UNIVERSITY OF
NEWCASTLE UPON TYNE

FACULTY OF
SCIENCE, AGRICULTURE & ENGINEERING

DEGREE PROGRAMME SPECIFICATION

1.	**Awarding Institution**	University of Newcastle upon Tyne
2.	**Teaching Institution**	University of Newcastle upon Tyne
3.	**Final Award**	MRes
4.	**Programme Title**	Bioinformatics
5.	**Programme Accredited by:**	
6.	**UCAS Code**	N/A
7.	**QAA Benchmarking Group(s)**	
8.	**Date of production/revision**	29/9/04

9. Programme Aims:

- To develop the multidisciplinary skills essential to produce the trained bioinformaticians required by academia and by the pharmaceutical and biotechnology industries
- To provide the fundamental computational knowledge required to tackle practical and theoretical problems in bioinformatics
- To provide an understanding of the most commonly used and most important analytical, quantitative and experimental methods in bioinformatics
- To develop research skills
- To develop and improve skills in the use of literary resources and information technology
- To develop skills in critical assessment, analysis and storage of information and/or data
- To provide a qualification enhancing employment prospects in bioinformatics
- To provide a programme which meets the FHEQ at Masters level and which takes appropriate account of the draft subject benchmark statements in Computing.

Other aims of the programme:

- To enable a choice between a computational/numerical theme or a biological theme for the more advanced studies
- To enhance Bioinformatics research by:
    - Providing research students to undertake substantial projects in bioinformatics
    - Generating a source of qualified research students interested in pursuing PhD research in bioinformatics

10. Intended Learning Outcomes; Teaching and Learning Strategies and Methods; Assessment Strategies and Methods

A Knowledge and understanding

A successful student will have gained and be able to demonstrate:

A1. An understanding of the application of computing and statistics to predictive biology.
A2. An understanding of biological data management, integration and handling.
A3. A demonstrable, broad knowledge of the computing, statistical and biological methods appropriate for dealing with bioinformatics problems.
A4. Knowledge of genomes, genome sequencing, genomic structure and comparison.
A5. An understanding of the technology for studies in modern post-genomic biology and the data that is generated by such studies.
A6. Advanced knowledge and understanding of chosen specialist areas in bioinformatics.
A7. An understanding of the theory and principles which underlie computing, so that students can appreciate the current state of these subjects and can adapt to continued rapid developments throughout their subsequent careers.
A8. Knowledge of an up-to-date object-oriented programming language.

Teaching & Learning Strategy

Fundamental and specialist knowledge (A1-A8) are imparted largely through direct student contact (lectures and tutorials), supplemented by practical sessions that may take the form of computing sessions (A7-A8), problem solving and assessed coursework, and project proposals. Student understanding and learning is enhanced by the use of computing and numerical exercises, problem solving, literature reviews, teamwork and practical work (in the research thesis in particular) and production of a project proposal. Independent learning is encouraged through the provision of reading lists, literature reviews and critical analysis of research papers, and ready access to online information resources. Adequate time is provided in all modules for private study for independent learning.

Assessment strategy

Formative strategies are used to assess problem solving and programming skills, group work and literature review exercises. Extra formative assessment is included to provide student feedback throughout the course, without contributing to module marks. Formal feedback is provided for each piece of assessed coursework in the form of an individual proforma and a review session in subsequent lectures (A1-A8).

