**City University of Hong Kong**
**Course Syllabus**

**offered by School of Data Science**
**with effect from Semester B 2022/23**

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## Part I Course Overview

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|---|---|
| **Course Title:** | Statistical Machine Learning II |
| **Course Code**: | SDSC6001 |
| **Course Duration:** | One Semester |
| **Credit Units**: | 3 |
| **Level**: | P6 |
| **Medium of Instruction:** | English |
| **Medium of Assessment:** | English |
| **Prerequisites**: *(Course Code and Title)* | SDSC5001 Statistical Machine Learning I |
| **Precursors**: *(Course Code and Title)* | Nil |
| **Equivalent Courses**: *(Course Code and Title)* | Nil |
| **Exclusive Courses**: *(Course Code and Title)* | Nil |

## Part II Course Details

### 1. Abstract

This course focuses on the theoretical foundation and fundamental methods in unsupervised and supervised learning, and Deep learning methods as well as the discipline of applying Python to program and implement aforementioned algorithms and methods.

### 2. Course Intended Learning Outcomes (CILOs)

*(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)*

| No. | CILOs | Weighting (if applicable) | Discovery-enriched curriculum related learning outcomes (please tick where appropriate) | | |
|---|---|---|---|---|---|
| | | | *A1* | *A2* | *A3* |
| 1. | State rigorously fundamental principles, ideas, theories, and methods of machine learning and deep learning | 20% | ✓ | | |
| 2. | Distinguish and compare various machine learning and deep learning models | 20% | ✓ | | |
| 3. | Apply common machine learning and deep learning methods and algorithms to datasets | 40% | ✓ | ✓ | ✓ |
| 4. | Solve some practical problems by existing machine learning and deep learning methods and designing new algorithms | 20% | ✓ | ✓ | ✓ |
| | | 100% | | | |

*A1: Attitude*
*Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.*

*A2: Ability*
*Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.*

A3: *Accomplishments*
*Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.*

## 3. Teaching and Learning Activities (TLAs)

*(TLAs designed to facilitate students' achievement of the CILOs.)*

| TLA | Brief Description | CILO No. | | | | | Hours/week (if applicable) |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | | |
| Lecture | Learning through **teaching** is primarily based on lectures and demonstrations. | ✓ | ✓ | ✓ | ✓ | | 39 hours in total |
| Mini-project | A typical machine learning problem will be given to students to solve. The students are expected to tackle the given problem, write a report and give a presentation. This learning activity will be mainly student-led but with instructor's structural guidance. | ✓ | ✓ | ✓ | ✓ | | After class |

Lectures cover not only the narrowly focused techniques in engineering economy but also the wider issues of the environment that affect engineering economic decision making. Students are expected to participate in class discussion when needed.

## 4. Assessment Tasks/Activities (ATs)

*(ATs are designed to assess how well the students achieve the CILOs.)*

| Assessment Tasks/Activities | CILO No. | | | | | Weighting | Remarks |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | | | |
| Continuous Assessment: _100_% | | | | | | | |
| Test<br>Questions are designed to see how well the students have learned the fundamental theory of machine learning and deep learning, and applications of them to some datasets. | ✓ | ✓ | ✓ | ✓ | | 50% | |
| Mini-Project<br>The project provides students chances to demonstrate how well they have achieved their intended learning outcomes. | ✓ | ✓ | ✓ | ✓ | | 25% | |
| Mini-Project Presentation<br>The project provides students chances to demonstrate how well they have achieved their intended learning outcomes. | ✓ | ✓ | ✓ | ✓ | | 25% | |
| | | | | | | 100% | |

## 5. Assessment Rubrics

*(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)*

Applicable to students admitted in Semester A 2022/23 and thereafter

| Assessment Task | Criterion | Excellent (A+, A, A-) | Good (B+, B) | Marginal (B-, C+, C) | Failure (F) |
|---|---|---|---|---|---|
| 1. Test | Ability to understand and apply the fundamental theory of machine learning and deep learning | High | Significant | Basic | Not even reaching marginal level |
| 2.Mini-Project Report | Ability to demonstrate the understanding of the basic concepts, fundamental theory, deep learning methods, and their applications to some datasets. | High | Significant | Basic | Not even reaching marginal level |
| 3.Mini-Project Presentation | Ability to demonstrate how well the intended learning outcomes are achieved. | High | Significant | Basic | Not even reaching marginal level |

Applicable to students admitted before Semester A 2022/23

| Assessment Task | Criterion | Excellent (A+, A, A-) | Good (B+, B, B-) | Fair (C+, C, C-) | Marginal (D) | Failure (F) |
|---|---|---|---|---|---|---|
| 1. Test | Ability to understand and apply the fundamental theory of machine learning and deep learning | High | Significant | Moderate | Basic | Not even reaching marginal level |
| 2. Mini-Project Report | Ability to demonstrate the understanding of the basic concepts, fundamental theory, deep learning methods, and their applications to some datasets. | High | Significant | Moderate | Basic | Not even reaching marginal level |
| 3.Mini-Project Presentation | Ability to demonstrate how well the intended learning outcomes are achieved. | High | Significant | Moderate | Basic | Not even reaching marginal level |

**Part III Other Information** (more details can be provided separately in the teaching plan)

**1. Keyword Syllabus**

*(An indication of the key topics of the course.)*

Classic Theory of Machine Learning:

Supervised Learning: Support Vector Machine; regularizations; Tree; Matrix Factorization

Unsupervised Learning: Clustering; Principal Component Analysis; Factor Analysis

Deep Neural Networks:

Feed-forward Neural Networks;

Convolutional Neural Networks;

Recurrent Neural Networks;

Autoencoders;

Generative Adversarial Networks;

Self-attention;

Transformer;

Deep Reinforcement Learning;

Graph Neural Networks

Other technologies of Machine Learning and Deep Learning:

Explainable AI;

Model Selection;

Transfer Learning;

Model Selection;

**2. Reading List**

**2.1 Compulsory Readings**

*(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)*

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|---|---|
| 1. | The Elements of Statistical Learning by Hastie, Tibshirani, and Friedman, Springer |
| 2. | Lecture Notes |

**2.2 Additional Readings**

*(Additional references for students to learn to expand their knowledge about the subject.)*

NIL