UNSW Course Outline

ACTL3143 Artificial Intelligence and Deep Learning Models for Actuarial Applications - 2024

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General Course Information

Course Code : ACTL3143
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : UNSW Business School
Academic Unit : School of Risk and Actuarial Studies
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Advances in artificial intelligence and machine learning - especially in deep learning methods -

are creating products and services with the potential to change the insurance industry and actuarial work. This course will introduce students to concepts in Artificial Intelligence (AI), with particular focus on deep learning models, and their applications to risk and insurance. A particular focus of the course will be on how those AI models can be combined with other actuarial techniques in order to solve business problems in insurance and risk management including pricing, reserving and capital management, and insurance business processes. Students will be expected to understand the theory behind the models considered and their relationship to other actuarial techniques, and to fit and evaluate various deep learning models using appropriate software.

Course Aims

There are two main differences between this course and generic computer science treatment of deep learning. Firstly, the course will highlight deep learning models which can be combined with other actuarial techniques (e.g. claim frequency modelling with GLMs, mortality forecasting). Secondly, the assumed knowledge for the course is tailored to actuarial students. Only a minimal coding experience is assumed (e.g. the basics of variables, control flow, functions), and the required coding concepts in Python will be taught in the lectures.

This course will complement the machine learning methods covered in ACTL3142 Actuarial Data and Analysis.

Course Learning Outcomes

Course Learning Outcomes	Program learning outcomes
CLO1 : Develop an understanding of artificial intelligence techniques and their potential application in insurance business processes	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO2 : Understand and explain the key features of various deep neural networks and their applications to various specialist areas of actuarial studies and insurance tasks, including highlighting their differences and limitations	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication • PLO5 : Responsible Business Practice
CLO3 : Implement deep neural networks using deep learning software and real world datasets	• PLO2 : Problem Solving • PLO3 : Business Communication
CLO4 : Combine deep neural networks with other actuarial techniques to solve problems in various types of insurance business, including pricing, reserving, and capital management	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication • PLO5 : Responsible Business Practice
CLO5 : Apply effective communication, discussion and report writing skills when interpreting results from deep learning algorithms and artificial intelligence systems	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication • PLO5 : Responsible Business Practice
CLO6 : Understand the ethical considerations related to the data colllection, design and implementation of various AI and deep learning models for actuarial and insurance applications	• PLO1 : Business Knowledge • PLO3 : Business Communication • PLO5 : Responsible Business Practice

Course Learning Outcomes	Assessment Item
CLO1 : Develop an understanding of artificial intelligence techniques and their potential application in insurance business processes	• Storywall Discussion forums • Assignment • Final Exam
CLO2 : Understand and explain the key features of various deep neural networks and their applications to various specialist areas of actuarial studies and insurance tasks, including highlighting their differences and limitations	• Storywall Discussion forums • Assignment • Final Exam
CLO3 : Implement deep neural networks using deep learning software and real world datasets	• Storywall Discussion forums • Assignment
CLO4 : Combine deep neural networks with other actuarial techniques to solve problems in various types of insurance business, including pricing, reserving, and capital management	• Final Exam • Storywall Discussion forums • Assignment
CLO5 : Apply effective communication, discussion and report writing skills when interpreting results from deep learning algorithms and artificial intelligence systems	• Final Exam • Storywall Discussion forums • Assignment
CLO6 : Understand the ethical considerations related to the data colllection, design and implementation of various AI and deep learning models for actuarial and insurance applications	• Final Exam • Storywall Discussion forums • Assignment

Learning and Teaching Technologies

Moodle - Learning Management System | Zoom | Echo 360 | EdStem

Learning and Teaching in this course

This course consists of:

- Self-study course material available on the course Moodle website (e.g. textbook chapters, lecture notes, exercises),

- Weekly lectures,

- Weekly labs, and

- Weekly consultation times.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates	Program learning outcomes
Storywall Discussion forums Assessment Format: Individual	30%	Start Date: Week 1 Due Date: Throughout term, see Moodle for details	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication • PLO5 : Responsible Business Practice
Assignment Assessment Format: Individual	40%	Start Date: Week 2 Due Date: The milestones will be due around weeks 5, 8, and 9 respectively, though see the Moodle page for the specific dates.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication • PLO5 : Responsible Business Practice
Final Exam Assessment Format: Individual	30%	Start Date: Not Applicable Due Date: Not Applicable	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication • PLO5 : Responsible Business Practice

Assessment Details
Storywall Discussion forums

Assessment Overview

These are aimed at encouraging students to keep up with the course materials.