B Subject–specific/professional skills

A successful student will be able to:

B1. Propose, carry out and write up an extended research project involving, where appropriate, a literature review, problem specifications, design, implementation, and analysis.
B2. Design and implement new software packages, and compositions of existing packages
B3. Apply their knowledge of specific computational, mathematical and statistical techniques to the storage and analysis of biological data.
B4. Have expertise in the use and applicability of up-to-date bioinformatics software tools.
B5. Perform system management and installation functions as required to support biological computations

Teaching & Learning Strategy

Subject specific and professional skills (B1-B5) are imparted by a combination of lectures, practicals, case studies and an in-depth research project tailored to individual interests. Optional modules also permit a student to tailor their degree content. Optional modules are delivered in the form of ‘short fat’ modules

that reduce the emphasis on formally taught material and instead adopt a more directed self-learning approach, including the use of interactive tutorials (both tutor and student led), self-directed study, laboratory practicals, problem-based learning and investigative work. The use of short fat modules in the second semester has several advantages: (i) key skills development and deep learning is enhanced due to increased student participation and interest; (ii) learning is concentrated, allowing the student to focus in depth on one subject at a time; (iii) the structure allows modules to be made available to bioinformatics courses aimed at continuing professional development (for industry or academia); and (iv) enables future extension of module choices. Practical sessions and problem-solving exercises are used to develop programming and analytical skills (B2-B3). Tutorials are used to focus on specific research topics in detail, to carry out problem solving exercises (B1) and critical analysis of the current software tools (B4), analytical techniques (B3) and research literature, to ensure up-to-date knowledge of subject-specific research fields.

Assessment strategy
Subject-specific and professional skills (B1-B5) are assessed by written examinations and continuously-assessed material that includes written reports, practical write-ups, literature reviews, group projects, oral presentations, a poster presentation and a research thesis. The assessment methods aim to evaluate the students' understanding and ability to apply the computational and statistical techniques that form the basis for the interdisciplinary science of bioinformatics.

C Cognitive skills
A successful student will be able to:
C1. Critically evaluate research and literature relating to bioinformatics.
C2. Solve computational problems.
C3. Present, store and handle quantitative information.
C4. Demonstrate appropriate bioinformatics solutions applied to analytical and information handling problems.

Teaching & Learning Strategy
Critical evaluation of current research will be developed through literature searching, through coursework exercises and in the research project in particular (C1). The ability to solve computational and numeric problems in bioinformatics (C2) will be acquired through practical sessions and self-directed learning. Tutorials and group discussion will be used to reinforce specific computational and numeric methodology (C3). Problem solving exercises and case studies will be used to improve student skills in the application of appropriate solutions to biology data handling and analysis (C4).

Assessment strategy
Cognitive skills (C1-C4) are primarily assessed continuously in the form of individual reports from practical studies, literature reviews, tutorial exercises and group project reports. Data and information handling and interpretation are a strong component of many modules and is also assessed through the use of examinations continuously assessed problem solving exercises.

D Key (transferable) skills
A successful student will have:
D1. The ability to communicate orally in English
D2. Written communication skills
D3. The ability to use computer based literacy resources
D4. The ability to work as part of a team
D5. Creativity skills

Teaching & Learning Strategy
Oral presentation skills are exercised by group discussions in tutorial sessions, by communication during group exercises, and by the preparation of oral presentations on specific research topics (D1). Written communication skills are developed during independent study, the preparation of coursework, web page design, poster presentation and through the completion of the research project proposal and the project thesis (D2). Formal lectures and practicals address the use of online literacy resources and research techniques, reinforced through the use of practice exercises (D3). Group project and student-led tutorials are used to develop team skills (D4). The preparation of web pages and poster presentations are used to enhance writing and creativity skills (whilst also improving computing skills) (D5).

Assessment strategy
Written communication skills are assessed by report preparation, the research thesis and literature reviews. Oral communication skills are assessed in oral presentations. The ability to use computer-based literacy resources is assessed through the preparation of literature reviews and through self-assessment. Team work is formally evaluated using small group-based problem solving and data analysis exercises. Independent work is assessed in literature reviews and research projects. Creativity is assessed through problem-solving exercises and poster preparation. The production of web pages is included in some modules to assess students' abilities to provide synopses of information in a scientific but creative fashion.

11 Programme Features, Structure and Curriculum

A & B Programme Features & Structure

This is a one year, full time, intensive modular programme. The programme consists of two parts: a ***taught component*** that runs for 6 months and a ***research project*** of 6 months duration, for which a thesis is submitted. The programme is centred in the School of Computing Science, where the students will be based. Due to the interdisciplinary nature of the course, some optional modules are delivered by members of other Schools.

