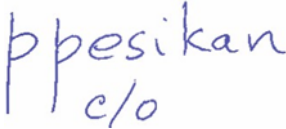


# Course Outline

---

School:	Eng. Tech. & Applied Science
Department:	Information and Communication Engineering Technology (ICET)
Course Title:	Data Structures and Algorithms
Course Code:	COMP 254
Course Hours/Credits:	56
Prerequisites:	COMP 228
Co-requisites:	N/A
Eligible for Prior Learning, Assessment and Recognition:	Yes
Originated by:	ILIA NIKA
Revised by:	ILIA NIKA
Revision Date:	Fall 2020
Current Semester:	Winter 2022
Approved by:	
	<hr/> Chairperson/Dean

---

*Students are expected to review and understand all areas of the course outline.*

*Retain this course outline for future transfer credit applications. A fee may be charged for additional copies.*

*This course outline is available in alternative formats upon request.*

## Acknowledgement of Traditional Lands

Centennial is proud to be a part of a rich history of education in this province and in this city. We acknowledge that we are on the treaty lands and territory of the Mississaugas of the Credit First Nation and pay tribute to their legacy and the legacy of all First Peoples of Canada, as we strengthen ties with the communities we serve and build the future through learning and through our graduates. Today the traditional meeting place of Toronto is still home to many Indigenous People from across Turtle Island and we are grateful to have the opportunity to work in the communities that have grown in the treaty lands of the Mississaugas. We acknowledge that we are all treaty people and accept our responsibility to honor all our relations.

## Course Description

Building on fundamentals of Object-Oriented programming, this course exposes the students to algorithms and data structures. Students will analyze, evaluate and apply appropriate data structures & algorithms for the implementation of a software system. Coursework emphasizes the classical data structures, basic algorithm design, common operations on data structures, and the use of mathematical techniques to analyze the efficiency of the various algorithms. The languages of instruction are Java and Python (optional).

## Program Outcomes

Successful completion of this and other courses in the program culminates in the achievement of the Vocational Learning Outcomes (program outcomes) set by the Ministry of Colleges and Universities in the Program Standard. The VLOs express the learning a student must reliably demonstrate before graduation. To ensure a meaningful learning experience and to better understand how this course and program prepare graduates for success, students are encouraged to review the Program Standard by visiting <http://www.tcu.gov.on.ca/pepg/audiences/colleges/progstan/>. For apprenticeship-based programs, visit <http://www.collegeoftrades.ca/training-standards>.

## Course Learning Outcomes

The student will reliably demonstrate the ability to:

1. Select the appropriate linear and nonlinear data structures to store the objects in order to minimize the memory and time required for insertion, access, search, modification, or removal operations.
2. Apply the CRUD and other operations, such as find, sort, traverse, reorganize or rebalance, on data structures.
3. Evaluate the basic design of algorithms including greedy, divide-and-conquer, randomized, and backtracking algorithms, and be able to select and apply these design strategies to solve programming problems.
4. Compare and contrast the operation of common data structures (such as linear structures, priority queues, tree structures, hash tables, and maps) in terms of time complexity, space utilization, and the abstract data types they implement.
5. Use mathematical techniques to analyze the efficiency of the various algorithms presented, as well as the common operations on the data structures discussed.
6. Design code and test applications that incorporate the use of linear and non-linear data structures as well as common algorithms to achieve efficiency and performance.

## Essential Employability Skills (EES)

The student will reliably demonstrate the ability to\*:

1. Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.
2. Respond to written, spoken, or visual messages in a manner that ensures effective communication.
3. Execute mathematical operations accurately.
4. Apply a systematic approach to solve problems.
5. Use a variety of thinking skills to anticipate and solve problems.
6. Locate, select, organize, and document information using appropriate technology and information systems.
7. Analyze, evaluate, and apply relevant information from a variety of sources.
10. Manage the use of time and other resources to complete projects.