Course Learning Outcomes

- CLO1 : Develop an understanding of artificial intelligence techniques and their potential application in insurance business processes
- CLO2 : Understand and explain the key features of various deep neural networks and their applications to various specialist areas of actuarial studies and insurance tasks, including highlighting their differences and limitations
- CLO3 : Implement deep neural networks using deep learning software and real world datasets
- CLO4 : Combine deep neural networks with other actuarial techniques to solve problems in various types of insurance business, including pricing, reserving, and capital management
- CLO5 : Apply effective communication, discussion and report writing skills when interpreting results from deep learning algorithms and artificial intelligence systems
- CLO6 : Understand the ethical considerations related to the data colllection, design and implementation of various AI and deep learning models for actuarial and insurance

applications

<u>Detailed Assessment Description</u>

The course offers formative activities to practice the concepts you have learned each week and aim at encouraging students to keep up with the course materials. These activities will reinforce your learning and help you identify the areas you need to focus on.

<u>Submission notes</u>

On Moodle

<u>Assignment submission Turnitin type</u>

Not Applicable

Assignment

<u>Assessment Overview</u>

Project involving application of course concepts.

<u>Course Learning Outcomes</u>

- CLO1 : Develop an understanding of artificial intelligence techniques and their potential application in insurance business processes
- CLO2 : Understand and explain the key features of various deep neural networks and their applications to various specialist areas of actuarial studies and insurance tasks, including highlighting their differences and limitations
- CLO3 : Implement deep neural networks using deep learning software and real world datasets
- CLO4 : Combine deep neural networks with other actuarial techniques to solve problems in various types of insurance business, including pricing, reserving, and capital management
- CLO5 : Apply effective communication, discussion and report writing skills when interpreting results from deep learning algorithms and artificial intelligence systems
- CLO6 : Understand the ethical considerations related to the data colllection, design and implementation of various AI and deep learning models for actuarial and insurance applications

<u>Detailed Assessment Description</u>

There will be a major assignment task involving the practical application of deep learning concepts in the course. It will also assess critical analysis and problem solving skills as well as communication skills, and correspond to course learning outcomes, and program learning goals.

The project will be submitted in stages:

1. Report Part 1 (10%),

2. Recorded Presentation (15%),

3. Report Part 2 (15%).

<u>Assessment Length</u>

5 pages

<u>Submission notes</u>

See lectures and Moodle for specific instructions.

<u>Assignment submission Turnitin type</u>

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

Final Exam

<u>Assessment Overview</u>

The examination will aim to assess the achievement of the learning course outcomes.

<u>Course Learning Outcomes</u>

- CLO1 : Develop an understanding of artificial intelligence techniques and their potential application in insurance business processes
- CLO2 : Understand and explain the key features of various deep neural networks and their applications to various specialist areas of actuarial studies and insurance tasks, including highlighting their differences and limitations
- CLO4 : Combine deep neural networks with other actuarial techniques to solve problems in various types of insurance business, including pricing, reserving, and capital management
- CLO5 : Apply effective communication, discussion and report writing skills when interpreting results from deep learning algorithms and artificial intelligence systems
- CLO6 : Understand the ethical considerations related to the data colllection, design and implementation of various AI and deep learning models for actuarial and insurance applications

<u>Detailed Assessment Description</u>

The exam will test the concepts presented in the lectures.

<u>Submission notes</u>

See lectures & Moodle for further details.

<u>Assignment submission Turnitin type</u>

Not Applicable

General Assessment Information

As a student at UNSW you are expected to display academic integrity in your work and interactions. Where a student breaches the UNSW Student Code with respect to academic

integrity, the University may take disciplinary action under the Student Misconduct Procedure. To assure academic integrity, you may be required to demonstrate reasoning, research and the process of constructing work submitted for assessment.

To assist you in understanding what academic integrity means, and how to ensure that you do comply with the UNSW Student Code, it is strongly recommended that you complete the Working with Academic Integrity module before submitting your first assessment task. It is a free, online self-paced Moodle module that should take about one hour to complete.

