**UNIVERSITY OF CALGARY**

**CUMMING SCHOOL OF MEDICINE**
**GRADUATE COURSE OUTLINE**

| COURSE TITLE:  Machine Learning for Health Data Science | | | |
|---|---|---|---|
| **Course Name and Number** | DATA 622 | | |
| **Pre/Co-Requisites** | DATA 601, 602, 603, 604 and admission to the Graduate Diploma in Data Science and Analytics | | |
| **Faculty** | Cumming School of Medicine, Graduate Science Education | | |
| **Instructor Name(s)** | Dr. Joon Lee | **Email** | joonwu.lee@ucalgary.ca |
| **Office Location** | TRW 5E17 | **Office Hours** | 3-4pm Thursdays on Zoom, or by appointment |
| **Instructor Email Policy** | Responds to @ucalgary emails within 24 hours on weekdays | | |
| **Telephone No.** | 403-220-2968 | | |
| **TA Name** | Steven Dykstra | **Email** | dykstras@ucalgary.ca |
| **Class Term, Days** | Winter 2021, Thursdays | | |
| **Class Times** | 5:00 – 8:00pm | | |
| **Class Location** | This course will take place **online** via Desire2Learn (D2L) and Zoom. To best succeed in the course, students are encouraged to participate in the asynchronous learning tasks using the D2L learning environment and synchronous Zoom sessions. There will be a synchronous Zoom session 5-8pm every Thursday throughout the term. To accommodate students who are unable to participate live due to a time difference or unforeseen circumstances, each synchronous session will be recorded and made available on D2L right after the session. | | |

| COURSE INFORMATION/DESCRIPTION OF THE COURSE |
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| This course is an introduction to machine learning with a focus on health applications. While the theoretical foundation behind each machine learning method will be covered, emphasis will be on hands-on skills and practical applications. Students will individually work on in-class quizzes and computer assignments/project to learn basic knowledge and hands-on skills, respectively. Students will also participate in interactive class discussions. |
| **LEARNING RESOURCES/REQUIRED READING** |
| There is no textbook in this course. All lecture slides, Jupyter notebooks, references, assignment/project information, and quizzes will be posted on D2L. |

| COURSE OBJECTIVES/LEARNING OUTCOMES |
|---|
| At the end of this course, students will be able to: |
| 1. Inspect and prepare health data sets for machine learning |
| 2. Explain the frameworks, utilities, and limitations of different machine learning methods |
| 3. Apply appropriate machine learning methods to a given health problem and data set |
| 4. Evaluate trained machine learning models with a particular focus on ethics and explainability |
| 5. Create a machine learning solution for a health problem |

**Communication**

Brightspace (By D2L) is located on the University of Calgary server and will be used extensively for communication with students. A link to the Zoom class will be provided on D2L. It is the student's responsibility to ensure that they receive all posted communications, documents, and e-mails sent by instructors or fellow students through D2L. Only your @ucalgary.ca e-mail address maybe linked to D2L. Please ensure that you are regularly checking your @ucalgary.ca email account.

**Learning Technology Requirements**

In order to successfully engage in learning experiences at the University of Calgary, students taking online, remote and blended courses are required to have reliable access to the following technology:
- A computer with a supported operating system, as well as the latest security and malware updates;
- A current and updated web browser;
- Webcam (built-in or external);
- Microphone and speaker (built-in or external), or headset with microphone;
- Current antivirus and/or firewall software enabled;
- Broadband internet connection

Most current laptops will have a built-in webcam, speaker and microphone.

Please see the following for a detailed explanation of the minimal required technology for online learning https://elearn.ucalgary.ca/technology-requirements-for-students/

A laptop, desktop, tablet or mobile device is required for D2L access. If you need help accessing or using D2L, please visit the Desire2Learn resource page for students: http://elearn.ucalgary.ca/d2l-student/

*The University of Calgary Cumming School of Medicine would like to acknowledge the traditional territories of the people of the Treaty 7 region in Southern Alberta, which includes the Blackfoot Confederacy (comprising the Siksika, Piikani, and Kainai First Nations), as well as the Tsuut'ina First Nation, and the Stoney Nakoda (including the Chiniki, Bearspaw, and Wesley First Nations). The City of Calgary is also home to Métis Nation of Alberta, Region III.*

