Announcements

- Assignment 2 is now available, due at the end of reading week (Feb 20). Face to face grading will be in the week of Feb 23.
- Assignment 1 grades will be available soon (resolving some discrepancies). Probably this afternoon.
- No class on Monday Feb 9 (Family day statutory holiday)
- My office hour now Thursday morning 10-11am.
Today

- Quiz 1 discussion
- Cameras and Projection, contd.

Quiz 1

- You can download your exams from the link on the course web page (look for “Handback”)
- Mark include
  - Generous partial credits
  - Rounded up ½ marks for each question
Details and Pointers

- Q1. Fill in the blank
  - Answer key: 12, 4, 13, 9, 14, 1, 10, 17
- Q2. Most ok, except part 3
- Q3. See L2
- Q4. Orthonormal basis
  - Read L5, Textbook p. 15. Try to be precise, esp. if question says “mathematically” or “define”
  - Many forgot “normal” part
- Q5. Transformations about coord axes
  - Most got these right
  - Part 4: Notice that rotation by 0 about *any* axis = Identity. In general, simplify your life by knowing cos 0 = 1, cos(90) = 0, etc.

Q6

\[
\begin{align*}
\mathbf{a} &= \mathbf{w} \begin{pmatrix} 1/2 \\ 1/2 \\ 3 \\ 0 \\ 3 \\ 1 \\ \end{pmatrix} \\
\mathbf{b} &= \mathbf{w} \begin{pmatrix} 1/2 \\ 1/2 \\ 3 \\ 0 \\ 3 \\ 1 \\ \end{pmatrix} \\
\mathbf{c} &= \begin{pmatrix} 0 \\ 3 \sqrt{2} \\ \end{pmatrix}
\end{align*}
\]
Q7 Knowledge Transfer

- (a) Most got it. \[ M = \begin{bmatrix} I & 0 \end{bmatrix} \] \[ p_w = M C p_c \]

- (b) Instance of transformation w. auxiliary frame
  - Discussed in L10,L11 and section 5.2
  - Plus very strong hint in the lectures to review this
  - Note that tire frame is defined wrt car frame

\[ p_c' = TRT'p_c \quad \text{where} \quad R = rot(x,y,z) \]
\[ p_w = MC TRT'p_c \]

Assignment 2

- Demo
What are the coordinates of the orthographic projection of \( p_e \) onto the image plane?

\[
p_e = \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix} \rightarrow \begin{pmatrix} x' \\ y' \\ 0 \\ 1 \end{pmatrix}
\]

ie \( N = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \) as a 4x4 matrix.

Want to convert it to a canonical box:

\[
\begin{pmatrix} x' \\ y' \\ \frac{z'}{f} \end{pmatrix} \rightarrow \begin{pmatrix} x_e \\ y_e \end{pmatrix}
\]

So move by \(-ve\) of that to set center of box to origin.
\[ T = \begin{bmatrix}
  \frac{-b + \frac{t}{2}}{2} & \frac{b + t}{2} & \frac{m + f}{2} \\
  -\frac{b + t}{2} & m + f & -\frac{b + t}{2} \\
  -\frac{m + f}{2} & -\frac{b + t}{2} & 1
\end{bmatrix} \]

Scale the box to have each side \((-1, 1)\)

Box's height is \(t - b\), change it to \(1 - (-1) = 2\)

\[ S = \begin{bmatrix}
  \frac{2}{n - f} & \frac{2}{n - f} & \frac{2}{n - f} \\
  \frac{2}{t - b} & \frac{2}{t - b} & \frac{2}{t - b} \\
  \frac{2}{t - b} & \frac{2}{t - b} & \frac{2}{t - b}
\end{bmatrix} \]

So total projection matrix is

\[ P = T S = \begin{bmatrix}
  \frac{2}{n - f} & \frac{2}{n - f} & \frac{2}{n - f} \\
  \frac{2}{t - b} & \frac{2}{t - b} & \frac{2}{t - b} \\
  \frac{2}{t - b} & \frac{2}{t - b} & \frac{2}{t - b}
\end{bmatrix} \]

Note: This is an affine transformation only!

Next class: need more: projective transform