COMP5045: COMPUTATIONAL GEOMETRY

Semester 1, 2017 | 6 Credit Points | Mode: Normal-Day
Coordinator(s): Joachim Gudmundsson

WARNING: This unit is an archived version! See Overview tab for delivered versions.

1. INTRODUCTION

In many areas of computer science- robotics, computer graphics, virtual reality, and geographic information systems are some examples- it is necessary to store, analyse, and create or manipulate spatial data. This course deals with the algorithmic aspects of these tasks: we study techniques and concepts needed for the design and analysis of geometric algorithms and data structures. Each technique and concept will be illustrated on the basis of a problem arising in one of the application areas mentioned above.

2. LEARNING OUTCOMES

Learning outcomes are the key abilities and knowledge that will be assessed in this unit. See assessment summary table below for details of which outcomes are assessed where. Outcomes are listed according to the course goals that they support.

Design (Level 4)

1. Attack theoretical and practical problems in various application domains.
2. Ability to read, understand, analyze and modify a given algorithm. Ability to design algorithmic solutions for given geometric problems.
3. Ability to analyze the complexity of a given algorithm

Maths/Science Methods and Tools (Level 3)

4. Understand and apply important techniques and results in computational geometry.
5. Knowledge of fundamental algorithms for several problems, for example algorithms to compute convex hulls, triangulate polygons, low-dimensional linear programming and Voronoi diagrams Knowledge of fundamental general algorithmic design techniques, such as greedy, dynamic programming and divide-and-conquer.
6. Knowledge of fundamental geometric data structures such as, data structures for range searching, point location, segment intersection and ray shooting.Knowledge of fundamental general design techniques for data structures, such as multi-level trees, duality and divide-and-conquer.

Communication (Level 3)

7. Argue the correctness and efficiency of a proposed solution. Mainly in writing but also orally.

For further details of course goals related to these learning outcomes, see online unit outline at http://cusp.eng.usyd.edu.au/students/view-unit-page/alpha/COMP5045 .

3. ASSESSMENT TASKS

ASSESSMENT SUMMARY

Assessment name	Team-based?	Weight	Due	Outcomes Assessed
Assignment*	No	12%	Week 3	5, 6, 7
Assignment*	No	12%	Week 5	2, 5, 6, 7
Assignment*	No	12%	Week 7	4, 5, 6
Assignment*	No	12%	Week 9	4, 5, 6
Assignment*	No	12%	Week 11	4, 5, 6
Assignment*	No	12%	Week 13	4, 5, 6
Final Exam	No	28%	Exam Period	2, 3, 4, 7

ASSESSMENT DESCRIPTION

* indicates an assessment task which must be repeated if a student misses it due to special consideration

There may be statistically defensible moderation when combining the marks from each component to ensure consistency of marking between markers, and alignment of final grades with unit outcomes.

Assignment: Assignment 1

Assignment: Assignment 2

Assignment: Assignment 3

Assignment: Assignment 4

Assignment: Assignment 5

Assignment: Assignment 6

Exam: To pass the course a minimum of 50% is required on the exam

ASSESSMENT GRADING

Final grades in this unit are awarded at levels of HD for High Distinction, DI (previously D) for Distinction, CR for Credit, PS (previously P) for Pass and FA (previously F) for Fail as defined by University of Sydney Assessment Policy. Details of the Assessment Policy are available on the Policies website at http://sydney.edu.au/policies . Standards for grades in individual assessment tasks and the summative method for obtaining a final mark in the unit will be set out in a marking guide supplied by the unit coordinator.
To pass this unit a minimum of 50% is required in the final exam.

4. ATTRIBUTES DEVELOPED

Attributes listed here represent the course goals designated for this unit. The list below describes how these attributes are developed through practice in the unit. See Learning Outcomes and Assessment sections above for details of how these attributes are assessed.

Attribute	Method
Design (Level 4)	In the four assignments the focus is on problem solving by applying and modifying algorithmic tools in computational geometry.
Maths/Science Methods and Tools (Level 3)	The ability analyze existing solutions and to state a correctness proof.
Communication (Level 3)	Ability to present an algorithm and argue its correctness.

For further details of course goals and professional attribute standards, see the online version of this outline at http://cusp.eng.usyd.edu.au/students/view-unit-page/alpha/COMP5045 .

5. STUDY COMMITMENT

Activity	Hours per Week	Sessions per Week	Weeks per Semester
Project Work - in class	12.00	1	13

Standard unit of study workload at this university should be from 1.5 to 2 hours per credit point which means 9-12 hours for a normal 6 credit point unit of study. For units that are based on research or practical experience, hours may vary. For lecture and tutorial timetable, see University timetable site at: web.timetable.usyd.edu.au/calendar.jsp

6. TEACHING STAFF AND CONTACT DETAILS

COORDINATOR(S)

Name	Room	Phone	Email	Contact note
Dr Gudmundsson, Joachim		02 9351 4494	joachim.gudmundsson@sydney.edu.au	

LECTURERS

Name	Room	Phone	Email	Contact note
Dr Gudmundsson, Joachim		02 9351 4494	joachim.gudmundsson@sydney.edu.au	

7. RESOURCES

PRESCRIBED TEXTBOOK(S)

M. de Berg, O. Cheong, M. van Kreveld and M. Overmars., *Computational Geometry: Algorithms and Application* (3rd edition). Springer-Verlag, Heidelberg, 2008. 978-3-540-77973-5.

