



## COIS-2020H-A: Data Structures and Algorithms 2022FA - Peterborough Campus

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### Instructor:

Instructor: Brian Patrick

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Phone Number: 705-748-1011 x7804

Office: OC 102.8

Office Hours: Tuesday and Wednesday, 10:00 - 11:00am or by appointment

### Meeting Times:

Tuesday and Thursday

12:00 - 13:50 ET

OCA 203

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### Department:

Academic Administrative Assistant: Elissa O'Neill

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### Description:

Data structures and algorithms are two fundamental, but mutually dependent, areas of Computer Science. They correspond closely and respectively to the data members and methods of a class in C#. The data structures are concerned with how the data associated with classes are represented, and the algorithms are concerned with how the data structures are manipulated using methods.

Always keeping in mind the underlying concepts of abstraction, encapsulation, and information hiding, the course challenges you to carefully consider which data structures and algorithms best

support the behaviour of a class and which classes together solve complex problems.

Throughout this course, you will be wearing two hats: as a user of classes and as a designer/implementer of classes. As an implementer, you are aware of all the structural and algorithmic details of a class, but as a user, you are confined only to those operations which are publicly available.

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## Learning Outcomes:

By the end of the course, a successful student should be able to:

1. Understand and apply the key tenets of object-oriented programming.
  2. Appreciate the advantages and disadvantages of fundamental linear and non-linear data structures.
  3. Design and analyze algorithms which are used to manipulate these data structures.
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## Course Fees:

A computer that is able to support the Microsoft .NET Framework and Visual Studio is required.

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## Texts:

### Reference Texts

T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, *Introduction to Algorithms* (4th Edition), The MIT Press, 2022

Earlier editions of the text will also suffice.

Any text on the C# programming language and the .NET Framework

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## Readings:

<http://msdn.microsoft.com> contains a wealth of information on the C# programming language and the .NET Base Class Library.

Supplementary notes and code will also be provided for each of the topics.

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## Assessments, Assignments and Tests:

### Assignments

Each assignment is a significant programming exercise that develops your programming skills and applies/extends the material from class. Assignments are also invaluable preparation for the coding sections on tests.

Each assignment is completed using pair or trio programming. **Pair or trio programming** is working with a partner or two on the design, implementation, testing, and documentation of a computer project. It enables you to bounce ideas off your partner(s), to learn from your partner(s), and to better catch syntactic and design flaws. Programming becomes more focussed, more educational, and less frustrating. For stronger programmers, it is an opportunity to mentor and to reinforce your own understanding of the material, i.e. "To teach is to learn". For less proficient programmers, it is an opportunity to benefit from others and to better your own programmer skills. In the end, you will likely produce higher quality code in less time and gain greater confidence.

Pair or trio programming however does come with its challenges. Finding time to meet with your partners either online or in person, ensuring that everyone is aware of and completes their responsibilities, dealing with inevitable personality conflicts, and managing expectations are all part of working with a team.

So, pair or trio programming is learning experience on many levels. Choose your team members carefully and feel free to reconstitute your teams after each assignment.

### Tests

Tests are taken in class or during the examination period. Each test is composed of three types of questions: theory, demonstration, and coding.

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## Grading:

### Three Assignments (using Pair or Trio Programming)

- Each assignment worth 1/9 (~11%) of your grade.
- The grade on a late assignment is deducted 10% per day (including weekends) up to five days. Thereafter, an assignment receives a grade of 0.

### Three Tests

- Each test is worth 2/9 (~22%) of your grade.
  - Test 1 will cover Parts I and II, Test 2 will cover Part III, and Test 3 will cover Part IV.
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## Grade Total by Withdrawal Date:

At least 1/3 (~33%) of your grade will be available by the course drop deadline on Tuesday, November 8, 2022.

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## Schedule:

### Part I

## **Week 0**

Thursday, September 8: Encapsulation (classes, data members, and methods), information hiding (access modifiers)

## **Week 1**

Tuesday, September 13: Inheritance (virtual methods, interfaces, and the object class), dynamic binding

Thursday, September 15: Fundamental data structures (arrays and linked lists)

## **Part II**

## **Week 2**

Tuesday, September 20: Stack (array)

Thursday, September 22: Stack (linked list) and Queue (linked list)

## **Week 3**

Tuesday, September 27: Queue (circular array)

Thursday, September 29: List (array)

## **Week 4**

Tuesday, October 4: List (linked list)

## **Part III**

Thursday, October 6: Closed Hash Table (array), hash function, linear/quadratic probing

## **Week 5**

Tuesday, October 11: Closed Hash Table (con't) and Open Hash table (array plus linked list)

Thursday, October 13: Open Hash Table (con't)