*\*There are 11 Essential Employability Skills outcomes as per the Ministry Program Standard. Of these 11 outcomes, the following will be assessed in this course.*

## Global Citizenship and Equity (GC&E) Outcomes

N/A

## Methods of Instruction

Pre-recorded lectures, Interactive lab sessions, Demonstrations, Hands-On Exercises

## Text and other Instructional/Learning Materials

### Text Book(s):

Required:

Data Structures and Algorithms in Java (6th ed., Goodrich, Tamassia & Goldwasser, ISBN-13: 978-1118771334, Publisher: Wiley; 6 edition, 2014.

### References:

Data Structures and Algorithms in Python [Goodrich, Tamassia & Goldwasser, Publisher: Wiley (March 22 2013), ISBN-13: 978-1118290279.

Object-Oriented Data Structures Using Java, 4th edition, By Nell Dale, Daniel T. Joyce, Chip Weems, ISBN-13: 9781284089097, Jones & Bartlett Learning, 2018.

### Online Resource(s):

Provided on eCentennial shell of this course.

### Material(s) required for completing this course:

Required textbook

## Evaluation Scheme

- ⇨ Lab Assignment 1: Using Fundamental Data Structures
- ⇨ Lab Assignment 2: Algorithm Analysis

- ⇨ Lab Assignment 3: Using Recursion
- ⇨ Lab Assignment 4: Using ADT Stacks, Queues, and Lists
- ⇨ Lab Assignment 5: Using Trees and Priority Queues
- ⇨ Lab Assignment 6: Using Maps and Hash Tables
- ⇨ Lab Assignment 7: Using Search Trees and Sorting
- ⇨ Test 1: MC Questions covering Week 1 - 6 materials - 5%  
Hands-On test - 20%
- ⇨ Test 2: MC Questions covering Week 7-13 materials - 5%  
Hands-On test - 20%

Evaluation Name	CLO(s)	EES Outcome(s)	GCE Outcome(s)	Weight/100
Lab Assignment 1	1, 2, 4, 6	2, 4, 5, 10		7
Lab Assignment 2	3, 4, 5	1, 2, 3, 5, 6		7
Lab Assignment 3	3, 4, 5, 6	2, 3, 4, 5, 10		7
Lab Assignment 4	1, 2, 4, 5, 6	1, 2, 3, 5, 10		7
Lab Assignment 5	1, 2, 4, 5, 6	2, 3, 4, 5, 7, 10		8
Lab Assignment 6	1, 2, 4, 5, 6	2, 3, 5, 7, 10		7
Lab Assignment 7	2, 3, 4, 5, 6	2, 3, 4, 5, 7, 10		7
Test 1	1, 2, 4, 5, 6	1, 2, 3, 4, 5, 6, 7, 10		25
Test 2	1, 2, 4, 5, 6	1, 2, 3, 4, 5, 6, 7, 10		25
<b>Total</b>				<b>100%</b>

If students are unable to write a test they should immediately contact their professor or program Chair for advice. In exceptional and well documented circumstances (e.g. unforeseen family problems, serious illness, or death of a close family member), students may be able to write a make-up test.

All submitted work may be reviewed for authenticity and originality utilizing Turnitin®. Students who do not wish to have their work submitted to Turnitin® must, by the end of the second week of class, communicate this in writing to the instructor and make mutually agreeable alternate arrangements.

When writing tests, students must be able to produce official Centennial College photo identification or they may be refused the right to take the test or test results will be void.

Tests or assignments conducted remotely may require the use of online proctoring technology where the student's identification is verified and their activity is monitored and/or recorded, both audibly and visually through remote access to the student's computer and web camera. Students must communicate in writing to the instructor as soon as possible and prior to the test or assignment due date if they require an alternate assessment format to explore mutually agreeable alternatives.

## Student Accommodation

The Centre for Accessible Learning and Counselling Services (CALCS) (<http://centennialcollege.ca/calcs>) provides programs and services which empower students in meeting their wellness goals,

accommodation and disability-related needs. Our team of professional psychotherapists, social workers, educators, and staff offer brief, solution-focused psychotherapy, accommodation planning, health and wellness education, group counselling, psycho-educational workshops, adaptive technology, and peer support. Walk in for your first intake session at one of our service locations (Ashtonbee Room L1-04, Morningside Room 190, Progress Room C1-03, The Story Arts Centre Room 285, Downsview Room 105) or contact us at [calcs@centennialcollege.ca](mailto:calcs@centennialcollege.ca), 416-289-5000 ext. 3850 to learn more about accessing CALCS services.