## UNIVERSITY OF CALGARY

### CUT POINTS FOR GRADES

This course adheres to the grading system outlined in the University of Calgary, Faculty of Graduate Studies Calendar. Grades of A+ and A are not distinguished in the calculation of GPAs. Percentage/letter grade conversion used for this course is as follows

| Grade | Grade Point Value | Percentage Conversion | Graduate Description |
|---|---|---|---|
| A+ | 4.00 | 95-100 | Outstanding |
| A | 4.00 | 85-94 | Excellent – superior performance showing comprehensive understanding of the subject matter |
| A- | 3.70 | 80-84 | Very Good Performance |
| B+ | 3.30 | 75-79 | Good Performance |
| B | 3.00 | 70-74 | Satisfactory Performance |
| B- | 2.70 | 65-69 | Minimum Pass for Students in the Faculty of Graduate Studies |
| C+ | 2.30 | 55-64 | All grades below 'B-" are indicative of failure at the graduate level and cannot be counted toward Faculty of Graduate Studies course requirements |
| C | 2.00 | 50-54 | |

**Assessment Components:** The University policy on grading related matters is outlined in the 2020-2021 Calendar.

| Assessment Methods | Description | Weight % | Due Date and Time |
|---|---|---|---|
| In-class Quizzes | A total of 10 quizzes, worth 2% each, will be administered on D2L during the first 10 minutes (i.e., 5:00-5:10pm) of each synchronous class except Weeks 1, 2, and 13. Each quiz will consist of 5 multiple choice or short answer questions, and will be closed book. The purpose of each quiz will be to test students' general knowledge and understanding of the topics covered in previous class. The answers and corresponding explanations will be given immediately following each quiz. Students can contact the instructor, preferably as early as possible, to request an alternative time or assessment if they are unable to complete the quiz synchronously due to personal or technical issues. | 20% | First 10 minutes of each class except Weeks 1, 2, and 13 |

| Assignments | A total of 10 assignments, worth 5% each, will help students acquire and practice computer skills related to the implementation of the machine learning methods they learn in each class. D2L will be used for accessing assignment materials, submission, and grading. | 50% | Due at the start of each class (i.e., 5pm) except Weeks 1, 2, and 13 |
|---|---|---|---|
| Project | Students will work on a project individually where they will be given a health dataset to solve a problem using machine learning methods. This project will be lengthier, more open-ended, and broader in scope than the assignments. | 30% | Due 11:55pm on Sunday, Apr 18 |

## ASSESSMENT AND EVALUATION INFORMATION

**ATTENDANCE AND PARTICIPATION EXPECTATIONS:**
Students are strongly recommended to attend every class remotely via Zoom, if possible, and actively participate in all components of each class including the quiz, lecture, discussion, and tutorial.

**GUIDELINES FOR SUBMITTING ASSIGNMENTS AND PROJECT:**
All submissions must be uploaded to the corresponding Dropbox on D2L. All assignments must be submitted by the start of the class (i.e., 5pm) on the day that they are due. The project must be submitted by 11:55pm on Sunday, April 18.
**Note:** It is the student's responsibility to keep a copy of each submission and to ensure that the proper version is submitted. Including a version date in your file name may be useful.

**FINAL EXAMINATIONS:**
There is no final exam in this course.

**EXPECTATIONS FOR WRITING:**
Writing should be understandable and typo-free.

**LATE AND/OR MISSING ASSIGNMENTS:**
Late submissions will receive a 5% penalty per day. Any submission late for 14 calendar days or more will receive a grade of zero. Valid reasons for late submission (e.g., medical, family emergency) must be brought to the instructor's attention as soon as possible, preferably before the deadline if possible.

