



# Machine Learning Sessional

## CSE-442

(Section-A/B)

Lecture-1

## *knowing the Course*

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رب زدني علما وارزقني فهما.

My Lord! Advance me in Knowledge and True Understanding.

# Content

- ▶ Introducing the course
- ▶ Rationale *(logical basis)*
- ▶ Course objectives
- ▶ Learning outcomes and general skills
- ▶ Course content
- ▶ Teaching learning strategies
- ▶ Assessment and Grading system
- ▶ Reference Books
- ▶ Some important instructions

# Introducing the course

- ▶ Course Code: CSE-442
- ▶ Course Title: Machine Learning Sessional
- ▶ Lecture Hours: 3.00
- ▶ Credit Hours: 0.75
  
- ▶ **PRE-REQUISITE:** None

# Introducing the course...

- ▶ **Instructors:**
  - *Asst. Prof. Dr. M. Akhtaruzzaman, MIST*
  - Lec. Shahriar Rahman, MIST
  - Lec. Nazmun Nahar, MIST

Venue

|                     |
|---------------------|
| Network Lab<br>(34) |
| (T3-1101)           |
| CSE-442(20)         |

| Day/Time | 0800-0855                                | 0900-0955                                     | 1000-1055 | 1055-1145 | 1145-1240   | 1245-1340 | 1345-1440 |
|----------|--|---|-----------|-----------|---|-----------|-----------|
| SUN      | CSE-429<br>Maj Mokhles, Asst Prof Shofiq | CSE-413<br>Asst Prof Nusrat, Asst Prof Nuzhat |           |           | CSE-444<br>AP Shahriar, Maj Mokhles, Lec Mustaqim<br>CSE-442<br>AP Akhter, Lec Shahriar, Lec Nazmun |           |           |

# RATIONALE (logical basis)

- ▶ The course is structured to orient different algorithm of machine learning practically to best suit the current needs.
- ▶ This course will help understand the iterative aspect of machine learning as models are exposed to new data, they are able to independently adapt.
- ▶ Models learn from previous computations to produce reliable, repeatable decisions and results and helps in implementing the enhanced learning parameters for maximum performance.

# OBJECTIVES

- ▶ To implement the appropriate learning algorithm to best suit the current needs.
- ▶ To use practical knowledge to enhance the learning parameters to achieve maximum performance.

# COURSE OUTCOMES (CO)

| No. | Course Learning Outcome<br>(Upon completion of the course, the students will be able to)   | Bloom's Taxonomy      | CP        | CA | KP | Assessment Methods |
|-----|--|-----------------------|-----------|----|----|--------------------|
| CO1 | Develop a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.                       | C2-C6, P1, P6         | 1         | 1  | 6  | T, Q               |
| CO2 | Evaluate the strengths and weaknesses of many popular machine learning approaches.   | C3, C6, A4, A5, P6    | 2         | 2  | 8  | ASG, T             |
| CO3 | Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning. | C2 – C6<br>P1, A1, A2 | 6         | 4  | 2  | R, Q, Pr           |
| CO4 | Design and implement various machine learning algorithms in a range of real-world applications.  | P3, A4, C3, C4, C6    | 3, 7, EP2 | 3  | 5  | T, Q               |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT- Mid Term Exam)



# COURSE CONTENT

## COURSE CONTENT

**Supervised Learning:** Regression, Model Selection and Generalization, Dimensions of a supervised learning algorithm; **Bayesian Decision:** Association Rules, Discriminant Functions; **Clustering:** k-means cluster, Hierarchical cluster, Expectation-Maximization Algorithm, Supervised Learning after Clustering; **Decision Tree:** Classification trees, Regression trees, Pruning, Multivariate trees; **Hidden Markov Model:** Basic problems of HMM, Evaluation problem, Model Selection in HMM, Find State Sequence; **Kernel Machines:** SVM, Victorian Kernels, Multiple Kernel Learning, One-Class Kernel Machine, Kernel Dimensionality Reduction; **Design and Analysis of ML Experiment:** Randomization, Interval Estimation, McNemer's Test, K-Fold Cross-Validated Paired t Test, Binomial Test, Approximate Normal Test.



