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Rochester Institute of Technology  
School of Interactive Games and Media  
152 Lomb Memorial Drive  
Rochester, NY 14623

## Syllabus

### IGME-750-01 Game Engine Design and Development Spring 2019 (2185)

#### Instructor Information

**Professor Name:** Chris Egert  
**Email Address:** caeics@rit.edu  
**Phone Number:** 475-4873  
**Office Location:** Golisano Hall (70-2005)  
**Office Hours:** By Appointment

#### Course Information

**Course Number:** IGME-750-01  
**Course Name:** Game Engine Design and Development  
**Credits:** 3 credits  
**Meeting Place/Time:** Orange Hall (13-1370) 12:00 PM – 12:50 PM MWF

#### Course Description

This course will provide students with theory and practical skills in game engine design topic areas such as understanding the graphics pipeline as it influences engine design, hardware principles and the relationship to game engine construction, mathematical principles involved in game engine design, scene graph construction and maintenance, texture and materials management, collision systems, physics systems, particle systems, and control systems. Furthermore, this course will examine software and toolsets that assist game engine designers in their tasks. Students will be expected to design and implement a game engine in teams as well as properly document their design and development strategy. (**Class 3, Credit 3**)

#### Important Dates

The last day to **add** or **drop** a course is **Tuesday, January 22nd, 2019**.

The last day to withdraw with a grade of **W** is **Friday, April 5th, 2019**. The deadline for withdraw is the **12th** week of the semester. The withdraw process must be completed before the deadline. Withdraw after the last day without a valid reason will be denied by the IGM office.

The final exam slot for this class is scheduled **Friday, May 3th, 2019 10:45 AM – 1:15 PM** in **Orange Hall (13-1370)**. Please note this is a scheduled meeting and attendance is mandatory based on the 2018 calendar revisions. A portion of your grade will be determined on this date via exam and/or project presentation. If you have a verifiable exam conflict, please let me know as soon as possible.

IGM School policy states that students have 60 days after the completion of a course to challenge any grade. After the 60 days expire, grades cannot be challenged.

## **Texts and Materials**

### **Required Texts**

- Gregory, Jason. **Game Engine Architecture, 3rd Edition**, CRC Press, 2019, ISBN: 978-1-138-03545-4

### **Optional Texts**

- McShaffry, Mike and Graham, David. **Game Coding Complete, 4<sup>th</sup> Edition**, Course Technology PTR, 2013, ISBN: 978-1-133-77657-4

### **Additional Materials**

- Access to Chris Cascioli's Graphics Framework
- API Manuals for DirectX and/or OpenGL and/or OGRE
- Addition readings distributed in class or through myCourses
- URLs to papers and references (some restricted to RIT VPN or IP Address)
- Software Systems and Libraries
- Systems documentation

### **MyCourses**

An important component of this course is the myCourses course shell. The course shell contains vital information such as readings, weekly assignments, code templates, supplemental materials, course notes, and other useful items. The course shell is also used for asynchronous discussions and group collaboration. In addition, myCourses contains a dropbox system that allows students to upload their assignments and code projects. It is your responsibility to log into myCourses on a regular basis to check for additional materials and assignments.

## **Course Pre-requisites, Goals, and Outcomes**

### **Pre-requisite Courses**

Students taking this course must have completed the following coursework or must have been granted credit through AP and/or transcript evaluation.

- IGME-601 Game Development Processes and IGME-603 Gameplay and Prototyping

### **Pre-requisite Skills**

It is the instructor's expectation that all students entering this course have the following skills and abilities.

- Ability to understand the design and development of a rapid prototype
- Ability to assimilate new APIs and software technologies in an expedient manner
- Ability to work in teams and groups of diverse development skills
- Ability to work on open-ended problems

### **Course Goals**

- The primary goal of this course is to provide students with the necessary theory and practice to allow for the design and implementation of game engines. This course will provide the student with a holistic view of the game engine development experience. Students will learn particular concepts in game engine design including advanced scene-graph techniques, motion, physics, textures and materials management, collisions systems, particle systems, controllers, and design and implementation toolsets. Particular emphasis will be placed on the development and/or modification of a large-scale game engine system, and in particular on systems management through threading, scheduling, memory

management and I/O optimization. Course projects are intended to provide students with practical experience with large scale game engines.

### **Course Outcomes**

By the end of this course,

- Students will be able to describe the fundamental components of a game engine.
- Students will be able to design and implement scene graph manipulation algorithms, including those for handling geometry, textures, lighting, and camera control.
- Students will be able to apply different motion and animation techniques in the construction of a game engine.
- Students will be able to analyze collision detection systems for game engines. In addition, students will learn how to apply collision detection systems to the construction of game engines.
- Students will be able to utilize tools, APIs, and advanced engine techniques in the development of modern game engines..