**Is a passing grade on a particular component essential to pass the course as a whole?** No

| CLASS SCHEDULE | | | |
|---|---|---|---|
| **Course Schedule Date** | **Topic** | **Instructor** | **Assignments/Due Dates & Times** |

| Jan 14 | Unit 1: Course Introduction & Groundwork | Dr. Joon Lee | |
|---|---|---|---|
| Jan 21 | Unit 2: Supervised Learning Part 1 – Classification | Dr. Joon Lee | Assignment 1 due 5pm on Jan 28<br>In-class Quiz 1 on Jan 28 |
| Jan 28 | Unit 2: Supervised Learning Part 2 – Regression | Dr. Joon Lee | Assignment 2 due 5pm on Feb 4<br>In-class Quiz 2 on Feb 4 |
| Feb 4 | Unit 3: Unsupervised Learning Part 1 – Clustering | Dr. Joon Lee | Assignment 3 due 5pm on Feb 11<br>In-class Quiz 3 on Feb 11 |
| Feb 11 | Unit 3: Unsupervised Learning Part 2 – Dimensionality Reduction | Dr. Joon Lee | Assignment 4 due 5pm on Feb 25<br>In-class Quiz 4 on Feb 25 |
| Feb 18 | No Class – Reading Week | | |
| Feb 25 | Unit 4: Ensemble Modeling | Dr. Joon Lee | Assignment 5 due 5pm on Mar 4<br>In-class Quiz 5 on Mar 4 |
| Mar 4 | Unit 5: Deep Learning Part 1 – Basic Neural Networks | Dr. Joon Lee | Assignment 6 due 5pm on Mar 11<br>In-class Quiz 6 on Mar 11 |
| Mar 11 | Unit 5: Deep Learning Part 2 – Advanced Neural Networks | Dr. Joon Lee | Assignment 7 due 5pm on Mar 18<br>In-class Quiz 7 on Mar 18 |
| Mar 18 | Unit 6: Sequential Data Modeling | Dr. Joon Lee | Assignment 8 due 5pm on Mar 25<br>In-class Quiz 8 on Mar 25 |
| Mar 25 | Unit 7: Reinforcement Learning | Dr. Joon Lee | Assignment 9 due 5pm on Apr 1<br>In-class Quiz 9 on Apr 1 |
| Apr 1 | Unit 8: Ethical & Explainable Machine Learning | Dr. Joon Lee | Assignment 10 due 5pm on Apr 8<br>In-class Quiz 10 on Apr 8 |
| Apr 8 | Course Reflections & Project Introduction | Dr. Joon Lee | Project due 11:55pm on Apr 18 |
| Apr 15 | Project Tutorial | Dr. Joon Lee | Project due 11:55pm on Apr 18 |

**NOTE:** All classes will be delivered synchronously and recorded for asynchronous access. Most lectures provide optional online reading materials which can be accessed asynchronously.


**Guidelines for Zoom Sessions**

Zoom is a video conferencing program that will allow us to meet at specific times for a 'live' video conference, so that we can have the opportunity to meet each other virtually and discuss relevant course topics as a learning community.

To help ensure Zoom sessions are private, do not share the Zoom link or password with others, or on any social media platforms. Zoom links and passwords are only intended for students registered in the course. Zoom recordings and materials presented in Zoom, including any teaching materials, must not be shared, distributed or published without the instructor's permission.

The use of video conferencing programs relies on participants to act ethically, honestly and with integrity; and in accordance with the principles of fairness, good faith, and respect (as the Code of Conduct). When entering Zoom or other video conferencing sessions, you play a role in helping create an effective, safe and respectful learning environment. Please be mindful of how your behaviour in these sessions may affect others. Participants are required to use names officially associated with their UCID (legal or preferred names listed in the Student Centre) when engaging in these activities. Instructors/moderators can remove those whose names do not appear on class rosters. Non-compliance may be investigated under relevant University of Calgary conduct policies. If participants have difficulties complying with this requirement, they should email the instructor of the class explaining why, so the instructor may consider whether to grant an exception, and on what terms. For more information on how to get the most out of your zoom sessions visit: https://elearn.ucalgary.ca/guidelines-for-zoom/.

Please be prepared, as best as you are able, to join class in a quiet space that will allow you to be fully present and engaged in Zoom sessions. Students will be advised by their instructor when they are expected to turn on their webcam (such as for group work, presentations, etc).

The instructor will record online Zoom class sessions for the purposes of supporting student learning in this class – such as making the recording available for review of the session or for students who miss a session. If you are unable to attend a Zoom session, please ensure to watch the recorded session at your convenience. These recordings will be used to support student learning only.

**Conduct During Lectures**

The classroom should be respected as a safe place to share ideas without judgement - a community in which we can all learn from one another. Students are expected to frame their comments and questions to lecturers in respectful and appropriate language, always maintaining sensitivity towards the topic. Students, employees, and academic staff are also expected to demonstrate behaviour in class that promotes and maintains a positive and productive learning environment.

