The Hong Kong Polytechnic University

Subject Description Form

Subject Code	COMP6707
Subject Title	Advanced Computational Intelligence
Credit Value	3
Level	6
Pre-requisite/ ~~Co-requisite~~/ ~~Exclusion~~	Knowledge in artificial intelligence / machine learning
Objectives	1. To motivate students with the understanding of Computational Intelligence (CI) theories and methodologies, including fuzzy logic, evolutionary computation, and artificial neural networks. 2. To apply the acquired knowledge and skills to various problem-solving situations, such as decision making, modeling, search and optimization, classification and regression.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: a) Understand fundamental principles and algorithms of computational intelligence. b) Analyze and evaluate strengths/weaknesses of various CI methodologies. c) Apply computational algorithms in engineering data analytic and optimization. d) Design and implement computational intelligence techniques to solve practical problems.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	The PhD-level course aims at presenting to the students different advanced techniques in computational intelligence. 1. Introduction: lets the students acquire the basic knowledge a. Overview of computational intelligence: inspiration, design, methodology, practical aspects of implementing procedures to solve real-world problems. b. Fuzzy sets, membership functions, fuzzy relations, fuzzy compositions, extension principle, approximate reasoning, fuzzy inference. c. Genetic algorithm, schemata theorem, nature-inspired algorithms, particle swarm optimization, differential evaluation. d. Neural computing, network architecture, multi-layer perceptrons, back-propagation algorithm, reinforcement learning. 2. Advanced: provides the students with powerful CI approaches: a. construction of knowledge base, type-2 fuzzy logic, fuzzy inductive reasoning, design of fuzzy systems. b. multi-objective evolutionary algorithms.

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<tr><td></td><td>c. distributed evolutionary algorithms.
d. hybrid techniques including neuro-fuzzy and genetic-fuzzy systems
e. advanced techniques in neural networks and deep learning (e.g., RBF networks, CNN, DBN, etc.)

3. Applications: show the students how to apply CI advanced techniques to solve complex problems in real scenarios.</td></tr>
<tr><td>Teaching/Learning Methodology (Note 3)</td><td>Lectures/ Seminars/ Tutorials / Project</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td></td><td></td></tr>
<tr><td>1. Project</td><td>40 %</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>2. Assignment and Presentation</td><td>20 %</td><td>√</td><td>√</td><td>√</td><td></td><td></td><td></td></tr>
<tr><td>3. Quiz/exam</td><td>40 %</td><td>√</td><td>√</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="6"></td></tr>
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Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Project: assessment of the ability of applying and implementing CI techniques to problem solving through real case studies.

Assignment: assessment of the theoretic studies with respect to the understanding of the relevant subject matters including new concepts, algorithms and techniques by providing answers to the assignment questions

Quiz/exam: assessment of the overall performance by quiz or exam.</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture/ Tutorial/ Seminar</td><td>39 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Reading</td><td>40 Hrs.</td></tr>
<tr><td>▪ Preparing project, assignment, quiz/exam</td><td>43 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>122 Hrs.</td></tr>
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Reading List and References	1. D. B. Fogel, D. R. Liu, J. M. Keller (2016), *Fundamentals of Computational Intelligence: Neural Networks, Fuzzy Systems, and Evolutionary Computation*, Wiley-IEEE Press. 2. S. Russell and P. Norvig (2009), *Artificial Intelligence: A Modern Approach*, Prentice-Hall, 3rd edition. 3. S. Haykin (2008), *Neural Networks and Learning Machines*, Prentice Hall, 3rd edition. 4. E. Trillas and L. Eciolaza (2015), *Fuzzy Logic: An Introductory Course for Engineering Students*, Springer. 5. E. Cuevas, V. Osuna, D. A. Oliva (2017), *Evolutionary Computation Techniques: A Comparative Perspective*, Springer. 6. Technical journals and Conference Proceedings, such as IEEE PAMI, IJCAI, NeurIPS, WCCI, AAAI.