Western Engineering

Western University

Faculty of Engineering

Artificial Intelligence Systems Engineering Program

AISE 2205A – ALGORITHMS AND DATA STRUCTURES FOR OBJECT ORIENTED DESIGN

Course Outline: Fall 2025

COURSE DESCRIPTION: This course surveys important computer algorithms and related data structures used in object-oriented software engineering. The course addresses the design, performance analysis and implementation of such algorithms by stressing their practical use and performance certification in large software applications. An understanding of how to "seal" designs to guarantee performance goals and ensure that all error conditions are caught will be discussed in this course.

ACADEMIC CALENDAR: Academic Calendar - Western University (uwo.ca)

PREREQUISITES: Computer Science 1026A/B or Engineering Science 1036A/B.

ANTIREQUISITES: Computer Science 2210A/B, Software Engineering 2205A/B

CEAB ACADEMIC UNITS: D3, ET1, ET2, KB3, KB4, PA1, PA2, PA3. Engineering Science 75%, Engineering Design 25%.

CONTACT HOURS:

Lectures occur weekly. Laboratory sessions occur weekly.

RECOMMENDED REFERENCES:

1. Frank M. Carrano and Timothy M. Henry, Data Structures and Abstractions with Java, Prentice Hall, 5th Edition, 2019, ISBN 10: 0-13-483169-1 ISBN 13: 978-0-13-483169-5
2. Goodrich, Michael T., Roberto Tamassia, and Michael H. Goldwasser, Data structures and algorithms in Java, John Wiley & Sons, 6th Ed., 2014 (ISBN: 978-1-118-77133-4).
3. Gayle Laakmann McDowell. Cracking the Coding Interview, Career Cup, 6th Edition, 2015, ISBN: 978-0-9847828-5-7.
4. Raoul-Gabriel Urma, Mario Fusco, Alan Mycroft, Modern Java in Action: Lambdas, streams, functional and reactive programming (ISBN 9781617293566) (https://www.manning.com/books/modern-java-in-action?query=modern%20java)

GENERAL LEARNING OBJECTIVES (CEAB GRADUATE ATTRIBUTES)

Knowledge Base (KB)	D	Engineering Tools (ET)	D	Impact on Society	
Problem Analysis (PA)	D	Individual & Teamwork		Ethics and Equity	
Investigation		Communication		Economics and Project Mgmt.	
Design (D)	D	Professionalism		Life-Long Learning	

Notation: x represents the content level code as defined by the CEAB. blank = not applicable; I = introduced (introductory); D = developed (intermediate) and A = applied (advanced).

COURSE MATERIALS: Weekly content and guides for the laboratories will be available on the course OWL site. The material for this course will be taught in both lectures and labs; therefore, it is imperative that you attend each lecture and lab.

UNITS: SI

COURSE TOPICS AND SPECIFIC LEARNING OUTCOMES:

The following table summarizes the course learning outcomes along with CEAB GAIs where the GAIs in bold indicate ones to be measured and reported annually.

Course Topics and Specific Learning Objectives	**CEAB Graduate Attributes Indicators**
1. Java Fundamentals and Object-Oriented Principles (OPP) Revisited At the end of this section, students will be able to:	
a. Explain the Object-Oriented Principles.	**KB 3**
b. Identify the implementations of OOP principles in Java.	**KB 3**
c. Apply OOP in their programming with Java.	ET 2
2. More Java Features At the end of this section, students will be able to:	
a. Identify some features of Java programming including Composition, Aggregation	ET 1, ET 2
b. Recognize the benefits of Generics.	KB 4
c. Working with Exception handing, Recursions, and the likes	ET 1, ET 2
3. Fundamental Data Structures	

At the end of this section, students will be able to:	
a. Identify, implement, and use basic data structures including arrays, lists and linked lists.	**KB3**, ET1, ET2
b. Identify, implement, and use queues and stack data structures.	**KB3**, ET1, ET2
c. Identify, implement, and use tree and graph data structures.	**KB3**, ET1, ET2
d. Identify, implement, and use Maps and Hash Tables.	**KB3**, ET1, ET2
e. Recognize and work with Java Collections framework.	ET 1, ET 2
f. Recognize and work with Java Streams framework.	ET 1, ET 2
4. Algorithm Analysis At the end of this section, students will be able to:	
a. Recognize the concepts of algorithms analysis.	**KB 3**, PA 1
b. Perform Asymptotic analysis on any given algorithm.	**KB 3**, PA 1, **PA 2, PA 3**
5. Fundamental Algorithms At the end of this section, students will be able to:	
a. Recognize and implement the main search algorithms. Provide the rationale of using a specific algorithm for any given search problem.	**KB 3**, PA 1, **PA 2, PA 3**, D3
b. Recognize and implement the main selection algorithms.	**KB 3**, PA 1, **PA 2, PA 3**
c. Recognize and implement the main sorting algorithms. Provide the rationale of using a specific algorithm for any given sorting problem.	**KB 3**, PA 1, **PA 2,** D3
d. Recognize and implement the main tree algorithms.	**KB 3**, PA 1, **PA 2, PA 3**
e. Recognize and implement the main graph algorithms. Provide the rationale of using a specific algorithm for any given graphing problem.	**KB 3**, PA 1, **PA 2, PA 3**, D3

EVALUATION:

Name	% Worth	CEAB GAs ASSESSED
Lab Exercise (Total = 6)	10%	ET1/ ET2/ D3
Lab Demo (Total = 2)	10%	ET1/ ET2/ D3
Mid-Term Examination	30%	KB3
Final Examination	50%	KB3/ PA2/ PA3
Bonus Quizzes (Total = 5)	5%	KB3

Note:

- A maximum-recorded mark for this course will be 100%, even if someone receives more than 100% mark after adding the bonus marks.
- The student who fails the Lab-Exercise part of the course, can only receive a maximum grade of 48 in the course, even if all the components add up to 50% marks or more.