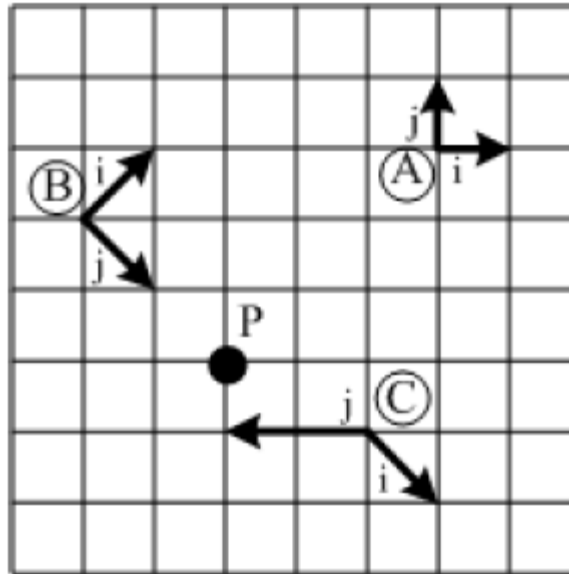# CPSC 314
Computer Graphics

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Sequences of Transformations

Announcements

- Assignment 1 due today.
  Small deadline extension: due at 11:59pm

- Motivation Movie. An early example of what vertex shaders can do

C³Homework:
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?
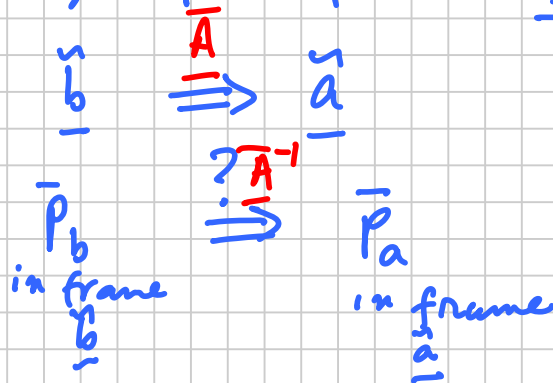
Sequence of Transformations

§   <u>Rigid Transformation</u>

Any combination of rotations & translations

$$\begin{bmatrix} R & t \\ \hline 0\ 0\ 0 & 1 \end{bmatrix}$$

* Most common/useful transformation

§   Change of reference frame

$$\underset{b}{\overset{\smile}{}} \overset{\overrightarrow{A}}{\Longrightarrow} \underset{a}{\overset{\smile}{}}$$

$$\overline{P}_b \overset{?\overline{A}^{-1}}{\Longrightarrow} \overline{P}_a$$

in frame   in frame
  $\underset{b}{\smile}$ $\underset{a}{\smile}$

Express each vector or point in $\underset{a}{\overset{\smile}{}}$, in frame $\underset{b}{\overset{\smile}{}}$

Eg.. $\overrightarrow{a}_1 = \underset{b}{\overset{\smile}{}} \overline{A}_1$

⟵ this is how you specify a new frame

So,

$$\underset{a}{\overset{\smile}{}} = \left(\overrightarrow{a}_1\ \overrightarrow{a}_2\ \overrightarrow{a}_3\ \underset{0}{\overset{\smile}{}} \right) = \underset{b}{\overset{\smile}{}} \left(\overline{A}_1\ \overline{A}_2\ \overline{A}_3\ \overline{A}_0 \right)$$

a 4×4 matrix

$$\boxed{\underset{a}{\overset{\smile}{}} = \underset{b}{\overset{\smile}{}} \overline{A}}$$

So both coordinates should refer to the same physical point

$$\underset{p}{\overset{\smile}{}} = \underset{b}{\overset{\smile}{}} \overline{P}_b = \underset{a}{\overset{\smile}{}} \overline{P}_a = \underset{b}{\overset{\smile}{}} \overline{A}\ \overline{P}_a$$

$$\overline{P_b} = \hat{\underline{A}} \, \overline{P_a}$$

$$\overline{P_a} = \left(\hat{\underline{A}}\right)^{-1} \overline{P_b}$$

§ Two different views of 4×4 matrices

(1) A transformation of points/data

(2) A change of reference frame

View(1)

$$\hat{p} = \underline{\tilde{b}} \, R \, S \, \overline{p}$$

View(2)

$$\hat{p} = \underline{\underset{\underset{\tilde{d}}{\underbrace{\qquad}}}{\tilde{b} \, \overset{\tilde{c}}{\overbrace{R \, S}} \, \overline{p}}}$$

This object
has same
cwrds in frame
$\underline{d}$ as the
original in $\underline{\tilde{b}}$