

ARTIFICIAL INTELLIGENCE GRADUATION MODULE 1

1. Thông tin về học phần (General Information)

Tên học phần (Course name): Artificial Intelligence Graduation Module 1

Mã học phần (Course code): ???

Số tín chỉ (Number of credits): 4

Loại học phần (Course type): Compulsory

Học phần tiên quyết (Prerequisites):

- Statistics and Probability (BAS1226)

Học phần trước (Previous courses):

Học phần song hành (Parallel courses):

Các yêu cầu đối với học phần (Course requirements):

- Lecture room: Projector, microphone and speaker, black board or white board.
- Laboratory:

Giờ tín chỉ đối với các hoạt động (Teaching and Learning hours):

- Lý thuyết (Lectures): 34h
- Bài tập (Exercises): 16h
- Bài tập lớn (Projects): 10h
- Thực hành (Labs): 0h
- Tự học (Individual reading): 0h

Địa chỉ Khoa/Bộ môn phụ trách học phần (Address of the Faculty/Department in charge of the course):

- Address: Faculty of Information Technology 1 – Posts and Telecommunications Institute of Technology, Km10, Nguyen Trai Street, Ha Dong District, Hanoi.
- Phone number : (024) 33510432

2. Mục tiêu học phần (Objectives)

Về kiến thức (Knowledge):

The aim of this course is to provide learners with important knowledge about machine learning, the core part of modern artificial intelligence, including:

- definitions and basic concepts
- machine learning types and machine learning problems
- machine learning algorithms for regression, classification, and clustering
- methods to build machine learning systems

Kỹ năng (Skills):

The aim of this course is to equip learners with skills in:

- applying the learned knowledge to solve machine learning problems
- building machine learning systems using Python
- evaluation of machine learning models.

Thái độ, Chuyên cần (Attitude):

Students are required to attend the classes and complete exercises and assignments.

3. Tóm tắt nội dung học phần (Description)

This course revises and extends the important knowledge about machine learning that students have studied in the previous semesters, including definitions and basic concepts, machine learning types (supervised learning, unsupervised learning, and semi-supervised learning), machine learning problems (regression, classification, and clustering), machine learning algorithms for regression (linear and non-linear), classification (logistic regression, Naïve Bayes, KNN, decision trees, random forests, SVMs), and clustering (flat and hierarchical), and other topics in machine learning (online learning, ensemble learning). The course also teaches students how to build machine learning systems using Python and how to evaluate them.

4. Nội dung chi tiết học phần (Outlines)

Chapter 1: Machine Learning Basics

- 1.1. Basic concepts
- 1.2. Types of learning
 - 1.2.1. Supervised learning
 - 1.2.2. Unsupervised learning
 - 1.2.3. Semi-supervised learning
 - 1.2.4. Reinforcement learning
- 1.3. Components of a machine learning system
 - 1.3.1. Learning phase
 - 1.3.2. Prediction phase
- 1.4. Evaluation of machine learning systems

Chapter 2: Python Programming Review

- 2.1. Introduction
- 2.2. Variables, Syntax, and Simple data types
 - 2.2.1. Variables
 - 2.2.2. Syntax
 - 2.2.3. Simple data types
- 2.3. Lists and Dictionaries
 - 2.3.1. Lists
 - 2.3.2. Dictionaries
- 2.4. Functions and Classes
 - 2.4.1. Functions
 - 2.4.2. Classes
- 2.5. Files and Exceptions
 - 2.5.1. Files
 - 2.5.2. Exceptions
- 2.6. Python libraries for machine learning
 - 2.6.1. Numpy
 - 2.6.2. Scipy
 - 2.6.3. Scikit-learn

Chapter 3: Regression

- 3.1. Introduction
- 3.2. Linear regression
 - 3.2.1. Simple linear regression
 - 3.2.2. Multiple linear regression

- 3.3. Non-linear regression
- 3.4. Evaluation of regression models

Chapter 4: Classification

- 4.1. Introduction
- 4.2. Logistic regression
 - 4.2.1. The logistic model
 - 4.2.2. Estimating the regression coefficients
 - 4.2.3. Making predictions
 - 4.2.4. Multiple logistic regression
- 4.3. Naïve Bayes classification
 - 4.3.1. Bayes' theorem
 - 4.3.2. Parameter estimation
 - 4.3.3. Making predictions
 - 4.3.4. Smoothing
- 4.4. K-nearest neighbor
 - 4.4.1. Lazy learning
 - 4.4.2. Sample similarity
 - 4.4.3. The KNN algorithm
- 4.5. Tree-based classification
 - 4.5.1. Decision trees
 - 4.5.2. Random forests
- 4.6. Support vector machines
 - 4.6.1. Max-margin classification
 - 4.6.2. SVMs for binary classification
 - 4.6.3. SVMs for multiple classes
- 4.7. Evaluation of classification models
- 4.8. Projects

Chapter 5: Clustering

- 5.1. Introduction
- 5.2. Similarities and distances
 - 5.2.1. Quantitative data
 - 5.2.2. Categorical data
 - 5.2.3. Textual data
- 5.3. Flat clustering
 - 5.3.1. K-means clustering
 - 5.3.2. K-medians clustering
- 5.4. Hierarchical clustering
 - 5.4.1. Bottom-up methods
 - 5.4.2. Top-down methods
- 5.5. Evaluation of clustering models
- 5.6. Projects

Chapter 6: Other Topics

- 6.1. Online learning
 - 6.1.1. Offline vs. Online learning
 - 6.1.2. The online perceptron algorithm
- 6.2. Semi-supervised learning
 - 6.2.1. Self training
 - 6.2.2. Co-training
 - 6.2.3. Graph-based semi-supervised learning
- 6.3. Ensemble learning

- 6.3.1. Boosting
- 6.3.2. Bagging
- 6.3.3. Bucket of models
- 6.3.4. Stacking
- 6.4. Practical issues

5. Học liệu (Textbooks)

5.1. Học liệu bắt buộc (Required Textbooks)

- [1] Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani. *An Introduction to Statistical Learning: With Applications in R*. Springer Publishing Company, Incorporated, 2014.

5.2. Học liệu tham khảo (Optional Textbooks)

- [2]. Stuart Russell and Peter Norvig. *Artificial Intelligence: A Modern Approach (3rd edition)*. Prentice Hall Press, Upper Saddle River, NJ, USA, 2009.
- [3] Shai Shalev-Shwartz and Shai Ben-David. *Understanding Machine Learning: From Theory to Algorithms*. Cambridge University Press, New York, NY, USA, 2014.
- [4] Sebastian Raschka, Vahid Mirjalili. *Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2 (3rd edition)*. Packt Publishing, 2019.
- [5] Eric Matthes. *Python crash course: a hands-on, project-based introduction to programming*, No Starch Press, 2016.

6. Phương pháp, hình thức kiểm tra – đánh giá kết quả học tập học phần (Grading Policy)

Grading method	Percentage	Group/Individual
- Attendance	10%	Individual
- Exercises	10%	Individual
- Mid-term projects/exam	20%	Group or individual
- Final examination	60%	Individual

**Trưởng Bộ môn
(Head of Department)**

**Giảng viên biên soạn
(Lecturer)**

Ngô Xuân Bách

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