



Mathematics for Machine Learning

1.0 Course Faculty Information

Prof. Dr. V. Saranya
Instructor
NSRIC Inc.,
London, Ontario, Canada

2.0 Course Information

Course Code and Title	NSRIC T0001: AI&ML	July
Month Year	2023	
Class Days	Monday - Friday	
Class Time	10:00 am – 11:00 am EST	
Course Credit Hours	3	
Class Location	NSRIC online platform	
prerequisites and/or co-requisites	N/A	
Level /A, E, H, I, K12, M, P, S, T, U, V, W	Foundational courses /I,P	

Note: The below classification of courses is related any areas of knowledge:

A: Advanced level academic level courses; **E:** Executive courses; **H:** Higher-level courses (i.e., graduate courses); **I:** Intermediate courses (i.e., university preparatory courses – Grade XII+); **K12:** Foundational, and lower-level courses; **M:** Mid-level courses (i.e., undergraduate courses); **P:** Professional courses; **S:** Short/seminar courses; **T:** Training courses; **U:** Tutorial Courses; **V:** Vocational training courses; and **W:** Workshop courses.

3.0 Professor Information

Name	Dr.V. Saranya
Title	NSRIC
Contact Information	saranyapulse@gmail.com
Office Location	NSRIC online platform
Office Hours	10: 30 am – 11:30 am EST (Saturdays) by email appointment

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4.0 Target Audiences

- Diploma and vocational training student
- University undergraduate level student
- Any student who is interested in Artificial Engineering and Machine Learning
- Students who want to know Basics of Artificial Engineering and Machine Learning offered by Dr. V. Saranya

5.0 Course Description

Mathematics for Machine Learning is a course that aims to provide a solid mathematical foundation for understanding various machine learning techniques. The course covers topics such as linear algebra, multivariate calculus, probability theory, optimization, and statistics. Students will learn about vector spaces, matrices, eigenvalues and eigenvectors, singular value decomposition, and other linear algebra concepts that are essential for understanding machine learning algorithms such as principal component analysis and support vector machines. The course also covers multivariate calculus topics such as partial derivatives, gradients, and optimization techniques, which are important for understanding deep learning algorithms. Students will learn about probability theory, including probability distributions, random variables, which are crucial for understanding statistical learning. By the end of the course, students will have gained the mathematical knowledge and skills necessary to understand and implement various machine learning algorithms. They should also be able to apply their knowledge to solve real-world problems using machine learning techniques by Prof. Saranya. V at NSRIC Platform to understand this course content.

6.0 Course Learning Outcomes

Upon successful completion of this course, students will be able to:

CLO1: Understanding of fundamental mathematical concepts such as linear algebra, multivariate calculus, probability theory, optimization, and statistics that are essential for machine learning.

CLO2: Ability to apply mathematical concepts to solve machine learning problems and implement machine learning algorithms.

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CLO3: Knowledge of linear algebra concepts such as vectors, matrices, eigenvalues and eigenvectors, singular value decomposition, and their applications to machine learning algorithms such as principal component analysis and support vector machines.

CLO4: Understanding of multivariate calculus concepts such as partial derivatives, gradients, optimization techniques, and their applications to deep learning algorithms.

CLO5: Ability to analyse and interpret machine learning models using mathematical techniques.

7.0 How the course supports the attainment of the student outcomes

1	2	3	4	5
High	Moderate	Moderate	High	Moderate

8.0 Course Materials

Online course materials

- Online PowerPoint presentation slides in pdf form
- Audio/visual recording of lectures (Optional)
- Online tutorial and meeting with students upon request
- Assignments and quizzes in the MLS system in pdf form
- Reading materials if any in pdf form

Textbook and resources (If any)

1. "Mathematics for Machine Learning". Copyright 2020 by Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong. Published by Cambridge University Press.

9.0 Academic Integrity

Students are encouraged to have a look at the NSRIC's statement of academic integrity at NSRIC website. It is noted that by signing this syllabus, you will acknowledge that you have understood that any detected plagiarism should be reported.

