



## UNSW Course Outline

# BINF9020 Computational Bioinformatics - 2023

Course Code : BINF9020  
Year : 2023  
Term : Term 3  
Teaching Period : T3  
Delivery Mode : In Person  
Delivery Format : Standard  
Delivery Location : Kensington

## General Course Information

Course Code : BINF9020  
Year : 2023  
Term : Term 3  
Teaching Period : T3  
Is a multi-term course? : No  
Faculty : Faculty of Engineering  
Academic Unit : School of Computer Science and Engineering  
Delivery Mode : In Person  
Delivery Format : Standard  
Delivery Location : Kensington  
Campus : Sydney  
Study Level : Postgraduate  
Units of Credit : 6

### Useful Links

[Handbook Class Timetable](#)

## Course Details & Outcomes

### Course Description

This course explores the computational basis of bioinformatics and complements and extends

understanding of bioinformatics tools and resources acquired in other courses, with a focus on the analysis of complex biological datasets and the application of mathematical and computational methods to problems in modern life science. Example domains include sequence analysis, gene expression and function, networks of interaction, and systems modelling.

Specific topics include: Algorithms and representations in DNA and protein sequence analysis: string matching and alignment, tree building methods, hidden Markov models and other probabilistic representations, genome assembly and mapping. Computational representations in systems biology including Boolean and Bayesian networks. Optimisation and machine learning approaches used in bioinformatics.

## Course Aims

The course aims to reinforce students' understanding of core bioinformatics engineering principles, as well as building their capabilities in core bioinformatics engineering practice. In particular, the course will improve students' ability to apply computational methods of analysis and modelling in modern biology, building on the use of bioinformatics tools acquired in prerequisite courses, and relating to research and industrial contexts. Development of software skills in bioinformatics complements strengthening of algorithmic knowledge combined with practical applications to biological data.

This course assumes that students have a background in bioinformatics and programming skills. It is part of the Bioinformatics major in the Master of Information Technology program.

## Relationship to Other Courses

Assumed knowledge acquired in the courses BINF2010 or COMP2041, or equivalent.

## Course Learning Outcomes

Course Learning Outcomes
CL01 : Reproduce, explain and apply the major methods of pairwise and multiple sequence analysis in bioinformatics
CL02 : Define key computational and statistical concepts in bioinformatics approaches to pairwise and multiple sequence analysis.
CL03 : Define Hidden Markov models, describe their associated algorithms, and discuss their application to biological sequence analysis.
CL04 : Define and apply machine learning methods of clustering and classification in analysis of genome-scale data.
CL05 : Express and apply key concepts from graph theory to model biological networks.
CL06 : Use and explain selected engineering approaches to the representation, execution and evaluation of models of biological processes and their application in systems biology.
CL07 : Research and present on a range of open-source software tools and techniques available to bioinformatics software developers.

Course Learning Outcomes	Assessment Item
CL01 : Reproduce, explain and apply the major methods of pairwise and multiple sequence analysis in bioinformatics	<ul style="list-style-type: none"> <li>• Programming assignment in 3 parts: sequence alignment</li> </ul>
CL02 : Define key computational and statistical concepts in bioinformatics approaches to pairwise and multiple sequence analysis.	<ul style="list-style-type: none"> <li>• Programming assignment in 3 parts: sequence alignment</li> </ul>
CL03 : Define Hidden Markov models, describe their associated algorithms, and discuss their application to biological sequence analysis.	<ul style="list-style-type: none"> <li>• Final Exam</li> </ul>
CL04 : Define and apply machine learning methods of clustering and classification in analysis of genome-scale data.	<ul style="list-style-type: none"> <li>• Homework: systems biology</li> </ul>
CL05 : Express and apply key concepts from graph theory to model biological networks.	<ul style="list-style-type: none"> <li>• Homework: systems biology</li> </ul>
CL06 : Use and explain selected engineering approaches to the representation, execution and evaluation of models of biological processes and their application in systems biology.	<ul style="list-style-type: none"> <li>• Final Exam</li> <li>• Homework: systems biology</li> </ul>
CL07 : Research and present on a range of open-source software tools and techniques available to bioinformatics software developers.	<ul style="list-style-type: none"> <li>• Group presentation</li> <li>• Final Exam</li> </ul>

## Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams | Echo 360

## Learning and Teaching in this course

In 23T3 this course will be delivered in person. All lectures will be in person, and lectures will be recorded. The tutorial and lab activities, including class presentations, will be in person. All course materials will be available via the Moodle course website. Students are expected to be in Sydney and able to attend campus to complete this course.

