COURSE SYLLABUS  
**CSC14006 – Pattern Recognition**

# GENERAL INFORMATION

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| Course name: | Pattern Recognition |
| Course name (in Vietnamese): | Nhận dạng |
| Course ID: | CSC14006 |
| Knowledge block: | Specialize |
| Number of credits: | 4 |
| Credit hours for theory: | 45 |
| Credit hours for practice: | 30 |
| Credit hours for self-study: | 90 |
| Prerequisite: |  |
| Prior-course: | Introduction to artificial intelligence |
| Instructors: | Lê Hoàng Thái |

# COURSE DESCRIPTION

The course is designed to provide students:

1. The foundations of pattern recognition, i.e. how patterns are recognized on the computer.

2. Wide understanding of different related topics, i.e., pattern recognition systems, preprocessing and feature extraction, theories of supervised and unsupervised learning, object classification and recognition, deep neural networks, and other topics as well.

3. With sufficient background in the theoretical concepts behind stages of pattern recognition systems, and to implement these systems using computer applications.

# COURSE GOALS

At the end of the course, students are able to

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| **ID** | **Description** | **Program LOs** |
| G1 | Describe about pattern recognition and its broad applications in various aspects of our day-to-day life. | 1.4.1, 3.1.1 |
| G2 | Explain the algorithms used in different phases of pattern recognition systems, including data acquisition, pre-processing, segmentation, feature extraction, and classification. | 1.4.1, 4.3.2, 4.3.3, 4.3.4 |
| G3 | Demonstrate the techniques used to recognize patterns, such as statistical approaches, data clustering, neural networks, etc. | 1.4.1 |
| G4 | Summarize knowledge of various applications of pattern recognition in real life, including reading research papers and preparing presentations. | 1.4.1, 2.3.2, 2.4.5, 3.1.1, 4.2.2 |
| G5 | Produce pattern recognition programs and implement various techniques discussed throughout the course. | 1.2.1, 1.4.1, 5.3.2 |

# COURSE OUTCOMES

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| **CO** | **Description** | **I/T/U** |
| G1.1 | Summarize the concepts of pattern recognition, including its definition, design cycle, applications, and algorithms. | T |
| G1.2 | Explain basic concepts involved in structural and statistical pattern recognition. | T |
| G2.1 | Experiment pattern recognition systems. | U |
| G2.2 | Compare and analyze algorithms used in pattern recognition. | U |
| G2.3 | Explain various techniques used in object detection and classification. | T |
| G3.1 | Explain various techniques used in pattern recognition systems, including supervised and unsupervised learning. | T |
| G3.2 | Apply mathematical tools to algorithm design. | U |
| G4.1 | Translate abstract ideas into practice. | T, U |
| G4.2 | Show the ability to read research papers. | U |
| G4.3 | Show the ability for oral presentations. | U |
| G5.1 | Describe the important principles of deep neural networks, support vector machine, Principal Component Analysis, Linear Discriminant Analysis, and local binary pattern. | T |
| G5.2 | Show a good programming style. | U |

