CS 491 – CS Skills for Simulation and Game Programming

Catalog Description: Game and simulation development is very much a data and math-intensive activity. A certain number of actions must be produced, and producing them by hand is hard. This is a middleware CS course that fills in many of the missing pieces for those wanting to enter the simulation and game development worlds in a software tool-building capacity.

Credits: This course combines approximately 90 hours of instruction, and approximately 30 hours of programming work for 4 credits.

Terms Offered: Fall

Prerequisites: CS 261 and (MTH 231 or CS 225) and MTH 252

Courses that require this as a prerequisite: None

Structure: Three 50-minute lectures per week
Note: Due to extensive programming assignments, this course has an implied, non-scheduled lab. The lab takes place on the students' own times, and is not part of the official course schedule.

Instructor: Mike Bailey

Measurable Student Learning Outcomes for CS 491 students:
On completion of the course, students will have demonstrated the ability to:

1. Manipulate geometry using vectors and transformation matrices (ABET Outcomes a, b, j)
2. Demonstrate the motion of Forward Kinematic systems (ABET Outcomes a, b, j)
3. Explain the solution for the motion of Inverse Kinematic systems (ABET Outcomes a, b, j)
4. Demonstrate constant-acceleration physics with bouncing (ABET Outcomes a, b, j)
5. Explain collision avoidance (ABET Outcomes a, b, j)
6. Demonstrate a keyframed animation (ABET Outcomes a, b, j)
7. Demonstrate a 3D particle system (ABET Outcomes a, b, j)
8. Demonstrate physical systems modeled as meshes (ABET Outcomes a, b, j)

Learning Resources: Professor's own course notes

Course Content:
- Parametric lines
- Vectors: dot product, cross product, uses for dot and cross products
• Matrices: definition, multiplication, transpose, determinant, inverse
• C++ vector and matrix classes and methods
• 3D coordinate systems, transformations
• Forward kinematics (hierarchical transformations)
• Newton’s method for solving for roots of nonlinear equations
• Inverse kinematics using Jacobian matrices and Cyclic Coordinate Descent
• Rigid-body constant-acceleration kinematics, projectiles
• Rigid-body dynamics, integrating equations of motion
• Keyframe animation
• Collision avoidance
• Collisions, impulse-momentum, rebounding
• Particle systems
• Modeling the world as a mesh of springs (e.g., cloth)
• Guest Lectures

Evaluation of Student Performance:
Projects: 800 points
Tests (2) 200 points total (i.e., 100 points each)
TOTAL 1000 points

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<th>Points</th>
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<tr>
<td>950</td>
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Students with Disabilities:
Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 737-4098.

Link to Statement of Expectations for Student Conduct, i.e., cheating policies
http://oregonstate.edu/studentconduct/offenses-0
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Revised: Fall 2014