Faculty of Engineering
The Graduate School of Biomedical Engineering

Term 3, 2022

BIOM9450 (Medical & Health Informatics)

COURSE DETAILS

Units of Credit	6
Contact hours	3 hours per week
Lecture (most weeks)	Tue 05:00PM - 06:30PM Online
Tutorial/Laboratory	Thu 11:30PM - 1:00PM Online & in person
	Thu 1:00PM - 2:30PM Online & in person
Course Coordinator	Hamid Alinejad Rokny Room 1002, Level 1, E26 Building Phone 9385 1725; E-mail: h.alinejad@unsw.edu.au
Lecturer	Hamid Alinejad Rokny (HAR)
Guest Lecturers:	Daniel Al Mouiee (UNSW Sydney) Mahdieh Labani (UNSW Sydney)
Demonstrator:	Daniel Al Mouiee (DAM), d.almouiee@unsw.edu.au Mahdieh Labani (ML), m.labani@unsw.edu.au Aravind Venkateswaran (AV), a.venkateswaran@student.unsw.edu.au

INFORMATION ABOUT THE COURSE

Background

Welcome to “Medical Informatics”. This course deals primarily with teaching you an appreciation of “Informatics as it applies to health” (information processing and communications applications in medical care). This is an introductory subject. However, in order to cover the material necessary to give you adequate practical database programming and web publishing skills, you will be required to devote significant amounts of time to reading lecture and reference materials, and in performing the prescribed programming tasks.

Accompanying the lecture program is a substantial set of tutorial and laboratory tasks. We will be teaching the **practical component in the ‘Green Room’ Computer Laboratories on the fifth floor of the Samuels building (depending on the COVID-19 situation)**. However, at this stage it is highly unlikely that we will be able to return to face-to-face laboratories and this the classes will run in an on-line mode. Outside of formal class times, it will be possible to access this room for work on tutorials and the major project. There are GSBmE guidelines on computer use that need to be followed.

By the end of week 1, accounts will have been set up for you on our Windows file server. Also a private directory for you to safely store your work will be allocated on the server. The laboratories will be accessible using a swipe card system based on your student card. This access will also be arranged during the first two weeks of semester.

BIOM9450 is a 6 UOC course and it is expected that you will devote a minimum of 8 hours per week to this course. In addition to the 3 hours in class, you should spend 5 hours per week reading lecture and reference materials and working on tutorial problems and assignments. This is particularly the case if you have not been exposed to programming, databases or web design.

Presumed knowledge

While no programming or database skills are required, some basic knowledge of HTML, structured query language or web page development would certainly be helpful.

HANDBOOK DESCRIPTION

www.handbook.unsw.edu.au/undergraduate/courses/current/BIOM9450.html

This course introduces the field of biomedical and health informatics, which is a developing body of knowledge and a set of techniques concerning the organisational management of information in support of improved patient care and health outcomes. The course includes an introduction to informatics and information systems, evidence-based medicine and clinical decision support. Aspects of database design, normalisation and structured query language (SQL), HTML, Javascript and middleware software for creating dynamic web pages capable of supporting electronic health records.

OBJECTIVES

This course introduces the field of “medical informatics”. Medical informatics is a developing

body of knowledge and a set of techniques concerning the organizational management of information in support of medical research, education, and patient care. Medical informatics combines medical science with several technologies and disciplines in the information and computer sciences and provides methodologies by which these can contribute to better use of the medical knowledge base and ultimately to better medical care.

TEACHING STRATEGIES

This course consists of integrated lecture and practical work. Problem solving is an essential component of this subject. A Moodle courseware module has been established for this course. Upcoming tutorial tasks, discussion groups and lecture notes and resource materials will be made available on this site during semester. Please look at announcements on Moodle for last minute changes. Assessments and feedback on practical work will be regularly provided to the students.

For the practical component and considering the relatively small number of students enrolled in this elective subject, more effective learning can be achieved by replacing formal lectures on computer applications with self-directed learning tasks. We shall be teaching PHP scripting software along with some basic Javascript and HTML. You will be given a package containing a set of tasks and accompanying resources (including textbooks, on-line help, web references, etc.). To make effective use of the package and your time you must read the lecture notes and relevant references before the corresponding laboratory and decide which areas you are having difficulty in understanding or which areas require further explanation.

