CPSC 314
Computer Graphics

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Cameras and Projection, contd..

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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.

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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.

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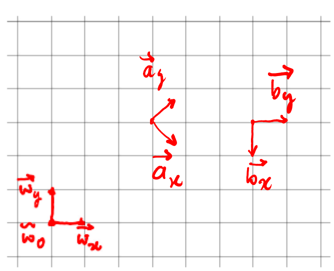
Q6



(a)

$$\underline{\tilde{a}} = \underline{\tilde{w}} \begin{pmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & 3 \\ \frac{1}{-\sqrt{2}} & \frac{1}{\sqrt{2}} & 3 \\ 0 & 0 & 1 \end{pmatrix}$$

(c) $\begin{pmatrix} 0 \\ -3\sqrt{2} \\ 1 \end{pmatrix}$

(b)

$$\underline{\tilde{b}} = \underline{\tilde{w}} \begin{pmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & 3 \\ \frac{1}{-\sqrt{2}} & \frac{1}{\sqrt{2}} & 3 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & \frac{3}{\sqrt{2}} \\ \frac{1}{-\sqrt{2}} & \frac{1}{\sqrt{2}} & \frac{3}{\sqrt{2}} \\ 0 & 0 & 1 \end{pmatrix}$$

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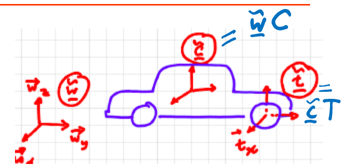
Q7 Knowledge Transfer

- (a) Most got it.

$$M = \left[\begin{array}{c|c} I & \begin{matrix} 0 \\ vs \\ 0 \end{matrix} \\ \hline & 1 \end{array}\right]$$



$$p_w = M C p_c$$

- (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

$$p_c' = T R T^{-1} p_c \quad \text{where } R = rot(x, ns)$$

$$p_w = M C\, T R T^{-1} p_c$$

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Assignment 2

- Demo

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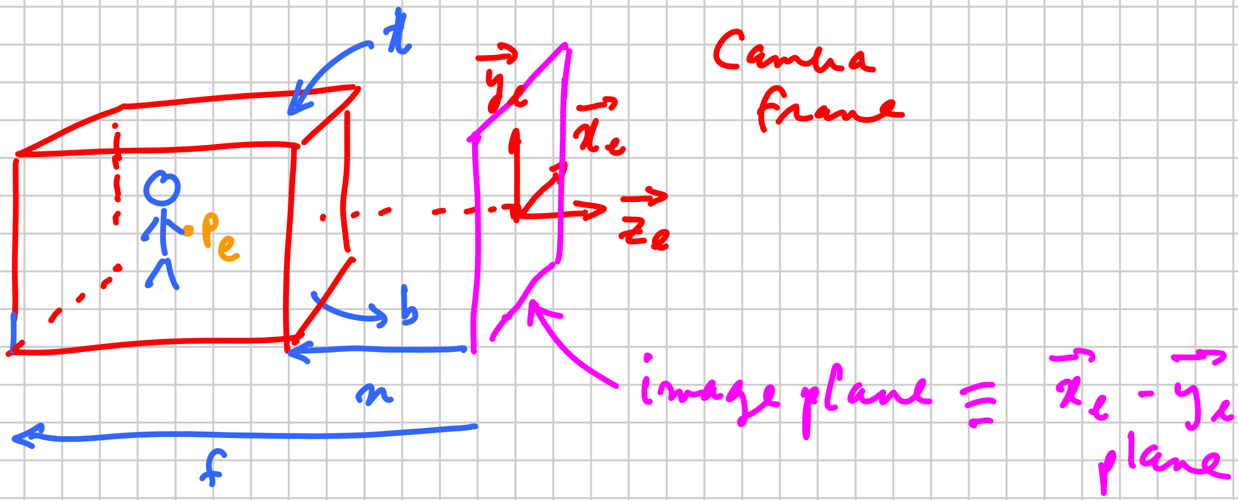


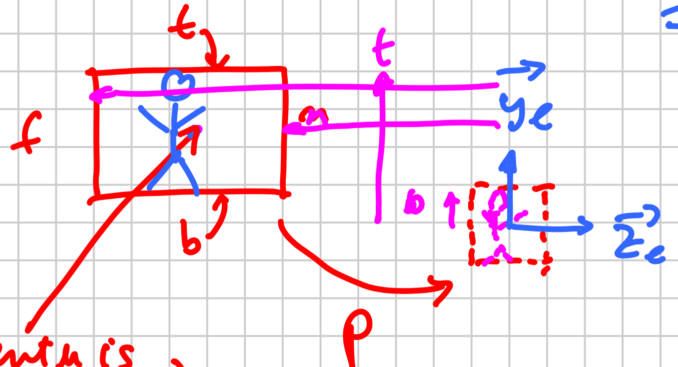
What are the coordinates of the orthographic projection of p_e onto the image plane?

$$p_e = \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix} \xrightarrow{N} \begin{pmatrix} x \\ y \\ 0 \\ 1 \end{pmatrix}$$

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

Want to convert it to a canonical box

$= p_c$ "clip coordinates"



Centre is at $\begin{pmatrix} \frac{b+t}{2} \\ \frac{n+f}{2} \end{pmatrix}$

So move by -ve of that to get centre of box to origin

$$T = \left[\begin{array}{c|c} I & \begin{matrix} -\frac{l+r}{2} \\ -\frac{b+t}{2} \\ -\frac{n+f}{2} \end{matrix} \\ \hline & 1 \end{array}\right]$$

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

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

$$S = \left[\begin{array}{ccc|c} \frac{2}{r-l} & & & \\ & \frac{2}{t-b} & & \\ & & \frac{2}{n-f} & \\ \hline & & & 1 \end{array}\right]$$

$\star$ In the new, translated frame

So total projection matrix is

$$P = TS = \left[\begin{array}{ccc|c} \frac{2}{r-l} & & & -\frac{r+l}{r-l} \\ & \frac{2}{t-b} & & -\frac{t+b}{t-b} \\ & & \frac{2}{n-f} & -\frac{n+f}{n-f} \\ \hline & & & 1 \end{array}\right]$$

Note: This an affine transformation only!

Next class: need more: projective transform