CS174A Assignment 2 - Part 1
Written Section: Simulations and Projections

Out: Fri, April 25th, 2014   **Value:** 5% of final grade
Due: Fri May 2nd, 2014 11:59 pm   **Total Points**: 100

1. (10 pts) How do you compute the position of a particle using explicit Euler?

2. (10 pts) An external force of $(2, 14.7, -5)^T$ is applied to a particle (mass=1) located at $(0, 0, 0)^T$ at t=0. Give the position of the particle at the time it hits the ground by computing it iteratively and using explicit Euler (dt=1).

3. (10 pts) Give the Lagrange equations of motion and completely specify the internal forces associated with:
   a. Heating and Melting Deformable Models – Mass-Springs Model
   b. Liquids – Particle Models
   c. Cloth – Viscoelasticity – Mass-Springs Model

4. (10 pts) Give the camera/viewing transformation matrix for an eye position $(2,10,3)^T$, a lookat point $(-2, 2, 0)^T$ and an up vector $(-1,-1,0)^T$.

5. (10 pts) Give the perspective projection matrix with a near plane of 1, far plane of 100, a horizontal field of view of 30◦, and an aspect ratio of 1:2.

6. (10 pts) Give the NDC-to-display transformation matrix for a viewport 200 pixels wide and 200 pixels high, with the origin in the upper left of the display.

7. (10 pts) A tetrahedron has vertices $(3, 2, 1, 1)^T$, $(0, 0, -3, 1)^T$, $(-2, -1, 2, 1)^T$, and $(1, 5, -1,1)^T$ in world coordinates. Give its coordinates in the camera coordinate system, after the viewing transformation from problem 4 above has been applied to the points in world coordinates.

8. (10 pts) Then give the tetrahedron coordinates in the clipping coordinate system, after the perspective warp for the frustum specified in problem 5 has been applied to the tetrahedron points in camera coordinates (that is, the answer from problem 7).

9. (10 pts) Then give its coordinates in the normalized device coordinate system, after the perspective divide has been applied to the answer from problem 8.

10. (10 pts) Finally, give the point coordinates in the display coordinate system, after the viewport transformation of problem 6 has been applied to the answer from problem 9.