

# CGRA251 (2017) - Computer Graphics

## Prescription

This course addresses the central algorithms, mathematical knowledge and programming for Computer Graphics. It will include topics such as geometry manipulation and computing, curvature and graphics applications of linear algebra and numerical integration. Students will implement algorithms using scripting tools and develop simple plugins for 3D computer graphics tools. Please note: this course will first run in 2017.

## Course learning objectives

Students who pass this course should be able to:

1. Implement a basic OpenGL application in C++ when given an appropriate basic framework from which to start. Be able to load, view, and manipulate a polygon mesh in OpenGL. Be able to explain and implement, in OpenGL, object picking, trilinear and tricubic interpolation, and basic space deformation based on a control lattice.
2. Explain and implement three-dimensional rigid object animation using physical simulation of position, velocity, acceleration and forces. Apply appropriate forces to a simulated object based on the position and velocity of other objects in the simulated scene.
3. Implement a basic ray tracer, including sphere, plane, triangle and disc primitives; multiple point light sources; shadows; Lambertian, mirror and Blinn-Phong specular reflection.
4. Demonstrate an ability to use a range of algebraic tools, including trilinear and tricubic interpolation, vector arithmetic (dot and cross products), intersection calculations between a ray and various primitive objects, velocity and position updates in physical simulation.

## Course content

The course has three components:

1. **Programming in C++ and OpenGL:** getting to grips with the programming language and library that are used in most professional computer graphics situations.
2. **Mathematics and graphics in OpenGL:** example uses of OpenGL that allow expression of some of the mathematics used in computer graphics, including interpolation, mesh handling, mesh deformation, object animation, and simulation.
3. **Introduction to ray tracing:** the mathematics and implementation of a simple ray tracer, including ray-object intersection, normal calculation, simple shading, shadowing, and reflections.

## Required Academic Background

Students must have passed CGRA 151 to give them an understanding of several of the basic concepts on which this course builds. Students must have passed an appropriate programming course (either COMP 103 or MDDN 242). Experience with C or C++ would be helpful (e.g., NWEN 241). Students must have mathematical background to be able to handle the algebra (either ENGR 121 or MATH 151 are required; for those who took ENGR 121, ENGR 122 would also be useful; alternative mathematical preparation can be considered with Head of School permission).

## Withdrawal from Course

Withdrawal dates and process:

<http://www.victoria.ac.nz/students/study/course-additions-withdrawals>

## Lecturers



**Neil Dodgson (Coordinator)**

neil.dodgson@vuw.ac.nz

04 4636922

329 Cotton, Kelburn



**Zohar Levi**

zohar.levi@vuw.ac.nz

04 463 5233 ext 7045

338 Cotton, Kelburn

## Teaching Format

### Dates (trimester, teaching & break dates)

- Teaching: 17 July 2017 - 20 October 2017
- Break: 28 August 2017 - 08 September 2017
- Study period: 24 October 2017 - 26 October 2017
- Exam period: 27 October 2017 - 18 November 2017

### Class Times and Room Numbers

#### 17 July 2017 - 27 August 2017

- **Monday** 14:10 - 15:00 – LT118, Laby, Kelburn
- **Wednesday** 14:10 - 15:00 – LT118, Laby, Kelburn
- **Friday** 14:10 - 15:00 – LT118, Laby, Kelburn

#### 11 September 2017 - 22 October 2017

- **Monday** 14:10 - 15:00 – LT118, Laby, Kelburn
- **Wednesday** 14:10 - 15:00 – LT118, Laby, Kelburn
- **Friday** 14:10 - 15:00 – LT118, Laby, Kelburn

### Other Classes

Tutorial sessions will be held in lecture times, as notified by the course lecturers.

### Set Texts and Recommended Readings

#### Required

There are no required texts for this offering.

### Mandatory Course Requirements

There are no mandatory course requirements for this course.

*If you believe that exceptional circumstances may prevent you from meeting the mandatory course requirements, contact the Course Coordinator for advice as soon as possible.*

### Assessment

The course is assessed entirely on programming assignments.

|   |              |          |     |
|---|--------------|----------|-----|
| Assignment 1: Introduction to OpenGL    | 11 August    | CLO: 1   | 20% |
| Assignment 2: Spatial deformation       | 15 September | CLO: 2,4 | 30% |
| Assignment 3: Boids: flocking animation | 2 October    | CLO: 2,4 | 20% |
| Assignment 4: A simple ray tracer       | 30 October   | CLO: 3,4 | 30% |

## Penalties

Assignments submitted late receive a 25% penalty for each day late.

## Extensions

The ECS submission system will automatically allocate up to three late days with no penalty. Additional extensions require the permission of the Course Coordinator and should be supported by appropriate documentation, e.g. a doctor's certificate.

## Submission & Return

All work will be submitted through the ECS submission system.

## Workload

The course requires 150 hours of work. There are 3 hours per week of scheduled class time. Students are expected to spend up to 7 hours per week consolidating what they have learnt in class and working on the assignments.

## Teaching Plan

## Links to General Course Information

- Academic Integrity and Plagiarism: <http://www.victoria.ac.nz/students/study/exams/integrity-plagiarism>
- Academic Progress: <http://www.victoria.ac.nz/students/study/progress/academic-progress> (including restrictions and non-engagement)
- Dates and deadlines: <http://www.victoria.ac.nz/students/study/dates>
- Grades: <http://www.victoria.ac.nz/students/study/progress/grades>
- Special passes: Refer to the Assessment Handbook, at <http://www.victoria.ac.nz/documents/policy/staff-policy/assessment-handbook.pdf>
- Statutes and policies, e.g. Student Conduct Statute: <http://www.victoria.ac.nz/about/governance/strategy>
- Student support: <http://www.victoria.ac.nz/students/support>
- Students with disabilities: [http://www.victoria.ac.nz/st\\_services/disability/](http://www.victoria.ac.nz/st_services/disability/)
- Student Charter: <http://www.victoria.ac.nz/learning-teaching/learning-partnerships/student-charter>
- Terms and Conditions: <http://www.victoria.ac.nz/study/apply-enrol/terms-conditions/student-contract>
- Turnitin: <http://www.cad.vuw.ac.nz/wiki/index.php/Turnitin>
- University structure: <http://www.victoria.ac.nz/about/governance/structure>
- VUWSA: <http://www.vuwsa.org.nz>

**Offering CRN:** [28399](#)

**Points:** 15

**Prerequisites:** CGRA 151; COMP 103 or MDDN 242; ENGR 121 or MATH 151 or permission of Head of School

**Duration:** 17 July 2017 - 19 November 2017

**Starts:** Trimester 2

**Campus:** Kelburn