Grading Basis

Standard

Requirements to pass course

In order to pass this course students must:

- Achieve a composite mark of at least 50 out of 100
- Engage actively in course learning activities and attempt all assessment requirements
- Meet any additional requirements specified in the assessment details
- Meet the specified attendance requirements of the course

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 May - 2 June	Lecture	Artificial Intelligence, Neural Networks, and Python
Week 2 : 3 June - 9 June	Lecture	Keras Deep Learning for Tabular Data
Week 3 : 10 June - 16 June	Lecture	Computer Vision
Week 4 : 17 June - 23 June	Lecture	Natural Language Processing
Week 5 : 24 June - 30 June	Lecture	Recurrent Neural Networks
Week 6 : 1 July - 7 July	Other	Flexibility week - no classes
Week 7 : 8 July - 14 July	Lecture	Advanced Topics
Week 8 : 15 July - 21 July	Lecture	Advanced Topics
Week 9 : 22 July - 28 July	Lecture	Advanced Topics
Week 10 : 29 July - 4 August	Lecture	Advanced Topics and Exam Preparation

Attendance Requirements

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

Course Resources

Prescribed Resources

Course website

The website for this course is on [Moodle](#).

The course will use various digital resources, but they all will be linked from Moodle.

To access the Moodle online support site for students, follow the links from that website to UNSW Moodle Support/Support for Students. Additional technical support can be obtained from itservicecentre@unsw.edu.au (02 9385 1333).

All course contents will be available from the course website. It is essential that you visit the site regularly to see any notices posted there by the course coordinator, as it will be assumed that they are known to you within a reasonable time.

Textbooks

There are many books of relevance to the course topics. The following book will be the main text references for a substantial part of the course: Aurélien Géron's textbook *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* (2nd or 3rd Edition), available digitally via UNSW Library's O'Reilly subscription.

Additional readings from the professional actuarial literature will also be used to provided additional context, details, and examples. This will be communicated in the course website.

Course Evaluation and Development

Feedback is regularly sought from students and continual improvements are made based on this feedback. At the end of this course, you will be asked to complete the myExperience survey, which provides a key source of student evaluative feedback. Your input into this quality enhancement process is extremely valuable in assisting us to meet the needs of our students and provide an effective and enriching learning experience. The results of all surveys are carefully considered and do lead to action towards enhancing educational quality.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Patrick Laub					Yes	Yes

Other Useful Information
Academic Information

COURSE POLICIES AND SUPPORT

The Business School expects that you are familiar with the contents of this course outline and the UNSW and Business School learning expectations, rules, policies and support services as listed below:

- Program Learning Outcomes
- Academic Integrity and Plagiarism
- Student Responsibilities and Conduct
- Special Consideration
- Protocol for Viewing Final Exam Scripts
- Student Learning Support Services

Further information is provided on the key policies and support page.

Students may not circulate or post online any course materials such as handouts, exams, syllabi or similar resources from their courses without the written permission of their instructor.

STUDENT LEARNING OUTCOMES

The Course Learning Outcomes (CLOs) – under the Outcomes tab – are what you should be able to demonstrate by the end of this course, if you participate fully in learning activities and successfully complete the assessment items.

CLOs also contribute to your achievement of the Program Learning Outcomes (PLOs), which are developed across the duration of a program. PLOs are, in turn, directly linked to UNSW graduate capabilities. More information on Coursework PLOs is available on the key policies and support page. For PG Research PLOs, including MPDBS, please refer to the UNSW HDR Learning Outcomes.

Academic Honesty and Plagarism

As a student at UNSW you are expected to display academic integrity in your work and interactions. Where a student breaches the UNSW Student Code with respect to academic integrity, the University may take disciplinary action under the Student Misconduct Procedure. To assure academic integrity, you may be required to demonstrate reasoning, research and the

process of constructing work submitted for assessment.

To assist you in understanding what academic integrity means, and how to ensure that you do comply with the UNSW Student Code, it is strongly recommended that you complete the [Working with Academic Integrity](#) module before submitting your first assessment task. It is a free, online self-paced Moodle module that should take about one hour to complete.

Submission of Assessment Tasks

SPECIAL CONSIDERATION

You can apply for special consideration when illness or other circumstances beyond your control interfere with your performance in a specific assessment task or tasks, including online exams. Students studying remotely who have exams scheduled between 10pm and 7am local time, are also able to apply for special consideration to sit a supplementary exam at a time outside of these hours.

