

**CMPT 231 Data Structures and Algorithms (3 sem. hrs.)**

**Fall 2016**

# **General Information**

***Instructor:***  Sean Ho, Ph.D.

**Email**: twu@seanho.com

**Office**: TBA

***Lecture:*** Tuesday, 13:10-15:50 (with 10min break), NEU

***Course description:***

Basic organization of programs, optimizing program structure, modularization. Data structures, searching and sorting algorithms, handling large data sets, analysis of algorithms.

**NB:** Not offered every year. See department chair.

Prerequisite(s): CMPT 140 or instructor’s consent.

**Topics:**

* Algorithmic complexity
* Sorting algorithms and trees
* Data structures
* Dynamic programming and greedy algorithms
* Graph algorithms

***Course Learning Outcomes***

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| **TWU Student Learning Outcomes** | **Course Learning Outcomes** |
| **Knowledge and its application**   * a broad foundational knowledge of human culture and the physical and natural world. * a depth of understanding in any chosen field(s) of study. * applied knowledge acquired through discipline-appropriate experiential learning. | * Become familiar with a variety of data structures and algorithms. |
| **Cognitive complexity**   * skills including: critical and creative thinking, quantitative reasoning, communication, research, and information literacy. * an ability to articulate various interdisciplinary and multi-disciplinary perspectives, integrating informed Christian perspectives. * an ability to respond with wisdom, humility and charity to questions, issues, and problems of the human condition. | * Critically evaluate the different strategies of solving a problem using computational means * Develop the ability to analyze a problem and formulate a solution. |
| **Inter- and intra-personal wellness**   * a holistic awareness of their personhood, purpose, and calling within the context of the communities in which they live and study. * personal and social health. * an appreciation of the role of community in wellness. | * Collaborate with fellow student in team activities. * Deepen connections to course content through exercises. |
| **Spiritual formation**   * a spiritual dimension by means of an exposure to a reflective and caring Christ-centred community which encourages: * a further understanding of God. * a discovery of a deep and personal spiritual foundation. * an embodiment of a Christ-like way of life characterized by love for and service to others. | * Consider how your beliefs, interests, values, experiences and feelings may impact your choices as a computing scientist. |
| **Social responsibility and global engagement**   * the resources, skills, and motivation to become engaged global citizens who serve locally, nationally, and globally in socially and economically just ways. * a commitment to informed and ethical reasoning. * respect for the dignity and rights of all persons. * respect for creation and its sustainable use and care. | N/A |
| **Leadership**   * skills to become creative, collaborative, informed, competent, and compassionate people who influence the various contexts into which they are called. * abilities and attitudes characterized by service, humility and integrity. | N/A |

# **Textbooks**

**Required**

* T. Cormen, E. Leiserson, R. Rivest, and C. Stein, *Introduction to Algorithms*, 3rd ed., MIT Press, 2009. [CLRS3]

**Optional**

* Clifford A. Shaffer, Data Structures and Algorithm Analysis, 2013. Available free online at <http://people.cs.vt.edu/shaffer/Book/>
* Jon Kleinberg and Éva Tardos, *Algorithm Design*, Addison-Wesley, 2006.
* Sanjoy Dasgupta, Christos Papadimitriou, and Umesh Vazirani, *Algorithms* (1st Edition). McGraw-Hill Higher Education, 2008. Available free online at <http://beust.com/algorithms.pdf>

**Other readings**

* Free Books by Ian Parberry <http://larc.unt.edu/ian/books/free/>
* J. Bentley, *An Introduction to Algorithm Design*, IEEE Computer, February 1979, pp. 66-78

# **Marking Scheme**

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| --- | --- | --- |
| **Items** | **%** | **Description** |
| Assignments | 54% | 6 total, approx. every 2 weeks. |
| Midterm Exam | 15% | Covers through lecture 5 |
| Final Exam | 31% | Covers entire semester |
| Total | 100% |  |

This is the grading scheme for this course:[[1]](#footnote-0)

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| --- | --- | --- | --- |
| Letter Grade | Definition | Grade Point | Percentage |
| A+ A  A- | Outstanding, excellent work | 4.3 4.0 3.7 | 95-100 85-94 80-84 |
| B+ B B- | Good, competent work | 3.3 3.0 2.7 | 77-79 73-76 70-72 |
| C+ C  C- | Adequate, reasonably satisfactory work | 2.3 2.0  1.7 | 67-69 63-66 60-62 |
| D+  D  D- | Minimally acceptable work | 1.3  1.0  0.7 | 57-59  53-56  50-52 |
| F | Inadequate work | 0.00 | 0-49 |

Final grades are determined by identifying natural breaks in the mark distribution based on TWU’s standard guidelines, with the exception that 95% is required for an A+.