Sunday, October 16: Assignment 1 due by 23:59 ET

## **Week 6**

Tuesday, October 18: Review for Test 1

Thursday, October 20: Test 1

## **Reading Break**

Monday, October 24 - Friday, October 28

## **Week 7**

Tuesday, November 1: Binary Tree and Priority Queue (binary heap)

Thursday, November 3: Priority Queue (con't)

## **Part IV**

## **Week 8**

Tuesday, November 8: Binary Search Tree and Binary Tree Traversals

Thursday, November 10: Binary Search Tree (con't)

Sunday, November 14: Assignment 2 due by 23:59 ET

## **Week 9**

Tuesday, November 15: Review for Test 2

Thursday, November 17: Test 2

## **Week 10**

Tuesday, November 22: AVL Tree (balanced binary search tree)

Thursday, November 24: AVL Tree (con't)

## Week 11

Tuesday, November 29: Splay Tree (amortized binary search tree)

Thursday, December 1: Splay Tree (con't)

## Week 12

Tuesday, December 6: Review for Test 3

Wednesday, December 7: Assignment 3 due by 23:59 ET

## Examination Period

December 9 - December 22: Test 3

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## Course Guidelines:

The course is divided into four parts:

- Part I: Review of C# and Object-Oriented Principles
- Part II: Stack, Queues, and Lists
- Part III: Closed Hash Tables, Open Hash Tables, and Priority Queues
- Part IV: Binary Trees, Binary Search Trees, AVL Trees, and Splay Trees

The lectures are an important component of the course and should **not** be missed. Each lecture will present background material for a topic and work through a number of examples to reinforce the learning. Some lectures, at least in part, will also review the requirements for assignments and tests.

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## Departmental Policies:

### Email Accounts

The Trent e-mail account is considered the official e-mail account and will be the only e-mail account used to communicate with students for academic and administrative purposes. Students are responsible for ensuring that they monitor and maintain their Trent e-mail account and to ensure that e-mail is accessed, read, and acted upon in a timely fashion. Students should be aware that e-mails from non-Trent accounts will not be considered official.

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## University Policies:

### Academic Integrity

Academic dishonesty, which includes plagiarism and cheating, is an extremely serious academic offence and carries penalties varying from failure on an assignment to expulsion from the University. Definitions, penalties, and procedures for dealing with plagiarism and cheating are set out in Trent University's *Academic Integrity Policy*. You have a responsibility to educate yourself –

unfamiliarity with the policy is not an excuse. You are strongly encouraged to visit Trent's Academic Integrity website to learn more: [www.trentu.ca/academicintegrity](http://www.trentu.ca/academicintegrity).

## Access to Instruction

It is Trent University's intent to create an inclusive learning environment. If a student has a disability and documentation from a regulated health care practitioner and feels that they may need accommodations to succeed in a course, the student should contact the Student Accessibility Services Office (SAS) at the respective campus as soon as possible.

## Sharing and Distribution of Course Content

Students in this class should be aware that classroom activities (lecture, seminars, labs, etc.) may be recorded for teaching and learning purposes. Any students with concerns about being recorded in a classroom context should speak with their professor. If a student shares or distributes course content in any way that breaches copyright legislation, privacy legislation, and/or this policy, the student will be subject to disciplinary actions under the relevant Academic Integrity Policy, the Charter of Student Rights & Responsibilities, or the Policy on the Protection of Personal Information, at a minimum, and may be subject to legal consequences that are outside of the responsibility of the university.

## Student Absenteeism, Missed Tests and Examinations

Students are responsible for completing all course requirements, including attending classes and meeting assignment deadlines as specified on their syllabus.

Adjustments and deferrals to dates for participation, assignment submissions, tests, midterms and final examinations are not automatic. It is the student's responsibility to email their instructor immediately if they are unable to fulfill academic requirements.

Courses delivered remotely may involve student participation in scheduled (synchronous) classes via web-based platforms, such as Zoom. Students unable to participate (i.e., by video and/or audio) should email their instructors to request alternative arrangements for participation in these scheduled (synchronous) classes.

Students are required to be available for all tests, midterms and exams that are listed in their course syllabus and scheduled by their instructor or the Office of the Registrar. Depending on their program, the instructor or the chair/director may decide on alternative arrangements for exams and tests. Normally a doctor's note or supporting documentation is not required; however, when a student's success in the course or program is in jeopardy as determined by the instructor or chair/director, documentation may be requested.

Specific SAS accommodations can be implemented for students registered with Student Accessibility Services (SAS), but it is the responsibility of the student to make these arrangements in advance as per SAS guidelines, and to discuss accommodations of due dates with their instructors.

Students can notify the Office of the Registrar of their wish to observe cultural or religious holidays during scheduled examination periods by the deadline set in the Academic Calendar. Personal travel plans are not acceptable reasons for missing tests or exams.

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