
CSC 406 – Computer Graphics

Geometry, Modeling, and Animation

Fall 2014

Lectures	Tyler Hall, Room 053	Thursday, 5:30-8:15 PM
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	Office hours:	Monday: 3:00 - 4:30 PM Thursday: 4:00 - 5:30 PM or by appointment
Teaching Assistant:	Adrian Flowers	Tyler Hall, Room 125 email: baflores@my.uri.edu
	Office hours:	Tuesday: 1:00-3:00 pm

The Course at a Glance

Prerequisites

CSC 212 and MTH 141

I know that the URI catalog lists CSC305 as a prerequisite, but CSC212 is the real CS prerequisite for this course (and should soon be the official one as well).

Of course, we will need some mathematics as well, but I will go over the material we need when we need it (e.g. some linear algebra). As long as you promise not to faint as soon as you encounter a new mathematical concept or notation, and are willing to take it in stride, you will do just fine.

Objectives

This course will concentrate exclusively on the geometric and kinematic aspects of computer graphics. We will concentrate mostly on 2D applications, but we will extend to 3D at the end of the semester. At the end of this course, you should be capable of

- Constructing a geometric model of a simple scene;
- Implementing the objects of this scene, using Processing and jogl;
- Controlling, interactively or automatically, the displacements of objects, including the “camera(s)” that capture the scene;
- Building a simple graphical user interface for your application, using Swing or AWT APIs.

Other aspects of computer graphics are covered in the following courses

- ART304 and ART306: 3D Graphics design (using Maya 2010),
- CSC492: Introduction to Computational Geometry,
- CSC583: Computer Vision, which can be seen as “reverse computer graphics”.

Equipment and References

Development environment

Processing and jogl

This semester we will use Processing for all our development. Processing is both a development environment (with a lousy little editor) and a library on top of Java. Because Processing is basically Java, this will allow us to transition to `jogl` for our graphics code, `jogl` being the Java version of OpenGL. All the functions of OpenGL map one-to-one to a function of `jogl` with the same name. So, if one day you want to do “real” OpenGL, you will only have to deal with the transition to C/C++, as you will already be familiar with the way OpenGL operates.

The IDE

You can use the Processing editor, but I am sure that you will very soon feel constrained by its limitations. Luckily, there is a plugin for Eclipse named `Proclipsing` that lets you do all your development with all the benefits (and headaches) of the Eclipse environment.

You can choose to develop either with the Processing editor or with Eclipse+Proclipsing. We will accept either format of project as long as you submit all the source files and media files needed for us to build and execute properly your project.

Course textbook

This semester, I have not picked an official textbook. The main reason for this is that I am really lousy at following a textbook. I am going to post `pdf` versions of my notes, but you might still want to purchase one of the following fine books:

Processing and jogl references

OpenGL references

Once you understand the differences in syntax between OpenGL and `jogl`, it is very easy to use the standard OpenGL references when developing `jogl`/Processing code.

The standard OpenGL references are the “red book” and the “blue book.” There is also a “green book” that is dedicated to OpenGL for Unix/X11, but I can’t see why anyone would submit

themselves voluntarily to something as ugly as X11/Motif programming (use a cross-platform framework instead!).

- *OpenGL Programming Guide* (the “red book”), Addison-Wesley, Reading, MA, 2000.
- *OpenGL Reference Manual* (the “blue book”), Addison-Wesley, Reading, MA, 2000.

These editions cover version 1.4 of OpenGL. Earlier versions of books (OpenGL v. 1.2) are available (see the “Links” page on the course’s web site)

My recommendation for an OpenGL reference is the following handy little book:

Edward Angel, *OpenGL - A Primer*, 2nd edition, Addison-Wesley, Reading, MA, 2004.

This book covers all the OpenGL we are going to need in this course and is small enough that you can carry it with you.

Mathematics for graphics

If you feel that you need a refresher on linear algebra or calculus, I have some links to nice online books on the course’s web site. A few good books that cover the mathematics commonly used in computer graphics and game development are

- *Eric Lengyel, Mathematics for 3D Game Programming and Computer Graphics*, Charles Media River, Hingham, MA, 2002.
- Philip Schneider and David H. Eberly, *Geometric Tools for Computer Graphics*, (The Morgan Kaufmann Series in Computer Graphics), Morgan Kaufmann, 2002.