Be aware that any computer-based task is a skill that needs time and practice to develop. Even though it is important to read a textbook on databases and web-publishing and to discuss concepts in lectures, **there is no substitute for hands-on computing.**

RELATIONSHIP TO OTHER COURSES

BIOM9450 is one of the few courses in GSBmE that deals with computing and informatics. In 2019 it had a name change from “Clinical Information Systems” but the course content remains substantially the same. Other courses that deal with more analytical aspects of biomedical computing include BIOM9621 (Biological Signal Analysis) and BIOM9711 (Modelling Organs, Tissues and Devices) that provides a practical overview of computational modelling in bioengineering, focusing on a range of applications including electrical stimulation of neural and cardiac tissues.

EXPECTED LEARNING OUTCOMES

On completion of this course, the student should have gained knowledge, concepts and skills in the following areas. Note that learning outcomes are annotated as *Ln* and these are cross-referenced in the Assessment schedule.

- *L1:* Fundamental understanding of the subject matter of biomedical health informatics including an overview of the use of computers and information in health care and a knowledge of common standards.

- *L2:* Understanding the differences between data, information and knowledge as it applies to medicine and the advantages and applications of different database topologies and network schemes.

- *L3:* Familiarity and skills in relational database programs, structured query language (SQL), developing and publishing web pages in HTML, dynamic web page creation by linking relational databases with HTML through SQL, and other scripting languages.

These learning outcomes relate most strongly to the following UNSW graduate outcomes. Scholars who are:

- understanding of their discipline in its interdisciplinary context
- capable of independent and collaborative enquiry
- rigorous in their analysis, critique and reflection
- able to apply their knowledge and skills to solving problems
- information and digitally literate

As well the learning outcomes foster professionals who are capable of independent, self-directed practice and they are also moderately related to fostering leaders who are capable of being enterprising, innovative and creative.

COMMUNICATION DURING LECTURE

In addition to Microsoft TEAMS, we will use the following tools/interfaces during the lecturers; please become famileir yourself with these web-based tools:

- **https://www.slido.com**
- **https://www.polleverywhere.com**

ASSESSMENT

There will be hand-in tutorial questions, end of semester quiz+computer exam and a major project. There will also be a final examination consisting of both qualitative and quantitative short-answer questions. The following criteria will be applied in assessing your work:

- evidence of critical understanding of the concepts developed in the course
- ability to apply these concepts to a range of software problems
- clarity of description, explanation and attention to the focus of the assessment task
- degree to which the material submitted for assessment addresses the specified requirements.

Assessment	Contribution	Comment
Diagnostic exam	0%	In week 1, we will ask you to answer some simple questions. This will help us to have an understanding of your background and skills.
Tutorials/Hand in Questions	40%	A major aspect of this course is practical computing skills. You will complete practicals and hand in assessments in the areas of database design, structured query language, Javascript and HTML and dynamic web page development (PHP). Assignments should be submitted on time. Marks may be deducted for late submission without prior approval. Learning outcomes focus on L3 but also include aspects of L2 and L1. Related graduate capabilities include: • understanding of the discipline in its interdisciplinary context. • rigorous in analysis, critique and reflection. • able to apply knowledge and skills to solving problems. • information and digitally literate. You have the opportunity to evaluate your understanding of each lecture by answering weekly assignments (W2, W3, W4, W5). These assignments will be based on the material presented in each week. This is an individual assignment and should be done by each student, separately.
Final exam	20%	An exam is scheduled at the end of semester. It comprises part written exam (10%) and part computer-based practical exam (10%). This assessment is a direct test of the degree to which the knowledge-based learning outcomes listed above have been achieved. If you have successfully completed the practical component of the course, then you should have no difficulty with the computer-based exam. Similarly, the written component

		of the exam should present no problems to people who have attended and participated in the lectures. Learning outcomes are primarily L1 for the written part and L3 for the computer-based part. Related graduate capabilities include: • understanding of the discipline in its interdisciplinary context. • rigorous in analysis, critique and reflection. • able to apply knowledge and skills to solving problems. • capable of independent and collaborative enquiry.
Project	40%	A major assessment component of this course is a computer-based project that integrates information form the lectures and practicals to produce a workable system that encompasses one aspect of a medical information system. This assessment is a direct test of the degree to which the knowledge-based learning outcomes listed above can be practically applied. Learning outcomes are primarily L3. Related graduate capabilities include: • capable of independent, self-directed practice. • capable of being enterprising, innovative and creative. Practically, we will give you access to the materials that are needed for the Major project after week 5, but it will be announced in week 3 to give you a big picture of what you need to do in the Major project. The Major project must be delivered by the due date (*will be announced later*). This task is an example of team-based learning. Therefore, we will divide students into groups with 3 members. The tasks will be divided between the team members to deliver the whole project. Students will be assigned into groups based on their diagnostic assessment test result. For example, Jimmy (who got a high-level score in the diagnostic assessment test), Hannah (who got a mid-level score), and Karen (who got a low-level score) will be in a same group. *How will we assess the main project?* • The score will be divided as below: • 30% of the score for individual group member contribution to the project (we will ask each member to run the healthcare system and provide an explanation about the scripts). • 70% will go for the whole project. This includes the final product (60%) + written report (10%).