## Use of Dictionaries

- Dictionary use is not permitted in test or examination settings.

## Program or School Policies

N/A

## Course Policies

N/A

## College Policies

Students should familiarize themselves with all College Policies that cover academic matters and student conduct.

All students and employees have the right to study and work in an environment that is free from discrimination and harassment and promotes respect and equity. Centennial policies ensure all incidents of harassment, discrimination, bullying and violence will be addressed and responded to accordingly.

### Academic Honesty

Academic honesty is integral to the learning process and a necessary ingredient of academic integrity. Forms of academic dishonesty include cheating, plagiarism, and impersonation, among others. Breaches of academic honesty may result in a failing grade on the assignment or course, suspension, or expulsion from the college. Students are bound to the College's AC100-11 Academic Honesty and Plagiarism policy.

To learn more, please visit the Libraries information page about Academic Integrity

<https://libraryguides.centennialcollege.ca/academicintegrity> and review Centennial College's Academic Honesty Module:

[https://myappform.centennialcollege.ca/centennial/articulate/Centennial\\_College\\_Academic\\_Integrity\\_Module\\_%202/story.html](https://myappform.centennialcollege.ca/centennial/articulate/Centennial_College_Academic_Integrity_Module_%202/story.html)

### Use of Lecture/Course Materials

Materials used in Centennial College courses are subject to Intellectual Property and Copyright protection, and as such cannot be used and posted for public dissemination without prior permission from

the original creator or copyright holder (e.g., student/professor/the College/or third-party source). This includes class/lecture recordings, course materials, and third-party copyright-protected materials (such as images, book chapters and articles). Copyright protections are automatic once an original work is created, and applies whether or not a copyright statement appears on the material. Students and employees are bound by College policies, including AC100-22 Intellectual Property, and SL100-02 Student Code of Conduct, and any student or employee found to be using or posting course materials or recordings for public dissemination without permission and/or inappropriately is in breach of these policies and may be sanctioned.

For more information on these and other policies, please visit [www.centennialcollege.ca/about-centennial/college-overview/college-policies](http://www.centennialcollege.ca/about-centennial/college-overview/college-policies).

Students enrolled in a joint or collaborative program are subject to the partner institution's academic policies.

## PLAR Process

This course is eligible for Prior Learning Assessment and Recognition (PLAR). PLAR is a process by which course credit may be granted for past learning acquired through work or other life experiences. The PLAR process involves completing an assessment (portfolio, test, assignment, etc.) that reliably demonstrates achievement of the course learning outcomes. Contact the academic school to obtain information on the PLAR process and the required assessment.

**This course outline and its associated weekly topical(s) may not be reproduced, in whole or in part, without the prior permission of Centennial College.**

Semester:	Winter 2022	Professor Name:	See eCentennial course shell
Section Code:	ALL	Contact Information:	See eCentennial course shell
Meeting Time & Location:	See myCentennial timetable	Delivery Method:	On-line with scheduled sessions

### Topical Outline (subject to change):

Week	Topics	Readings/Materials	Weekly Learning Outcome(s)	Instructional Strategies	Evaluation Name and Weight	Evaluation Date
1	Course Overview Language Primer	Chapter 1, 2 Java, Python book (optional)	Review: Declare and create objects in Java Object-Oriented Design Principles Inheritance, Abstract classes, Generics, Exceptions  Optional: Declare and create objects in Python Use Expressions Use conditional and loops Define and use functions Use simple I/O Define and use classes	Pre-Recorded Lecture Demonstration Interactive Lab Session Hands-On Exercises		
2-3	Fundamental Data Structures	Chapter 3 Java book	Implement add/remove operations on an array. Define Linked Lists. Implement insert/remove operations on a linked list.	Pre-Recorded Lecture Demonstration Interactive Lab Session Hands-On Exercises	Lab Assignment 1: Using fundamental data structures.	Week 3
4	Algorithm Analyses	Chapter 4 Java Chapter 3 Python	Examine the use of experimental analysis to study the efficiency of algorithms.  Define primitive operations.  Review seven functions used to compare growth rates.  Use "Big-Oh" notation to establish asymptotic upper bounds.  Perform asymptotic analysis on basic algorithms.	Pre-Recorded Lecture Demonstration Interactive Lab Session Hands-On Exercises		