The following book covers all the material of the previous two books, but in a less compact form, plus a lot of more advance material on animation and rendering:

T. Akenine-Möller and E. Haines, *Real-Time Rendering*, 2nd edition, A.K. Peters Ltd., 2002.

Grading

Examinations

There will not be any “long” examination for this course (no midterm, no final exam), but short quizzes may be held occasionally during the semester. The quizzes will typically not be announced in advance. You will only be allowed to take a make up quiz for one you missed if you have a valid excuse for your absence.

Assignments

We will have a new programming assignment nearly each week (except for the last two weeks of the semester, which will be dedicated to the final project). For each programming assignment, you will be asked to provide complete documented (in javadoc/Doxygen style) source code and a report. On “slow” weeks I may also hand out homework assignments that will deal with the theoretical aspects of the material covered in this course.

Final project

Instead of a final exam, we will have a final project of your choosing. Final projects may be done individually or by groups of two students. Presentations of the final projects will take place on the day and time scheduled for the final examination of this course. Attendance of the presentations (of all presentations) is mandatory if you want your final project to be graded.

The Mix

The following coefficients will be used to compute the final grade:

Homework Assignments:	15%
Programming Assignments:	50%
Quizzes	10%
Final Project	25%

General URI Guidelines (annotated)

Accommodations for special needs

Section 504 of the Rehabilitation act of 1973 and the Americans with Disabilities Act of 1990 require the University of Rhode Island to provide academic adjustments or the accommodations for students with documented disabilities. The student with a disability shall be responsible for self-identification to the Disability Services for Students in the Office of Student Life, providing appropriate documentation of disability, requesting accommodation in a timely manner, and follow-through regarding accommodations requested. It is the student's responsibility to make arrangements for any special needs and the instructor's responsibility to accommodate them with the assistance of the Office of Disability Services for Students.

Any student with a documented disability is welcome to contact me as early in the semester as possible so that we may arrange reasonable accommodations. As part of this process, please be in touch with Disability Services for Students Office at 330 Memorial Union, 401-874-2098.

Academic honesty

All submitted work must be your own. If you consult other sources (class readings, articles or books from the library, articles available through internet databases, or websites) these MUST be properly documented, or you will be charged with plagiarism and will receive an F for the paper. In some cases, this may result in a failure of the course as well. In addition, the charge of academic dishonesty will go on your record in the Office of Student Life. If you have any doubt about what constitutes plagiarism, visit the following website:

<http://gervaseprograms.georgetown.edu/hc/plagiarism.html>,

the URI Student Handbook, and University Manual sections on Plagiarism and Cheating at

<http://www.uri.edu/facsen/8.20-8.27.html>

Any good writer's handbook as well as reputable online resources will offer help on matters of plagiarism and instruct you on how to acknowledge source material. If you need more help understanding when to cite something or how to indicate your references, PLEASE ASK. academic enhancement center The work in this course is complex and intensive. To do the best you can, its a good idea to visit the Academic Enhancement Center (AEC) in Roosevelt Hall. The AEC offers a comfortable environment in which to study alone or together, with or without a tutor. AEC tutors can answer questions, clarify concepts, check understanding, and help you to study. You can make an appointment or walk during office hours – Monday through Thursday from 9 am. to 9 pm, Friday from 9 am to 1 pm, and Sunday from 4 pm. to 8 pm. For a complete schedule For a complete schedule - including when tutors are available specifically for this class - go to www.uri.edu/aec, call (401) 874-2367, or stop by the fourth floor in Roosevelt Hall.

Unless explicitly stated otherwise, all work should be done individually. Any evidence of cheating may result in expulsion from the class with a failing grade and will be brought to the attention of the Dean for disciplinary action.

You are strongly encouraged to discuss the assignments with other students, and try to figure them out together, but when comes the time of writing a report or developing code, you are expected to do it by yourself (or with other students from your group when the assignment explicitly mentions groups of 2 to 3 students).

Copying software from a book or from a web site without identifying the original author(s) of the work is plagiarism, which is a form of cheating.

The Writing Center

The Writing Center is for “all writers, all disciplines, at all levels, and all stages of writing.” If an instructor suggests that you go to the Writing Center, it is not a punishment, and does mean that you are a terrible writer. It means the instructor wants you to receive more individualized attention to your writing than s/he is able to provide, given the constraints of the class. It will only improve your grade. If possible, call ahead for an appointment (874-4690). Drop-in tutorials are often available. You may make repeat appointments, requesting the same tutor each time if you wish. See their Web Page:

<http://www.uri.edu/artsci/writing/center/index.shtml>

for tips on how to make the best of your Writing Center visit.

