

COURSE SYLLABUS

CMPT 829: COMPUTER GRAPHICS

Catalogue Description

An introduction to computer graphics that includes real-time and off-line realistic image synthesis techniques, and basic animation techniques such as key framing and physics-based methods. Programmable raster graphics, ray tracing and efficient data structures for both are also introduced.

Prerequisite(s): 6 credit units of 300-level CMPT, and one of (MATH 264 or MATH 266 or EE 216 or CE 318).

Class Time and Location: Tu/Th 2:30am-3:50pm, Thorv 205A

Website: moodle

Instructor Information

Instructor Ian Stavness

Contact: Email: ian.stavness@usask.ca,
Phone: 306-966-7995

Help desk hours: Location: 3rd floor Spinks computer lab
Hours: 2-3pm on Wednesdays before assignments due, or by appointment

Teaching Assistants Andrew Wagemakers (ajw659@mail.usask.ca)

Learning Objectives

CMPT 829 exposes students to a comprehensive introduction to the fundamentals of computer graphics programming. The learning outcomes for this course include:

- Describe the basic graphics pipeline and how forward and backward rendering factor in this.
- Create a program to display 3D models of simple graphics images.
- Derive linear perspective from similar triangles by converting points (x, y, z) to points $(x/z, y/z, 1)$.
- Obtain 2-dimensional and 3-dimensional points by applying affine transformations.
- Apply 3-dimensional coordinate system and the changes required to extend 2-dimensional transformation operations to handle transformations in 3D.
- Explain the concept and applications of texture mapping, sampling, and anti-aliasing.
- Implement simple procedures that perform transformation and clipping operations on simple 2D images.
- Implement a simple real-time renderer using the OpenGL API with vertex buffers and shaders.
- Compare and contrast the different rendering techniques.
- Represent curves and surfaces using both implicit and parametric forms.
- Create simple polyhedral models by surface tessellation and using 3D modeling tools (e.g. Blender).
- Describe the tradeoffs in different representations of rotations.
- Implement the spline interpolation method for producing in-between positions and orientations.
- Implement basic physics-based animation algorithms for particle dynamics using simple Newtonian mechanics with Euler methods.

Student Evaluation

Grading Scheme

Assignments	30%
Midterm Exam (Nov. 9, in class)	10%
Final Exam	20%
Class Project	40%
Total	100%

Assignments

The assignments will involve graphics programming and 3D modeling. If an undergraduate course in computer graphics has already been taken, these assignments can be omitted by permission of the instructor. If omitted, the 20% of the final grade will be re-distributed to the midterm and final exams.

- Part 1 20% due Sept. 18 Basic OpenGL application
- Part 2 20% due Oct. 2 Camera controls
- Part 3 30% due Oct. 16 Shading
- Part 4 30% due Oct. 30 Texture mapping

Project

The project will assigned on an individual basis.

Criteria That Must Be Met To Pass

Students must achieve an total mark of 50% or greater to pass the course.

Attendance Expectation

Regular attendance is expected. Attendance is mandatory for all student presentations.

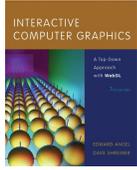
Final Exam Scheduling

The Registrar schedules all final examinations, including deferred and supplemental exams. Students are advised not to make travel arrangements for the exam period until the official exam schedule has been posted.

Note: All students must be properly registered in order to attend lectures and receive credit for this course.

Textbook Information

Required Text



“Interactive Computer Graphics” **7th Edition** by Edward Angel (Pearson, 2012).

Recommended Texts



“OpenGL Programming Guide” **8th Edition** by Dave Shreiner et al. (Addison-Wesley, 2013).

Lecture Schedule

Topic	Subtopics
Computer Graphics Overview	Images, Models, Pipeline architecture
C++ Programming Review	C vs. C++, Build processes, Conventions
Modern OpenGL Programming	OpenGL pipeline, Libraries, Conventions, Basic shaders
Linear Algebra	Vectors, Matrices, Coordinate systems
Geometry	Curves, Surfaces, Implicit vs. Parametric forms, Polygons
Transformations	Points vs. Vectors, Homogeneous transformations
Viewing	Projections, OpenGL camera control
Shading	Lighting models, Surface normals, Phong shading
Texture Mapping	Mapping methods, Texture coordinates,
Buffers and Blending	Translucency, Compositing images, Anti-aliasing
Clipping	Cohen-Sutherland, Bounding boxes, Hidden-surface removal
Rasterization	Line drawing, Polygon fill, Line scanning
Environment Maps	Reflection models, Sphere map, Cube map,
Shadow Maps	Projective shadows, Depth maps, Shadow test
Parametric Animation	Camera motion, Splines, Quaternions
Physics-based Animation	Dynamics, Particles, Rigid-bodies, Fluid simulation
3D Displays	Visual cues, Stereoscopic displays, Head-coupled rendering