		• Individual team member assessment will be based on the task that each team member is responsible for. • We will make a TEAMS channel (under the main TEAMS channel) for each team, separately. *How can you deliver your Major project?* • We will give you 15 minutes to deliver your Major project to the instructor. You need to show that your healthcare system works without any issue. • The healthcare system can be run either on i) your own machine; ii) Green room machines. • You can present the Major project either F-2-F (depending on the COVID-19 situation) or through Microsoft TEMAS. • All group members should be in the presentation and must be able to run and explain the product (their healthcare system).
Bonus (Individual contribution to the TEAMS discussions)	5%	The main purpose of team-based learning is to learn from each other. We have allocated a 5% Bonus for your contribution in your group discussion. This will be assessed by the number of your contribution in the discussions in the TEAMS channel. For example, if there are 5 discussions in your TEAMS channel, and Jimmy contributed to 4 of them actively, he will get 4% of the score (out of 5%). This will be evaluated by the course coordinator/lecturer. The TEAMS channel discussion should be related to either i) the proposed main project; ii) or weekly assignments.

RELEVANT RESOURCES

Moodle and Microsoft TEAMS channel is the main resource for this course. On the Moodle page and Microsoft TEAMS channel, I will also include links to online training in areas such as SQL, relational databases, HTML, Javascript and PHP that are provided free to UNSW students through LYNDA. These will be your best resource. There is no prescribed text, but useful reference books include:

- "Biomedical informatics: computer applications in health care and biomedicine", 3rd Ed. Shortliffe et al. (2006) (S610.285/59)
- "Medical informatics: computer applications in health care and biomedicine", Wiederhold et al. (2001) (MB610.285/23 B)
- "Guide to Medical Informatics, The Internet and Telemedicine" 2nd Ed. Coiera (2001) (MB025.0661/24 E)

- "Handbook of Medical Informatics" J. van Bemmel, M. Mussen (Eds) (1997) (MB610.285/43)
- "Healthcare Data Analytics" J. K. Reddy, M. C. Aggarwal (2015)
- Many web resources on "Medical Informatics" or "Health Informatics"
- "SQL for Dummies", A.G. Taylor, IDG Books, 2001.
- HTML guides **http://www.htmlgoodies.com/primers/html**
- PHP Tutorial **http://devzone.zend.com/tag/PHP101** (numerous other web resources exist)
- **https://www.w3schools.com**
- PHP Manual **http://php.net/manual/en/index.php**
- "How to do Everything with Dreamweaver MX", M. Meadhra, McGraw Osborne, 2002.
- Learning Relational Databases **https://www.lynda.com/Access-tutorials/Learning-Relational-Databases/604214-2.html**

COURSE EVALUATION AND DEVELOPMENT

Anonymous student feedback on the course and the lecturers in the course is gathered periodically using the university's myExperience Process. Your feedback is much appreciated and taken very seriously. Continual improvements are made to the course based in part on such feedback and this helps us to improve the course for future students. In the past, students suggested that they needed more time for completing practical work and many felt that they would benefit more from open-source or more accessible tools. PHP scripting language is used for dynamic web page creation. The use of PHP received positive responses because it is open source and commonly used. However, we recognised that there is a great deal to learn so we will place more emphasis on PHP and less on other programming tasks such as Javascript. We will provide more links to online teaching resources through LYNDA for those not so familiar with programming. We will also move the computer-based quiz from the final week of term to the exam block to give more time for completing the major project. This is especially the cause in 2021 with the shorter term times.

DATES TO NOTE

Refer to MyUNSW for Important Dates available at:
https://my.unsw.edu.au/student/resources/KeyDates.html

PLAGIARISM

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise will have their names entered on plagiarism register and will be liable to disciplinary action, including exclusion from enrolment.

It is expected that all students must at all times submit their own work for assessment. Submitting the work or ideas of someone else without clearly acknowledging the source of borrowed material or ideas, is plagiarism.