# SKILL MAPPING

| No. | Course Learning Outcome  | PROGRAM OUTCOMES (PO) |   |   |   |   |   |   |   |   |    |    |    |
|-----|--|-----------------------|---|---|---|---|---|---|---|---|----|----|----|
|     |  | 1                     | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | Able to develop a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.               |                       | H |   |   |   |   |   |   |   |    |    |    |
| CO2 | Able to evaluate the strengths and weaknesses of many popular machine learning approaches.   |                       |   |   |   | H |   |   |   |   |    |    |    |
| CO3 | Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning. |                       |   |   | M |   |   |   |   |   |    |    |    |
| CO4 | Able to design and implement various machine learning algorithms in a range of real-world applications.  |                       |   | H |   |   |   |   |   |   |    |    |    |

(H – High, M- Medium, L-low)

# 12 POs

|                 |       |   |   |
|-----------------|-------|---|---|
| Problem Solving | PO 1  | <b>Engineering Knowledge</b>            | Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.   |
|                 | PO 2  | <b>Problem Analysis</b>                 | Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.  |
|                 | PO 3  | <b>Design/ Development of Solutions</b> | Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.   |
|                 | PO 4  | <b>Investigation</b>                    | Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.   |
|                 | PO 5  | <b>Modern Tool Usage</b>                | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.  |
| Society         | PO 6  | <b>The Engineer and Society</b>         | Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.  |
|                 | PO 7  | <b>Environment and Sustainability</b>   | Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.  |
|                 | PO 8  | <b>Ethics</b>                           | Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.  |
| Teamwork        | PO 9  | <b>Indivi. &amp; Team Wo.</b>           | Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.   |
|                 | PO 10 | <b>Communication</b>                    | Communicate effectively on complex engineering activities with the engineering community and with society at large. Some of them are, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
|                 | PO 11 | <b>Project Manage. and Finance</b>      | Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.   |
| Long term       | PO 12 | <b>Life Long Learning</b>               | Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.  |

# TEACHING LEARNING STRATEGY

## ▶ Face-to-Face Learning

- Lectures
- Practical / Tutorial / Studio
- Student-Centered Learning

## ▶ Self-Directed Learning

- Non-face-to-face learning
- Revision
- Assessment Preparations

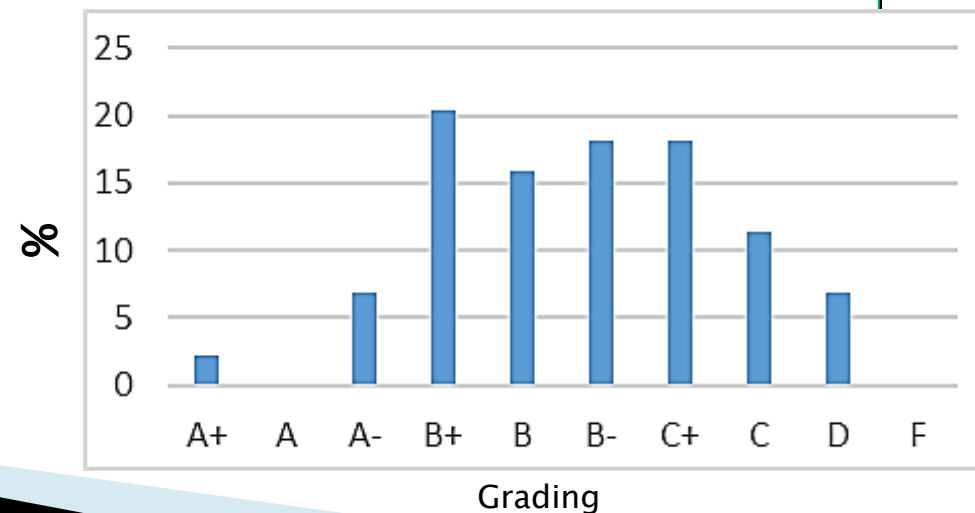
## ▶ Formal Assessment

- Continuous Assessment
- CT/Mid
- Final Examination/Mini Project

# ASSESSMENT STRATEGY

| Components                               |                                  | Grading |
|--|----------------------------------|---------|
| Continuous Assessment (40%)              | Eval, Test & Assignment          | 40%     |
|  | Atten. + Perfor.                 | 10%     |
|  | Presentations (Proposal + Final) | 10%     |
| Final Exam (Quiz + Proj. Demo. + Report) |                                  | 40%     |
| Total Marks                              |                                  | 100%    |

