

## 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:** 4

**Prerequisites:** CS 261, MTH 232, MTH 251, MTH 252

**Courses that require this as a prerequisite:** None

**Structure:** Three 50-minute lectures per week

**Instructor:** Mike Bailey

### 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

### Learning Resources:

Professor's own course notes

### Course Learning Outcomes:

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)

**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/http:%252Foregonstate.edu/studentconduct/code/index.php>