The programme consists of mandatory modules, optional modules, and the major individual project and dissertation. The programme provides a comprehensive training in interdisciplinary aspects of Computing Science and Statistics. The taught component of the course accounts for 100 credits and the Research Project 80 credits.

The ***taught component*** of the course is split across semester 1 and semester 2.

Semester 1 modules build the basic grounding in, and understanding of, bioinformatics theory and applications, together with necessary computational and numeric understanding to undertake more specialist modules. Five mandatory modules (55 credits total) run from week 1 to week 12. An additional 10-credit module is chosen from options to provide students with the opportunity to begin to tailor their degree content. These modules are examined in January at the end of semester 1. The numerical skills mandatory module starts in semester 1 and runs through until week 9 of semester 2.

Semester 2 introduces modules that build key research skills (generic and specialist) and impart deep learning by building on, and applying, the fundamental knowledge gained in semester 1. Optional modules are worth 10 credits each and occupy weeks 1 to 9 (with the research project starting in week 10) and taught in intensive three-week periods. There are three sets of these modules, with two modules in each set, and one module is selected from each set (i.e. a total of 30 option credits). In addition, a compulsory 5-credit module is devoted to building generic key skills, including literature searching, a group project and presentation exercises.

The pairing of optional modules supports two distinct themes to allow tailoring of the specialist learning. Each second semester two-module option set provides a choice between a computational/numerical theme or a more biologically-oriented theme. Students often fall into two classes based on preference for numerical/computational or biological modules (see 'A Review of Bioinformatics Education in the United Kingdom', http://www.hgmp.mrc.ac.uk/~dcounsel/education.html) and this mechanism allows their degree's content to be tailored accordingly. However, the choice of one theme or the other is not mandatory.

Research project. The 80-credit research project is of six months duration. The research project may be based in a research group from one of the Schools that offer bioinformatics-related research training, including the Schools of Computing Science, Mathematics and Statistics, Biology and Cell and Molecular Biosciences. Project placements may also be offered from external sites such as the European Bioinformatics Institute, and industrial placements from pharmaceutical companies such as Astra Zeneca and GlaxoWellcome may also be available. Each student will begin preparatory work on their selected research project (literature search, background reading) during semester 2 as part of their transferable skills module, and will produce a research proposal with a workplan in the style of a standard research council grant application. A poster presentation and oral presentation will also form a requirement of the research project, together with the completion of the finished research thesis. The second semester Research Skills module accounts for five credits of the 80-credit research project.

C Programme Curriculum
Degree of Master of Research in Bioinformatics

Code: 4809

(a) Candidates shall take the following compulsory modules:

Code	*Credits*	*Descriptive title*
CSC850	(10)	Bioinformatics Theory
CSC851	(5)	Bioinformatics Applications
CSC852	(20)	Bioinformatics Programming in Java
CSC853	(10)	Computing for Bioinformatics
CSC854	(15)	Numeric Skills (Statistics and Mathematics)
CSC855	(5)	Research Skills for Bioinformatics
CSC869	(75)	Research Project

(b) Candidates shall select one module from each of the following groups, giving a total of 40 credits.

Group 1

Code	*Credits*	*Descriptive title*
CSC856	(10)	Computational Analysis of Complex Biological Systems
CSC857	(10)	Systems Administration for Bioinformatics

Group 2

Code	*Credits*	*Descriptive title*
CSC859	(10)	Statistical Bioinformatics
CSC860	(10)	Comparative and Evolutionary Genomics

Group 3

Code	*Credits*	*Descriptive title*
CSC864	(10)	Advanced Object-oriented Design and Programming
CSC862	(10)	Gene Expression, Proteomics and Array Informatics

Group 4

Code	*Credits*	*Descriptive title*
CSC863	(10)	Protein Structure Informatics
CSC861	(10)	e-Science for Bioinformatics