As members of the University community, students, employees and academic staff are expected to demonstrate conduct that is consistent with the University of Calgary Calendar, the Code of Conduct and Non-Academic Misconduct policy and procedures, which can be found at https://www.ucalgary.ca/policies/forms/title.

**Equity, Diversity and Inclusion**

The Cumming School of Medicine recognizes that equity, diversity, and inclusion benefits and strengthens all communities, including the medical community and those served by it. We aim to actively engage all learners, particularly those from equity seeking groups including women, Indigenous peoples, visible/racialized minorities, persons with disabilities, and LGBTQ+. While our faculty continues to learn about more equitable, diverse, and inclusive approaches to education, we welcome and appreciate suggestions to help us ensure that all learners are well served by our courses.

To help cultivate learning environments that support diverse and inclusive perspectives and lived experiences, learners are invited to let instructors know if:
- they have names and/or pronouns they would prefer to use that differ from those that appear on official records
- scheduled class meetings conflict with religious events so that alternative arrangements can be made

If they are not already, learners are also encouraged to become familiar with the various opportunities for diverse engagement, learning, and support on campus, including, but not limited to the following resources:

**The Office of Equity, Diversity and Inclusion**
https://www.ucalgary.ca/equity-diversity-inclusion

**The Q Centre**
https://www.su.ucalgary.ca/programs-services/student-services/the-q-centre/

**The Writing Symbols Lodge**
https://www.ucalgary.ca/student-services/writing-symbols/home

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**INTERNET AND ELECTRONIC COMMUNICATION DEVICE INFORMATION**

Cell phones must be turned off in class unless otherwise arranged with the instructor.

The use of laptop and mobile devices is acceptable when used in a manner appropriate to the course and classroom activities. Students are to refrain from accessing websites that may be distracting for fellow learners (e.g. personal emails, Facebook, YouTube). Students are responsible for being aware of the University's Internet and email use policy, which can be found at
https://www.ucalgary.ca/policies/files/policies/acceptable-use-of-electronic-resources-and-information-policy.pdf

### MEDIA AND RECORDING IN LEARNING ENVIRONMENTS

**Media recording for lesson capture**
Please refer to the following statement on media recording of students: https://elearn.ucalgary.ca/wp-content/uploads/2020/05/Media-Recording-in-Learning-Environments-OSP_FINAL.pdf

The instructor will use media recordings to capture the delivery of a lecture. These recordings are intended to be used for lecture capture only and will not be used for any other purpose. Although the recording device will be fixed on the Instructor, in the event that incidental student participation is recorded, the instructor will ensure that any identifiable content (video or audio) is masked, or will seek consent to include the identifiable student content to making the content available on University approved platforms.

**Media recording for assessment of student learning**
The instructor may use media recordings as part of the assessment of students. This may include but is not limited to classroom discussions, presentations, clinical practice, or skills testing that occur during the course. These recordings will be used for student assessment purposes only and will not be shared or used for any other purpose.

**Media recording for self-assessment of teaching practices**
The instructor may use media recordings as a tool for self-assessment of their teaching practices. Although the recording device will be fixed on the instructor, it is possible that student participation in the course may be inadvertently captured. These recordings will be used for instructor self-assessment only and will not be used for any other purpose.

**Student Recording of Lectures**
Audio or video/visual recording of lectures is prohibited except where explicit permission has been received from the instructor.

### UNIVERSITY OF CALGARY POLICIES AND SUPPORTS

**ACADEMIC ACCOMMODATIONS**
Students seeking an accommodation based on disability or medical concerns should contact Student Accessibility Services; SAS will process the request and issue letters of accommodation to instructors. For additional information on support services and accommodations for students with disabilities, visit www.ucalgary.ca/access/. Students who require an accommodation in relation to their coursework based on a protected ground other than disability should communicate this need in writing to their Instructor. The full policy on Student Accommodations is available at www.ucalgary.ca/policies/files/policies/student-accommodation-policy.pdf

**IMPORTANT INFORMATION**
Any research in which students are invited to participate will be explained in class and approved by the appropriate University Research Ethics Board

