured as follows:
Modules are delivered sequentially, with students taking 60 credits in each semester.

Semester 1
1. WHR7201, Introduction to Human Genomics
2. WHR7202, Omics Techniques and their Application to Genomic Medicine
3. R and Python Programming in Biomedical Research
4. Omics Data Analytics and Practical Training

Semester 2
5. Computational Genomics, Transcriptomics and Evolution
6. Mathematical Modeling and Application
7. Single Cell Analytics
8. Machine Learning / AI and Application to Biomedical Research

Semester 3:
9. Research projects of bioinformatics, computational biology and data science

For part-time students of two year study, students will learn Module 3, 4, 5 & 8 (60 taught credits) in Yr 1, and conduct Module 1, 2, 6 & 7 (60 taught credits) and research projects in Yr 2.

Academic Year of Study FT - Year 1

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
Introduction to Human Genomics	WHR7201	15	7	Compulsory	1	Semester 1
Omics Techniques and their Application to Genomic Medicine	WHR7202	15	7	Compulsory	1	Semester 1
R and Python Programming in Biomedical Research	CAN7031	15	7	Compulsory	1	Semester 1

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Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
Omics Data Analytics and Practical Training	CAN7031	15	7	Compulsory	1	Semester 1
Computational Genomics, Transcriptomics and Evolution	CAN7032	15	7	Compulsory	1	Semester 2
Mathematical Modeling and Application	CAN7033	15	7	Compulsory	1	Semester 2
Single Cell Analytics	CAN7034	15	7	Compulsory	1	Semester 2
Machine Learning / AI and Application to Biomedical Research	CAN7035	15	7	Compulsory	1	Semester 2
Research Project	CAN7036	60	7	Core	1	Semester 2-3

Academic Year of Study PT - Year 1

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
R and Python Programming in Biomedical Research	CAN7030	15	7	Compulsory	1	Semester 1
Omics Data Analytics and Practical Training	CAN7031	15	7	Compulsory	1	Semester 1
Computational Genomics, Transcriptomics and Evolution	CAN7032	15	7	Compulsory	1	Semester 2
Machine Learning / AI and Application to Biomedical Research	CAN7035	15	7	Compulsory	1	Semester 2

Academic Year of Study PT - Year 2

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
Introduction to Human Genomics	WHR7201	15	7	Compulsory	2	Semester 1
Omics Techniques and their Application to Genomic Medicine	WHR7202	15	7	Compulsory	2	Semester 1

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Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
Mathematical Modeling and Application	CAN7033	15	7	Compulsory	2	Semester 2
Single Cell Analytics	CAN7034	15	7	Compulsory	2	Semester 2
Research Project	CAN7036	60	7	Core	2	Semester 3

What are the entry requirements?

Potential students are expected to have, or be expecting, a minimum 2:1 in a relevant subject of quantitative background, such as genetics, genomics, maths, physics, engineering and computer sciences. Students with a 2:1 in Biology, Medicine, or a relevant natural sciences subject with strong quantitative skills will also be considered. Applicants with a 2:2 and strong supporting evidence may be considered on an individual basis.

English Language proficiency is required at the standard level for QMUL PGT entry for STEM subjects (IELTS 6.5, TOEFL 92, PTE Academic 62).

Intercalating Students will be considere if

1. Have successfully completed at least three years of the MBBS, BDS or equivalent medical course.
2. Have passed year 3 or 4 exams immediately prior to entry at the first opportunity.
3. Demonstrate a clear and unequivocal interest in the field by written application and/or interview.
4. For students internal and external to QMUL the beginning of the first term for the following year must start after all the assessments for the QMUL MSc are completed.

How will the quality of the programme be managed and enhanced? How do we listen to and act on your feedback?

The Staff-Student Liaison Committee provides a formal means of communication and discussion between schools/institutes and its students. The committee consists of student representatives from each programme in the school/institute together with appropriate representation from staff within the school/institute. It is designed to respond to the needs of students, as well as act as a forum for discussing programme and module developments. Staff-Student Liaison Committees meet regularly throughout the year.

Each school/institute operates a Learning and Teaching Committee, or equivalent, which advises the School/Institute Director of Taught Programmes on all matters relating to the delivery of taught programmes at school level including monitoring the application of relevant QM policies and reviewing all proposals for module and programme approval and amendment before submission to Taught Programmes Board. Student views are incorporated in the committee's work in a number of ways, such as through student membership, or consideration of student surveys.

For quality control, we use ARCS module evaluation surveys which are then formally discussed at the BCI Teaching and Learning committee and student staff liaison committee. In addition, we analyse Postgraduate Taught Experience Survey (PTES) responses and report to the faculty TLC. Finally, we have external examiners who comment on our programme specifications and delivery on per semester basis.

What academic support is available?

BCI run an induction programme specifically for its MSc intake each year.

Module organisers are the first point of academic contact for advice and support during the taught component.

Project supervisors are allocated once project topics have been decided upon and will supervise students' daily activity during the research project.

The Programme Director acts as the coordinator of all programme activities, supported by the administrative lead and staff of the BCI Teaching Office.

If there is requirement for further advice or support the Director of Taught Programmes and BCI PG Teaching Board may be consulted.

Programme-specific rules and facts

N/A

How inclusive is the programme for all students, including those with disabilities?

To make this programme inclusive, we have done the following:
• Learning outcomes for each module are made explicit to all students;
• Course materials and weblinks are reviewed each year, and reading lists and associated journals / book texts are available to students electronically via the Library Services;
• Lectures are recorded using Blackboard Collaborate QMPlus, and the recordings are released to students immediately after the lectures automatically in the system;
• Course / module QMPlus content is checked for accessibility standards with the E-learning Unit.

Queen Mary has a central Disability and Dyslexia Service (DDS) that offers support for all students with disabilities, specific learning difficulties and mental health issues. The DDS supports all Queen Mary students: full-time, part-time, undergraduate, postgraduate, UK and international at all campuses and all sites.

Students can access advice, guidance and support in the following areas:
• Finding out if you have a specific learning difficulty like dyslexia
• Applying for funding through the Disabled Students' Allowance (DSA)
• Arranging DSA assessments of need
• Special arrangements in examinations
• Accessing loaned equipment (e.g. digital recorders)
• Specialist one-to-one "study skills" tuition
• Access to course materials in alternative formats (e.g. recordings, Braille)
• Providing educational support workers (e.g. note-takers, readers, library assistants)
• Mentoring support for students with mental health issues and conditions on the autistic spectrum.

Links with employers, placement opportunities and transferable skills

The Programme Director, module leads and collaborative partners at QMUL all have excellent links with individuals in both academia and industry who recruit bioinformaticians and data analysts in the UK. Through the Cancer Research UK network, Turing network, IADS/DERI the Programme Director and many module leads are associated with, this programme has a network of high quality genomics, bioinformatics and data science contacts in academia and industry working on cancer and human genetics/genomics. External collaborators and speakers from Turing, IADS/DERI, CRUK City of London Centre, Genomics England, ICR, GSK and other companies / agencies will be invited to deliver research / career seminars and provide employment updates. Through these interactions, students can identify key research area(s) and further enhance their transferable skills for future

employment opportunities.

Programme Specification Approval

Person completing Programme Specification:	Dr Jun Wang
Person responsible for management of programme:	Dr Jun Wang
Date Programme Specification produced / amended by School / Institute Education Committee:	7 Feb 2023
Date Programme Specification approved by Taught Programmes Board:	7 Feb 2023