Development of specific Intended Learning Outcomes occurs through the following modules (compulsory modules in bold text, optional modules in normal, italic text)

A1.	An understanding of the application of computing and statistics to predictive biology	**CSC850, CSC851, CSC852, CSC854,** *CSC856, CSC857, CSC859, CSC860, CSC861, CSC862, CSC863, CSC864,* **CSC869.**
A2.	An understanding of biological data management, integration and handling.	**CSC851, CSC852, CSC854, CSC855,** *CSC857, CSC859, CSC861, CSC862, CSC863, CSC864,* **CSC869.**
A3.	A demonstrable, broad knowledge of the computing, statistical and biological methods appropriate for dealing with bioinformatics problems.	**CSC850, CSC851, CSC852, CSC854,** *CSC857, CSC859, CSC861, CSC862, CSC863, CSC864,* **CSC869.**
A4.	Knowledge of genomes, genome sequencing, genomic structure and comparison.	**CSC850, CSC851,** *CSC856, CSC860, CSC862, CSC863,*
A5.	An understanding of the technology for studies in modern post-genomic biology and the data that is generated by such studies.	**CSC850, CSC851,** *CSC860, CSC862, CSC863, CSC864***.**
A6.	Advanced knowledge and understanding of chosen specialist areas in bioinformatics.	*CSC856, CSC857, CSC859, CSC860, CSC861, CSC862, CSC863, CSC864,* **CSC869**
A7.	An understanding of the theory and principles which underlie computing, so that students can appreciate the current state of these subjects and can adapt to continued rapid developments throughout their subsequent careers.	**CSC852, CSC853, CSC855,** *CSC857, CSC861, CSC864***.**
A8.	Knowledge of an up-to-date object-oriented programming language.	**CSC852, CSC855,** *CSC861, CSC864.*
B1.	Propose, carry out and write up an extended research project involving where appropriate a literature review, problem specifications, design, implementation, and analysis.	**CSC855, CSC869.**
B2.	Design and implement new software packages, and compositions of existing packages	**CSC852, CSC855,** *CSC861, CSC864.*
B3.	Apply their knowledge of specific computational, mathematical and statistical techniques to the storage and analysis of biological data.	**CSC850, CSC851, CSC852, CSC854, CSC855**, *CSC856, CSC857, CSC859, CSC860, CSC861, CSC862, CSC863, CSC864,* **CSC869**
B4.	Have expertise in the use and applicability of up-to-date bioinformatics software tools.	**CSC850, CSC851,** *CSC857, CSC861, CSC862, CSC863, CSC864,*
B5.	Perform system management and installation functions as required to support biological computations	**CSC852, CSC853,** *CSC857, CSC861, CSC864.*
C1.	Critically evaluate research and literature relating to bioinformatics.	**CSC850, CSC851, CSC855,** *CSC859, CSC860, CSC861, CSC862, CSC863, CSC864,* **CSC869.**
C2.	Solve computational problems.	**CSC852, CSC853, CSC854, CSC855,** *CSC856, CSC857, CSC859, CSC861, CSC864,* **CSC869.**
C3.	Present, store and handle quantitative information.	**CSC851, CSC852, CSC853, CSC854, CSC855,** *CSC856, CSC857, CSC859, CSC862, CSC863, CSC864,* **CSC869.**
C4.	Demonstrate appropriate bioinformatics solutions	**CSC851, CSC852, CSC854,**

applied to analytical and information handling problems.	*CSC856, CSC857, CSC860, CSC861, CSC862, CSC863, CSC864,* **CSC869.**
D1. Ability to communicate orally in English	**CSC855,** *CSC860, CSC861, CSC862, CSC863, CSC864,* **CSC869.**
D2. Written communication skills	**CSC850, CSC851, CSC852, CSC853, CSC855,** *CSC856, CSC860, CSC861, CSC862, CSC863, CSC864,* **CSC869.**
D3. Ability to use computer based literacy resources	**CSC850, CSC851, CSC853, CSC855,** *CSC856, CSC860, CSC861, CSC862, CSC863, CSC864,* **CSC869.**
D4. Ability to work as part of a team	**CSC852, CSC854, CSC855,** *CSC856, CSC860, CSC861, CSC862,* **CSC864.**
D5. Creativity skills	**CSC852, CSC853, CSC854, CSC855,** *CSC859, CSC861, CSC864,* **CSC869.**

