COMP3170

Computer Graphics

Session 1, Special circumstances 2021

School of Computing

Contents

Disclaimer

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Notice

As part of Phase 3 of our return to campus plan, most units will now run tutorials, seminars and other small group activities on campus, and most will keep an online version available to those students unable to return or those who choose to continue their studies online.

To check the availability of face-to-face activities for your unit, please go to timetable viewer. To check detailed information on unit assessments visit your unit's iLearn space or consult your unit convenor.

General Information

Unit convenor and teaching staff
Malcolm Ryan
malcolm.ryan@mq.edu.au
Contact via Email
Email for appointment

Credit points
10

Prerequisites
130cp at 1000 level or above including COMP2000 or COMP229 or COMP2010 or COMP225 or COMP2160

Corequisites

Co-badged status

Unit description
This unit is the study of pictures, images and animations generated by computers, as well as tools used to produce these pictures. This unit introduces the mathematical foundations of computer graphics, examines how to model three-dimensional objects, introduces techniques for creating animations, and explores how realistic scenes are rendered. Practical work involves using a graphics library, such as OpenGL, under Unix or Windows platforms.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

ULO1: Understand the fundamentals of vector geometry and employ them in devising algorithms to achieve a variety of graphic effects.

ULO2: Program 2D and 3D graphical applications using OpenGL embedded in a programming language (such as OpenGL in Java)

ULO3: Apply vector geometry to implement and combine 3D transformations including rotation, translation, scale and perspective.

ULO4: Program vertex and fragment shaders to implement effects such as lighting,

texturing, shadows and reflections.

ULO5: Explain the core concepts behind advanced graphics techniques such as ray-casting and indirect lighting.

General Assessment Information

Weekly Quizzes

The weekly quizzes are provided on iLearn in the weekly content sections. The quizzes provide weekly feedback on your progress in the unit. They are intended to help you identify areas that you need to study further. Each quiz must be done within the designated week or the following week at the latest. You may attempt each quiz multiple times, and your final mark for each quiz will be the best mark that you achieve on that quiz. The quiz questions change each time that you attempt it. Take each quiz early, study anything that you were unable to answer correctly, and take the quiz again for your best mark.

Submitting Assignments

Detailed submission instructions are included in each assignment. The following are some general principles:

- Programs should be developed using Github Classroom as a repository throughout development. This acts as a backup and record of your work. Your last commit before the deadline will be marked as your submission. Plagiarism checkers will also be applied to program submissions.
  - "Commit early, commit often, and push every commit"
- The Graphics Transformations assignment is to be submitted as a PDF through the iLearn submission page which uses Turn-it-in to detect plagiarism.

Policy on Late Assignments

No extensions will be granted except in cases of special consideration. Students who have not submitted any work for the task prior to the deadline will be awarded a mark of 0 for the task, except for special consideration cases. Plan to submit early.

Assessment Tasks

Name	Weighting	Hurdle	Due
Online quizzes	10%	No	Weekly
Graphics Transformations	10%	No	Week 7
3D Interactive Visualisation	20%	No	Week 12
2D Interactive Graphics Program	20%	No	Week 6

Name	Weighting	Hurdle	Due
Final Examination	40%	No	Exam period

Online quizzes

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 6 hours
Due: **Weekly**
Weighting: **10%**

Weekly online quizzes covering the lecture material.

On successful completion you will be able to:
- Understand the fundamentals of vector geometry and employ them in devising algorithms to achieve a variety of graphic effects.
- Apply vector geometry to implement and combine 3D transformations including rotation, translation, scale and perspective.
- Program vertex and fragment shaders to implement effects such as lighting, texturing, shadows and reflections.
- Explain the core concepts behind advanced graphics techniques such as ray-casting and indirect lighting.

Graphics Transformations

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 15 hours
Due: **Week 7**
Weighting: **10%**

Use mathematics and sketching to solve computer graphics problems involving 2D and 3D geometric transformations

On successful completion you will be able to:
- Understand the fundamentals of vector geometry and employ them in devising algorithms to achieve a variety of graphic effects.
- Apply vector geometry to implement and combine 3D transformations including rotation,

translation, scale and perspective.

3D Interactive Visualisation

Assessment Type [1]: Programming Task
Indicative Time on Task [2]: 26 hours
Due: **Week 12**
Weighting: **20%**

Create an interactive 3D graphics application using OpenGL. Your program will display on the screen the 3D appearance of a scene.

On successful completion you will be able to:

- Understand the fundamentals of vector geometry and employ them in devising algorithms to achieve a variety of graphic effects.
- Program 2D and 3D graphical applications using OpenGL embedded in a programming language (such as OpenGL in Java)
- Apply vector geometry to implement and combine 3D transformations including rotation, translation, scale and perspective.
- Program vertex and fragment shaders to implement effects such as lighting, texturing, shadows and reflections.

2D Interactive Graphics Program

Assessment Type [1]: Programming Task
Indicative Time on Task [2]: 26 hours
Due: **Week 6**
Weighting: **20%**

Develop an interactive graphics application using only 2D graphics. The application will be built using OpenGL.

On successful completion you will be able to:

- Program 2D and 3D graphical applications using OpenGL embedded in a programming language (such as OpenGL in Java)

Final Examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 2 hours
Due: **Exam period**
Weighting: **40%**

Final written examination

On successful completion you will be able to:

- Understand the fundamentals of vector geometry and employ them in devising algorithms to achieve a variety of graphic effects.
- Program 2D and 3D graphical applications using OpenGL embedded in a programming language (such as OpenGL in Java)
- Apply vector geometry to implement and combine 3D transformations including rotation, translation, scale and perspective.
- Program vertex and fragment shaders to implement effects such as lighting, texturing, shadows and reflections.
- Explain the core concepts behind advanced graphics techniques such as ray-casting and indirect lighting.