## Other Professional Outcomes

n/a

## Additional Course Information

n/a

# Assessments

## Assessment Structure

Assessment Item	Weight	Relevant Dates
Programming assignment in 3 parts: sequence alignment Assessment FormatIndividual	20%	Start DateNot Applicable Due DateNot Applicable Post Date15/09/2023 04:00 PM
Homework: systems biology Assessment FormatIndividual	14%	Start DateNot Applicable Due DateNot Applicable Post Date10/10/2023 10:30 AM
Group presentation Assessment FormatGroup	16%	Start DateNot Applicable Due DateNot Applicable Post Date24/10/2023 10:30 AM
Final Exam Assessment FormatIndividual	50%	Start DateNot Applicable Due DateNot Applicable Post Date14/11/2023 10:30 AM

## Assessment Details

### Programming assignment in 3 parts: sequence alignment

#### Assessment Overview

A programming assignment focusing on the dynamic programming alignment algorithm.

Two weeks is allocated for development of each programming component, and one week for collecting data and report preparation.

Marking is with respect to a rubric and feedback will be provided with the online assessment.

#### Detailed Assessment Description

Detailed assignment specification is released on Moodle.

#### Assessment Length

5 weeks

#### Submission notes

Moodle

#### Assessment information

Refer to specification.

### Assignment submission Turnitin type

Not Applicable

## **Homework: systems biology**

### Assessment Overview

A two-part self-directed data analysis and programming task on methods from lectures.

One week for each part of the homework is allocated for completing exercises and answering questions.

Marking is with respect to a rubric and feedback will be provided with the online assessment.

### Detailed Assessment Description

Specification for each homework notebook released on Moodle.

### Assessment Length

Short answers plus code in Jupyter notebooks

### Submission notes

Moodle

### Assessment information

Refer to specification.

### Assignment submission Turnitin type

Not Applicable

## **Group presentation**

### Assessment Overview

Open-source bioinformatics software environments

Research and present on a selected topic. Marks will include a peer-assessed component.

Presentation time of approximately 30 minutes per team, report of about 5 pages, depending on team size.

Marking is with respect to a rubric and feedback will be provided with the online assessment.

### Detailed Assessment Description

Specification for presentation and report is released on Moodle.

### Assessment Length

Team slides plus written report of approximately 1-2 pages per member

### Submission notes

Moodle

### Assessment information

Refer to specification.

### Assignment submission Turnitin type

Not Applicable

## **Final Exam**

### Assessment Overview

A formal exam in the exam period covering the lecture content of the course.

A two hour exam comprising written and multiple choice answers based on problem solving.

Marking is with respect to a rubric.

### Detailed Assessment Description

Exam details are released on Moodle.

### Assessment Length

Two hour final exam

### Submission notes

Moodle

### Assessment information

Refer to specification.

### Assignment submission Turnitin type

Not Applicable

## **General Assessment Information**

n/a

### Grading Basis

Standard

## Requirements to pass course

Course mark is the sum of marks for assessed course components with a mark of 50 or greater required to pass.

# Course Schedule

## Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

## General Schedule Information

Lectures in Term 3 will be **In Person** and will be held on **Tuesdays 11am-1pm in H13 Lawrence Theatre** (Lecture 1) and on **Thursdays 1-3pm in Ainsworth G02** (Lecture 2). Each week has three scheduled tutorial/lab times on **Tuesdays 3-4pm and 5-6pm** and **Wednesdays 12-1pm in Quad G055**.

**Please note:** we will use **only** the following tutorial/lab times:

**Weeks 2-5:** a 1 hour tutorial **Tuesday 3-4pm**

**Weeks 7-8:** a 2 hour lab **Tuesday 3-4 and 5-6pm**

**Week 9:** three 1 hour group presentation slots **Tuesday 3-4pm and 5-6pm** and **Wednesday 12-1pm**

*However, remember times may be subject to change !*

All schedule details available from the Moodle course page.