All assessments which you hand in **must** have a **Non Plagiarism Declaration Cover Sheet**. This is for both individual and group work. Attach it to your assignment before submitting it to the Course Coordinator or at the School Office.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at: **https://student.unsw.edu.au/plagiarism**

ACADEMIC ADVICE

UNSW has a wide range of student support services. You can find useful information in the following links:

student conduct policy: **https://student.unsw.edu.au/conduct**

Academic misconduct procedure:

https://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Other information:

http://www.student.unsw.edu.au

https://my.unsw.edu.au/student/howdoi/HowDoI_MainPage.html

http://www.counselling.unsw.edu.au

In case, if you need some adjustment in teaching or learning environment you are encouraged to discuss your situation with your course coordinator. For more information look at here: **https://student.unsw.edu.au/els**

For information about:

- Notes on assessments and plagiarism,
- Special Considerations,
- School Student Ethics Officer, and
- BESS

Refer to the School website available at:

http://www.engineering.unsw.edu.au/biomedical-engineering/

LECTURE/TUTORIAL PROGRAM

week	Lab/Lec	date	who	subject	90 minutes, unless specified
1	Lecture	13 Sep	HAR	Introduction to medical informatics and Database intro	17:00 - 20:00
2	Lab	15 Sep	DAM & ML & AV	Introduction to medical informatics and Database intro	11:30 - 13:00 13:00 - 14:30
2	Lecture	20 Sep	HAR & DAM	GitHub	17:00 - 18:30
2	Lab	22 Sep	DAM & ML & AV	GitHub	11:30 - 13:00 13:00 - 14:30
3	Lecture	27 Sep	HAR	Structured Query Language (SQL)	17:00 - 18:30
3	Lab	29 Sep	DAM & ML & AV	Structured Query Language (SQL)	11:30 - 13:00 13:00 - 14:30
4	Lecture	4 Oct	HAR	Hypertext Markup Language (HTML) forms and Dreamweaver	17:00 – 18:30
4	Lab	6 Oct	DAM & ML & AV	Hypertext Markup Language (HTML) forms and Dreamweaver	11:30 - 13:00 13:00 - 14:30
5	Lecture	11 Oct	HAR	Javascript	17:00 - 18:30
5	Lab	13 Oct	DAM & ML & AV	Javascript	11:30 - 13:00 13:00 - 14:30
6	Break	18 Oct	-	Major project	No Lecture, No Lab
7	Lecture	25 Oct	HAR	PHP basics	17:00 - 18:30
7	Lab	27 Oct	DAM & ML & AV	PHP basics	11:30 - 13:00 13:00 - 14:30
8	Lecture	1 Nov	HAR & ML	PHP & SQL database; developing website in Python	17:00 - 18:30
8	Lab	3 Nov	DAM & ML & AV	Project	11:30 - 13:00 13:00 - 14:30
9	Lecture	8 Nov	HAR	XML and AJAX	17:00 - 18:30
9	Lab	10 Nov	DAM & ML & AV	Project	11:30 - 13:00 13:00 - 14:30
10	Lecture	15 Nov	HAR	Introduction to Bio-Data Informatics and Clinical decision systems	17:00 - 18:30
10	Lab	17 Nov	DAM & ML & AV	Project	11:30 - 13:00 13:00 - 14:30

COURSE CONTENT IN DETAILS

Week/subjects	Topics
Week 1: Introduction to Medical Informatics and Database Intro	• What is data science not? • Data science is not machine learning • Data science is not statistics • Data science is not big data • Data science is one of the best jobs • Health data science • Data formats • Interdisciplinary Nature of Biomedical Informatics • Lack of Adoption of Computers/Informatics in Clinical Care • Healthcare Sectors • Uses and advantages of an electronic medical record (EMR) • Databases and database management systems (DBMS) • Data types • Relational database topology • Indexes, keys and referential integrity • Database design • Database normalisation
Week 2: GitHub	• Software development history • What is Version Control (VC)? • Version Control usage motivation. • What is Git? • Basic Git workflows and syntax: • Cloning • Pulling • Adding • Committing • Pushing • Git branching: • Checking out • Merging • Git hands-on example • What is GitHub? • Basic GitHub Workflow • Repository creation • Project management using Issues • Pull requests • Actions • GitHub Hands on example • Real world examples of open-source GitHub repository
Week 3: Structured Query Language (SQL)	• Why do we Need Queries? • DBMS Languages • Structured Query Language (SQL) • Data types • Tables in SQL • SQL Operators • SQL Query • Nested Queries • Petstore Database • Sample Questions