# TEACHING PLAN

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| **ID** | **Topic** | **Course outcomes** | **Teaching/Learning Activities (samples)** |
| 1 | Class overview: Class organization, topics overview, software etc.  Pattern recognition: Introduction to Biometric Systems | G1.1, G1.2, G4.1 | Lecturing  Q&A, Group discussion  QZ1: Quiz 1  (Chapter 1) |
| 2 | Various phases of pattern recognition systems | G2.1, G2.2, G2.3, G4.1 | Lecturing  Demonstration, Q&A  QZ2: Quiz 2 |
| 3 | Feature extraction, object detection and classification using Local binary pattern (LBP) | G2.2, G2.3, G3.1, G3.2 | Lecturing  Demonstration, discussion |
| 4 | Feature extraction using Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA). | G2.2, G2.3, G3.1, G3.2 | Lecturing  Demonstration, discussion |
| 5 | Data clustering, Classification and Template matching (algorithms: K-mean, k-nearest neighbor and Support vector machine). | G2.2, G2.3, G3.1, G3.2 | Lecturing  Demonstration |
| 6 | Various phases of Face Recognition System, including face detection, face alignment, feature extraction, feature matching and their applications. | G2.1, G2.2, G2.3, G3.1, G3.2, G4.1 | Question & answer  Case study and discussion  QZ3: Quiz 3 |
| 7 | An introduction to Deep Learning:  Deep learning architectures | G1.1, G1.2,  G2.1, G2.2,  G2.3, G3.1,  G3.2, G4.1 | Lecturing  Demonstration |
| 8 | Deep Learning Tutorial: Why Deep? Tips for Training Deep Neural Network. | G1.1, G1.2,  G2.1, G2.2,  G2.3, G3.1,  G3.2, G4.1 | Lecturing  Q&A, discussion  QZ4: Quiz 4 |
| 9 | Deep learning architectures: convolutional neural networks (CNNs) and their applications. | G1.1, G1.2,  G2.1, G2.2,  G2.3, G3.1,  G3.2, G4.1 | Lecturing |
| 10 | Presentations | G4.1, G4.2,  G4.3, G5.1, G5.2 | Case study, discussion  Demonstration |
| 11 | Review | G5.2 | Lecturing  Q&A, Discussion  Project submitted |

For the practical laboratory work, there are 10 weeks which cover similar topics as it goes in the theory class. Each week, teaching assistants will explain and demonstrate key ideas on the corresponding topic and ask students to do their lab exercises either on computer in the lab or at home. All the lab work submitted will be graded. There would be a final exam for lab work.

# ASSESSMENTS

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| **ID** | **Topic** | **Description** | **Course outcomes** | **Ratio (%)** |
| **A1** | **Assignments** |  |  | **20%** |
| A11 | Quizzes: QZ1, QZ2, QZ3, and QZ4. | Small quizzes in class for each topic | G1.1, G1.2,  G2.1, G2.2,  G2.3, G3.1,  G3.2, G4.1 | 5% |
| A12 | Homework: HW1, HW2, and HW3 | HW1, HW3: reading comprehension and writing reports in English  HW2, HW3: practicing based on knowledge taught in class | G4.1, G4.2,  G4.3, G5.1, G5.2 | 5% |
| A13 | Weekly labwork: LW1–LW10 |  | G4.1, G4.2,  G4.3, G5.1, G5.2 | 10% |
| **A2** | **Projects** |  |  | **20%** |
| A21 | Project |  | G4.1, G4.2  G4.3, G5.1,G5.2 | 20% |
| **A3** | **Exams** |  |  | **60%** |
| A31 | Lab final exam | In-class programming exam on computer | G5.2 | 10% |
| A32 | Presentations | Oral presentations with slides.  Describe the understanding of different topics. | G4.1, G4.2,  G4.3, G5.1, G5.2 | 20% |
| A33 | Final exam | Closed book exam.  Describe the understanding of different topics, analyze & program to solve problems | G5.1, G5.2 | 30% |

# RESOURCES

# Textbooks

* ***Pattern Classification 2nd Edition,*** *Richard O. Duda, Peter E. Hart, and David G. Stork Wiley, 2004.*
* ***Handbook of Biometrics,*** *Anil K. Jain, Patrick Flynn, and Arun A. Ross, Springer, 2008.*
* ***Handbook of Face recognition,*** *Stan Z. Li and Anil K. Jain, Springer, 2011.*
* ***Deep Learning for Computer Vision with Python, Starter Bundle****, Dr. Adrian Rosebrock, 2017.*
* ***Deep Learning for Computer Vision with Python, Practitioner Bundle,*** *Dr. Adrian Rosebrock, 2017.*

# Others

* <http://www.pyimagesearch.com/contact>

# GENERAL REGULATIONS & POLICIES

* All students are responsible for reading and following strictly the regulations and policies of the school and university.
* Students who are absent for more than 3 theory sessions are not allowed to take the exams.
* For any kind of cheating and plagiarism, students will be graded 0 for the course. The incident is then submitted to the school and university for further review.
* Students are encouraged to form study groups to discuss on the topics. However, individual work must be done and submitted on your own.

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| *Ho Chi Minh City, February 13th, 2023*  ***DEAN OF FACULTY***  A signature of a person  Description automatically generated  Dinh Ba Tien |