Standards of behavior

Students are responsible for being familiar with and adhering to the published “Community Standards of Behavior: University Policies and Regulations” which can be accessed in the University

Student Handbook. If you must come in late, please do not disrupt the class. Please turn off all cell phones, pagers, or any electronic devices.

Religious holidays

It is the policy of the University of Rhode Island to accord students, on an individual basis, the opportunity to observe their traditional religious holidays. Students desiring to observe a holiday of special importance must provide written notification to each instructor.

Illness Due to Flu

The nation is experiencing widespread influenza-like illness. If any of us develop flu-like symptoms, we are being advised to stay home until the fever has subsided for 24 hours. So, if you exhibit such symptoms, please do not come to class. Notify me at 874-2701 or jyh@cs.uri.edu of your status, and we will communicate through the medium we have established for the class. We will work together to ensure that course instruction and work is completed for the semester.

The Centers for Disease Control and Prevention have posted simple methods to avoid transmission of illness. These include: covering your mouth and nose with tissue when coughing or sneezing; frequent washing or sanitizing your hands; avoiding touching your eyes, nose, and mouth; and staying home when you are sick. For more information please view <http://www.cdc.gov/flu> or <http://flu.gov>. URI Health Services web page, <http://www.health.uri.edu>, will carry advice and local updates.

Additional Rules of Conduct

Late Submissions

By default we will apply a penalty of 10 points (out of a maximum grade of 100 points) for each day late, and assignments will not be accepted if they are more than one week late. Now, we understand that you may have other obligations outside of this course, so we may grant exceptions to this rule on a case-per-case basis. This being said, there will be no exception to the following rule:

On the mid-semester drop day and on the last day of class, if a student has more than half of his/her assignments late, then that student will get a grade of 0 for any assignment more than 2 weeks late.

Laboratory use

Any abuse of computer or software equipment will be brought to the attention of the appropriate authority for disciplinary action. Software piracy (the use, appropriation, or storage of illegal copies of software) is a form of abuse of the equipment and will be treated accordingly.

Attendance

Class attendance is not mandatory, although I strongly suggest that you make efforts to attend all classes. We will spend a significant part of the time in classes discussing about examples of programs, possible errors, bugs, etc. Don't spend too much time taking notes during classes; rather make efforts to understand on-line what is going on. It will only get easier as we advance in the semester.

Incomplete grade

In the past I have been much too lenient in giving an Incomplete grade at the end of the semester. This almost always eventually turns into a headache for me, so starting this semester, I am going to apply strictly the University guidelines:

A student shall receive a report of Incomplete in any course in which the course work has been passing up until the time of a documented precipitating incident or condition, but has not been completed because of illness or another reason which in the opinion of the instructor justifies the report. (Section 8.53.20 University Manual).

Note that overload from other courses does not fulfill the University policy conditions. Neither does a hard drive/laptop failure (we have a computer laboratory for your use).

I am going to post regularly grades on the course's web site, together with indicative levels for A, B, C, D letter grades. If your grade average is below the D level, then you should drop before the limit date, or petition for a late drop if that date has passed. You simply cannot dump your problems on my lap at the end of the semester.

Tentative Class Schedule

Week 1	Computer Graphics: Introduction <ul style="list-style-type: none">• Structure of the course• Processing, jogl, Proclipse• Coordinates, Part 1
Weeks 2	Basic 2D Geometry <ul style="list-style-type: none">• Coordinates, Part 2• Points and vectors• Reference frames• Transformations between reference frames
Weeks 3-4	Simple Animation <ul style="list-style-type: none">• Path vs. trajectory• Point kinematics• Kinematics of solid objects
Week 5	Simple Geometric Problems <ul style="list-style-type: none">• Distance to a line, to a plane• Intersection problems• Collision detection
Week 6	Simple Geometric Models of Objects <ul style="list-style-type: none">• Discrete vs. continuous• Parametric vs. implicit models
Weeks 7–8	Better Object Models <ul style="list-style-type: none">• Hierarchical models• Splines, NURBS• Texture maps
Weeks 9–10	Animation, Part II <ul style="list-style-type: none">• Key framing• Forward kinematics of articulated objects• Inverse kinematics of articulated objects
Week 11–12	Moving to 3D <ul style="list-style-type: none">• From 2D geometry to 3D geometry• Orthographic camera• Pinhole perspective camera• 3D models
Week 13	Misc. Problems <ul style="list-style-type: none">• Collision detection• Optimization