CPSC 314
Computer Graphics

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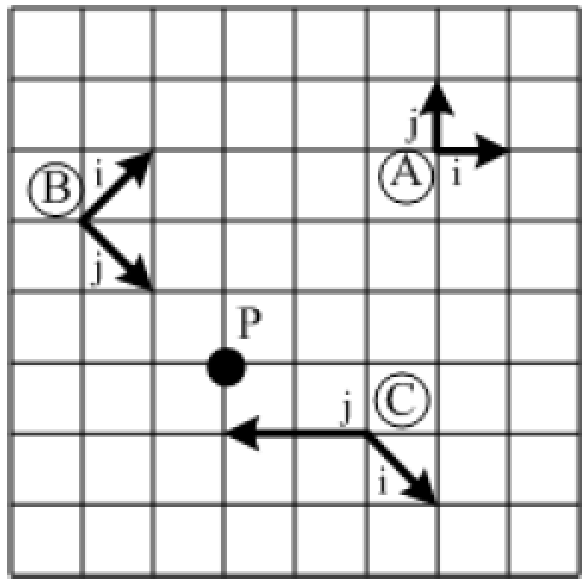
Frames and their uses

Announcements

- Assignment 2 will be out soon (probably late today).
- Reminder: Midterm 1 on Feb 7, in class.
- Assignment 2 deadline pushed to Feb 10 to provide some flexibility… but
  I strongly recommend finishing it before the midterm, to gain better understanding of transformations
- Assignment 2 grading will be Feb 11-14.

C^3Homework: Basis and Transformation



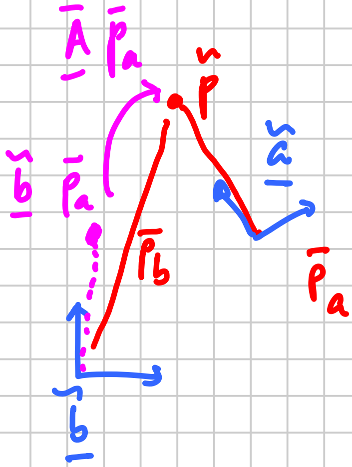
- What are the coordinates of point P in frame A, B, and C?
- Which frame is orthonormal?
- How to transform a point from frame C to frame B?

Frames

Note Title 2014-01-27

§

Suppose $\underline{\vec{a}}$ is defined wrt. $\underline{\vec{b}}$



$$\underline{\vec{a}} = \underline{\vec{b}}\,\underline{\bar{A}} \leftarrow \text{input}$$

$$\boxed{\vec{p} = \underline{\vec{a}}\,\bar{p}_a = \underline{\vec{b}}\,\bar{p}_b}$$

view ②

$$\overbrace{\underline{\vec{b}}\,\underline{\bar{A}}}^{\text{a new frame } \underline{\vec{a}}}\,\bar{p}_a = \underline{\vec{b}}\,\bar{p}_b$$

view ① I moved $\bar{p}_a$ by $\underline{\bar{A}}$

§ 2 ways to interpret a matrix-vector multiplic

a "new x" function

view 1

$$\begin{matrix}x'\\y'\\1\end{matrix} = \begin{bmatrix}\cdot & \cdot & \cdot\\ \cdot & \cdot & \cdot\\ 0 & 0 & 1\end{bmatrix}\begin{bmatrix}x\\y\\1\\1\end{bmatrix}$$

a row produces a number on LHS.

view 2

$$\begin{bmatrix}\cdot & \cdot & \cdot\\ \cdot & \cdot & \cdot\\ 0 & 0 & 1\end{bmatrix}\begin{bmatrix}x\\y\\1\\1\end{bmatrix}$$

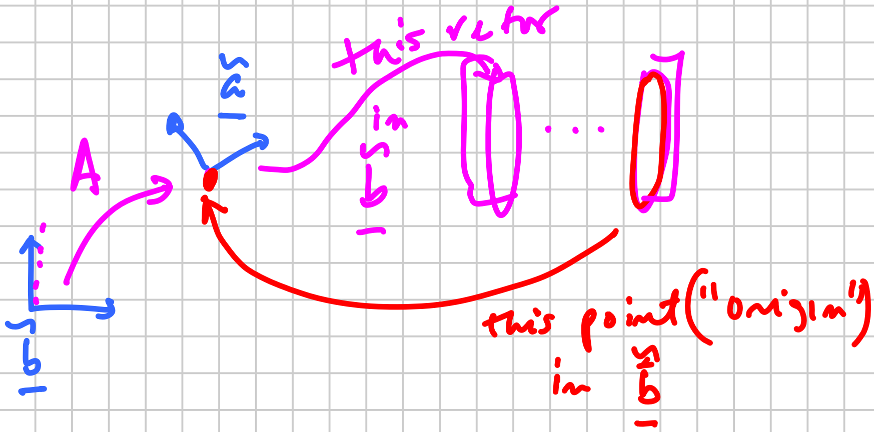
a column is "a new interpretation of x"

new x-axis

If A is a matrix that defines a new frame $\hat{\underline{a}}$ in terms of an old frame $\hat{\underline{b}}$, i.e. $\hat{\underline{a}} = \hat{\underline{b}} A$

★ ★ the first column has the coords of new frame's X-axis in the old frame

Similarly second colum is Y-axis, etc.



§ Typical Uses of Frames (Chapter 5)

World $\quad \hat{\underline{w}} \quad$ Everything else defined w.r.t. $\hat{\underline{w}}$
Synonyms: Scene

Object $\quad \hat{\underline{o}} = \hat{\underline{w}}\,\bar{\underline{O}} \quad$ Fixed to object
Synonym: Modeling frame

Eye $\quad \hat{\underline{e}} = \hat{\underline{w}}\,\bar{\underline{E}} \quad$ fixed to eye/camera
Synonym: View frame, Camera

$$\hat{p} = \hat{\underline{o}}\,\bar{p}_o = \hat{\underline{w}}\,\bar{\underline{O}}\,\bar{p}_o = \hat{\underline{w}}\,\bar{\underline{E}}\,\bar{p}_e = \hat{\underline{e}}\,\bar{p}_e$$

$$\bar{p}_e = \underbrace{\bar{\underline{E}}^{-1}\,\bar{\underline{O}}}_{\text{Model View Matrix}}\,\bar{p}_o$$