MONASH University

FIT3088
Computer graphics

Unit guide

Semester 1, 2009

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FIT3088 Computer graphics - Semester 1, 2009

Unit leader :

Lecturer(s) :

Clayton

- Jon McCormack

Tutors(s) :

Clayton

- Jon McCormack

Introduction

Welcome to FIT3088 Computer Graphics. This course aims to give a general introduction to two and three-dimensional computer graphics. Computer graphics techniques play a major a role in computing and many other disciplines. Applications include such diverse areas as graphical user interfaces (GUIs), photorealistic simulation in the film and television industries, scientific visualisation, medical simulation, Geographic Information Systems (GIS), Virtual Reality (VR), interactive multimedia and computer games. In addition to these many applications, computer graphics has a strong foundation in computer science. This course has an emphasis on theory, with reference to the practical applications of algorithms and techniques. Successful completion of the course should give you a solid background in the basics of modern computer graphics topics, such as synthetic camera models, graphics programming languages, hidden surface removal and shading algorithms. This knowledge can be applied to engineer simple graphics applications and serves as a basis to more advanced study in graphics at honours and postgraduate level.

Unit synopsis

ASCED: 020115 Computer Graphics

Computer graphics deals with techniques for generating lines, curves and surfaces. This subject covers graphics devices, graphics software, line, arc and curve drawing, clipping, scan conversion and overlapping regions, 2D and 3D transformations, shading and hidden surface algorithms, synthetic camera models, real-time interaction and computer animation.

Learning outcomes

Knowledge and Understanding

At the completion of this unit, students will have an understanding of:

K1. Mathematical representations of basic geometric primitives in Euclidean space, such as points, lines, polygons and parametric curves.

K2. How to use homogeneous co-ordinates and transformations on geometric objects in two and three dimensions. How to combine multiple transformations efficiently.

K3. Orthographic, parallel and perspective projections and their related homogeneous transformations.

K4. Appropriate data structures for hierarchical representation of polygonal datasets.

K5. Rasterisation algorithms for drawing in frame buffers

K6. The use of Quaternions to represent object rotation

K7. A synthetic camera model for viewing and projecting of two and three-dimensional geometry.

K8. Algorithms for hidden surface removal and backface elimination. The capacity to analyse the space and time complexity of these algorithms to determine the most appropriate in a given situation.

K9. BRDF Shading models: Lambert, Phong, Blinn's Phong, Torrance-Sparrow-Blinn-Cook-Beckmann, Oren-Nayar

K10. Textures and texture mapping.

K11. Basic knowledge of aliasing theory.

K12. Interpolative shading models. Shadow algorithms. Local and global illumination models.

K13. The OpenGL state-machine and graphics pipeline.

Attitudes, Values and Beliefs

At the completion of this unit, students will have attitudes that will allow them to:

A1. Understand the role and value of visual communication in the arts and sciences

A2. Appreciate the uses and application of interactive, real-time graphics and software rendering.

Practical Skills

At the completion of this unit, students will be able to:

P1. Program basic interactive graphics applications in C/C++ and OpenGL.

P2. Apply computer graphics theory and algorithms to the design of visual computing applications.

Workload

For on campus students, workload commitments are:

- two-hour lecture each week, and
- two-hour tutorial each fortnight
- aminimum of 4-5 hours of personal study per one hour of contact time inorder to satisfy the reading and assignment expectations.
- Youwill need to allocate up to 5 hours per week in some weeks, for use ofa computer and assignment work.

Unit relationships

Prerequisites

It is a prerequisite that before attempting this unit you must have satisfactorily completed FIT2004 or CSE2304 or CSC2040, or equivalent.

In addition, students beginning FIT3088 are assumed to be able to:

Design, edit, build and debug software in Java and/or C/C++ in a Linux environment Understand the appropriate maths background: linear algebra Coordinate reference frames in 2D and 3D Points and Vectors - vector addition, scalar multiplication - inner and outer products Basis Vectors and Metric Tensors - orthonormal basis, metric tensor Matrices - Matrix multiplication, matrix transpose, determinant, inverse Basic calculus: integration, ode's pde's.

Relationships

FIT3088 is an elective unit in the BCS/BSE degrees.

