Worksheet III

Answer all the problems completely on a separate sheet of paper. Read all the problems closely, and ask if you have any questions on what a problem means. This worksheet is due at the start of class on Mon, Oct 06.

Problem 1 (2 pts)

What is the difference between a **basis** and a **frame**?

Problem 2 (3 pts)

What is are **homogenous coordinates** and why are they useful in graphics?

Problem 3 (6 pts)

In the following, `T(x,y,z)` refers to a translation by the vector `(x,y,z)`. `S(a,b,c)` refers to a scaling the x- y- and z- basis vectors by the components `(a,b,c)` respectively. `Rx(a)` refers to a rotation about the x axis by a degrees, while `Ry(a)` and `Rz(a)` refer to rotations about the y and z axes, respectively. For example:

> `T(1,0,0) Rx(45)` gives a composite transformation that first rotates a point by 45 degrees around the x-axis, and then translates it one unit along the positive x-axis.
>
> `S(2,2,2) T(1,1,2)` gives a composite transformation that first translates a point by (1,1,2) and then scales it by (2,2,2).

Note that there can be more than one sequence of transformations that results in the same composite transformation.

Please answer true or false for each statement below. For a statement to be true, it must be true for any vector the transformation is applied to. No justification is necessary.

(a) `T(1,0,0) Rx(45) = Rx(45) T(1,0,0)`

(b) `T(0,0,1) T(0,1,0) = T(0,1,0) T(0,0,1)`

(c) `S(2,2,2) T(1,1,2) = T(1,1,2) S(2,2,2)`

(d) `T(1,0,0) Rz(180) = T(-1,0,0) Rz(0)`

(e) `T(1,0,0) Rz(90) = Rz(90) T(0,-1,0)`

(f) `Ry(180) = S(1,-1,1)`

Problem 4 (7 pts)

Construct a transformation matrix that will rotate a 3-dimensional polyhedron centered at the point `(2,3,1)` 30 degrees around the vector `(1,1,0)`.

You should give this construction in terms of the basic transformation matrices we discussed in class. You should detail the numeric values of these matrices (including of the final composite matrix). You do **not** need to show you work for multiplying the matrices (you are welcome to use a calculator, Sage, or even glMatrix to do the arithmetic). *Hint:* be careful about the order of multiplications!