Week 4: Hypertext Markup Language (HTML) Forms and Dreamweaver	• Programming in HTML • Hypertext Markup Language • HTML Editor • Hypertext & HTML • Headings, Tags, Nested Tags • Structure of a Web Page • Tags vs. Elements • Structural Elements • Simple HTML Program • HTML Text Tags: Paragraph Tag • HTML Formatting Tags • HTML Horizontal Rule • HTML font, alignment • HTML LIST, Nested Lists • HTML Character Entities • Linking, Anchors • Mailto • Inserting Images • HTML map • Basic Colour Names • Tables • cellpadding • Frames • HTML Forms • Password • Checkbox, list box, etc • Submit Button • Dreamweaver
Week 5: Javascript	• Why JavaScript? • What is JavaScript? • Basic JavaScript Syntax • Scripts in HEAD or BODY • Functions in the BODY and HEAD • Functions in external file • Variables • Data Conversion • Arithmetic and Logical Operators • Statements & Loops • Literals • Sample Code • Object Oriented Programming • Class and Object Example • The main JavaScript Objects • Core Objects – Regular Expressions • Browser Objects • HTML Objects • HTML Objects – documents • HTML Objects – Events • Event Example - OnLoad
Week 6: Break (No Lecture, No Lab)	Break (No Lecture, No Lab)
Week 7: PHP Basics	• What is PHP? • Basic syntax

	• Variables • Echoconstruct • Strings • String concatenation • Heredoc • Operators • Pre/post – increment/decrement • Include file, Require file • if, if else, elseif • Switch • Functions • Arrays • 'for' loops • 'foreach' loop • 'while' and 'do while' loops • GET and HTML forms • POST and HTML forms • HTML entities
Week 8: PHP & SQL database, Synapse Analytics, Data Governance	• Files – fwrite • Files – fopen, fclose • Files – fread • Files – unlink (delete) • Files – upload • Files – upload • Files – permissions • Strings • PHP Date • Sessions • Cookies • ODBC • PHP database connection • SQL queries from PHP • Retrieving SQL query results • Some MS Access SQL • More PHP ODBC functions? • What is Python? • Python for web development • The importance of using Python for building a website • Examples of Sites Created Using Python • What is front-end development? • What is the backend development? • Key Differences Between Front-End vs. Back-End • Introduction of more popular Python web development frameworks • Developing a website with the Django framework • Developing a website with the Flask framework
Week 9: AJAX and XML	• What is XML • XML tree • XML elements, XML attributes • XML namespaces • XML httprequest • XML DOM • XML query • What is AJAX?

	• The XMLHttpRequest Object • AJAX request • AJAX Server Response • AJAX XML • AJAX PHP • AJAX Database • AJAX Examples
Week 10: Introduction to Bio-Data Informatics and Clinical decisions systems	• What is data science? • A few data science examples • Quantitative Data • CSV (comma separate value) files • NGS data • Qualitative Data • extensible markup language) files and strings • JSON (Javascript object notation) files and strings • Image data • Machine learning in the analysis of health data • What is ML? • ML models • Support vector machine • Neural network • Decision tree • Clustering • Classification • Deep learning • Example of ML in health data • Bioinformatics • What is bioinformatics • Genomics • Human genome • Genome structure • Components of the human genome • Data types in bioinformatics • FASTA, FASTQ, BAM, VCF • Genomic data • variants • SNP (DNA-Seq Somatic Variant Analysis) • Insertion and deletion • Copy number variation (Copy Number Variation Analysis) • GWAS • Expression • RNA-Seq (RNA-Seq Gene Expression Analysis) • Chromatin • Chromatin Immunoprecipitation Sequencing (ChIP-Seq) • MACS2 • Genotype or phenotype • How can we identify genomic variants? • NGS • Whole genome sequencing • Whole exome sequencing • The pipeline • Geneious as an example • Clinical decisions systems

APPENDIX: ENGINEERS AUSTRALIA (EA) PROFESSIONAL ENGINEER COMPETENCY STANDARD

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.	YES
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.	YES
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline.	YES
PE1.4 Discernment of knowledge development and research directions within the engineering discipline.	YES
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline.	YES
E1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline.	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving.	YES
PE2.2 Fluent application of engineering techniques, tools and resources.	YES
PE2.3 Application of systematic engineering synthesis and design processes.	
PE2.4 Application of systematic approaches to the conduct and management of engineering projects.	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability.	
PE3.2 Effective oral and written communication in professional and lay domains.	YES
PE3.3 Creative, innovative and pro-active demeanour.	
PE3.4 Professional use and management of information.	YES
PE3.5 Orderly management of self, and professional conduct.	
PE3.6 Effective team membership and team leadership	YES