Casey Rhyss Capacio

1. Write the homogeneous 4x4 matrices for the following transforms:

A:

$$\begin{bmatrix} 1 & 0 & 0 & 7 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix} = \begin{pmatrix} x+7 \\ y \\ z \\ 1 \end{pmatrix}$$

B:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(60) & -\sin(60) & 0 \\ 0 & \sin(60) & \cos(60) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix} = \begin{pmatrix} x \\ \cos(60) \cdot y - \sin(60) \cdot z \\ \sin(60) \cdot y + \cos(60) \cdot z \\ 1 \end{pmatrix} = \begin{pmatrix} x \\ 0.5y - 0.866z \\ 0.866y + 0.5z \\ 1 \end{pmatrix}$$

C:

$$\begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(60) & -\sin(60) & 0 \\ 0 & \sin(60) & \cos(60) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 0 & 7 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

2. A flattened Tom has his front-to-back length reduced by 95%. Give the matrix that enables this transform.

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0.05 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix} = \begin{pmatrix} x \\ y \\ 0.05z \\ 1 \end{pmatrix}$$

3. A flattened Tom also falls from an upright position. What homogeneous transform can be used here, ignoring the unflattened paws

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0.05 & 0 & 0 \\ 0 & 0 & 0.05 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix} = \begin{pmatrix} x \\ 0.05y \\ 0.05z \\ 1 \end{pmatrix}$$

4. What about this Tom? Assuming he rotates 300 degrees per second, what transformation matrix would be applied to a hardware that can perfectly execute **60** frames per second (no lags, no speed ups)?

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(300) & -\sin(300) & 0 \\ 0 & \sin(300) & \cos(300) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix}$$

5. And changing from cartoons to anime, how would we scale Choji 10x bigger, and make him roll towards the camera at 24 **rotations per second**, and have him charge **forward 240 units per second** towards the enemies? (the camera just changed angles, but the object is still rolling forward from his original orientation). Assume the same perfect 60 fps hardware from #4.

$$\begin{bmatrix} 10 & 0 & 0 & 0 \\ 0 & 10 & 0 & 0 \\ 0 & 0 & 10 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 24 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 0 & 7 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 240 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix}$$