SUBJECT OUTLINE

94691 Deep Learning

Course area UTS: Transdisciplinary Innovation
Delivery Autumn 2019; City
Credit points 8cp
Requisite(s) 36102 iLab 1
Result type Grade, no marks

Subject coordinator

Mr. Alexander Scriven

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Subject description

This subject gives students a holistic understanding of deep learning, based on readings of research papers, coding exercises and practical assignments. Students become familiar with the underlying principles of deep learning neural networks, as well as with commonly used architectures and their applications. On completion of the subject, students are able to build, test and deploy deep learning models using industry standard software.

Subject learning objectives (SLOs)

Upon successful completion of this subject students should be able to:

1. Form an intuitive and mathematical understanding of Vanilla Neural Networks
2. Articulate the strengths, weaknesses and use cases of a variety of Deep Learning neural network architectures.
3. Implement and optimise a variety of Deep Learning neural network architectures
4. Communicate the selection, training & analysis of deep learning models for business use cases in a context-appropriate manner
5. Synthesise and interpret relevant academic papers as well as other sources of knowledge relating to deep learning to build a model for current progress and potential future directions, commercial applications and ethical implications
6. Understand and utilise the latest work towards visualising and uncovering insights from traditionally ‘black-box’ models.

Course intended learning outcomes (CILOs)

This subject contributes specifically to the development of the following course intended learning outcomes:

- Explore and test models and generalisations for describing the behaviour of sociotechnical systems and selecting data sources, taking into account the needs and values of different contexts and stakeholders (1.2)
- Use transdisciplinary approaches to seeing and doing to uncover underrepresented, or misrepresented, elements of a system (1.4)
- Critique contemporary trends and theoretical frameworks in data science for relevance to one's own practice (2.1)
- Apply and assess data science concepts, theories, practices and tools for designing and managing data discovery investigations in professional environments that draw upon diverse data sources, including efforts to shed light on underrepresented components (2.4)
- Develop, test, justify and deliver data project propositions, methodologies, analytics outcomes and recommendations for informing decision-making, both to specialist and non-specialist audiences (4.3)
- Engage in active, reflective practice that supports flexible navigation of assumptions, alternatives and uncertainty

in professional data science contexts (5.1)

Contribution to the development of graduate attributes

The subject gives students a practical introduction to Deep Learning with a focus on applications. Popular architectures are covered and students are given opportunities to apply and interpret them in realistic settings. Technical skills are developed through practical coding labs and assessment tasks. As this area is developing rapidly, students are also encouraged to develop self-learning skills via assessment tasks that require them to research and assimilate recent and historical papers on the topic.

The subject addresses the following graduate attributes (GA):

GA 1 Sociotechnical systems thinking

GA 2 Creative, analytical and rigorous sense making

GA 3 Create value in problem solving and inquiry

GA 4 Persuasive and robust communication

Teaching and learning strategies

This subject is conducted in 6 face-to-face sessions with weekly activities & readings assigned between classes. The classes are divided into a lecture component and a ‘lab’ component. Each comprising 1-1.5 hours depending on the content for that particular week. The lab components themselves involve two types of activities:

1) 'code together’ sessions in which the instructor and students build understanding through collaboratively coding solutions to problems or implementing the theoretical content of the week.

2) Practical coding tasks for students to complete themselves and in small groups.

Assignments are a mix of practical coding exercises, report writing (to a business stakeholder) and literature reviews. This means that students get exposed to historical and current academic research in the area while developing tangible skills to implement these technologies and communicate highly technical matters to nonspecialist business audiences.

Due to the rapidly advancing nature of this field it is critical for students to develop skills in quickly absorbing, dissecting and understanding academic research and their value to business problems.

Program

Week/Session	Dates	Description
1	11 - 15 Mar	Introduction to Python **Notes:** ○ Python - Basic python (variables, control statements, functions etc)
2	18 - 22 Mar	Python (continued) and calculus **Notes:** ○ Python - numpy and pandas (dataframes, summary stats, math methods, strings and dates) ○ Calculus - derivatives,partial derivatives, chain rule, gradients.
3	25 - 29 Mar	Python (continued) and linear algebra **Notes:** ○ Python - Pandas (selecting (loc + iloc), reshape, sorting, functions, groupby) ○ Linear Algebra - Matrices, multiplication, derivatives, jacobian