# Course Resources

## Prescribed Resources

There is no required textbook for this course. However, please see the recommended resources to access introductory or deeper background reading and for further study on some of the course topics.

## Recommended Resources

- "Bioinformatics Algorithms: An Active Learning Approach (Volumes I and II)" by Compeau and Pevzner, Active Learning Press (2015)
- "Biological Sequence Analysis – Probabilistic models of proteins and nucleic acids" by Durbin, Eddy, Krogh and Mitchison, Cambridge University Press (1998)
- "Introduction to Systems Biology – Design Principles of Biological Circuits (2<sup>nd</sup> Edition)" by Uri Alon, CRC Press, 2019.
- "Systems Biology – A Textbook (2<sup>nd</sup> Edition)" by Edda Klipp *et al.*, Wiley-VCH, 2016.

- “Networks (2<sup>nd</sup> Edition)” by Mark Newman, Oxford University Press, 2018.
- “Nonlinear Dynamics and Chaos with Applications to Physics, Biology, Chemistry and Engineering (2<sup>nd</sup> Edition)” by Steven Strogatz, CRC Press, 2015.
- “Computational Modeling of Gene Regulatory Networks – A Primer” by Hamid Bolouri, Imperial College Press, 2008.

Lecture slides, discussion forums, announcements and specifications for assessed material will be made available on the course Moodle website (accessible through myUNSW).

## Additional Costs

n/a

## Course Evaluation and Development

This course will be evaluated through the online MyExperience process at the end of session. Individual lecturers may also distribute surveys on their own teaching. Feedback from these surveys is taken seriously and you are encouraged to respond. This is the second year in which the course is offered; feedback indicated that having additional course staff would be helpful, and this is planned for 2023.

## Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Michael Bain	<a href="mailto:m.bain@unsw.edu.au">m.bain@unsw.edu.au</a>				No	No
	COURSE EMAIL	<a href="mailto:bi3020@cse.unsw.edu.au">bi3020@cse.unsw.edu.au</a>				No	Yes
Lecturer	Raymond Louie	<a href="mailto:r.louie@unsw.edu.au">r.louie@unsw.edu.au</a>				No	No

## Other Useful Information

### Academic Information

#### I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit / Submit rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's [Special Consideration page](#).

#### II. Administrative matters and links



All students are expected to read and be familiar with UNSW guidelines and policies. In particular, students should be familiar with the following:

- [Attendance](#)
- [UNSW Email Address](#)
- [Special Consideration](#)
- [Exams](#)
- [Approved Calculators](#)
- [Academic Honesty and Plagiarism](#)
- [Equitable Learning Services](#)

### III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

*Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.*

### Academic Honesty and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: [student.unsw.edu.au/plagiarism](http://student.unsw.edu.au/plagiarism). The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student

Misconduct Procedures are available here:

[www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf](http://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf)

## Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

## Faculty-specific Information

[Engineering Student Support Services](#) – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

[Engineering Industrial Training](#) – Industrial training questions

[UNSW Study Abroad](#) – study abroad student enquiries (for inbound students)

[UNSW Exchange](#) – student exchange enquiries (for inbound students)

[UNSW Future Students](#) – potential student enquiries e.g. admissions, fees, programs, credit transfer

## Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

## School Contact Information

**CSE Help!** - on the Ground Floor of K17

- For assistance with coursework assessments.

**The Nucleus Student Hub** - <https://nucleus.unsw.edu.au/en/contact-us>

- Course enrolment queries.

**Grievance Officer** - [grievance-officer@cse.unsw.edu.au](mailto:grievance-officer@cse.unsw.edu.au)

- If the course convenor gives an inadequate response to a query or when the courses convenor does not respond to a query about assessment.

**Student Reps** - [stureps@cse.unsw.edu.au](mailto:stureps@cse.unsw.edu.au)

- If some aspect of a course needs urgent improvement. (e.g. Nobody responding to forum queries, cannot understand the lecturer)

You should **never** contact any of the following people directly:

- Vice Chancellor
- Pro-vice Chancellor Education (PVCE)
- Head of School
- CSE administrative staff
- CSE teaching support staff

They will simply bounce the email to one of the above, thereby creating an unnecessary level of indirection and a delay in the response.