| Subj    | Grading | GPA |          |      |     |
|---------|---------|-----|----------|------|-----|
|         |         |     | Students | %    | %   |
| CSE 403 | A+      | 4   | 1        | 2.27 | 9.1 |
|         | A       | 3.8 | 0        | 0    |     |
|         | A-      | 3.5 | 3        | 6.82 |     |
|         | B+      | 3.3 | 9        | 20.5 | 55  |
|         | B       | 3   | 7        | 15.9 |     |
|         | B-      | 2.8 | 8        | 18.2 |     |
|         | C+      | 2.5 | 8        | 18.2 | 30  |
|         | C       | 2.3 | 5        | 11.4 |     |
|         | D       | 2   | 3        | 6.82 |     |
|         | F       | 0   | 0        | 0    | 0   |
|         | Total   |     | 44       | 100  | 100 |
|         | Mean    |     |          |      |     |



# GRADING SYSTEM

|                    |    |      |
|--------------------|----|------|
| ▶ 80% and above    | A+ | 4.00 |
| ▶ 75% to below 80% | A  | 3.75 |
| ▶ 70% to below 75% | A- | 3.50 |
| ▶ 65% to below 70% | B+ | 3.25 |
| ▶ 60% to below 65% | B  | 3.00 |
| ▶ 55% to below 60% | B- | 2.75 |
| ▶ 50% to below 55% | C+ | 2.50 |
| ▶ 45% to below 50% | C  | 2.25 |
| ▶ 40% to below 45% | D  | 2.00 |
| ▶ below 40%        | F* | 0.00 |

|    |                                     |
|----|-------------------------------------|
| AB | Absent,                             |
| C  | Collegiate (>85% Attendance)        |
| DC | Dis-collegiate (85%-70% Attendance) |
| NC | Non-collegiate (<70% Attendance)    |
| VW | Voluntary Withdrawn                 |
| X  | Project/Thesis Continuation         |
| E  | Expelled                            |
| S  | Satisfactory                        |