4	1 - 5 Apr	Review / work on Assignment 1A
4	4 Apr	**Block session 1: Vanilla neural nets** **Notes:** **Vanilla neural networks** • Introduction to neural networks • Build a neural network from scratch • Assignment 1A briefing
5	8 - 12 Apr	Review / continue working on Assignment 1A
5	11 Apr	**Block Session 2: Training and optimising deep neural networks** **Notes:** **Training & Optimising Deep Neural Networks** ○ Software & Hardware ○ Weight initilisation ○ Optimisation Algorithms ○ Regularisation ○ Tips & Tricks
6	15- 19 Apr	Review Block Session 2 Material / Complete Assignment 1 **Notes:** **Assignment 1A due: 11:59 PM, Sunday April 21st**
	22 - 26 Apr	STUVAC
7	29 Apr - 3 May	Review / Assignment 1B **Notes:** Review notes / start work on Assignment 1B
7	2 May	**Block session 3: Computer Vision** **Notes:** **Computer Vision** • Types of CV tasks • CNN architecture • Classic architectures • Advanced: SSD, YOLO etc • Assignment 1B briefing

8	6 - 10 May	Review / Assignment 1B **Notes:** Review notes / continue working on Assignment 1B
8	9 May	**Block session 4: Sequence Models** **Notes:** **Sequence Models** RNN LSTM
9	13 - 17 May	Review / Assignment 1B **Notes:** Review notes / continue working on Assignment 1B
9	16 May	GANs **Notes:** • GANs • DRL (if time permits) • Assignment 2 briefing
10	20 - 24 May	Review / complete Assignment 1B **Notes:** • Review notes • **Complete and submit Assignment 1B. Due: 11:59 PM, Sunday 26th May**
11	27 - 31 May	Review notes / complete and submit Assignment 2 **Notes:** • Review notes • **Complete and submit Assignment 2 A and B. Due: 11:59 PM, Sunday 2nd Jun.**
11	30 May	Model deployment **Notes:** • Introduction to webapps for hosting models • Basics of JS, HTML, CSS • DJango/Flask webapp framework • Deployment on Heroku/AWS

12	3 - 7 Jun	Work on Assignment 3
13	10 -14 Jun	Work on Assignment 3
14	17 - 21 Jun	Complete and submit Assignment 3 **Notes:** **Due: 11:59 PM, Thursday 20th June**

Additional information

Please note that the official channels for communication with the teaching staff are Canvas and Email. Slack channels are not monitored by staff.

Assessment

Important Note: A detailed Assessment Brief outlining specific requirements for each assessment task will be provided in the relevant block sessions and made available in Canvas. Ensure you consult these briefs ***before*** you undertake the assessment tasks.

Formative feedback will be provided during on-campus sessions.

To request an extension, students should email the subject coordinator in advance. Typically, we will expect to see appropriate evidence of progress made before granting such extensions.

Assessment task 1: Assessment task 1: Building Neural Network Architectures

Intent: Gain hands-on experience building neural network architectures for real-world business cases.

Objective(s): This task addresses the following subject learning objectives:

1, 2, 3, 4 and 6

This assessment task contributes to the development of course intended learning outcome(s):

1.2, 2.4, 4.3 and 5.1

Type: Report

Groupwork: Individual

Weight: 40%

Criteria: (See assessment brief for further details)
Criteria for Part A:

- Rigour in addressing technical brief in terms of completeness and appropriate coverage of test suite (70%)
- Clear, efficient, concise code appropriately commented (20%)
- Effort and results on model extension component (10%)

Criteria for Part B:

- Persuasive justification & discussion of model, technical and architectural choices including assumptions where relevant (30%)
- Insightfulness and quality of results including their assessment, interpretation and recommended next steps (20%)
- Clear, efficient, concise (working) model code appropriately commented (40%)

- Appropriateness of format and communication style of written report (10%)

Criteria linkages:

Criteria	Weight (%)	SLOs	CILOs
Rigour in addressing brief in terms of completeness. Appropriate coverage of test suite (Part A)	26	3	2.4
Clear, efficient, concise code appropriately commented (Part A)	8	1	1.2
Effort and results on model extension component (Part A)	4	1	1.2
Persuasive justification & discussion of model, technical and architectural choices including assumptions where relevant (Part B)	19	6	5.1
Insightfulness and quality of results including their assessment, interpretation and recommended next steps (Part B)	12	2	5.1
Clear, efficient, concise (working) model code appropriately commented (Part B)	25	3	2.4
Appropriateness of format and communication style of written report (Part B)	6	4	4.3

SLOs: subject learning objectives
CILOs: course intended learning outcomes

Assessment task 2: Assessment task 2: Deep learning research & its industrial applications

Intent: Gain familiarity with academic research in Deep Learning and its application to current industry problems

Objective(s): This task addresses the following subject learning objectives:

2, 4, 5 and 6

This assessment task contributes to the development of course intended learning outcome(s):

1.4, 2.1, 4.3 and 5.1

Type: Report

Groupwork: Individual

Weight: 30%

Criteria: (See assessment brief for further details)
Criteria for Part A:

- Depth of understanding of how the architecture works and its key applications (10%)
- Thorough historical analysis of key research & technologies. (30%)
- Clear articulation iof how each advancement built upon and improved or solved a problem with the previous one. (45%)
- Insightful discussion of latest research and promising future directions (15%)

Criteria for Part B:

- Selection of real, impactful industry problem including clear, understandable outline of the scale and details of problem (30%)
- Clear explanation of how chosen architecture could assist solving the proposed industry problem (40%)
- Discussion of challenges and proposed solutions in utilisation of chosen architecture for chosen problem. (20%)
- Context appropriate language and style (10%)

Criteria linkages:

Criteria	Weight (%)	SLOs	CILOs
Depth of understanding of how the architecture works and its key applications (Part A)	6	2	5.1
Thorough historical analysis of key research & technologies (Part A)	18	5	2.1
Clear articulation of how each advancement built upon and improved or solved a problem with the previous one (Part A)	27	5	2.1
Insightful discussion of latest research and promising future directions (Part A)	9	6	1.4
Selection of real, impactful industry problem including clear, understandable outline of the scale and details of problem (Part B)	12	4	4.3
Clear explanation of how chosen architecture could assist solving the proposed industry problem (Part B)	16	4	4.3
Discussion of challenges and proposed solutions in utilisation of chosen architecture for chosen problem. (Part B)	8	6	1.4
Context appropriate language and style (Part B)	4	4	4.3

SLOs: subject learning objectives
CILOs: course intended learning outcomes

Assessment task 3: Assessment task 3: Deep Learning final project

Intent: Gain familiarity with building sequence-based neural network architectures.

Objective(s): This task addresses the following subject learning objectives:

1, 2, 3 and 4

This assessment task contributes to the development of course intended learning outcome(s):

1.2, 2.4, 4.3 and 5.1

Type: Report

Groupwork: Group, group assessed

Weight: 30%

Criteria: (See assessment brief for further details)

- Justification & discussion of model, technical & architectural choices including assumptions where relevant (30%)
- Quality of results including their assessment, interpretation and recommended next steps (20%)
- Clear, efficient, concise (working) model code appropriately commented (40%)
- Well written report ensuring format and communication style is context appropriate (10%)

Criteria linkages:

Criteria	Weight (%)	SLOs	CILOs
Justification & discussion of model, technical & architectural choices including assumptions where relevant	30	2	5.1
Quality of results including their assessment, interpretation and recommended next steps	20	3	2.4
Clear, efficient, concise (working) model code appropriately commented	40	1	1.2
Well written report ensuring format and communication style is context appropriate	10	4	4.3

SLOs: subject learning objectives
CILOs: course intended learning outcomes

References

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Statement about assessment procedures and advice

Students must refer to the UTS assessment information, which is published in the Coursework Assessments Policy and Procedures.

Statement on copyright

Statement on intellectual property

All courses in the Faculty of Transdisciplinary Innovation involve industry, public sector, not-for-profit and/or community engagement. In general, undergraduate students own their intellectual property (IP) rights as outlined in the UTS Student Rules and the UTS Intellectual Property Policy. Depending on the nature of the industry, public sector, not for profit and/or community engagement, students acknowledge that they may be required by these external partners to assign their IP rights in a project if they choose to participate in certain industry-related experiences. In situations where students have agreed to assign IP rights, UTS encourages our Industry partners to credit students by name if they elect to implement any student ideas (at a minimum).

In certain subjects, an organisation may choose to share confidential company information for student learning purposes, e.g. data, insights, reports. In such circumstances, students are required to return all physical and electronic copies of data and reports back to the organisation and to share their insights, ideas and reports with the partner via the subject coordinator at the end of the subject. This arrangement is outlined in a non-disclosure agreement from the organisation signed by students in the subject to which this situation applies.

Retention of student work

Students should refer to UTS Course and subject requirements regarding retention of their work for any internal or external purpose (Rule 3.9.2). Any student who does not wish his or her work to be used as outlined should notify the subject coordinator by email. Retention of a student's work for these purposes does not affect any copyright or other intellectual property rights that may exist in the student's work.

Statement on UTS email account

Email from the University to a student will only be sent to the student's UTS email address. Email sent from a student to the University must be sent from the student's UTS email address. University staff will not respond to email from any other email accounts for currently enrolled students.