**INSTRUCTOR INTELLECTUAL PROPERTY**

Course materials created by professor(s) (including course outlines, presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the professor(s). These materials may NOT be reproduced, redistributed or copied without the explicit consent of the professor. The posting of course materials to third party websites such as note-sharing sites without permission is prohibited. Sharing of extracts of these course materials with other students enrolled in the course at the same time may be allowed under fair dealing

## COPYRIGHT LEGISLATION
All students are required to read the University of Calgary policy on Acceptable Use of Material Protected by Copyright www.ucalgary.ca/policies/files/policies/acceptable-use-of-material-protected-by-copyright-policy.pdfand requirements of the copyright act (https://laws-lois.justice.gc.ca/eng/acts/C-42/index.html) to ensure they are aware of the consequences of unauthorised sharing of course materials (including instructor notes, electronic versions of textbooks etc.). Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy

## ACADEMIC INTEGRITY
**T**he Cumming School of Medicine expects intellectual honesty from its students. Course participants should be aware of University policies relating to Principles of Conduct, Plagiarism and Academic Integrity. These are found in the printed Faculty of Graduate Studies Calendar, or online under Academic Regulations in the Faculty of Graduate Studies Calendar, available at **Faculty of Graduate Studies Academic Regulations**

## ACADEMIC MISCONDUCT
For information on academic misconduct and its consequences, please see the University of Calgary Calendar at www.ucalgary.ca/pubs/calendar/current/k.html

## EMERGENCY EVACUATION AND ASSEMBLY POINTS
Assembly points for emergencies have been identified across campus. The primary assembly points for South Campus (Health Science Centre (HSC); Health & Research Innovation Centre (HRIC); Heritage Medical Research Building (HMRB) and Teaching, Research and Wellness (TRW)) are:
- HSC and HMRB: HRIC Atrium (alternate assembly point is Parking Lot 6)
- HRIC: HMRB Atrium (alternate assembly point is Parking Lot 6)
- TRW: McCaig Tower (alternate assembly point is HMRB – Atrium)

## APPEALS
If there is a concern with the course, academic matter or a grade, first communicate with the instructor. If these concerns cannot be resolved, students can proceed with an academic appeal, as per Section N of the Faculty of Graduate Studies Calendar. Students must follow the official process and should contact the Student Ombuds Office (www.ucalgary.ca/student-services/ombuds)for assistance with this and with any other academic concerns, including academic and non-academic misconduct

## THE FREEDOM OF INFORMATION AND PROTECTION OF PRIVACY (FOIP) ACT
This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIP) and students should identify themselves on written assignments (exams and term work.) by their name and ID number on the front page and ID on each subsequent page. Assignments given by you to your course instructor will remain confidential unless otherwise stated before submission. The assignment cannot be

returned to anyone else without your expressed permission to the instructor. Grades will be made available on an individual basis and students will not have access to other students' grades without expressed consent. Similarly, any information about yourself that you share with your course instructor will not be given to anyone else without your permission

## WELLNESS AND MENTAL HEALTH RESOURCES

The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the excellent mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the SU Wellness Centre, at www.ucalgary.ca/wellnesscentre/services/mental-health-services and the Campus Mental Health Strategy website at www.ucalgary.ca/mentalhealth/

## SUPPORTS FOR STUDENT LEARNING, SUCCESS, AND SAFETY

**Student Ombudsman**: The Student Ombuds' Office supports and provides a safe, neutral space for students. For more information, please visit www.ucalgary.ca/ombuds/ or email ombuds@ucalgary.ca

**Student Union:** The SU Vice-President Academic can be reached at (403) 220-3911 or suvpaca@ucalgary.ca; Information about the SU, including elected Faculty Representatives can be found here: www.su.ucalgary.ca/

**Graduate Student's Association**: The GSA Vice-President Academic can be reached at (403) 220- 5997 or gsa.vpa@ucalgary.ca; Information about the GSA can be found here: gsa.ucalgary.ca

## SAFEWALK

Campus security will escort individuals, day or night, anywhere on campus (including McMahon Stadium, Health Sciences Centre, Student Family Housing, the Alberta Children's Hospital and the University LRT station). Call 403-220-5333 or visit www.ucalgary.ca/security/safewalk. Use any campus phone, emergency phone or the yellow phone located at most parking lot pay booths. Please ensure your personal safety by taking advantage of this service.