CMSC 435 Final Exam (Fall 2015)

Instructions: Clearly write your name on this sheet. Answer each problem in the space provided. If you need extra space, clearly write your name and the problem number on an extra sheet of paper, write on extra sheet in the answer space on the exam paper, and turn in the extra sheet with your exam.

Write legibly. If the person grading the test cannot read something, s/he will simply assume that you meant the illegible portion as a note to yourself and they will ignore it. If you lose points because part of your answer could not be read, you will not be given the opportunity to explain what it says.!

Be clear and concise. The answers to most questions should be short. If you find yourself writing an excessively long response, you may want to think more carefully about the question. Long rambling answers generally get fewer points than short ones do because there are more opportunities to mark something wrong. **The purpose of short-answer questions is to determine if you know what you are talking about, a few key words can usually communicate this.**

You may use any notes you have written on **both sides** of a **single 8.5 x 11** inch sheet of paper. You may not ask questions of other students, look at another students exam, use a textbook, use a phone or calculator, or seek any other form of assistance. In summary: do not cheat. Persons caught cheating will be subject to disciplinary action.

Each question is marked with a number of points. There are 75 points total. You have 75 minutes. The test is designed with the same minutes as points, if you find yourself spending much more than a minute per point on a question, you might want to move on and come back to it at the end.

Do not worry if the test seems too long or too hard. I am not afraid to curve grades. I will not be surprised if most students do not finish or if the average score is around 50%. That is okay, as long as there is variance in the scores, I can amplify the signal.

If something isnt clear, ask!

Good luck

Name: _____

GL Login: _____

DO NOT OPEN THE TEST UNTIL TOLD TO BEGIN

1. True/False and Fill in the Blank. 1 pt per blank.

   (a) (1 pt) Cubic _____ splines are C^2 continuous, but do not interpolate keyframes.

   (b) (1 pt) A quaternion has _____ elements.

   (c) (1 pt) A _____ joint has translational degrees of freedom.

   (d) (1 pt) A ball and socket joint has _____ degrees of freedom. (How many?)

   (e) (1 pt) True/False: Interpolating Euler angles produces high-quality animation. _____

   (f) (1 pt) True/False: All Catmull-Rom splines can be represented as Hermite splines. _____

   (g) (1 pt) True/False: Computing the arc length of a cubic spline requires evaluating the square root of a quartic polynomial. _____

   (h) (1 pt) True/False: Guassian Quadrature is a numerical technique for estimating integrals. _____

   (i) (1 pt) True/False: This class is awesome. _____

   (j) (1 pt) True/False: I get the idea of the sort of questions that will be in this section. _____

   (k) (1 pt) True/False: I am so glad there is this practice exam. _____

   (l) (1 pt) True/False: The professor doesn't want to use up all his good questions in a practice exam. _____

   (m) (1 pt) True/False: This is getting a bit ridiculous. _____ .

   (n) (1 pt) True/False: I am skipping ahead to the next question. _____

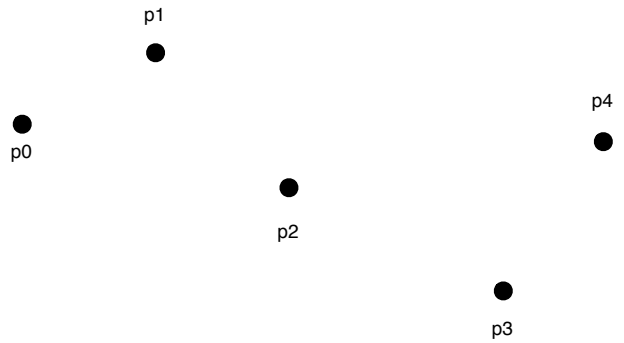
   (o) (1 pt) True/False: Adventure is out there. _____

   (p) (1 pt) I think I will get an _____ in this class.

   (q) (3 pts) My favorite fruits are _____ , _____ , and _____ .

   (r) (1 pt) True/False: This statement is false. _____

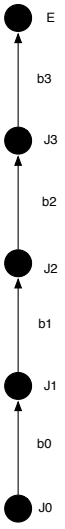
2. (10 pts) Draw a plausible approximation of a cubic Catmull-Rom spline through the points below. At key point draw the direction of the tangent. Use the same boundary conditions as for Assignment 1 (i.e. assume $p0$ and $p4$ are duplicated).



3. (10 pts) Assume keyframe 4 corresponds to frame 70 and keyframe 5 corresponds to frame 90. Assume that numerical integration estimated that the arc length from 70 to 75 is 1, from 70 to 80 is 3, from 70 to 85 is 6, and from 70 to 90 is 10. Give a formula for a parametric value u that corresponds to frame 80 assuming constant speed between the keyframes.

4. (5 pts) Describe how you would compute a coordinate frame for a camera located at position $\mathbf{c}$ and looking at position of interest $\mathbf{i}$. Assume that $\mathbf{y}$ is up.

5. (10 pts) Resketch the kinematic chain below to account for the following rotations from the default pose. Assume positive angles coorespond to counter-clockwise rotations. The rotation at $J0$ is $45°$, at $J1$ is -90, at $J2$ is 45, and at $J3$ is 90. Let $J0$ be at the origin, $R(\theta)$ be the transformation matrix that rotates a vector by θ degrees, and each bone offset be given by the vector bi. Give a formula for the position of the end effector E.



6. (5 pts) If the end effector's position (in world space) is $\mathbf{e}$ and a joint's location (in world space) is $\mathbf{j}$ and it's axis of rotation is u, give an expersion for the instantaneous change in $\mathbf{e}$ induced by rotating the joint (i.e. $\partial e/\partial\theta$).

7. (5 pts) Why have a motion capture actor stand in a T-pose? Why the motorcycle pose?

8. (5 pts) How can physics be used to compute character animations?