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| Logo Fast | **NATIONAL UNIVERSITY**  **of Computer & Emerging Sciences, Lahore** |

Department of Data Science

**Introduction to Data Science**

**FALL 2021**

**Instructor Name:**  Dr. Irfan Younas  **TA Name (if any):**

**Email address:** irfan.younas@nu.edu.pk **Email address:**

**Office Location/Number:** C-146 **Office Location/Number:**

**Office Hours:** Tuesday 3:00-4:00 PM, Thursday 3:00pm to 4:00pm  **Office Hours:**

**Course Information**

**Program:** BSDS **Credit Hours:** 3 **Type:** Core

**Pre-requisites (if any):**  Programming competence,

**Course Website (if any)** : SLATE, Google classroom

**Class Meeting Time:**

**Course Description/Objectives/Goals:**

Data Science is the study of the generalizable extraction of knowledge from data. Being a data scientist requires an integrated skill set spanning computer science, mathematics, statistics, and domain expertise along with a good understanding of the art of problem formulation to engineer effective solutions. The goal of this course is to teach students to answer questions with data. To do this, we will learn the necessary skills to manage and analyze data with case studies. In this course student learn concepts such as data collection and integration, exploratory data analysis, statistical inference and modeling, machine learning, and high-dimensional data analysis.

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| **Course Learning Outcomes (CLOs):** | | |
| At the end of the course students will be able to: | **Domain** | **BT\* Level** |
| understand the basics of Data Science, |  |  |
| prepare and wrangle the data for analysis, |  |  |
| perform exploratory data analysis to investigate data so as to discover patterns, to spot anomalies, to test hypothesis and to check assumptions with the help of summary statistics and graphical representations, |  |  |
| understand and apply machine learning algorithms to gain insight from the data |  |  |
| \* BT= Bloom’s Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain.    **Bloom's taxonomy Levels:** 1. Knowledge, 2. Comprehension, 3. Application, 4. Analysis, 5. Synthesis, 6. Evaluation | | |

***Textbook(s) /Supplementary Readings*:**

There is no standard "textbook" for this course. The following book will be used as a primary text to guide some of the discussions, but it will be heavily supplemented with lecture notes and reading assignments from other sources.

Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014. ISBN 978-1-449-35865-5.

**Additional references and books related to the course:**

Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (Free online.)

Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. Morgan Kaufmann Publishers. 2012. ISBN 978-0-12-381479-1.

Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. MIT Press. 2013. ISBN 0262018020. ( Online info available here.)

Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. O'Reilly 2013. ISBN 978-1-449-36132-7.

**Tentative Weekly Schedule**

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| Week | Topics to be covered | Readings | Assignments/Projects? |
| 1 | * Introduction to Data Science * Introduction to Machine Learning: Supervised, unsupervised learning * Intro to Linear Regression: Model Representation for single variable Linear Regression, |  | Home work-1 |
| 2-3 | * Introduction to Python   + Python Basics: basic data types, container types, variables, control structures, functions & procedures, classes & instances, modules & packages, exceptions, files & standard library, etc.   + Popular Data Science modules: Numpy, Pandas, Matplotlib, Tools etc, |  |  |
| 4-5 | * Introduction to Machine Learning, Supervised and Unsupervised learning * Linear Regression (Regression Problems) * Gradient Descent * Multiple Variable Linear Regression and Polynomial Regression, Normal Equation, Logistic Regression |  | Quiz 1, Assignment 1, HOMEWORK 2, |
| 6-7 | * Logistic Regression (Classification Problems) * Regularization |  | Midterm-1, Assignment 2 |
| 8- 9 | * k-Nearest Neighbors (k-NN) * Advice for applying ML , ML System Design, model selection, parameters optimization, learning curves, model’s underfitting and overfitting detection and solution, evaluation measures,   Clustering Algorithms |  | Quiz 2 |
| 10-11 | * Feature Generation and Feature selection   + Overview of Feature Generation (**F**eature extraction), Dimensionality Reduction using Principal Component Analysis   + Overview of Feature Selection approaches * Introduction to Filter-based and Wrapper-based approaches; |  | Assignment# 3, Quiz 3 |
| 11-12 | * Introduction to Statistics basics, descriptive stat, statistical inference * Data Wrangling   + Data cleaning, data reshaping, data preprocessing |  | Homework 3, |
| 12-13 | * Basic Exploratory Data Analysis   + Basic tools (plots, graphs and summary statistics) of EDA * Statistical measures for analysis * Exploratory Data Analysis   + Use of R-squared and other measures for analysis   + Model transformations |  | Assignment 4/Homework 4, Quiz 4 |
| 14-15 | * Data visualization * Mining Social Network Graphs * Data Science and Ethical Issues |  | Homework 5, |

**(Tentative) Grading Criteria**

Quizzes 10%

*Assignments/Homeworks/Project 15 -* 25%

*Midterms* 25-30%

*Final Exam* 40 - 45%

***Total:*  100 %**

**Course Policies**

* *Course outline may change 10-20% as we proceed in the semester*
* ***Grading scheme: Relative***
* Depending on the situation of COVID 19, this weightage of midterms can be reduced and added in assignments/homeworks/project.
* *Weightage of other evaluations can also be adjusted if needed.*
* *Assignment deadlines for assignment and Project are hard.*
* *NO Cell Phone usage in class, they must be turned off at all times.*
* *There will be no retake of quizzes or exams.*
* ***Integrity in the assignments/quizzes is expected; otherwise result would be an F grade in the course or may be the case is forwarded to Disciplinary committee.***
* *Attendance MUST be ensured according to the University policy to avoid disqualification.*