12 Criteria for Admission:

The programme is available to graduates in any science discipline (minimum entry qualification is a 2(ii), or equivalent), including Biological Sciences, Engineering Sciences, or Physical Sciences. Graduates in Computing Sciences or Mathematics may also be accepted, but will need to be dealt with on an individual basis because of the potential overlap of their first degree with the modules in this MRes.

Admissions policy

The admissions policy conforms to the University's standard policy for postgraduate students. Upon receipt of a completed application form candidates may be offered an interview. Offers of places may be made to suitably qualified candidates, conditional upon two satisfactory references and upon the applicant achieving a minimum of a 2nd class degree (or overseas equivalent), if they do not hold such a degree at the time of application. Applicants whose first degree is not taught in English must provide evidence of a satisfactory command of English by means of an IELTS score of 6.5 or greater or an equivalent TOEFL score (570). The number of places on the degree programme will be limited.

Arrangements for non-standard entrants

Graduates with a non-scientific background will be considered if they can demonstrate evidence of a strong biology background or strong mathematical/computing skills.

13 Support for Students and their Learning:

Induction
The first week of the first term/semester is an Induction Week with no formal teaching. During this period all students attend an induction programme in which they will be given detailed programme information relating to their course and the timetable of lectures/practicals/labs/ tutorials/etc. In particular all new students will be given general information about the School and their course, as described in the Degree

Programme Handbook. The International Office offers an additional induction programme for overseas students (see http://www.ncl.ac.uk/international/coming_to_newcastle/orientation.phtml).

Study skills support
Students will learn a range of Personal Transferable Skills, including Study Skills, as outlined in the Programme Specification. Some of this material, e.g. time management is covered in the appropriate Induction Programme. Students are explicitly tutored on their approach to their individual project.

Academic support
The initial point of contact for a student is with a lecturer or module leader, or their tutor (see below) for more generic issues. Thereafter the Degree Programme Director or Head of School may be consulted. Issues relating to the programme may be raised at the Staff/Student Committee, and/or at the Board of Studies.

Pastoral support
All students are assigned a personal tutor whose responsibility is to monitor the academic performance and overall well-being of their tutees. Details of the personal tutor system can be found at http://www.ncl.ac.uk/undergraduate/support/tutor.phtml. In addition the University offers a range of support services, including the Student Advice Centre, the Student Counselling Service, the Mature Student Support Service, and a Childcare Support Officer, see http://www.ncl.ac.uk/undergraduate/support/welfare.phtml.

Support for Special Needs
Support for students with special needs is provided as required and the University's Disability Support Service can be consulted where appropriate. For further details see http://www.ncl.ac.uk/undergraduate/support/disability.phtml.

Learning resources
The University's main learning resources are provided by the Robinson and Walton Libraries (for books, journals, online resources), and Information Systems and Services, which supports campus-wide computing facilities, see http://www.ncl.ac.uk/undergraduate/support/acfacilities.phtml.
All new students whose first language is not English are required to take an English Language test in the Language Centre. Where appropriate, in-sessional language training can be provided. The Language Centre houses a range of resources for learning other languages which may be particularly appropriate for those interested in an Erasmus exchanges. See http://www.ncl.ac.uk/undergraduate/support/langcen.phtml.
The School of Computing Science has well equipped computer laboratories consisting of networked PCs. Key software used in the support and delivery of the programme is available to students free of charge. The School has its own library which is mainly used for the support of advanced topics and is a particularly valuable resource for individual projects.