It is a prerequisite that before attempting this unit you must have satisfactorily completed FIT2004 or CSE2304 or CSC2040, or equivalent. You may not study this unit and CSC3130, CSE3313, DGS3622, FIT3005, GCO3817, RDT3510, RDT3622 in your degree.

Continuous improvement

Monash is committed to ‘Excellence in education’ (Monash Directions 2025 - http://www.monash.edu.au/about/monash-directions/directions.html) and strives for the highest possible quality in teaching and learning.

To monitor how successful we are in providing quality teaching and learning Monash regularly seeks feedback from students, employers and staff. One of the key formal ways students have to provide feedback is through Unit Evaluation Surveys. The University’s Unit Evaluation policy (http://www.policy.monash.edu/policy-bank/academic/education/quality/unit-evaluation-policy.html) requires that every unit offered is evaluated each year. Students are strongly encouraged to complete the surveys as they are an important avenue for students to “have their say”. The feedback is anonymous and provides the Faculty with evidence of aspects that students are satisfied and areas for improvement.

Faculties have the option of administering the Unit Evaluation survey online through the my.monash portal or in class. Lecturers will inform students of the method being used for this unit towards the end of the semester.

Student Evaluations

If you wish to view how previous students rated this unit, please go to http://www.adm.monash.edu.au/cheq/evaluations/unit-evaluations/

Improvements to this unit

A Monquest evaluation will be run for this unit.

Unit staff - contact details

Unit leader

None provided

Lecturer(s) :

Associate Professor Jon McCormack
Associate Professor
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Fax +61 3 990 55157

Tutor(s) :

Associate Professor Jon McCormack
Associate Professor
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Teaching and learning method

Lectures (2 hours per week), Practical Assignments (2), Tutorials (every second week), Consultation.

Tutorial allocation

On-campus students should register for tutorials/laboratories using Allocate+.

Communication, participation and feedback

Monash aims to provide a learning environment in which students receive a range of ongoing feedback throughout their studies. You will receive feedback on your work and progress in this unit. This may take the form of group feedback, individual feedback, peer feedback, self-comparison, verbal and written feedback, discussions (on line and in class) as well as more formal feedback related to assignment marks and grades. You are encouraged to draw on a variety of feedback to enhance your learning.

It is essential that you take action immediately if you realise that you have a problem that is affecting your study. Semesters are short, so we can help you best if you let us know as soon as problems arise. Regardless of whether the problem is related directly to your progress in the unit, if it is likely to interfere with your progress you should discuss it with your lecturer or a Community Service counsellor as soon as possible.

Unit Schedule

Week	Topic	Key dates
1	Course Overview, Introduction, History	
2	Displays, 2D Graphics with Processing	
3	Text, Curves and Simple Transformations	
4	Affine transforms, Compound Transforms	
5	Introduction to OpenGL	
6	3D transforms and primitives	Assignment 1 Due

Mid semester break		
7	Synthetic Camera Models, Projections	
8	Animation and Interactivity	
9	Backface elimination, Hidden surface removal	
10	Shading and illumination models	
11	Interpolative shading models	
12	Global illumination: ray tracing and radiosity	Assignment 2 Due
13	Revision	

Unit Resources

Prescribed text(s) and readings

Recommended text(s) and readings

Highly Recommended

Slater, Mel et. al.: Computer Graphics and Virtual Environments: from realism to real-time, Addison Wesley, 2002.

Hearn, Donald and M. Pauline Baker: Computer Graphics with OpenGL (3rd International Edition), Pearson Prentice Hall, 2004

Angel, Edward: OpenGL: A Primer, (2nd Edition) Addison Wesley, 2004.

Supplementary Reading

Van Verth, James M. and Lars M. Bishop: Essential Mathematics for Games and Interactive Applications, A Programmers Guide, Morgan Kaufmann, 2004.

Shreiner, D. et. al.: OpenGL Programming Guide (5th Edition), The Official Guide to Learning OpenGL, Version , Addison Wesley 2006.

Angel, Edward: Interactive Computer Graphics: A top-down approach using OpenGL (Third Edition), Addison Wesley, 2003.

Hill, F.S. Jr.: Computer Graphics Using Open GL (2nd Edition), Prentice-Hall, 2001.

Required software and/or hardware

Processing: available at www.processing.org

Jogl (Java OpenGL) available from java.net

Any machine with OpenGL or MESA installed (see: www.opengl.org).