COURSE WEBSITE(S)

Blackboard Learn

8. ENROLMENT REQUIREMENTS

ASSUMED KNOWLEDGE

Students are assumed to have a basic knowledge of the design and analysis of algorithms and data structures: you should be familiar with big-O notations and simple algorithmic techniques like sorting, binary search, and balanced search trees.

PREREQUISITES

None.

9. POLICIES

ACADEMIC HONESTY

While the University is aware that the vast majority of students and staff act ethically and honestly, it is opposed to and will not tolerate academic dishonesty or plagiarism and will treat all allegations of dishonesty seriously.

All students are expected to be familiar and act in compliance with the relevant University policies, procedures and codes, which include:

- *Academic Honesty in Coursework Policy 2015*
- *Academic Honesty Procedures 2016*
- *Code of Conduct for Students*
- *Research Code of Conduct 2013* (for honours and postgraduate dissertation units)

They can be accessed via the University"s Policy Register: http://sydney.edu.au/policies (enter "Academic Honesty" in the search field).

Students should never use document-sharing sites and should be extremely wary of using online "tutor" services. Further information on academic honesty and the resources available to all students can be found on the Academic Integrity page of the University website: http://sydney.edu.au/elearning/student/EI/index.shtml

Academic Dishonesty and Plagiarism

Academic dishonesty involves seeking unfair academic advantage or helping another student to do so.

You may be found to have engaged in academic dishonesty if you:

- Resubmit (or "recycle") work that you have already submitted for assessment in the same unit or in a different unit or previous attempt;
- Use assignment answers hosted on the internet, including those uploaded to document sharing websites by other students.
- Have someone else complete part or all of an assignment for you, or do this for another student.
- Except for legitimate group work purposes, providing assignment questions and answers to other students directly or through social media platforms or document ("notes") sharing websites, including essays and written reports.
- Engage in examination misconduct, including using cheat notes or unapproved electronic devices (e.g., smartphones), copying from other students, discussing an exam with another person while it is in progress, or removing confidential examination papers from the examination venue.
- Engage in dishonest plagiarism.

Plagiarism means presenting another person's work as if it is your own without properly or adequately referencing the original source of the work.

Plagiarism is using someone else's ideas, words, formulas, methods, evidence, programming code, images, artworks, or musical creations without proper acknowledgement. If you use someone's actual words you must use quotation marks as well as an appropriate reference. If you use someone's ideas, formulas, methods, evidence, tables or images you must use a reference. You must not present someone's artistic work, musical creation, programming code or any other form of intellectual property as your own. If referring to any of these, you must always present them as the work of their creator and reference in an appropriate way.

Plagiarism is always unacceptable, regardless of whether it is done intentionally or not. It is considered dishonest if done knowingly, with intent to deceive or if a reasonable person can see that the assignment contains more work copied from other sources than the student's original work. The University understands that not all plagiarism is dishonest and provides students with opportunities to improve their academic writing, including their understanding of scholarly citation and referencing practices.

USE OF SIMILARITY DETECTION SOFTWARE

All written assignments submitted in this unit of study will be submitted to the similarity detecting software program known as **Turnitin**. Turnitin searches for matches between text in your written assessment task and text sourced from the Internet, published works and assignments that have previously been submitted to Turnitin for analysis.

There will always be some degree of text-matching when using Turnitin. Text-matching may occur in use of direct quotations, technical terms and phrases, or the listing of bibliographic material. This does not mean you will automatically be accused of academic dishonesty or plagiarism, although Turnitin reports may be used as evidence in academic dishonesty and plagiarism decision-making processes.

Computer programming assignments may also be checked by specialist code similarity detection software. The Faculty of Engineering & IT currently uses the MOSS similarity detection engine (see http://theory.stanford.edu/~aiken/moss/) . These programs work in a similar way to TII in that they check for similarity against a database of previously submitted assignments and code available on the internet, but they have added functionality to detect cases of similarity of holistic code structure in cases such as global search and replace of variable names, reordering of lines, changing of comment lines, and the use of white space.

IMPORTANT: School policy relating to Academic Dishonesty and Plagiarism.

In assessing a piece of submitted work, the School of IT may reproduce it entirely, may provide a copy to another member of faculty, and/or to an external plagiarism checking service or in-house computer program and may also maintain a copy of the assignment for future checking purposes and/or allow an external service to do so.

Other policies

See the policies page of the faculty website at http://sydney.edu.au/engineering/student-policies/ for information regarding university policies and local provisions and procedures within the Faculty of Engineering and Information Technologies.

10. WEEKLY SCHEDULE

Note that the "Weeks" referred to in this Schedule are those of the official university semester calendar
https://web.timetable.usyd.edu.au/calendar.jsp

Week	Topics/Activities
Week 1	Art gallery theorems and polygon triangulation
Week 2	Sweepline algorithms, convex hulls, lower bounds
Week 3	Line segment intersection and polygon partitioning
	Assessment Due: Assignment*
Week 4	Linear programming and probabilistic analysis
Week 5	Orthogonal range searching I: kd-tress and range trees
	Assessment Due: Assignment*
Week 6	Orthogonal range searching II: fractional cascading and interval trees
Week 7	Planar point location
	Assessment Due: Assignment*
Week 8	Arrangements and duality
Week 9	Voronoi diagrams and Delaunay triangulation
	Assessment Due: Assignment*
Week 10	Approximation algorithms
	Reading material: Dilation and detour in geometric networks
	Reading material: The well-separated pair decomposition and its applications
Week 11	The Frechet distance
	Assessment Due: Assignment*
Week 12	Binary space partition
Week 13	Recap
	Assessment Due: Assignment*
STUVAC (Week 14)	Study week
Exam Period	exam week
	Assessment Due: Final Exam