SYLLABUS

1. **Course name:** Machine Learning
2. **Course code:** MALE321063
3. **Credits:** 3 (3/0/6)
   Duration: 15 weeks (45h main course and 90h self-study)
4. **Instructors:**
   1- Nguyen Thanh Hai, PhD
   2- Nguyen Manh Hung, PhD
   3- Ngo Quoc Cuong, MEng
5. **Course conditions**
   Prerequisites: Programing Language
   Corequisites: Statistic Theory
6. **Course description**

This course provides students fundamental knowledge about pattern recognition and machine learning. This course introduces fundamental supervised and unsupervised learning algorithm as well as recommendation system.

7. **Course Goals**

Goals	***Goal description*** *(This course provides students:)*	**ELOs**
G1	Fundamental supervised and unsupervised learning algorithm	01 (H) 07 (M)
G2	An ability to identify, evaluate and analysis an regression/ classification system.	02 (M), 03 (M)
G3	An ability design an regression/ classification system.	10 (L) 11 (H)

** Note: High: H; Medium: M; Low: L*

8. **Course Learning Outcomes (CLOs)**

CLOs		***Description*** *(After completing this course, students can have:)*	**Outcome**
G1	G1.1	Have knowledge about linear regression models	1, 7
	G1.2	Have knowledge about non-linear regression models	1, 7
	G1.3	Have knowledge about clustering problem	1, 7
	G1.4	Have knowledge about dimensional reduction	1, 7
	G1.5	Have knowledge about recommendation systems	1, 7

G2	G2.1	Have ability to identify an image based recognition	2, 3
	G2.2	Have ability to evaluate and analysis an natural language based recognition	2, 3
G3	G3.1	Have ability to design an regression or classification system	10, 11
	G3.2	Have ability to validate and verify and an regression or classification sytems	10, 11

9. Study materials

- Textbooks:

[1] Christopher M. Bishop, *Pattern Reconition and Machine Learning*, 2nd ed Springer, 2007.

- References:

[2] Duda, Richard, Peter Hart, and David Stork. *Pattern Classification*. 2nd ed. New York, NY: Wiley-Interscience, 2000.

[3] Hastie, T., R. Tibshirani, and J. H. Friedman. *The Elements of Statistical Learning: Data Mining, Inference and Prediction*. New York, NY: Springer, 2001.

10. Sudent Assessments

- Grading points: 10

- Planning for students assessment is followed:

Type	Contents	Linetime	Assessment techniques	CLOs	Rates (%)
Midterms					**50**
Exam01	Short exercise	Begin/ end of each week	Short question in class	G1.1-G1.5	10
Exam02	Coding exercise	week 11	Individual paper assessment in class	G2.1-G2.2,	20
Exam03	Project report	week 15	Individual paper assessment in class	G3.1, G3.3,	20
Final exam					**50**
Final Exam	Final report	week 16	Project report	G1.1-G1.5 G2.1-G2.2	

11. Course details:

Weeks	Contents	CLOs
1	***Chapter 1:*** **< Machine Learning Introduction>** *(3/0/6)*	

	A/* Contents and teaching methods: (3)* **Contents:** 1.1 Machine learning introduction 1.2 Unsupervised learning 1.3 Supervised learning **Teaching methods**: + Theoretical lectures + Questions	G1.1
	***B/* Self-study contents**: *(6)* + Interpretation methods + Inductive methods	G1.1
2	***Chapter 2:* < LINEAR REGRESSION >** *(6/0/12)*	
	A/* Contents and teaching methods: (3)* **Contents:** 2.1 Linear regression 2.2 Object function 2.3 Optimization **Teaching methods**: + Theoretical lectures + Questions	G1.1
	***B/* Self-study contents**: *(6)* + Object function derivative + Exercises	G1.1
3	***Chapter 2:* < LINEAR REGRESSION (cont.)>** *(6/0/12)*	
	A/* Contents and teaching methods:(3)* **Contents:** 2.4 Multivariable problems 2.5 Multivariable features 2.6 Optimal multivariable function **Teaching methods**: + Theoretical lectures + Questions	G1.1
	***B/* Self- study contents**: *(6)* + Standard equation + Optimal by standard equation	G1.1
4	***Chapter 3:* < CLASSIFICATION>** *(3/0/6)*	
	A/* Contents and teaching methods: (3)* **Contents:** 3.1 Classification 3.2 Object function for classified problems 3.3 Optimal objet function for classified problems	G1.1