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10. Assessment for Grade

This course contains assignment and quizzes for assessment. Student will receive a "Certificate of completion" after successful completion of the course.

Important Note:

- i) The below classified courses (i.e., academic courses) will only be evaluated based on the grade system shown in Table 2. A grade and certificate will be issued for the student(s) and participant(s).
A: Advanced level academic level courses; **H:** Higher-level courses (i.e., graduate courses); **I:** Intermediate courses (i.e., university preparatory courses – Grade XII+); **K12:** Foundational, and lower-level courses; **M:** Mid-level courses (i.e., undergraduate courses).
- ii) The below classified courses will **not** be evaluated based on the grade system shown in Table 2. A certificate will be issued for the student(s) and participant(s).
E: Executive courses; **P:** Professional courses; **S:** Short/seminar courses; **T:** Training courses; **U:** Tutorial Courses; **V:** Vocational training courses; and **W:** Workshop courses.

Participation/Engagement/Performance

Your participation in every aspect of the course is important for the learning process. Your engagement in every discussion in the course, due delivery of all assignments, quizzes, and research projects will be fruitful. These efforts from your side will reflect your performance in the course delivery and your commitments. This performance is the reflection of your dream grade!!

Assignments

You will be given **1 assignment** during the course delivery. The due dates for assignments are specified in the course content and schedule section. The assignments will be given time to time to solve/answer during the term. Assignments will be posted through NSRIC online platform at least one week before they are due. Due dates are given in course schedule (tentative schedule). However, in case of any special circumstance, the date will be posted beforehand or announced in class.

Quizzes

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A Maximum of 2 quizzes (maximum of **Two MCQ @ five** minute) will be taken based on class lectures and performance. The quiz will be taken in the beginning of the lecture through NSRIC online platform. If you miss the quiz without any valid official excuse, you will receive **zero** for the non-attended quiz. If any student fails to attend the quiz, he/she must submit a valid reason to the instructor. In such case, he/she should appear another quiz or may be averaged on the quizzes that he/she attended. It will depend on the situation and instructor.

11.0 Advice and additional requirements

I advise you to:

- Please contact me if you need any help.
- Students are expected to attend all scheduled online lecture classes.
- Students are expected to study from the course materials and/or textbooks which will help to easily read and understand.
- Students are encouraged to write their own notes during lectures/presentations (pdf PowerPoint presentations, and additional materials if any).
- Students are encouraged to attend online platform classes on time because late-attendee disrupts the flow of the class for both the instructor and the other students.

Additional information (During Online Course offering Period)

- The PowerPoint course materials, and video lectures will be available at the NSRIC Platform.
- There will be scheduled discussion/tutorial sessions on **every Monday** at the class scheduled time. All students must attend this session (Need student request).
- There will be an office hour for students on Monday from 10:30 am – 11:30 am, Toronto, Canada time. Students need to send an email request so that a zoom meeting can be arranged. In addition, any time student can set up an online appointment (i.e., phone, zoom, and/or other mode of communications) based on availability of the course instructor. However, student should send an email request for setting up this type of meeting.

12.0 Course Topics

1. Introduction to Artificial Intelligence (AI) and Machine Learning (ML)
2. Mathematics for Machine Learning

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3. Supervised Learning
4. Unsupervised Learning
5. Deep Learning
6. Reinforcement Learning
7. Natural Language Processing (NLP)
8. AI Ethics and Bias
9. Case Studies and Real-World Applications

13.0 Course Contents and Schedule

Lec. No.	Module	Topics	Remarks
Mathematics for Machine Learning			
1.	Mathematics	Linear Algebra Operations	
2.	Mathematics	Linear Regression	
3.	Mathematics	Mean, Variance and Standard Deviation	Quiz 1
4.	Mathematics	Mean, Variance and Standard Deviation	
5.	Mathematics	Find a matrix or vector norm using NumPy	
6.	Mathematics	Find a matrix or vector norm using NumPy	
7.	Mathematics	Understanding Hypothesis Testing	Assignment
8.	Mathematics-Calculus	Uni-variate Optimization – Data Science	
9.	Mathematics-Calculus	Multi-variate Optimization – Data Science	
10.	Revision	Summary	Quiz 2

Prepared by Dr. V. Saranya, OE Division, NSRIC Inc., London, ON, Canada.