Equipment and consumables required or provided

Students studying off-campus are required to have the minimum system configuration specified by the Faculty as a condition of accepting admission, and regular Internet access. On-campus students, and those studying at supported study locations may use the facilities available in the computing labs. Information about computer use for students

is available from the ITS Student Resource Guide in the Monash University Handbook. You will need to allocate up to **n** hours per week for use of a computer, including time for newsgroups/discussion groups.

Study resources

Study resources we will provide for your study are:

- Weekly detailed lecture notes;
- Tutorials every second week of semester, beginning week 3
- Assignment specifications and sample solutions;
- A sample examination;
- Discussion groups;
- This Unit Guide outlining the administrative information for the unit;
- The unit web site on MUSO, where resources outlined above will be made available.

Library access

The Monash University Library site contains details about borrowing rights and catalogue searching. To learn more about the library and the various resources available, please go to http://www.lib.monash.edu.au.

The Educational Library and Media Resources (LMR) is also a very resourceful place to visit at http://www.education.monash.edu.au/library/

Monash University Studies Online (MUSO)

All unit and lecture materials are available through MUSO (Monash University Studies Online). Blackboard is the primary application used to deliver your unit resources. Some units will be piloted in Moodle. If your unit is piloted in Moodle, you will see a link from your Blackboard unit to Moodle (http://moodle.monash.edu.au) and can bookmark this link to access directly. In Moodle, from the Faculty of Information Technology category, click on the link for your unit.

You can access MUSO and Blackboard via the portal: http://my.monash.edu.au

Click on the Study and enrolment tab, then Blackboard under the MUSO learning systems.

In order for your Blackboard unit(s) to function correctly, your computer needs to be correctly configured.

For example:

- Blackboard supported browser
- Supported Java runtime environment

For more information, please visit: http://www.monash.edu.au/muso/support/students/downloadables-student.html

You can contact the MUSO Support by phone : (+61 3) 9903 1268

For further contact information including operational hours, please visit:
http://www.monash.edu.au/muso/support/students/contact.html

Further information can be obtained from the MUSO support site:
http://www.monash.edu.au/muso/support/index.html

Assessment

Unit assessment policy

To pass this unit, a student must obtain :

- 40% or more in the unit's examination and
- 40% or more in the unit's assignments
  and
- an overall unit mark of 50% or more

If a student does not achieve 40% or more in the unit examination or the assessment then a mark of no greater than 44N will be recorded for the unit.

Assignment tasks

- **Assignment Task**

  Title : Assignment 1

  Description :

  Programming assignment 1: 2D graphics
  Weighting : 10%

  Criteria for assessment :

  Adherence to the specification; quality of programming: robustness, efficiency, correctness; correct implementation of required and optional features; adequate documentation; Creativity and innovation of solution; Quality of graphics code.
  Due date : Friday, 3rd April 2009
- **Assignment Task**

  Title : Assignment 2: 3D Graphics

  Description :

  Programming assignment 2: 3D graphics
  Weighting : 20%

  Criteria for assessment :

  Adherence to the specification; quality of programming: robustness, efficiency, correctness; correct implementation of required and optional features; adequate documentation; Creativity and innovation of solution; Quality of graphics code.

  Due date : Friday, 29th May 2009

Examinations

- **Examination 1**

  Weighting : 70%

  Length : 3 hours

  Type (open/closed book) : Closed book

Assignment submission

Assignments will be submitted by electronic submission. On-campus students Submit the assignment via the on-line submission system on or before the due date. Do not email submissions. The due date is the date by which the submission must be received. Penalties apply for late submission.

University and Faculty policy on assessment

Due dates and extensions

The due dates for the submission of assignments are given in the previous section. Please make every effort to submit work by the due dates. It is your responsibility to structure your study program around assignment deadlines, family, work and other commitments. Factors such as normal work pressures, vacations, etc. are seldom regarded as appropriate reasons for granting extensions. Students are advised to NOT assume that granting of an extension is a matter of course.

Requests for extensions must be made to the unit lecturer at your campus at least two days before the due date. You will be asked to forward original medical certificates in cases of illness, and may be asked to provide other forms of documentation where necessary. A copy of the email or other written communication of an extension must be attached to the assignment submission.