14 Methods for Evaluating and Improving the Quality and standards of Teaching and Learning:

Module reviews
All modules are subject to review by questionnaires which are considered by the Board of Studies. Changes to, or the introduction of new, modules are considered at the School Teaching and Learning Committee and at the Board of Studies. Student opinion is sought at the Staff/Student Committee and/or the Board of Studies. New modules and major changes to existing modules are subject to approval by the Faculty Teaching and Learning Committee.

Programme reviews

The Board of Studies conducts an Annual Monitoring and Review of the degree programme and reports to Faculty Teaching and Learning Committee.

External examiner reports
External Examiner reports are considered by the Board of Studies under Reserved Business, in the absence of the student representatives. The Board responds to these reports through Faculty Teaching and Learning Committee.

Accreditation reports
This programme is not accredited by any professional body.

Student evaluations
All modules, and the degree programme, are subject to review by student questionnaires. Informal student evaluation is also obtained at the Staff/Student Committee, and the Board of Studies.

Feedback mechanisms
Feedback to students is effected via the Staff/Student Committee and the Board of Studies.

Faculty and University Review Mechanisms
The Programme is subject to the University's Internal Subject Review programme, see http://www.ncl.ac.uk/internal/academic-quality/qualityhome.htm#2.

15 Regulation of Assessment:

Pass Marks
The pass mark, as defined in the University's Postgraduate Examination Conventions (http://www.ncl.ac.uk/calendar/university.regs/tpmdeprexamconv.pdf), is 50.

Course Requirements
Progression is subject to the University's Postgraduate Progress Regulations (http://www.ncl.ac.uk/calendar/university.regs/tpmdepr.pdf) and Postgraduate Examination Conventions (http://www.ncl.ac.uk/calendar/university.regs/tpmdeprexamconv.pdf).

Common Marking Scheme
The University employs a common marking scheme, which is specified in the Postgraduate Examination Conventions (http://www.ncl.ac.uk/calendar/university.regs/tpmdeprexamconv.pdf), namely

<50	Fail
50-59	Pass
60-69	Pass with Merit
70+	Pass with Distinction

Role of the External Examiner
An External Examiner, a distinguished member of the subject community, is appointed by Faculty Teaching and Learning Committee, after recommendation from the Board of Studies. The External Examiner is expected to:

See and approve examination papers
Moderate examination and coursework marking
Attend the June/October Board of Examiners

16 Indicators of Quality and Standards:

Professional Accreditation Reports
Not applicable.

Internal Review Reports
Although this programme was not yet being taught at the time of the Internal Subject Review of the School of Computing Science held on 28/29th April 2003, it was icnluded in the assessment procedures and was subsequently approved by Faculty Teaching and Learning Committee and University Teaching and Learning Committee.
The overall judgement of the review was that "The team was impressed by the very positive relationships between the staff and students in the School - it was abundantly clear that the subject group is very student-focused and this was to their significant credit, with students commenting favourably about the approachable nature of the staff as a whole. The overall provision was felt to be excellent, with a significant number of commendations relating to good practice in the School, which others may wish to consider and incorporate into their own procedures."

Previous QAA Reports
This programme was not running in the last QAA subject review of Computing Science in 1994.

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 she/he takes full advantage of the learning opportunities provided. The accuracy of the information contained is reviewed by the University and may be checked by the Quality Assurance Agency for Higher Education.

17 Other Sources of Information:

The University Prospectus (see http://www.ncl.ac.uk/postgraduate)

The School Prospectus (see http://www.ncl.ac.uk/postgraduate/subjects/computing)

The University and Degree Programme Regulations (see http://www.ncl.ac.uk/calendar/pdf/uniregs.pdf and http://www.ncl.ac.uk/regulations/regulations.html?id=619)

The Degree Programme Handbook (see http://www.cs.ncl.ac.uk/degrees/pg/bioinformatics/2004bioinformatics.html)

QAA Subject Review Report