SE2205A: Algorithms and Data Structures for Object Oriented Design

Course Outline 2019-20

Description:
SE2205A surveys some important computer algorithms and related data structures used in object-oriented software engineering today. These algorithms and data structures are discussed using Java programming language. It covers the design, performance analysis and implementation of such algorithms in Java, stressing their practical use in large software applications or systems.

Instructor: Mehdi Delrobaei, Ph.D., P.Eng.
Email: mdelrob@uwo.ca
Consultation: By appointment or via email.

Academic Calendar Copy: Survey of important computer algorithms and related data structures used in object-oriented software engineering. Design, performance analysis and implementation of such algorithms, stressing their practical use and performance certification of large software applications. Understand how to "seal" designs to guarantee performance goals and insure that all error conditions are caught.

Contact Hours: 3 lecture hours, 2 laboratory hours, 0.5 course.

Antirequisites: Computer Science 2210a/b.

Prerequisites: Computer Science 1026A/B or ES 1036A/B or the former Computer Science 036a/b, Computer Science 1027A/B or 1037A/B, or permission of the Department.

Co-requisite:
Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

CEAB Academic Units: Engineering Science 75%, Engineering Design 25%.

Required Textbook: None

Other Required References: None.

Recommended Books:

General Learning Objectives (CEAB Graduate Attributes)

<table>
<thead>
<tr>
<th>Knowledge Base</th>
<th>2/2</th>
<th>Use of Engineering Tools</th>
<th>2/2</th>
<th>Impact on Society and the Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Analysis</td>
<td>3/2</td>
<td>Individual and Team Work</td>
<td></td>
<td>Ethics and Equity</td>
</tr>
<tr>
<td>Investigation</td>
<td></td>
<td>Communication Skills</td>
<td></td>
<td>Economics and Project Management</td>
</tr>
<tr>
<td>Design</td>
<td></td>
<td>Professionalism</td>
<td></td>
<td>Life-Long Learning</td>
</tr>
</tbody>
</table>

Notation: x/y, where x is the cognitive level (1: Remember, 2: Understand, 3: Apply) at which the attribute is assessed and y is the academic level (1: Beginner, 2: Intermediate, 3: Advanced) at which the attribute is assessed.

Specific Learning Objectives:

- Gain experience writing programs in Java.
- Learn how the choice of data structures and algorithm design methods impacts the performance of programs.
- Learn object-oriented design principles.
- Review specific data structures such as arrays, binary trees, queues and graphs.
- Study specific data structures such as dictionaries, hash tables, AVL tree, red-black and n-ary trees.
- Study and review specific algorithms design methods such as the greedy method, divide and conquer, and dynamic programming.

Topics and Specific Learning Objectives

At the end of the course, students are expected to be familiar with these topics. These topics may not be delivered in class with the same order as below.

1. **Introduction to Java**
   At the end of this section, students will be able to:
   a. Understand Java Class Library and the interface set,
   b. Compare the use of arrays, linked lists, stacks, and queues.

2. **Analysis of algorithms**
   At the end of this section, students will be able to:
   a. Measure an algorithm’s efficiency,
   b. Understand the big-O notation.
Course Outline: SE2205A – Fall 2019

3. **Sorting Algorithms**
   At the end of this section, students will be able to:
   a. Understand different sorting algorithms,
   b. Compare the sorting algorithms.

4. **Searching Algorithms**
   At the end of this section, students will be able to:
   a. Understand different searching algorithms,
   b. Implement a search method.

5. **Dictionaries and hashing**
   At the end of this section, students will be able to:
   a. Understand dictionaries and hashing specifications,
   b. Implement hash tables.

6. **Trees and Heap**
   At the end of this section, students will be able to:
   a. Understand the concepts of search trees,
   b. Compare different tree structures.

7. **Graphs Algorithms**
   At the end of this section, students will be able to:
   a. Understand the concepts and terminologies related to graph algorithms,
   b. Implement graph traversal algorithms.

8. **Dynamic Programming**
   At the end of this section, students will be able to:
   a. Understand the dynamic-programming algorithmic design pattern,
   b. Implement the dynamic programming approach.

**Note:** The above topics are subject to adjustments and changes given time restrictions.

**Evaluation**

<table>
<thead>
<tr>
<th>Course Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Assignments</td>
<td>30%</td>
</tr>
<tr>
<td>Midterm</td>
<td>20%</td>
</tr>
<tr>
<td>Final Examination</td>
<td>50%</td>
</tr>
</tbody>
</table>

To obtain a passing grade in the course, a mark of 50% or more must be achieved on the final examination as well as on the lab assignments and midterm exam. A final examination or lab assignments or midterm < 50% will result in a final course grade of 48% or less.

**Lab Assignments:** There will be three programming assignments.

**Final Examination:** The final examination will be take place during the regular examination period.

**Late Submission Policy:** There will be strict deadlines for lab submissions. Marks will be
deducted for late assignment. 10% per day will be subtracted for late submission, to a maximum of 2 days late at which point a zero will be applied.