### **Program Goals and/or Outcomes**

This course contributes to the overall program goals and/or outcomes specified for IGM curricula. In particular, this course contributes to the following program goals and/or outcomes:

- apply knowledge of game design, game development processes, gameplay theory and prototyping to the field
- conduct applied and integrative research in the field of game design and development
- apply current technology in a media-centric context
- effectively communicate technical and design concepts through writing, speech, and formal presentation
- effectively participate and contribute to multidisciplinary design and development teams

### **Topics**

- Introduction to Game Engine Systems
- Core Components for Game Engine Systems
- Architectural Models for Game Engines
- Tools and toolsets
- Scene Graphs and Object Representation
- Motion and Animation
- Collision and Physics Systems
- Control Systems
- Advanced Concepts in Engine Development

### **Course Organization**

This course is comprised of a number of evaluated components. Please read over the list of expectations carefully. Each component consists of a graded weight and general expectations for the component.

**In Class Participation and Activities [25%]** – I expect all students to be present for classes and to be actively engaged in classroom discussion and group activities. This is more than just showing up for class, it also means being prepared and contributing in a positive, productive

manner during class time. In class participation and activities includes, but is not limited, to activities such as reading discussions, writing code, testing code, analyzing code, homework, experimental work, debating options, and verifying solutions.

**Assessment Activities [75%]** – The majority of this grade will be assignments throughout the semester that will expose students to the design and development of Game Engines. I expect that you have reasonable programming skills and are fluent or can quickly learn a low-level API such as DirectX 11, OpenGL 3.X, OGRE, or something similar. Although I prefer assessment activities that relate to the design and development of code and systems, I also have the option to include activities such as quizzes, take home exams, and in-class exams.

## **Course Evaluation**

Points	Letter Grade	Grade Points
90-100	A	4.00
80-89.9	B	3.00
70-79.9	C	2.00
69.9 or below	F	0.00

Note: Although my intent is to use full letter grades for this course, I do reserve the right to use partial letter grades. In either a full or partial grade system, and grade below 70 will be a failing grade.

## **Course Resources**

### **Office Hours**

All faculty have between two and six office hours per week depending upon their teaching load for the semester. Office hours may be scheduled as specific time blocks or may be available upon request. Office hour information is posted at the top of this syllabus. Please make sure that if you need to use office hours, you show up in a timely manner and you come prepared to present your problem to your instructor. Sometimes, faculty choose to hold their office hours in the lab or at an alternative location. If the location differs from the office hour location on this syllabus, the faculty will post the alternative location on his or her door and/or in email communication when setting the appointment.

### **Advisors**

In the event that you have general questions about this course, and you feel you want to talk to someone outside of the instructor, you can always make an appointment with a faculty or professional advisor to discuss issues. You can also discuss any issues with the Undergraduate Coordinator (Anthony Jefferson).

### **Other Channels for Help**

It is important to realize that there are number of general help avenues available on campus. The RIT Academic Support Center (<http://www.rit.edu/studentaffairs/asc>) has a number of resources for students in terms of assistance with math, science, and writing skills.

## **Accommodations**

Any student requiring academic accommodation due to a disability must submit a request for accommodation with the Institute. Accommodation requests are emailed to faculty from the

Institute the week before classes start or shortly after the student registers for the course during add/drop week. Students needing accommodation should verify with the instructor that the accommodation request was received. It is the student's responsibility to work with the instructor to ensure that accommodation requirements are met. For more information on disability services and accommodations, please contact the Disability Services Office at <http://www.rit.edu/dso>.

## **Rules and Additional Information**

**Late Policy** – No late assignments will be accepted in this course. Any assignments turned in after the due date and time will be returned to the student ungraded.

**Incomplete Policy** – Incomplete ("I") grades are reserved for cases in which the student is making credible course progress, and then something occurs in the student's life that prevents the completion of the course. Incomplete grades are not a mechanism to delay a failing grade nor are they a means to stave off probation or a suspension. In order for an instructor to grant an incomplete, credible documentation must be provided at the instructor's or school's request.

**Challenging Grades** – If you challenge a grade, it must be done in a timely manner, within a week of the return of an assignment. Remember that in challenging a grade, the instructor reserves the right to revisit the grading on the entire assignment and may adjust the grade appropriately. This is mentioned not to discourage a student with a legitimate complaint over a grade, but to rather address the often blatant problem of "point weaseling" on assignments.

**Classroom Etiquette** – Due to time constraints, it is important that you arrive at class each day prepared to work. For classes that require computing equipment, be sure to log in and have your software ready at the beginning of each class. If you are late to class, please try to enter the classroom with minimal disruption. You should make sure that devices such as cell phones, MP3 players, and other disruptive devices are turned off for the class period.

