San José State University
College of Science / Department of Computer Science
CS-116B, Computer Graphics Algorithms, Section 1, Spring 2018

Course and Contact Information

Instructor: Robert Bruce

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Office Hours: Monday and Wednesday, 1pm-2pm

Class Days/Time: Monday and Wednesday, 3pm-4:15pm

Classroom: Science, SCI-311

Prerequisites: CS 116A (with a grade of "C-" or better) or instructor consent

Course Format

Technology Intensive, Hybrid, and Online Courses

This class is technology intensive. You will need an Intel x86 or compatible laptop or desktop machine. We will be working in a GNU/Linux or OSX development environment. You will be using command line tools such as make, gcc, etc. Developing in Windows is strongly discouraged and will not be supported by the instructor.

Faculty Web Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on the Canvas Leaning Management System course login website at http://sjsu.instructure.com. You are responsible for regularly checking with the messaging system through MySJSU at http://my.sjsu.edu to learn of any updates.

Course Description

In-depth discussion of algorithms and techniques used in computer graphics and their implementation. Topics include: animation, fractals, anti-aliasing, fill algorithms, visible surface algorithms, color and shading, ray tracing, radiosity and texture maps. Substantial programming required.

Course Goals

Course Learning Outcomes (CLO)

Upon successful completion of this course, students will be able to:

1. Create a physics engine based on Newton's three laws of motion.
2. Apply vector kinematics to a particle system for soft body dynamics.
3. Apply vector mathematics to compute the surface normal for light reflection.
4. Apply the Mass Spring Model to simulate cloth.
5. Apply the Marching Squares algorithm to create two-dimensional meta-balls.

Required Texts/Readings

Textbook

Physics for game developers (2nd Edition) by David M. Bourg and Bryan Bywalec. This book is available electronically from the SJSU King Library at https://sjsu-primo.hosted.exlibrisgroup.com/primo-explore/fulldisplay?docid=01CALS_ALMA71456333270002901&context=L&vid=01CALS_SJO&search_scope=EVERYTHING&isFrbr=true&tab=everything&lang=en_US.

Other Readings

Deformation Constraints in a Mass-Spring Model to Describe Rigid Cloth Behavior by Xavier Provot. This electronic article is available from the Stanford university website at https://graphics.stanford.edu/courses/cs468-02-winter/Papers/Rigidcloth.pdf

Advanced Character Physics by Thomas Jakobsen. This electronic article is available from the Penn State university website at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.206.4908&rep=rep1&type=pdf

Real time physics class notes by Matthias Müller, Jos Stam, Doug James, and Nils Thürey. This electronic document is available from author's website at http://matthias-mueller-fischer.ch/realtimephysics/coursenotes.pdf

Mass Spring Particle Systems by Stephen Spinks. This electronic document is available from the author's website at http://www.stephenspinks.com/documents/documentation.pdf

Marching cubes: A high resolution 3D surface construction algorithm by William E. Lorensen and Harvey E. Cline. This electronic article is available electronically through the ACM Digital library at https://login.libaccess.sjlibrary.org/login?qurl=http%3a%2f%2fdx.doi.org%2f10.1145%2f37401.37422%3fnosfx%3dy

Other technology requirements / equipment / material

A notebook or desktop computer running GNU/Linux or OSX. Mac (OSX) notebooks are available for loan from the SJSU King Library. A limited number of Linux desktop computers are available for loan - students must provide their own screen, keyboard, and mouse - from the instructor on a first-come, first-serve basis for the duration of the semester.

Library Liaison

Kate Barron, kate.barron@sjsu.edu

Course Requirements and Assignments

There are five programming assignments in this course. The programming assignments are designed as building blocks which lead to a culminating final project: a particle-based, soft-body simulation system. Detailed instructions and specifications for each programming assignment will be posted to the *Canvas Leaning Maneging System course login website at http://sjsu.instructure.com* with adequate time for students to complete each assignment by the assignment deadline. Students are strongly encouraged to ask the instructor for clarification on each programming assignment specification.

Final Examination or Evaluation

There will be a final exam on **Thursday, May 17 at 12:15pm in SCI-311**. The final exam will be based on in-class lecture material and material from our textbook. The final exam will be comprised of fifteen multiple-choice questions. This is a closed note, closed-book exam. No electronic devices (including mobile phone) may be used during the exam. The final exam is worth 15% of your overall grade.

