



CBMS793

Research Topic: Advanced Biomolecular Analysis

S2 Day 2016

Dept of Chemistry & Biomolecular Sciences

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General Information

Unit convenor and teaching staff

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Credit points

4

Prerequisites

Admission to MRes

Corequisites

Co-badged status

Unit description

This unit addresses some advanced methods of analysis utilised in the biomolecular sciences. Biomolecular sciences spans the study of individual molecular structures and biochemical reactions to also encompass the 'omics' sciences of genomics, proteomics, metabolomics and glycomics. These sciences all generate large and complex datasets that require specialized programs and methods to assemble and analyse. The analyses are challenging, as they not only require a good knowledge of biochemistry, molecular biology, and cell and developmental biology, but also an understanding of limitations of both the programs and the data quality. This unit will provided a background to the data acquisition methods, quality control of the datasets, and analysis methods within a number of these areas. Most importantly it will provide hands-on experience in the analysis of real large-scale datasets and the correct use of the appropriate analysis tools available.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

Learning Outcomes

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

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Familiarisation with experiment design and ability to critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Processing of datasets using specific software, providing a broad overview of data in terms of size, quality and utility for further analysis
- Competency to analyze large datasets and compare it with established information about the system under investigation
- Demonstrate ability to effectively report, communicate and draw new conclusions about a biomolecular system from large analytical datasets.

General Assessment Information

- All written work must be submitted via Turnitin on the CBMS793 iLearn website, or as otherwise advised by the unit convenor.
- Late submissions **will** be penalised with 20% loss of the maximum mark for each day past the deadline. More than 2 days late will result in zero marks awarded unless **Disruption to Studies application** has been requested.
- If there is any medical reason why you cannot submit work on time you should lodge a **Disruption of Studies application**, otherwise your mark will be penalized for lateness.

Assessment Tasks

Name	Weighting	Due
<u>Take home examination</u>	10%	25th August
<u>Proteomics Data Analysis Report</u>	25%	6th October
<u>Genomics quiz</u>	10%	13th Oct
<u>Genomics Data Presentation</u>	25%	3rd November
<u>Final Examination</u>	30%	Examination Period

Take home examination

Due: **25th August**

Weighting: **10%**

Exam assessing some of the fundamental principles and concepts important in the application of protein mass spectrometry and proteomics, including peptide fragmentation, targeted mass spectrometry and principles of experimental design. Content from Week 1-3 will be assessed in the form of short answer questions. There will be 5 questions of equal weighting.

On successful completion you will be able to:

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Familiarisation with experiment design and ability to critically assess the quality of large biomolecular datasets prior to in-depth analysis

Proteomics Data Analysis Report

Due: **6th October**

Weighting: **25%**

Students will be given a dataset containing information from a large scale quantitation LC/MS experiment. The dataset needs to be evaluated using Perseus, and a report containing information about quantitative changes presented. The report should present visual statistical analysis providing an overview of the experiment and illustrating differences in samples (e.g. Hierarchical Clustering, Principle-Component-Analysis), and an evaluation of key proteins and the pathways they are associated with. The report should contain sufficient methodological detail appropriate for publication purposes in quality proteomics journals.

On successful completion you will be able to:

- Familiarisation with experiment design and ability to critically assess the quality of large biomolecular datasets prior to in-depth analysis
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- Competency to analyze large datasets and compare it with established information about the system under investigation
- Demonstrate ability to effectively report, communicate and draw new conclusions about a biomolecular system from large analytical datasets.

Genomics quiz

Due: **13th Oct**

Weighting: **10%**

Students will be given raw paired-end next generation sequencing data equivalent to ~50kb of an assembled genome. Students will be tasked with assembling the data following the necessary pre-processing steps, and then annotating the genes and features on the assembled DNA using tools covered in the preceding sessions. The task will be assessed by 1. producing a fasta file of assembled dna contigs, 2. a file of gene/ORF annotations, 3. filling in the summary table (provided) and answering 3 short questions about their data.

On successful completion you will be able to:

- Familiarisation with experiment design and ability to critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Processing of datasets using specific software, providing a broad overview of data in terms of size, quality and utility for further analysis
- Demonstrate ability to effectively report, communicate and draw new conclusions about a biomolecular system from large analytical datasets.

Genomics Data Presentation

Due: **3rd November**

Weighting: **25%**

Students to be given two genome datasets. These are to be analysed following guidelines presented in the tutorials. The outcomes of these results are to be given as an Oral Presentation of 12min plus 3min question time.

On successful completion you will be able to:

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Familiarisation with experiment design and ability to critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Processing of datasets using specific software, providing a broad overview of data in terms of size, quality and utility for further analysis
- Competency to analyze large datasets and compare it with established information about the system under investigation
- Demonstrate ability to effectively report, communicate and draw new conclusions about a biomolecular system from large analytical datasets.

Final Examination

Due: **Examination Period**

Weighting: **30%**

This will be a 2h exam consisting of a series of problem solving, data interpretation questions and short essays.

On successful completion you will be able to:

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Familiarisation with experiment design and ability to critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Competency to analyze large datasets and compare it with established information about the system under investigation
- Demonstrate ability to effectively report, communicate and draw new conclusions about a biomolecular system from large analytical datasets.

Delivery and Resources

This unit uses team-based teaching in the form of 'lectorials' that encompass both lectures and hands-on experiences in using various data analysis software programs and tools. The tutors are actively involved in research activities to bring knowledge from real-world experiences in their respective fields. All class sessions take place on Thursday 12-4pm in F7B433 unless otherwise instructed. Tutorials will NOT be recorded. You must attend these tutorials to gain practical experience with data analysis. As some of the assessment is based on your practical use of specific software it is essential that you attend these classes.

