Course specification

(2206 Pattern Recognition)

Faculty: HICIT - **Higher Institute for Computers & Information Technology**
Programme(s) on which the course is given: Under graduate program in Computer Science
Major or minor element of programme: Core
Department offering the programme: Department of Computer Science
Department offering the course: Department of Computer Science
Year / Class: 2rd Year – 2nd semester
Date of specification approval: 22/2/2016

A- Basic Information

Title: Pattern Recognition **Code: 2206**
Weekly Hours:
Lecture: 3 **Exercise: -** **Practical: 3** **Total: 6**

B- Professional Information

1- Course Objectives:

The objective of this course is to teach the Pattern Recognition methodologies.

After completing this course, the student should be able to:

a. Understand the Pattern Recognition theory.
b. Understand the PR techniques related to the analysis, design and implementation of the system that holds Patterns.
c. Understand how to apply the PR concepts in building a real Pattern Recognition system.

2- Program ILOs Covered by Course

Program Intended Learning Outcomes			
Knowledge and understanding	**Intellectual Skills**	**Professional and practical skills**	**General and Transferable skills**
a6, a7, a12, a14, a21	**b2, b3, b4**	**c10, c16**	**d5, d11**

3 - Intended learning outcomes of course (ILOs)

a: Knowledge and Understanding

a1. Understand and apply a wide range of principles and tools available to the PR principles,
a2. Understand the notion of Pattern Recognition systems,
a3. Understand the PR in the software process.

a4. Understand the linear classifiers, understand the Nonlinear classifiers, understand the notion of clustering, understand the various types of clustering algorithms.

b: Intellectual skills

b1. Synthesis and evaluating the technical concepts of the syllabus.

b2. Appraisal of theory and its relevance to different situations, analysis of tasks into understandable and manageable subtasks.

b3. Synthesis of clearly and precisely stated solutions for problems.

b4. test the proposed implemented systems for validity, correction, refinement and maintenance of the proposed systems.

c: Professional and practical skills

c1. Develop a qualitative and quantitative skills including data analysis, interpretation and extrapolation

c2. Design, write and debug computer prototype and real pattern recognition systems covering all the basic concepts in PR choosing a suitable language for the Implementation.

d: General and transferable skills

d1. Work in a group to Build a prototype and real PR systems using the general knowledge in the course, solving general computational problems

d2- Learn some Internet/Library searching strategies.

d3- write a short report using appropriate scientific language.

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4- Contents

Topic	Hours	Lec.	Exc/Lab
Introduction : Pattern Recognition Systems (Sensing, Segmentation and Grouping, Feature Extraction, Classification, and Post Processing). the design cycle, learning and adaptation.	8	4	4
Bayesian Decision Theory: Bayes Decision Theory- Continues Features, Minimum-Error – Rate Classification. The Normal Density: Univariate Density, Multivariate Density.Marckov Chains.	12	6	6
Linear Classifiers: Linear Discriminant Functions and Decision Hyperplanes, the Perceptron Algorithm, Least Square Methods, Mean Square Estimation.	12	6	6
Nonlinear Classifiers: The two layer Perceptron, Three Layer Perceptrons, Algorithms Based on correct Classification of the Training Set, The Backpropagation Algorithm, Validations on the Backpropagation Theme, The Cost Function Choice.	12	6	6
Clustering : Basic Concepts, Proximity Measures. Sequential Clustering Algorithms: Basic Sequential Algorithmic Scheme, Modified Basic Sequential Algorithmic Scheme, and a Two-Threshold Sequential Algorithmic Scheme.	12	6	6
Hierarchical Clustering Algorithms: Agglomerative Algorithms, Agglomerative Algorithms Based on Matrix Theory.	8	4	4

Clustering via cost optimization : Stochastic Simulated Annealing, Deterministic Simulated Annealing.	8	4	4
Clustering using Genetic Algorithms.	6	3	3

5 -Teaching and learning methods

5.1 Lectures
5.2 Tutorial Exercises
5.3 Practical Lab
5.4 Discussions.

6-Student assessment methods

6.1 Midterm Exam: To assess the knowledge and understanding achieved by the student during the previous weeks.

6.2 Final Exam: To evaluate what the student gain at the end of the course, and to assess: the knowledge and understanding, general skills, and intellectual skills.