# Class Evaluation

| Assessment Criteria          | Outstanding / Excellent<br>(A+, A, A-) ( > 70% marks)<br>(CGPA > 3.50)   | Very good / Good<br>(B+, B, B-) (55-70% marks)<br>(CGPA > 2.75)   | Average / Satisfactory<br>(C+, C) (45-55% marks)<br>(CGPA > 2.25)  | Poor / Not satisfactory<br>(D) (40-45% marks)<br>(CGPA > 2.00)   | Very Poor / Fail<br>(F) ( < 40% marks)<br>(CGPA = 0.00)  |
|------------------------------|--|---|--|--|--|
| Information Gathering Report | <p>Mastery of course content at the <b>highest level of attainment</b> that can reasonably be expected of students at a given stage of development.</p> <p>Students have shown such <b>outstanding promise</b> in the aspect of the discipline under study that he/she may be strongly encouraged to continue.</p> <ul style="list-style-type: none"> <li>* A formal <b>coverpage</b> with all the necessary information written appropriately</li> <li>* <b>Structure</b> of the report is highest quality and coherent</li> <li>* No or almost <b>negligible</b> grammatical errors</li> <li>* No or almost <b>negligible</b> formatting errors</li> <li>* <b>Information</b> gathered is very relevant and logical</li> <li>* Have <b>analytical</b> representation <b>outside the subject matter</b></li> <li>* <b>Summarization</b> of outcomes and diagrams are error-free and reasonable</li> </ul> | <p>Strong performance demonstrating a <b>high level of attainment</b> for a student at a given stage of development.</p> <p>Students have shown <b>solid promise</b> in the aspect of the discipline under study.</p> <ul style="list-style-type: none"> <li>* A formal <b>coverpage</b> with all the necessary information written appropriately</li> <li>* Structure of the report is good and <b>moderately coherent</b></li> <li>* No or almost <b>negligible</b> grammatical errors</li> <li>* No or almost <b>negligible</b> formatting errors</li> <li>* <b>Information</b> gathered is relevant and logical</li> <li>* Have <b>analytical</b> representation and reflects knowledge on <b>subject matter</b></li> <li>* Summarisation of outcomes and diagrams have minimal error and are reasonable</li> </ul> | <p>A totally <b>acceptable</b> performance demonstrating an adequate level of attainment for a student at a given stage of development.</p> <p>Students <b>not yet showing unusual promise</b>, and may continue to study in the discipline with reasonable hope of intellectual development.</p> <ul style="list-style-type: none"> <li>* A formal <b>coverpage</b> with all the necessary information written appropriately</li> <li>* Structure of the report is acceptable and <b>more or less coherent</b></li> <li>* Has <b>minor</b> grammatical and formatting errors</li> <li>* Information gathered is satisfactory and logical</li> <li>* Reflects deficiency in knowledge on subject matter</li> <li>* Summarisation of outcomes and diagrams have few errors and are not so reasonable</li> </ul> | <p>A <b>marginal</b> performance in the required exercises demonstrating a minimal passing level of attainment.</p> <p>A student has given <b>no evidence of prospective growth</b> in the discipline; the student would be well advised <b>not to continue</b> in the academic field.</p> <ul style="list-style-type: none"> <li>* <b>No formal coverpage</b> or having less/wrong information on the coverpage</li> <li>* <b>structure</b> of the report not acceptable and not coherent</li> <li>* Has unexpected <b>grammatical errors</b></li> <li>* Having <b>formatting errors</b></li> <li>* Information gathered is <b>illogical</b> or not relevant</li> <li>* Reflects <b>lack of knowledge</b> on the subject matter</li> <li>* <b>Summarization</b> of outcomes and diagrams are missing or quite unreasonable</li> </ul> | <p>An <b>unacceptable</b> performance.</p> <p>The student's performance in the required exercises has revealed almost <b>no understanding</b> of the course content.</p> <p>The student may <b>not be suitable for registering further study/courses</b> in the discipline before remedial work is undertaken.</p> <ul style="list-style-type: none"> <li>* <b>No formal coverpage</b> or having less/wrong information on the coverpage</li> <li>* <b>Structure</b> of the report not acceptable and not coherent</li> <li>* Has unexpected <b>grammatical and formatting errors</b></li> <li>* Information gathered is not relevant and logical</li> <li>* Reflects <b>lack of knowledge</b> on the subject matter</li> <li>* <b>Summarisation</b> of outcomes and diagrams are missing or quite unreasonable</li> </ul> |



# REFERENCE BOOKS

- ▶ *Pattern Recognition and Machine Learning - Christopher M. Bishop; Springer*
- ▶ *Machine Learning - Tom Mitchell, McGraw Hill*
- ▶ *Introduction to Machine Learning, Second Edition - Ethem Alpaydin*
- ▶ *Pattern Recognition Sergios Theodoridis and Konstantinos Koutroumbas; Elsevier Inc.*
- ▶ *Machine Learning: An Algorithmic Perspective - Stephen Marsland*

***Note: Follow the provided Lab-manuals and relevant materials.***

# SOME IMPORTANT INSTRUCTIONS

- ▶ Alternating weeks Lab (  $\frac{Class}{2}$  )
- ▶ Prepare (select topics) for mini-project (group project).
  - Face detection and recognition with custom-made dataset.
  - Voice/speech detection, recognition, and person identification with custom-made dataset
  - Chat-bot system with custom-made dataset based on MIST
  - Chat-bot system with custom-made dataset based on Health pre-screening
  - Self trained Chat-bot  
(automatic generation of dataset through speech interaction)
  - Insulin dose prediction for diabetic patients
- ▶ Each group  $\leq 4$  members.

# SOME IMPORTANT INSTRUCTIONS...

- ▶ Please attend all the classes.
  - Below 70 % : No permission for exam
- ▶ Please **do not copy** in your Reports /Assignments /Exams.
  - A copy script will get **0** (ZERO)
- ▶ Please submit your report/assignment on time.
  - Late submission will be marked on **60%**
- ▶ Be attentive, active, and cooperative in the class.
- ▶ Provide feedback with relevant questions.
- ▶ Do not disturb others in the class.

# SOME IMPORTANT INSTRUCTIONS...

- ▶ Class materials will be shared through Google Classroom
  - Classroom ID (Class Code): **fnhqzg6**



- ▶ Please focus on relevant topics/discussions.

***To know the Quality of Life of communities,  
Know the Medical and Health service facilities.***

**Thank You**