Late assignment

Assignments received after the due date will be subject to a penalty of 1 mark per day, including weekends. Assignments received later than one week (seven days) after the due date will not normally be accepted. In some cases, this period may be shorter if there is a need to release sample solutions.

This policy is strict because comments orguidance will be given on assignments as they are returned, and samplesolutions may also be published and distributed, after assignment marking or with the returned assignment.

Return dates

Students can expect assignments to be returned within two weeks of the submission date or after receipt, whichever is later.

Assessment for the unit as a whole is in accordance with the provisions of the Monash University Education Policy at http://www.policy.monash.edu/policy-bank/academic/education/assessment/

We will aim to have assignment results made available to you within two weeks after assignment receipt.

Plagiarism, cheating and collusion

Plagiarism and cheating are regarded as very serious offences. In cases where cheating has been confirmed, students have been severely penalised, from losing all marks for an assignment, to facing disciplinary action at the Faculty level. While we would wish that all our students adhere to sound ethical conduct and honesty, I will ask you to acquaint yourself with the University Plagiarism policy and procedure (http://www.policy.monash.edu/policy-bank/academic/education/conduct/plagiarism-procedures.html) which applies to students detected plagiarising.

In this University, cheating means seeking to obtain an unfair advantage in any examination or any other written or practical work to be submitted or completed by a student for assessment. It includes the use, or attempted use, of any means to gain an unfair advantage for any assessable work in the unit, where the means is contrary to the instructions for such work.

When you submit an individual assessment item, such as a program, a report, an essay, assignment or other piece of work, under your name you are understood to be stating that this is your own work. If a submission is identical with, or similar to, someone else's work, an assumption of cheating may arise. If you are planning on working with another student, it is acceptable to undertake research together, and discuss problems, but it is not acceptable to jointly develop or share solutions unless this is specified by your lecturer.

Intentionally providing students with your solutions to assignments is classified as "assisting to cheat" and students who do this may be subject to disciplinary action. You should take reasonable care that your solution is not accidentally or deliberately obtained by other students. For example, do not leave copies of your work in progress on the hard drives of shared computers, and do not show your work to other students. If you believe this may have happened, please be sure to contact your lecturer as soon as possible.

Cheating also includes taking into an examination any material contrary to the regulations, including any bilingual dictionary, whether or not with the intention of using it to obtain an advantage.

Plagiarism involves the false representation of another person's ideas, or findings, as your own by either copying material or paraphrasing without citing sources. It is both professional and ethical to reference clearly the ideas and information that you have used from another writer. If the source is not identified, then you have plagiarised work of the other author. Plagiarism is a form of dishonesty that is insulting to the reader and grossly unfair to your student colleagues.

Register of counselling about plagiarism

The university requires faculties to keep a simple and confidential register to record counselling to students about plagiarism (e.g. warnings). The register is accessible to Associate Deans Teaching (or nominees) and, where requested, students concerned have access to their own details in the register. The register is to serve as a record of counselling about the nature of plagiarism, not as a record of allegations; and no provision of appeals in relation to the register is necessary or applicable.

Non-discriminatory language

The Faculty of Information Technology is committed to the use of non-discriminatory language in all forms of communication. Discriminatory language is that which refers in abusive terms to gender, race, age, sexual orientation, citizenship or nationality, ethnic or language background, physical or mental ability, or political or religious views, or which stereotypes groups in an adverse manner. This is not meant to preclude or inhibit legitimate academic debate on any issue; however, the language used in such debate should be non-discriminatory and sensitive to these matters. It is important to avoid the use of discriminatory language in your communications and written work. The most common form of discriminatory language in academic work tends to be in the area of gender inclusiveness. You are, therefore, requested to check for this and to ensure your work and communications

are non-discriminatory in all respects.

Students with disabilities

Students with disabilities that may disadvantage them in assessment should seek advice from one of the following before completing assessment tasks and examinations:

- Faculty of Information Technology Student Service staff, and / or
- your Unit Coordinator, or
- Disabilities Liaison Unit

Deferred assessment and special consideration

Deferred assessment (not to be confused with an extension for submission of an assignment) may be granted in cases of extenuating personal circumstances such as serious personal illness or bereavement. Information and forms for Special Consideration and deferred assessment applications are available at http://www.monash.edu.au/exams/special-consideration.html. Contact the Faculty's Student Services staff at your campus for further information and advice.