Computer Science (COMP) 658

Computational Intelligence (Revision 2)

Status:	Replaced with new revision, see the **course listing** for the current revision
Delivery mode:	**Grouped study**
Credits:	3
Area of study:	Information Systems
Prerequisites:	Knowledge in a high-level programming language, such as C, C++, or Java. Such knowledge has to be demonstrated either through: 1. successful completion of, or exemption from, COMP501; or 2. successful completion of, or exemption from, COMP504; or 3. professor approval, where you contact the **Course Professor** and explain how you gained knowledge in a high-level programming language (e.g., through an undergraduate course, job experience). Students who are concerned about not meeting the prerequisite for this course

	are encouraged to contact the **Course Professor** before registering.
Precluded:	None
Faculty:	**Faculty of Science and Technology**
Notes:	This is a graduate level course and students need to apply and be approved to one of the graduate programs or as a non-program **School of Computing and Information Systems** graduate student in order to take this course. Minimum admission requirements must be met. Undergraduate students who do not meet admission requirements will not normally be permitted to take this course.
Instructor:	**Dr. Sabine Graf**

Overview

Computational Intelligence (CI) is a relatively new area which is becoming more and more important in society today and in the future, especially due to the growing possibilities of gathering data and the need for intelligent systems. CI deals with nature-inspired computational methodologies and approaches to solve complex problems for real world challenges to which traditional methodologies and approaches are ineffective or infeasible. As such, CI methodologies and approaches aim at creating intelligent systems by using innovative and nature-inspired algorithms.

This course is designed for those who are interested in learning more about how intelligent systems work as well as their potential to solve complex real-

world problems through the use of innovative and nature-inspired algorithms. The course will focus on the main CI approaches and methodologies, namely artificial neural networks, genetic algorithms, swarm optimization, and fuzzy systems. The course is a research-based course and therefore focuses on leading students to investigate the current state of research in CI areas as well as to gain comprehensive theoretical knowledge from scientific research about the basic concepts and features of CI methodologies and approaches. The course also is very practical-oriented and hands-on since it focuses on showing students real world applications of CI approaches and guides them to use their theoretical knowledge to design and build CI algorithms for solving real world problems. Furthermore, the course aims at encouraging students to critically think and reflect about the learned concepts and algorithms as well as emphasizes discussions among students on CI related topics.

Outline

Unit 0: Course Orientation

In this unit, students will get familiar with the elements of this course and how to use them in the learning process. These elements include the study guide, web resources, assignments, discussion forums, etc.

Unit 1: Introduction to Computational Intelligence

This unit will lead students through several important overview papers on the fundamental ideas and research in CI. Moreover, the unit will point out the key conferences, journals, and societies related to CI. At the end of the unit, students will be asked to reflect on what they have learned and discuss questions related to CI with each other as part of their participation marks.

Unit 2: Artificial Neural Networks

This unit will lead students to go through several important literatures on the topic of artificial neural networks (ANN). Students will learn about the general concept of ANN, different types of ANN, different types of learning (supervised and unsupervised learning), and applications of ANN algorithms in real world. At the end of the unit, students will be asked to reflect about what they have learned and discuss about questions related to ANN with each other in a discussion forum as part of their participation marks.

Unit 3: Genetic Algorithms

This unit will lead students to go through several important literatures on the topic of genetic algorithms (GA). Students will learn about the general concept and features of GAs, different types of GAs, different strategies of using GA features, and applications of GA algorithms in real world. At the end of the unit, students will be asked to reflect about what they have learned and discuss about questions related to GA with each other in a discussion forum as part of their participation marks.

Unit 4: Swarm Optimization

This unit will lead students to go through several important literatures on the topic of swarm optimization. Students will learn about the general concept and features of swarm optimization, different types of swarm optimization algorithms and their concepts/features, and applications of swarm optimization algorithms in real world. At the end of the unit, students will be asked to reflect about what they have learned and discuss about questions related to swarm optimization with each other in a discussion forum as part of their participation marks.

Unit 5: Fuzzy Systems

This unit will lead students to go through several important literatures on the topic of fuzzy systems. Students will learn about the general concept and features of fuzzy systems, different strategies for using features of fuzzy systems, and applications of fuzzy systems in real world. At the end of the unit, students will be asked to reflect about what they have learned and discuss about questions related to fuzzy systems with each other in a discussion forum as part of their participation marks.

Unit 6: Hybridization of CI Algorithms

This unit will lead students to go through several important literatures on the topic of hybridization of computational intelligence algorithms. Students will learn about why such hybrid algorithms can be beneficial, the general concepts of how to combine algorithms, different types of hybrid algorithms and their benefits, and applications of such hybrid algorithms in real world. At the end of the unit, students will be asked to reflect about what they have learned and discuss about questions related to hybridization of CI algorithms with each other in a discussion forum as part of their participation marks.

Learning outcomes

Upon successful completion of this course, you should be able to

- **gain comprehensive theoretical knowledge** as well as **practical skills** related to the design, implementation and analysis of CI approaches, algorithms and methods.
- explain, critically review, and discuss research papers in areas of CI.
- independently analyse research papers in areas of CI and write literature review papers on topics of CI.
- discuss and argue about current topics in CI.
- design and build CI algorithms and approaches to real-life problems, analyse and improve these algorithms and approaches, as well as argue, justify and discuss decisions made during the development processes.

Evaluation

To **receive credit** for COMP 658, you must achieve a cumulative course grade of **B- (70 percent)** or better and achieve an average grade of at least 50% on the assignments and 50% on participation. Your cumulative course grade will be based on the following assessment.

Activity	Weight
Assignment 1– Literature Review Paper and Peer Review	25%
Assignment 2 – Programming Task 1 (task given; algorithm can be chosen)	20%
Assignment 3 – Presentation of Literature Review Paper	20%
Assignment 4 – Programming Task 2 (task given; combine two algorithms or choose another algorithm)	20%
Participation	15%
Total	**100%**

Materials

The reading materials for this course will be taken entirely from web-based resources, accessible freely on the web or via our AU online library, and will include scientific papers as well as online tutorials and webpages. These materials aim at presenting our students on one hand with the basics in CI and on the other hand with current research in this field.

All materials of this course will be made available through a link guide on the course Web site.

Other Materials

Additionally, the course will include:

- the units of the course study guide
- detailed descriptions of the requirements for the assignments
- discussion and reflection forums (for announcements and student discussions)
- a course evaluation form

Special Course Features

COMP 658 will be offered in paced electronic mode. Online paced study is facilitated through a variety of computer mediated communication options, and can be completed at the student's workplace or home.

COMP 658 encourages and requires interaction and discussions between students through discussion forums and reflection forums. Furthermore, it includes innovative features such as peer-reviewing and presentations.

Special Note

Students registered in this course will NOT be allowed to take an extension due to the nature of the course activities.

Important links

- **Future Course Offerings**
- **Important Dates and Deadlines**
- **MScIS Contact Information**

Athabasca University reserves the right to amend course outlines occasionally and without notice. Courses offered by other delivery methods may vary from their individualized study counterparts.

Opened in Revision 2, March 3, 2022

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View **previous revision**