6.3 Course Project: To allow students work in team, and to evaluate knowledge, understanding, intellectual, and transferable skills.

6.4 Course Work &Quizzes: To keep the student always in the course, and to evaluate knowledge, understanding, intellectual, and transferable skills.

Assessment Schedule

Assessment	**Week #**
Mid Term Exam	**8**
Final Exam	**16**
Course Project	**3-14**
Course Work &Quizzes	**2-14**

Assessment Weight

Assessment	**Weigh %**
Mid Term Exam	**5%**
Final Exam	**80%**
Course Project	**10%**
Course Work &Quizzes	**5%**
Total	**100**

Course Work &Quizzes: (Short Exams, Assignments, Researches, Reports, Presentations, Class/Project discussion)

7- List of references

7.1 Text Books

- Pattern Recognition, S. Theodoridis, and K. Koutroumbas, 2006.
- Pattern Classification, Richard O. Duda, Peter E. Hart, and David G. Stork,2001.

Pattern Recognition 4th Edition **by** Sergios Theodoridis Sergios Theodoridis Konstantinos Koutroumbas

8- Required Facilities

8.1 Tools/Software

- .NET framework

9- Course Matrices

9.1-Course Content/ILO Matrix

Course Contents	a1	a2	a3	a4	b1	b2	b3	b4	c1	c2	d1	d2	d3
Introduction : Pattern Recognition Systems (Sensing, Segmentation and Grouping, Feature Extraction, Classification, and Post Processing). the design cycle, learning and adaptation.	x	x	x		x	x	x		x				
Bayesian Decision Theory: Bayes Decision Theory- Continues Features, Minimum-Error – Rate Classification. The Normal Density: Univariate Density, Multivariate Density. Marckov Chains.	x	x	x		x	x	x		x				
Linear Classifiers: Linear Discriminant Functions and Decision Hyperplanes, the Perceptron Algorithm, Least Square Methods, Mean Square Estimation.	x	x	x	x	x	x	x	x	x				
Nonlinear Classifiers: The two layer Perceptron, Three Layer Perceptrons, Algorithms Based on correct Classification of the Training Set, The Backpropagation Algorithm, Validations on the Backpropagation Theme, The Cost Function Choice.	x	x	x	x	x	x	x	x	x	x			
Clustering : Basic Concepts, Proximity Measures. Sequential Clustering Algorithms: Basic Sequential Algorithmic Scheme, Modified Basic Sequential Algorithmic Scheme, and a Two-Threshold Sequential Algorithmic Scheme.	x	x	x	x	x	x	x	x	x	x			
Hierarchical Clustering Algorithms: Agglomerative Algorithms, Agglomerative Algorithms Based on Matrix Theory.	x	x	x	x	x	x	x	x	x	x			
Clustering via cost optimization : Stochastic Simulated Annealing, Deterministic Simulated Annealing.	x	x	x	x	x	x	x	x	x	x			
Clustering using Genetic Algorithms.	x	x	x	x	x	x	x	x	x	x			
Course project											x	x	x

9.2-Learning Method /ILO Matrix

Learning Methods	a1	a2	a3	a4	b1	b2	b3	b4	c1	c2	d1	d2	d3
Lecture	x	x	x	x	x	x	x	x	x	x			
Tutorial Exercises					x	x	x	x	x	x			
Practical Lab					x	x	x	x	x	x			
Discussion					x	x	x	x	x	x	x	x	x

9.3-Assessment Methods /ILO Matrix

Assessment Methods	a1	a2	a3	a4	b1	b2	b3	b4	c1	c2	d1	d2	d3
Mid Term Exam	x	x	x	x	x	x	x	x	x	x			
Final Exam	x	x	x	x	x	x	x	x	x	x			
Course Project	x	x	x	x	x	x	x	x	x	x	x	x	x
Course Work &Quizzes	x	x	x	x	x	x	x	x	x	x	x	x	x

Course Coordinator: Prof. Dr. Hussein Rady **( )**
Head of Department: Dr. Farouk Shabaan **( )**
Date: 22/2/2016