**Missing Class** –Based on the class organization, attendance may or may not be a graded component. For such items as sanctioned RIT events and religious observances not covered under RIT's academic calendar, it is important that students communicate with the instructor before the event. In the case of an illness or unexpected absence, the student should try to communicate with the faculty in as timely of a manner as possible. When class is missed, it is up to the student to make up work and to acquire any course materials. Absences in any form do not postpone due dates unless agreed upon by the instructor. **NOTE: If you plan to be absent for GDC and/or career day activities, please let me know in advance if possible.**

**Course Cancellation** – In the event that the faculty cannot attend a class session, students will be contacted via email and cancellation signs with the IGM logo will be placed on classroom doors. Explicit instructions for a cancellation will be communicated via e-mail.

**E-Mail Address** – All official communications should occur between your RIT e-mail address and the faculty's RIT e-mail address. Please check your RIT e-mail on a daily basis for important notifications. Furthermore, faculty will not be able to respond to requests that do not originate from an RIT e-mail.

**Two Factor Authentication** – RIT has switched to multifactor authentication (MFA, 2FA) for just about everything. Because it is tied into myCourses and other online facilities, it is important that you have working MFA with you for any class activity. Failure to do so such that you cannot complete an assignment or activity will result in a zero grade for the component requiring MFA.

## Academic Integrity

**All students taking IGM courses are bound by the School of Interactive Games and Media policy on Academic Integrity.**

The School of Interactive Games and Media does not condone any form of academic dishonesty. Any act of improperly representing another person's work as one's own (or allowing someone else to represent your work as their own) is construed as an act of academic dishonesty. These acts include, but are not limited to, plagiarism in any form or use of information and materials not authorized by the instructor during an examination or for any assignment.

If a faculty member judges a student to be guilty of any form of academic dishonesty, the student will receive a **FAILING GRADE FOR THE COURSE**. Academic dishonesty involving the abuse of RIT computing facilities may result in the pursuit of more severe action.

If the student believes the action by the instructor to be incorrect or the penalty too severe, the faculty member will arrange to meet jointly with the student and with the faculty member's immediate supervisor. If the matter cannot be resolved at this level, an appeal may be made to the GCCIS Academic Conduct Committee.

If the faculty member or the faculty member's immediate supervisor feels that the alleged misconduct warrants more severe action than failure in the course, the case may be referred to the GCCIS Academic Conduct Committee. The Academic Conduct Committee can recommend further action to the dean of the student's college including academic suspension or dismissal from the Institute.

The following definitions will be used to clarify and explain unacceptable conduct. This is not intended to be an exhaustive list of specific actions but a reasonable description to guide one's actions.

**CHEATING** includes knowingly using, buying, stealing, transporting or soliciting, in whole or part, the contents of an administered/non-administered test, test key, homework solution, paper, project, software project or computer program, or any other assignment. It also includes using, accessing, altering, or gaining entry to information held in a computer account or disk owned by another, or using assets (code, art, design, narrative, research, etc.) created by another without the express permission of the IP owner (where appropriate), or, in the case of free-to-use or publicly available materials, proper citation and reference to the original work (where appropriate).

**COLLUSION** means the unauthorized collaboration with another person in preparing written work or computer work (including electronic media) offered for credit. Final work submitted by a student must be substantially the work of that student. Collaboration on an assignment is expressly forbidden unless it is explicitly designated as a group project. When there is any doubt, a student should consult the instructor (NOT ANOTHER STUDENT) as to whether some action is considered collusion.

Whenever there is any question as to whether a particular action is considered academic dishonesty, the instructor should be consulted.

## **Gender Discrimination**

RIT is committed to providing a safe learning environment, free of harassment and discrimination as articulated in our university policies located on our governance website. RIT's policies require faculty to share information about incidents of gender based discrimination and harassment with RIT's Title IX coordinator or deputy coordinators, regardless whether the incidents are stated to them in person or shared by students as part of their coursework.

If you have a concern related to gender-based discrimination and/or harassment and prefer to have a confidential discussion, assistance is available from one of RIT's confidential resources on campus (listed below).

- The Center for Women & Gender: Campus Center Room 1760; 585-475-7464
- CARES (available 24 hours/7 days a week) Call or text 585-295-3533.
- RIT Student Health Center – August Health Center/1st floor; 585-475-2255.
- RIT Counseling Center - August Health Center /2nd floor - 2100; 585-475-2261.
- The Ombuds Office – Student Auxiliary Union/Room 1114; 585-475-7200 or 585-475-2876.
- The Center for Religious Life – Schmitt Interfaith Center/Rm1400; 585-475-2137.
- NTID Counseling & Academic Adv. Services – 2nd Floor Lynden B. Johnson; 585-475-6468 (v), 585-286-4070 (vp).

## **Finally...**

All information is subject to change. (any and all changes will be announced in class and posted on myCourses).