**Deliverables Submission:** All submissions will be electronic by OWL and GitHub.

**Use of English:** In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work apart from the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission. This also includes code coherence, spacing, and English use within.

**Attendance:** All classes and laboratories are mandatory unless otherwise stated. Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the department, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

**Absence Due to Illness or Other Circumstances:** Students should immediately consult with the instructor or department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see the attached “Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled”). The student should seek advice from the instructor or department Chair regarding how best to deal with the problem. Failure to notify the instructor or department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

For more information concerning medical accommodations, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

**Cheating and Plagiarism:** Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (http://www.turnitin.com).
Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

**Policy on Repeating All Components of a Course:** Students who are required to repeat an Engineering course must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment, or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted by the student for grading in subsequent years.

**Internet and Electronic Mail:** Students are responsible for regularly checking their Western email and the course web site ([https://owl.uwo.ca/portal/](https://owl.uwo.ca/portal/)) and making themselves aware of any information that is posted about the course. The expectation is to check at least once every 24 hours.

**Accessibility:** Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

**Support Services:** Office of the Registrar, [http://www.registrar.uwo.ca/](http://www.registrar.uwo.ca/)  
Student Development Centre, [http://www.sdc.uwo.ca/](http://www.sdc.uwo.ca/)  
Engineering Undergraduate Services, [http://www.eng.uwo.ca/undergraduate/](http://www.eng.uwo.ca/undergraduate/)  
USC Student Support Services, [http://westernusc.ca/services/](http://westernusc.ca/services/)

Students who are in emotional/mental distress should refer to Mental Health @ Western, [http://www.health.uwo.ca/mental_health/](http://www.health.uwo.ca/mental_health/), for a complete list of options about how to obtain help.
INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

If, on medical or compassionate grounds you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

A. GENERAL REGULATIONS & PROCEDURES

1. All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.

2. If you are an upper year student and you are missing a test/assignment/lab or examination that is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If your course work is MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097.

3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.

4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.

5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM TESTS

1. If you are in first year and you are unable to write a term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.

2. If you are an upper year student and you are unable to write a term test, inform your instructor PRIOR to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request relief.

3. Be prepared to provide supporting documentation to the Department Chair and/or the Undergraduate Services Office (see next page for information on documentation).

4. Discuss with the instructor if and when the test can be rescheduled. N.B. The approval of the Chair or the Undergraduate Services Office is required when rescheduling term tests.

C. FINAL EXAMINATIONS

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.

2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, sleeping in, misreading timetable and travel arrangements.

3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department and the Associate Dean and in order to apply you must sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.
PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

D. LATE ASSIGNMENTS

1. Advise the instructor if you are having problems completing the assignment on time (prior to the due date of the assignment).
2. Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4. i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.
   ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean, Undergraduate Studies.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You may want to seek advice from your academic counsellor in the Undergraduate Services Office.

G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, you must provide the doctor with a Student Medical Certificate to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor’s notes will not be accepted; only the Student Medical Certificate will be accepted.

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

H. ACADEMIC CONCERNS

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).

2. You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.

3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your academic counsellor.
Calendar References: Check these regulations in your 2018 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness: http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_12

Academic Accommodations for Students with Disabilities: http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_10

Academic Accommodations for Religious or Holy Days: http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_16

Course Withdrawals: http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=6&SelectedCalendar=Live&ArchiveID=#Page_75

Examinations: http://www.westerncalendar.uwo.ca/PolicyPages.cfm?PolicyCategoryID=5&command=showCategory&SelectedCalendar=Live&ArchiveID=

Scheduling of Term Assignments: http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_78

Scholastic Offences: http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20

Student Medical Certificate: https://www.eng.uwo.ca/files/undergraduate/forms/smc.pdf

Engineering Academic Regulations: http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=4&SelectedCalendar=Live&ArchiveID=#Page_86

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

Add Deadlines:
- First term half course (i.e. “A” or “F”) September 14, 2018
- Full courses and full-year half course (i.e. “E”, “Y” or no suffix) September 14, 2018
- Second term half course (i.e. “B” or “G”) January 15, 2019

Drop Deadlines:
- First term half course (i.e. “A” or “F”) November 12, 2018
- Full courses and full-year half courses (i.e. “E”, “Y” or no suffix) November 30, 2018
- Second term half or second term full course (i.e. “B” or “G”) March 7, 2019

Contact Information:

Undergraduate Services Office: SEB 2097 Telephone: (519) 661-2130 E-mail: engugrad@uwo.ca
Dept. of Chemical and Biochemical Engineering & Green Process Engineering: TEB 477 Telephone: (519) 661-2131 E-mail: cbeugrad@uwo.ca
Dept. of Civil and Environmental Engineering: SEB 3005 Telephone: (519) 661-2139 E-mail: civil@uwo.ca
Dept. of Electrical and Computer Engineering, Software Engineering & Mechatronics Engineering: TEB 279 Telephone: (519) 661-3758 Email: eceugrad@uwo.ca
Dept. of Mechanical and Materials Engineering: SEB 3002 Telephone: (519) 661-4122 E-mail: mmeundergraduate@uwo.ca

Revised 08/01/18