Week	Topics	Readings/Materials	Weekly Learning Outcome(s)	Instructional Strategies	Evaluation Name and Weight	Evaluation Date
5	Recursion	Chapter 5 Java Book Chapter 4 Python book	Examine recursion.  Use recursion to implement the factorial function, ruler drawing, binary search, and file systems.  Analyze recursive algorithms.	Pre-Recorded Lecture Demonstration Interactive Lab Session Hands-On Exercises	Lab Assignment 2: Algorithm Analysis	Week 5
6	Stacks, Queues, and Deques	Chapter 6 Java book Chapter 6 Python	Define Stack and Queue Abstract Data Types.  Implement an array-based stack and queue.  Implement a stack and a queue using a singly linked list  Reverse an array using a stack.  Define Deque Abstract Data Type.  Implement a deque.	Pre-Recorded Lecture Demonstration Interactive Lab Session Hands-On Exercises	Lab Assignment 3: Using Recursion	Week 6
7-8	List and Iterator ADTs	Chapter 7 Java Chapter 7 Python	Implement and analyze dynamic arrays.  Define the positional list ADT.  Implement positional lists using a doubly linked list.  Define and implement Iterators.  Summarize List-based algorithms in Java Collections framework.	Pre-Recorded Lecture Demonstration Interactive Lab Session Hands-On Exercises  Hands-On Test	Hands-On Test 1  Lab Assignment 4: Using ADT Stacks, Queues, and Lists	Week 7, Week 8
9	Trees	Chapter 8 Java Chapter 8 Python	Analyze trees and binary trees.  Implement trees using arrays.  Analyze and use tree traversal algorithms.	Pre-Recorded Lecture Demonstration Interactive Lab Session Hands-On Exercises		
10	Priority Queues	Chapter 9 Java Chapter 9 Python	Define the priority queue ADT.  Implement a priority queue with unsorted and sorted lists.	Pre-Recorded Lecture Demonstration Interactive Lab Session	Lab Assignment 5: Using Trees and Priority	Week 10



Week	Topics	Readings/Materials	Weekly Learning Outcome(s)	Instructional Strategies	Evaluation Name and Weight	Evaluation Date
			<p>Explain Heap data structure. Implement a priority queue with a heap.</p> <p>Analyze heap-based priority queues.</p> <p>Sort priority queues.</p>	Hands-On Exercises	Queues	
11	Maps and Hash Tables	Chapter 10 Java Chapter 10 Python	<p>Define the Map ADT.</p> <p>Implement an unsorted map.</p> <p>Explain Hash functions.</p> <p>Implement a hash table.</p> <p>Use sorted maps.</p> <p>Use Set ADT.</p>	Pre-Recorded Lecture Demonstration Interactive Lab Session Hands-On Exercises	Lab Assignment 6: Using Maps and Hash Tables.	Week 11
12	Search Trees	Chapter 11 Java Chapter 11 Python	<p>Examine Binary Search Trees.</p> <p>Implement insert/delete operations.</p> <p>Analyze the performance of binary search trees.</p> <p>Explain balanced search trees.</p>	Pre-Recorded Lecture Demonstration Interactive Lab Session Hands-On Exercises		
13	Sorting and Selection	Chapter 12 Java Chapter 12 Python	<p>Examine Merge-sort.</p> <p>Examine Quick-sort.</p> <p>Analyze sorting algorithms.</p> <p>Summarize and compare sorting algorithms.</p>	Pre-Recorded Lecture Demonstration Interactive Lab Session Hands-On Exercises	Lab 7 Assignment: Using Search Trees and Sorting	Week 13
14	Test 2	Week 7-13 materials	Week 7-13 learning outcomes	Hands-On test	Hands-On Test 2	Week 14