Special consideration is primarily intended to provide you with an extra opportunity to demonstrate the level of performance of which you are capable. To apply, and for further information, see Special Consideration on the UNSW [Current Students](#) page.

Special consideration applications will be assessed centrally by the Case Review Team, who will update the online application with the outcome and add any relevant comments. The change to the status of the application immediately sends an email to the student and to the assessor with the outcome of the application.

Please note the following:

1. Applications can only be made through Online Services in myUNSW (see the UNSW [Current Students](#) page). Applications will not be accepted by teaching staff. The lecturer-in-charge/ course coordinator will be automatically notified when your application is processed.
2. Applying for special consideration does not automatically mean that you will be granted a supplementary exam or other concession.
3. If you experience illness or misadventure in the lead up to an exam or assessment, you must submit an application for special consideration, either prior to the examination taking place, or prior to the assessment submission deadline, except where illness or misadventure prevent you from doing so.
4. If your circumstances stop you from applying before your exam or assessment due date, you must apply within 3 working days of the assessment or the period covered by your supporting documentation.

5. Under the UNSW Fit To Sit/Submit rule, if you sit the exam/submit an assignment, you are declaring yourself well enough to do so and are cannot subsequently apply for special consideration.
6. If you become unwell on the day of – or during – an exam, you must stop working on your exam, advise your course coordinator or tutor and provide a medical certificate dated within 24 hours of the exam, with your special consideration application. For online exams, you must contact your course coordinator or tutor immediately via email, Moodle or chat and advise them you are unwell and submit screenshots of your conversation along with your medical certificate and application.
7. Special consideration requests do not allow the awarding of additional marks to students.

Further information on Business School policy and procedure can be found under "Special Consideration" on the key policies and support page.

LATE SUBMISSION PENALTIES

For assessments other than examinations, late submission will incur a penalty of 5% per day or part thereof (including weekends) from the due date and time. An assessment will not be accepted after 5 days (120 hours) of the original deadline unless special consideration has been approved. An assignment is considered late if the requested format, such as hard copy or electronic copy, has not been submitted on time or where the 'wrong' assignment has been submitted.

For assessments which account for 10% or less of the overall course grade, and where answers are immediately discussed or debriefed, the LIC may stipulate a different penalty. Details of such late penalties will be available on the course Moodle page.

FEEDBACK ON YOUR ASSESSMENT TASK PERFORMANCE

Feedback on student performance from formative and summative assessment tasks will be provided to students in a timely manner. Assessment tasks completed within the teaching period of a course, other than a final assessment, will be assessed and students provided with feedback, with or without a provisional result, within 10 working days of submission, under normal circumstances. Feedback on continuous assessment tasks (e.g. laboratory and studio-based, workplace-based, weekly quizzes) will be provided prior to the midpoint of the course.

Faculty-specific Information

PROTOCOL FOR VIEWING FINAL EXAM SCRIPTS

UNSW students have the right to view their final exam scripts, subject to a small number of very specific exemptions. The UNSW Business School has set a protocol under which students may view their final exam script. Individual schools within the Faculty may also set up additional local processes for viewing final exam scripts, so it is important that you check with your School.

If you are completing courses from the following schools, please note the additional school-specific information:

- Students in the **School of Accounting, Auditing & Taxation** who wish to view their final examination script should also refer to this page.
- Students in the **School of Banking & Finance** should also refer to this page.
- Students in the **School of Information Systems & Technology Management** should also refer to this page.

COURSE EVALUATION AND DEVELOPMENT

Feedback is regularly sought from students and continual improvements are made based on this feedback. At the end of this course, you will be asked to complete the myExperience survey, which provides a key source of student evaluative feedback. Your input into this quality enhancement process is extremely valuable in assisting us to meet the needs of our students and provide an effective and enriching learning experience. The results of all surveys are carefully considered and do lead to action towards enhancing educational quality.

QUALITY ASSURANCE

The Business School is actively monitoring student learning and quality of the student experience in all its programs. A random selection of completed assessment tasks may be used for quality assurance, such as to determine the extent to which program learning goals are being achieved. The information is required for accreditation purposes, and aggregated findings will be used to inform changes aimed at improving the quality of Business School programs. All material used for such processes will be treated as confidential.

TEACHING TIMES AND LOCATIONS

Please note that teaching times and locations are subject to change. Students are strongly advised to refer to the Class Timetable website for the most up-to-date teaching times and locations.