Grading Information

Determination of Grades

Percent range	Grade
97% to 100% inclusive	A+
93% to 96% inclusive	A
90% to 92% inclusive	A-
87% to 89% inclusive	B+
83% to 86% inclusive	B
80% to 82% inclusive	B-
77% to 79% inclusive	C+
73% to 76% inclusive	C
70% to 72% inclusive	C-
67% to 69% inclusive	D+
63% to 66% inclusive	D
60% to 62% inclusive	D-

Below 60%	F

Grade breakdown

ASSIGNMENT OR EXAM	POINT VALUE
Programming Project 1: Marching Squares	10
Programming Project 2: Particle explosion simulation	10
Programming Project 3: Rope simulation with gravity and collision detection	10
Programming Project 4: Cloth simulation with gravity	15
Programming Project 5: Cloth simulation with gravity, wind, and collision detection	25
Midterm Exam	15
Final Exam	15
TOTAL POINTS	100

Incomplete assignments

Points will be deducted for incomplete or partially working solutions.

Late assignments

Programming assignments submitted after their specified due date will be considered late and subject to minimally 50% loss in points (additional points will be deducted for incomplete projects as noted above).

Makeup Exams

Exams must be your own work. Makeup exams will only be given in extraordinary circumstances with instructor approval; instructor MUST be notified in advance.

Classroom Protocol

Regular class attendance is highly recommended. Students are responsible for knowing all materials covered through in-class lectures and assigned readings. Please be mindful of fellow students and the instructor by not talking on mobile phones during instruction. Students are expected to leave the class quietly in the event they must use their mobile phones.

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/

CS-116B / Computer Graphics Algorithms, Spring 2018, Course Schedule

Course Schedule

Week	Date	Topics, Readings, Assignments, Deadlines
1	Wednesday, January 24	Introduction: Course overview and objectives
1	Monday, January 29	Lecture: Marching squares algorithm
2	Wednesday, January 31	Lecture: Marching cubes algorithm Read: *Marching cubes: A high resolution 3D surface construction algorithm*, pp. 163-169
2	Monday, February 5	Lecture: Building a Physics Engine Read: *Physics for game developers*, pp. 281-289 Note: last day to drop classes.
3	Wednesday, February 7	Lecture: Vector operations Read: *Physics for game developers*, pp. 495-505
3	Monday, February 12	Lecture: A review of classical mechanics in physics Read: *Physics for game developers*, pp. 3-33
4	Wednesday, February 14	Lecture: Kinematics Read: *Physics for game developers*, pp. 35-69 **DUE: Programming Project 1**
4	Monday, February 19	Lecture: Force Read: *Physics for game developers*, pp. 71-83
5	Wednesday, February 21	Lecture: Real-time simulations Read: *Physics for game developers*, pp. 143-159
5	Monday, February 26	Lecture: Particles Read: *Physics for game developers*, pp. 161-187
6	Wednesday, February 28	Lecture: Explosions Read: *Physics for game developers*, pp. 353-368
6	Monday, March 5	Lecture: Connecting objects Read: *Physics for game developers*, pp. 255-279
7	Wednesday, March 7	Lecture: Mass Spring Model Read: *Deformation Constraints in a Mass-Spring Model to Describe Rigid Cloth Behavior*, pp. 1-8
7	Monday, March 12	Lecture: Runge-Kutta Integration Read: *Advanced Character Physics*, pp. 1-19
8	Wednesday, March 14	Lecture: Verlet integration simulation **DUE: Programming Project 2**
8	Monday, March 19	Midterm Exam Review
9	Wednesday, March 21	**MIDTERM EXAM**
--	Monday, March 26	SPRING BREAK: NO CLASS TODAY
--	Wednesday, March 28	SPRING BREAK: NO CLASS TODAY

Week	Date	Topics, Readings, Assignments, Deadlines
9	Monday, April 2	Lecture: Newton-Raphson Solver
10	Wednesday, April 4	Lecture: Collision detection Read: *Physics for game developers*, pp. 205-225
10	Monday, April 9	Lecture: Rigid body simulation Read: *Real Time Physics Class Notes*, pp. 45-52
11	Wednesday, April 11	Lecture: Volumetric mesh creation using Delaunay tetrahedralization Read: *Real Time Physics Class Notes*, Section 3.6 (pp. 17-18) **DUE: Programming Project 3**
11	Monday, April 16	Lecture: Cloth simulation mistakes
12	Wednesday, April 18	Lecture: Image Morphing
12	Monday, April 23	Lecture: Rendering Smoke and Fire in Real-Time
13	Wednesday, April 25	Lecture topic: To Be Determined **DUE: Programming Project 4**
13	Monday, April 30	Lecture topic: To Be Determined
14	Wednesday, May 2	Lecture topic: To Be Determined
14	Monday, May 7	Lecture topic: To Be Determined
15	Wednesday, May 9	Lecture topic: To Be Determined
15	Monday, May 14	Final Exam Review **DUE: Programming Project 5**
Final Exam	Thursday, May 17	**FINAL EXAM at 12:15pm in SCI-311**