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources
Classes

Each week you should attend two hours of lectures. Each week you should also attend your two hour mixed workshop class (the first hour of this class includes tutorial material; the second hour is practical time). For details of days, times and rooms for classes consult the timetables webpage. Note that mixed workshop classes commence in **week 1**. You should have selected a mixed workshop class during enrolment. You should attend the mixed workshop class which you are enrolled in. If you do not have a class, or if you wish to change one, you should follow the

usual procedures for change of enrolment. Please note that you are expected to attend your mixed workshop class - this is the first place to obtain help with the unit.

Resources to assist your learning

iLearn is your first place to visit for weekly unit information including lectures, workshops, assignment specifications, discussion forums and other resources.

Echo360 Lecture Recordings and live lecture streaming are available - for more information, see the Echo360 student guide. If using lecture recordings, be sure to keep up to date with the lectures each week. The lectures will present material that is relevant to asignments and workshops, so keeping up with lectures is important for your progress in the unit.

The required textbook for this unit is Computer Graphics Programming in OpenGL with Java 2nd edition, by V. Scott Gordon and John Clevenger, 2019. This textbook is available for purchase through Booktopia (which has acquired the University Coop Bookshop). It is also available as an ebook in the library.

There are a number of online resources about OpenGL. You can use http://www.opengl.org/, as your starting point or use Google to look for specific items. The JOGL interface to OpenGL is described at https://jogamp.org/.

Technology used and required

We will use Java JDK, Eclipse and JOGL to develop and debug OpenGL programs. See iLearn for more details.

Websites

We will be using the University's online learning system iLearn. Students should check COMP3170 on iLearn regularly for updates.

Discussion Boards

We will use the forums hosted within iLearn. Feel free to post questions there. Important announcements (such as tips and clarifications on assignments) will often be posted there.

Teaching and learning strategy

COMP3170 is taught via lectures in a lecture room and live streamed, and mixed workshop classes in a laboratory. The work you do and the feedback that you receive play a crucial role in your learning. Lectures are used to introduce new material, give examples of the use of programming methods and techniques and put them in a wider context. Furthermore, to highlight the relationship between teaching, research and learning, an advanced topic will occasionally be introduced during the lectures. This additional material will not be examined as such but may prove useful to complete the assignments.

You learn by processing concepts, not just by hearing them. Mixed workshop classes are small group classes in the laboratories which give you the opportunity to do exactly that by interacting with a tutor who has a sound knowledge of the subject and with your peers. This also gives you a chance to practice your programming skills. You have many opportunities to seek and to receive feedback. During lectures, you are encouraged to ask the lecturer questions to clarify anything you might not be sure of. Each week, you will be given problems to solve in the mixed

workshop classes. The discussion and the solutions provided will help you to understand the material in the unit, to do the work for the assignments, and to prepare you for the final exam. It is important that you keep up with these problems every week. Each week you should:

- Attend lectures, take notes, ask questions
- Study the on-line lecture slides/notes and textbook as directed by the lecturer
- Attend your mixed workshop class and seek feedback from your tutor on your work
- Attempt the weekly online quiz and study/seek assistance with any questions that you do not know how to answer correctly
- Start working on any assignments as soon as they have been released.

Time management and programming

COMP3170 is a ten credit point unit. You are therefore expected to spend approximately ten hours per week on this unit, including the study break weeks - 150 hours in total. Since each week each student should attend three hours of lectures, and attend a two hour mixed workshop, the remaining five hours per week will be spent on private study and assigned assessable work outside of class. A significant portion of the outside time will be spent on programming. Mastering some basic skills early in the semester can save you tenfold in time and energy. In particular, many students have difficulty managing large projects and have problems with some of the trickier aspects of OpenGL in Java. The textbook provides a good introduction to OpenGL and JOGL - read it!

You cannot learn graphics programming - or any kind of programming for that matter - simply by reading a textbook. You could make a start by copying some of the programs from the unit website, then modifying and running the programs to gain an understanding of how they work. Make sure you try to understand each line of code. Programming is a science and an art; it is not magic. The assignments in this unit could take many hours to complete. Don't expect to complete any of the assignments over a single weekend. Start each assignment early, get some basic functionality going, and try to become proficient in the parts of OpenGL that will be necessary for the assignment. It is often a good idea to write sample programs that let you test a single feature you are exploring before embedding it in the large project.

Unit Schedule

The provisional schedule of lecture content is as follows. Changes may be made as the session progresses and will be seen on iLearn.

Week	Topics Covered
1	Introduction: Techniques and applications of computer graphics; GPU; first programming examples.
2	2D Basics: 2D coordinate systems and transformation between them - world coordinates, Normalised Device Coordinates and viewport coordinates. 2D graphics programming examples.
3	2D Transformations: Vectors and matrices; 2D transformation matrices and how to use them.

Week	Topics Covered
4	2D Camera: Scene graph and placing the camera in the scene; drawing circles and Bezier curves.
5	3D Transformations and Meshes: Extending transformation matrices to 3D; rotations in 3D; introducing fragment shaders.
6	3D Camera and Perspective: The projection matrix and perspective divide;
Break	
7	Rasterisation - from Models to Pixels
8	Depth buffer and transparency
9	Shading and illumination
10	Shading and texturing
11	Texturing
12	Effects
13	Revision

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- Getting help with your assignment
- Workshops
- StudyWise
- Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Changes from Previous Offering

There are no major changes from the previous offering.

Changes since First Published

Date	Description
16/02/2021	Back the way it was. I had it right the first time.
16/02/2021	Changed unit schedule to reflect different mid-semester break Changed deadline on take-home exam to the end of the break.