	Teaching methods: + Theoretical lectures + Questions	
	***B/* Self- study contents**: *(6)* + Calculating derivation for target function + Exercises	G1.1
5	***Chapter 4:* < OVERFITING >** *(3/0/6)*	
	A/* Contents and teaching methods: (3)* **Contents:** 4.1 Overfitting problem 4.2 Identification overfitting problem. 4.3 Handle overfitting problem **Teaching methods**: + Theoretical lectures + Questions	G3.1
	***B/* Self- study contents**: *(6)* + Calculating gradient in a regilization + Exercises	G3.1 - G3.2
6	***Chapter 5:* < NON-LINEAR SYSTEMS >** *(9/0/18)*	
	A/* Contents and teaching methods: (3)* **Contents:** 5.1 Neuron network 5.2 Object function **Teaching methods**: + Questions and answers + Guide	G1.2
	***B/* Self- study contents**: *(6)* + Reinforce the knowledge learned	G1.2
7	***Chapter 5:* < NON-LINEAR SYSTEMS (cont.) >** *(9/0/18)*	
	A/* Contents and teaching methods: (3)* **Contents:** 5.3 Forward propagation 5.4 Backward propagation **Teaching methods**: + Theoretical lectures + Questions	G1.2
	***B/* Self- study contents**: *(6)* + Reinforce the knowledge learned + Exercises	G1.2
8	***Chapter 5:* < NON-LINEAR SYSTEMS (cont.) >** *(9/0/18)*	

	A/* Contents and teaching methods: (3)* **Contents:** 5.5 Suport Vector Machine 5.6 Using support vector machine **Teaching methods**: + Theoretical lectures + Questions	G1.2
	***B/* Self- study contents**: *(6)* + Exercises	G1.2 G2.1
9	***Chapter 6:* < MODEL SELECTION>** *(3/0/6)*	
	A/* Contents and teaching methods: (3)* **Contents:** 6.1 Select model size 6.2 Select model parameters 6.3 Dataset Evaluation **Teaching methods**: + Theoretical lectures + Questions	G3.2
	***B/* Self- study contents**: *(6)* + Reinforce the knowledge learned	
10	***Chapter 7:* < CLUSTERING >** *(3/0/6)*	
	A/* Contents and teaching methods: (3)* **Contents:** 7.1 Unsupervised learning 7.2 Clustering problems 7.3 K-means algorithm 7.4 Graph method **Teaching methods**: + Theoretical lectures + Questions	G1.3
	***B/* Self- study contents**: *(6)* + Spectral clustering method	G2.1
11	**PROJECT REPORT**	
	A/* Contents and teaching methods: (3)* **Contents:** 1 Project report **Teaching methods**: + Presentation + Evaluation	G2.1 G2.2 G3.1

	***B/* Self- study contents**: *(6)* + Reinforce the knowledge learned	G2.1 G2.2 G3.2
12	**>** *(6/0/12)*	
	A/* Contents and teaching methods: (3)* **Contents:** 8.1 Dimensonal reduction 8.2 Princible Component Analysis (PCA) **Teaching methods**: + Theoretical lectures + Questions	G1.4
	***B/* Self- study contents**: *(6)* + LDA method + Exercises	G1.4
13	***Chapter 8:* < DIMENSIONAL REDUCTION OF DATA (cont.) >** *(6/0/12)*	
	A/* Contents and teaching methods: (3)* **Contents:** 8.3 LLE method 8.4 Iso-Map method **Teaching methods**: + Theoretical lectures + Questions	G1.4
	***B/* Self- study contents**: *(6)* + Progam the LLE- Iso Map methods + Exercises	G1.4
14	***Chapter 9:* < RECOMMENDATION SYSTEMS >** *(3/0/6)*	
	A/* Contents and teaching methods: (3)* **Contents:** 9.1 Introduced about recommendation systems 9.2 Hidden models 9.3 Program recommendation systems **Teaching methods**: + Theoretical lectures + Questions	G1.4
	***B/* Self- study contents**: *(6)* + Reinforce the knowledge learned + Exercises	G1.4
15	**PROGRAMMING EXERCISES REPORT**	
	A/* Contents and teaching methods: (3)* **Contents:**	G2.1 G2.2 G3.1

	1 Recommendation systems 2 Hidden models 3 Recommendation systems programing **Teaching methods**: Report – Assess	G3.2
	***B/* Self- study contents**: *(6)* + Reinforce the knowledge learned + Group Discussion	G3.1 G3.2

12. Learning ethics:

- Home assignments and projects must be done by the students themselves. Plagiarism found in the assessments will get zero point

13. First approved date:

14. Approval level:

Dean	**Department**	**Instructor**

15. Syllabus updated process

1st time: Updated content dated	Instructors
2st time: Updated content dated	Head of department