Policies

Late Assignments

Assignment are due on Mondays at 11:55pm. Late assignments may be submitted by the following Thursday before 11:55pm, but will be deducted 50 %. Assignments submitted later than this will receive a mark of zero.

Missed Assignments

Missed assignments (submitted later than Thursday at 11:55pm following the assignment deadline) will be given a grade of zero.

Missed Examinations

1. "Students who have missed an exam or assignment must contact their instructor as soon as possible. A doctor's note is required for misses due to illness. Arrangements to make up the exam may be arranged with the instructor. Missed exams throughout the year are left up to the discretion of the instructor if a student may make up the exam or write at a different time. If a student knows prior to the exam that she/he will not be able to attend, they should let the instructor know before the exam."
2. "Final exams - a student who is absent from a final examination through no fault of his or her own, for medical or other valid reasons, may apply to the College of Arts and Science Dean's office. The application must be made within three days of the missed examination along with supporting documentary evidence. Deferred exams are written during the February mid-term break for Term 1 courses and in early June for Term 2 and full year courses."

Incomplete Course Work and Final Grades

When a student has not completed the required course work, which includes any assignment or examination including the final examination, by the time of submission of the final grades, they may be granted an extension to permit completion of an assignment, or granted a deferred examination in the case of absence from a final examination. Extensions for the completion of assignments must be approved by the Department Head, or Dean in non-departmentalized Colleges, and may exceed thirty days only in unusual circumstances. The student must apply to the instructor for such an extension and furnish satisfactory reasons for the deficiency. Deferred final examinations are granted as per College policy.

In the interim, the instructor will submit a computed percentile grade for the course which factors in the incomplete course work as a zero, along with a grade comment of INF (Incomplete Failure) if a failing grade. In the case where the instructor has indicated in the course outline that failure to complete the required course work will result in failure in the course, and the student has a computed passing percentile grade, a final grade of 49% will be submitted along with a grade comment of INF (Incomplete Failure).

If an extension is granted and the required assignment is submitted within the allotted time, or if a deferred examination is granted and written in the case of absence from the final examination, the instructor will submit a revised computed final percentage grade. The grade change will replace the previous grade and any grade comment of INF (Incomplete Failure) will be removed. For provisions governing examinations and grading, students are referred to the University Council Regulations on Examinations subsection of the Calendar.

(2011 University of Saskatchewan Calendar/Academic Courses Policy)

Academic Honesty

The University of Saskatchewan is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Student Conduct & Appeals subsection of the University Secretary Website and avoid any behaviour that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or

participation in an offense. Academic dishonesty is a serious offense and can result in suspension or expulsion from the University.

All students should read and be familiar with the Regulations on Academic Student Misconduct, <http://www.usask.ca/secretariat/student-conduct-appeals/StudentAcademicMisconduct.pdf>, as well as the Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints and Appeals,

<http://www.usask.ca/secretariat/student-conduct-appeals/StudentNon-AcademicMisconduct.pdf>.

Academic honesty is also defined and described in the Department of Computer Science Statement on Academic Honesty:

<http://www.cs.usask.ca/undergrad/honesty.php>.

For more information on what academic integrity means for students see the Student Conduct & Appeals subsection of the University Secretary Website at:

<http://www.usask.ca/secretariat/student-conduct-appeals/forms/IntegrityDefined.pdf>

Examinations with Disability Services for Students (DSS)

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Disability Services for Students (DSS) if they have not already done so. Students who suspect they may have disabilities should contact DSS for advice and referrals. In order to access DSS programs and supports, students must follow DSS policy and procedures. For more information, check

<http://www.students.usask.ca/disability/>, or contact DSS at 966-7273 or dss@usask.ca.

Students registered with DSS may request alternative arrangements for mid-term and final examinations. Students must arrange such accommodations through DSS by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by DSS.