It is expected that each student will bring to class a laptop PC computer to install data analysis software, or prior arrangements must be made with the convenor.

Software Requirements

Software used in this module can be installed in weeks 1 or 2 and will be available for use during the software sessions starting week 3.

- Skyline (<https://skyline.gs.washington.edu/labkey/project/home/begin.view?>)
- Perseus (<http://www.coxdocs.org/doku.php?id=perseus:start>)

All official correspondence with lecturers and tutors is to be made using the CBMS793 iLearn website.

Unit Schedule

Week	Date	Title	Lecturer
Proteomics			

1	Thurs 4 Aug	Unit overview Introduction to protein mass spectrometry (detecting ions - instruments, scan types, peptide fragmentation and common proteomic workflows) - Introduction to quantitative mass spectrometry techniques	MM MMcKay
2	Thurs 11 Aug	Principles of protein identification: peptide fragmentation and the automation of spectral assignment - Targeted Mass Spectrometry (From SRM to DIA: Using Area Under the Curve (AUC) approaches for quantitation via SWATH)	MMcKay
3	Thurs 18 Aug	Principles of experiment design and statistical analysis in proteomics Quantitation of Large DIA Proteomic Datasets	MM MMcKay
4	Thurs 25 Aug	Tools for the quantitation of peptides and proteins PeakView and Perseus	CK MMcKay
5	Thurs 1 Sept	Combining experimental design with statistical power in DIA experiments	CK
6	Thurs 8 Sept	DIA data analysis	CK
7	Thurs 15 Sept	Pathway mapping and data mining	DP
Mid-Semester Break 19 Sept-30 Sept			
Genomics			
8	Thurs 6 Oct	Genomics Introduction Introduction to the unix/linux command line and useful tools	IP, MO
9	Thurs 13 Oct	Introduction to sequencing data quality control, assembly and annotation Genomics Quiz	MO
10	Thurs 20 Oct	Metagenomic analysis 1 Introduction to R	MO

11	Thurs 27 Oct	Metagenomic analysis 2 Transcriptome analysis tools	MO
12	Thurs 3 Nov	Genomics - Oral Presentations	MO
13	Thurs 10 Nov	Revision	MM

Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](#). Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

New Assessment Policy in effect from Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy_2016.html. For more information visit http://students.mq.edu.au/events/2016/07/19/new_assessment_policy_in_place_from_session_2/

Assessment Policy prior to Session 2 2016 <http://mq.edu.au/policy/docs/assessment/policy.html>

Grading Policy prior to Session 2 2016 <http://mq.edu.au/policy/docs/grading/policy.html>

Grade Appeal Policy <http://mq.edu.au/policy/docs/gradeappeal/policy.html>

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the [Learning and Teaching Category](#) of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in [eStudent](#). For more information visit ask.mq.edu.au.

Student Support

Macquarie University provides a range of support services for students. For details, visit <http://stu>

dents.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- [Workshops](#)
- [StudyWise](#)
- [Academic Integrity Module for Students](#)
- [Ask a Learning Adviser](#)

Student Services and Support

Students with a disability are encouraged to contact the [Disability Service](#) who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the [Acceptable Use of IT Resources Policy](#). The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

PG - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

Learning outcomes

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
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- Demonstrate ability to effectively report, communicate and draw new conclusions about a biomolecular system from large analytical datasets.

Assessment tasks

- Take home examination
- Proteomics Data Analysis Report
- Genomics quiz
- Genomics Data Presentation
- Final Examination

PG - Discipline Knowledge and Skills

Our postgraduates will be able to demonstrate a significantly enhanced depth and breadth of knowledge, scholarly understanding, and specific subject content knowledge in their chosen fields.

This graduate capability is supported by:

Learning outcomes

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Familiarisation with experiment design and ability to critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Processing of datasets using specific software, providing a broad overview of data in terms of size, quality and utility for further analysis
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PG - Critical, Analytical and Integrative Thinking

Our postgraduates will be capable of utilising and reflecting on prior knowledge and experience, of applying higher level critical thinking skills, and of integrating and synthesising learning and knowledge from a range of sources and environments. A characteristic of this form of thinking is the generation of new, professionally oriented knowledge through personal or group-based critique of practice and theory.

This graduate capability is supported by:

Learning outcomes

- Familiarisation with experiment design and ability to critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Demonstrate ability to effectively report, communicate and draw new conclusions about a biomolecular system from large analytical datasets.

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PG - Research and Problem Solving Capability

Our postgraduates will be capable of systematic enquiry; able to use research skills to create new knowledge that can be applied to real world issues, or contribute to a field of study or practice to enhance society. They will be capable of creative questioning, problem finding and problem solving.

This graduate capability is supported by:

Learning outcomes

- Processing of datasets using specific software, providing a broad overview of data in terms of size, quality and utility for further analysis
- Competency to analyze large datasets and compare it with established information about the system under investigation

Assessment tasks

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PG - Effective Communication

Our postgraduates will be able to communicate effectively and convey their views to different social, cultural, and professional audiences. They will be able to use a variety of technologically supported media to communicate with empathy using a range of written, spoken or visual formats.

This graduate capability is supported by:

Learning outcomes

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
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PG - Engaged and Responsible, Active and Ethical Citizens

Our postgraduates will be ethically aware and capable of confident transformative action in relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to national and global issues

This graduate capability is supported by:

Learning outcomes

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Familiarisation with experiment design and ability to critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Demonstrate ability to effectively report, communicate and draw new conclusions about a biomolecular system from large analytical datasets.

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Changes from Previous Offering

Molecular graphics and glycomics analyses have been removed from the 2016 S2 offering of

CBMS793, enabling more dedicated focus on core disciplines of proteomics and genomics.