Course Descriptions

Mathematics is a fundamental tool for understanding and developing machine learning algorithms. This module provides a comprehensive introduction to the mathematical foundations of machine learning, covering key concepts and techniques that are essential for success in this field. The module begins with a review of linear algebra, including matrix operations, eigenvalues and eigenvectors, and the singular value decomposition. It then covers calculus, including

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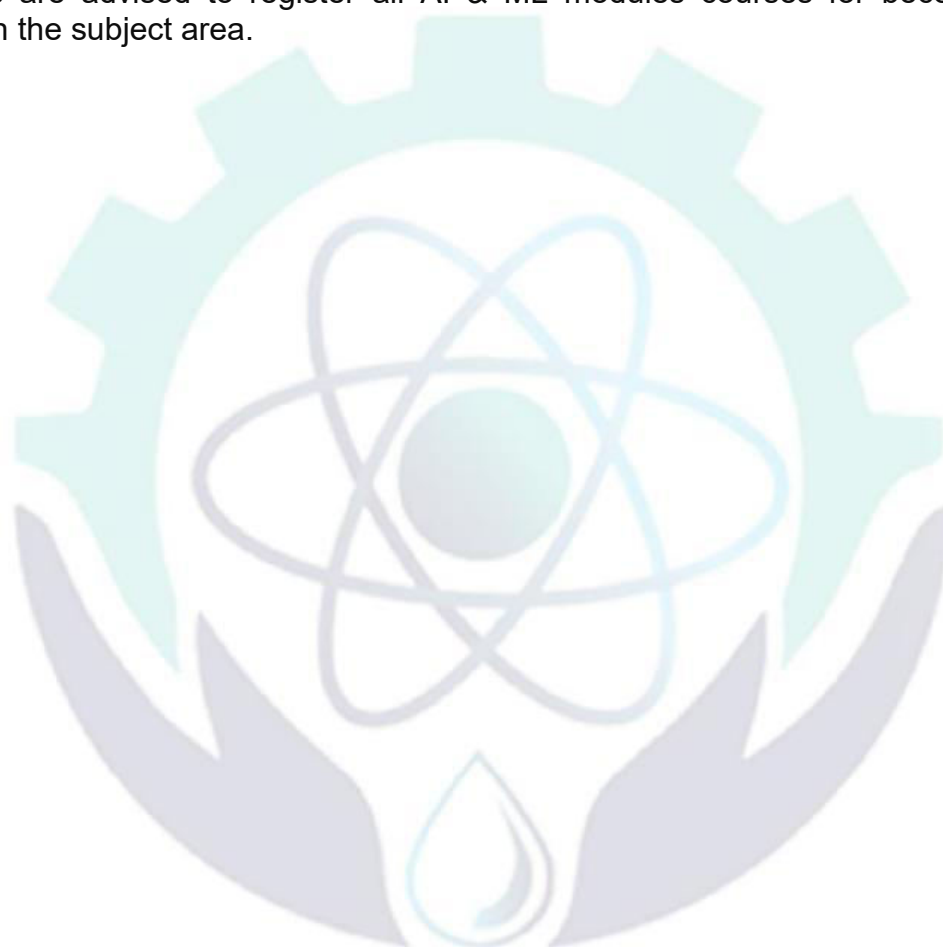
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differentiation, integration, optimization, and gradient descent. The module also explores probability theory, including basic concepts such as random variables and probability distributions.

Captions: Linear algebra, Probability and statistics and calculus.

Requirements/Instructions

Students are advised to register all AI & ML modules courses for becoming the master in the subject area.



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