1. The instructor reserves the right to make such adjustments in course content and sequence as may be needed.
2. Missed exams will be given zero, unless special arrangements have been made with the instructor.

# Tentative **Schedule**

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| **Week** | **Dates** | **Topics** | **Text Selections (CLRS)** |
| 1 | Sept 13 | Introduction, Analysis of Algorithms  Insertion Sort, Asymptotic Notation | Ch 1, 2, 3 |
| 2 | Sept 20 | Divide-and-Conquer: Strassen, Fibonacci, Polynomial Multiplication  Quicksort, Randomized Algorithms | Ch 4  Ch 5.1-5.3  Ch 7 |
| 3 | Sept 27 | Heapsort, Dynamic Sets, Priority Queues  Linear-time Sorting: Lower Bounds, Counting Sort, Radix Sort, | Ch 6  Ch 8.1-8.3 |
| 4 | Oct 4 | Order Statistics, Median  Bucketsort | Ch 9  Ch 8.4 |
| 5 | Oct 11 | Hashing, Hash Functions  Universal Hashing, Perfect Hashing | Ch 11 |
| 6 | Oct 18 | Binary Search Trees, Tree Walks  Midterm review | Ch 12 (skip 12.4) |
| 7 | Oct 25 | Midterm Exam |  |
| 8 | Nov 1 | Red-black Trees, B-trees | Ch 13  Ch 18 |
| 9 | Nov 8 | Dynamic Programming | Ch 15 |
| 10 | Nov 15 | Greedy Algorithms, Huffman coding | Ch 16.1-16.3 |
| 11 | Nov 22 | Graph algorithms  Breadth-first search (BFS)  Depth-first search (DFS), and applications  Minimum spanning trees | Ch 22  Ch 23 |
| 12 | Nov 29 | Shortest Paths: Single-source shortest paths problem, Dijkstra, Bellman-Ford | Ch 24 |
| 13 | Dec 6 | Other advanced topics  Semester Review, Course wrap-up. |  |
|  |  | FINAL EXAM. (Dec 7 - 17) |  |

# **Other information and Policies**

**Late Assignment Policy**

ALL assignments should be done on time. Assignment will not be accepted after the due date.

**Lecture Attendance**

Lecture attendance is strongly encouraged. Students who miss more than 25% of class sessions may be barred from taking the final exam [See Academic Calendar].

**Policy on laptops in class**

Laptops are allowed to be used in class only for course-related work (e.g., following lecture notes online, trying out different code example interactively, researching add-on libraries pertinent to the subject, etc.). Students are expected to abide by this on the honour system.

**Course Grading System**

TWU’s grading practices and academic policies (see twu.ca/policies) are incorporated by reference in this syllabus and are upheld in this course, with the exception of the following specifics of the grading system.

Final grades are determined by identifying natural breaks in the mark distribution based on TWU’s standard guidelines, with the exception that 95% is required for an A+. The Standard Grading System can be found at the University Homepage > Academics > Academic Calendar > Academic Information > Grading Practices [University Homepage > Academics > Academic Calendar > Academic Information > Grading Practices](http://www.twu.ca/academics/calendar/2014-2015/academic-information/grading-practices/).

**Academic Integrity and Avoiding Plagiarism at TWU**

One of the core values of Trinity Western University is the integration of academic excellence with high standards of personal, moral, and spiritual integrity. The University considers it a serious offence when an individual attempts to gain unearned academic credit. It is the student’s responsibility to be informed about what constitutes academic dishonesty. For details on this, and on identifying and avoiding plagiarism go to the [University Homepage > Academics > Academic Calendar > Academic Information > Academic Policies > Academic Dishonesty and Plagiarism](http://www.twu.ca/academics/calendar/2014-2015/academic-information/academic-policies/academic-dishonesty-and-plagiarism.html).

**Campus Closure and Class Cancellation Policy**

In the event of extreme weather conditions or other emergency situations go to the [University Homepage > Campus Notification (in the page footer) > Class cancellation policy](http://www.twu.ca/campus/campus-notification.html).

**Students with a Disability**

Students with a disability who need assistance are encouraged to contact the Equity of Access Office upon admission to TWU to discuss their specific needs. All disabilities must be recently documented by an appropriately certified professional and include the educational impact of the disability along with recommended accommodations. Within the first two weeks of the semester, students must meet with their professors to agree on accommodations appropriate to each class. Students should follow the steps detailed by the Equity of Access Office outlined in the Student Life section of the University Calendar.

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1. According to the TWU standard grading system, see http://twu.ca/governance/policies/university-standard-grading-system.html [↑](#footnote-ref-0)