CPSC 426: Computer Animation
Assignment 2

out: Fri February 7, 2014
due: in class Fri February 14, 2014

> Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page.

Name: ____________________

Student Number: ____________________

Question 1	/ 2
Question 2	/ 2
Question 3	/ 2
Question 4	/ 5
Question 5	/ 3
Question 6	/ 6
TOTAL	/ 20

This assignment has 6 questions, for a total of 20 points.

1. (2 points) Is the follosing a combination of a rotation matrix and a uniform scale? Why or why not?
$$\begin{bmatrix} 1 & -1 & 0 \\ 0 & 0 & -sqrt2 \\ 1 & 1 & 0 \end{bmatrix}$$

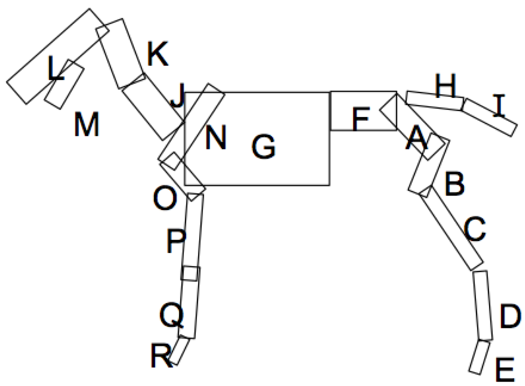
2. (2 points) Compute the following quaternion product:
$(2 - 3\mathbf{i} + \mathbf{k}) \otimes (0 + \mathbf{i} - \mathbf{j})$

3. (2 points) Show that the unit quaternions given by q and $-q$ represent the same orientation, where $q = \langle \cos\frac{\theta}{2}, \sin\frac{\theta}{2}\overrightarrow{\mathbf{k}} \rangle$, representing a rotation of θ around the axis $\overrightarrow{\mathbf{k}}$.

4. (5 points) Express $\text{Rot}(y, 90°)$ in the following representations: (a) rotation matrix; (b) quaternion; (c) XZX Euler angles.

5. (3 points) Using quaternion multiplication, show that
$\text{Rot}(z, 90°)\text{Rot}(x, -90°)\text{Rot}(z, -90°) = \text{Rot}(y, -90°)$

6. (6 points) Consider the articulated skeleton model of a horse, as shown below.



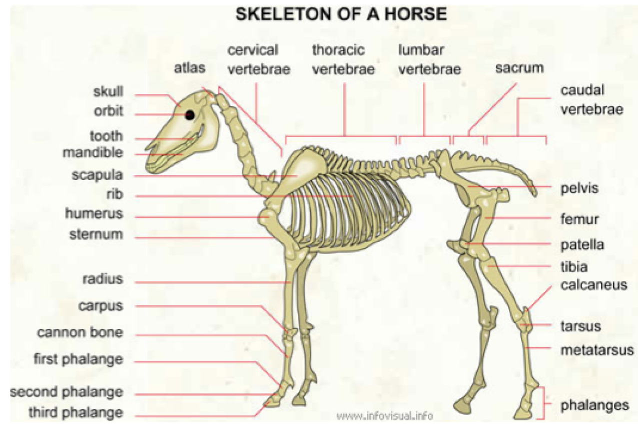


Image from: http://www.infovisual.info/02/072_en.html

(a) [2] Sketch a scene graph for all the given links for the horse. Label the links in your scene graph with the letters used in the above diagram. Assume that link A is the root link, i.e., that its parent link is the world coordinate frame.

(b) [2] Develop an expression for the transformation matrix that would be used to render the head of the horse, i.e., that takes points from frame L to the world frame. Assume that the transformation matrix M_Z that is associated with link Z takes a point from its coordinate frame to to its parent frame.

(c) [2] Develop an expression for the transformation matrix that takes a point in the head coordinate frame and expresses it in the coordinate frame of the hoof of the front leg, i.e., frame R.