CPSC 314
Computer Graphics

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Lecture 9: Hierarchies, Rotations

Preliminaries

- Announcements
  - A1 face to face grading starts today.
  - A2 was released on Friday, on schedule.
- Today: wrapping up transformations
  - Quiz 1 summary. Save any questions to end of class or Piazza
  - A2 preview
  - Scene Graphs and Object3D
  - Mathematics of Rotation (Textbook Chapter 2.5)

Quiz 1 results

Average Score	High Score	Low Score	Standard Deviation	Average Time
85%	100%	49%	5.08	39:01

Next Class

- Rotation, Normals, Cameras and Projection
  Read Chapter 10

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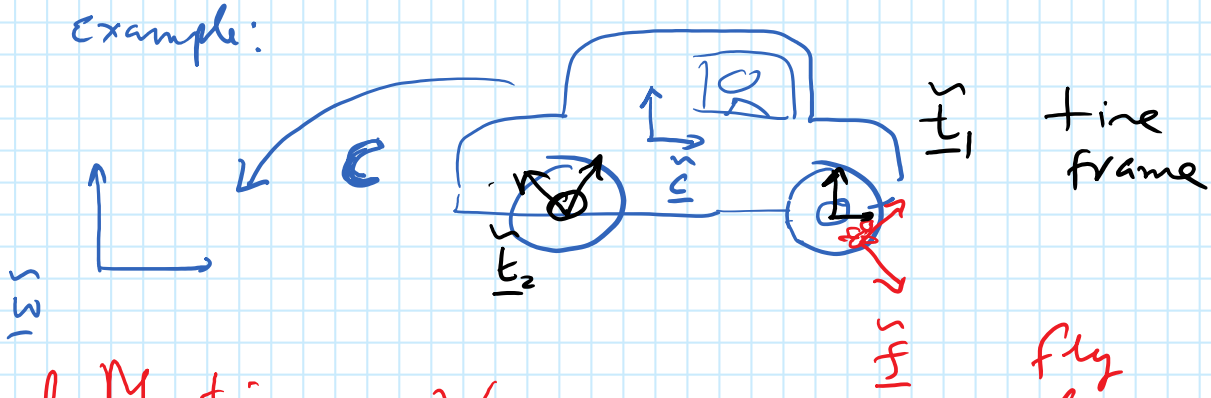
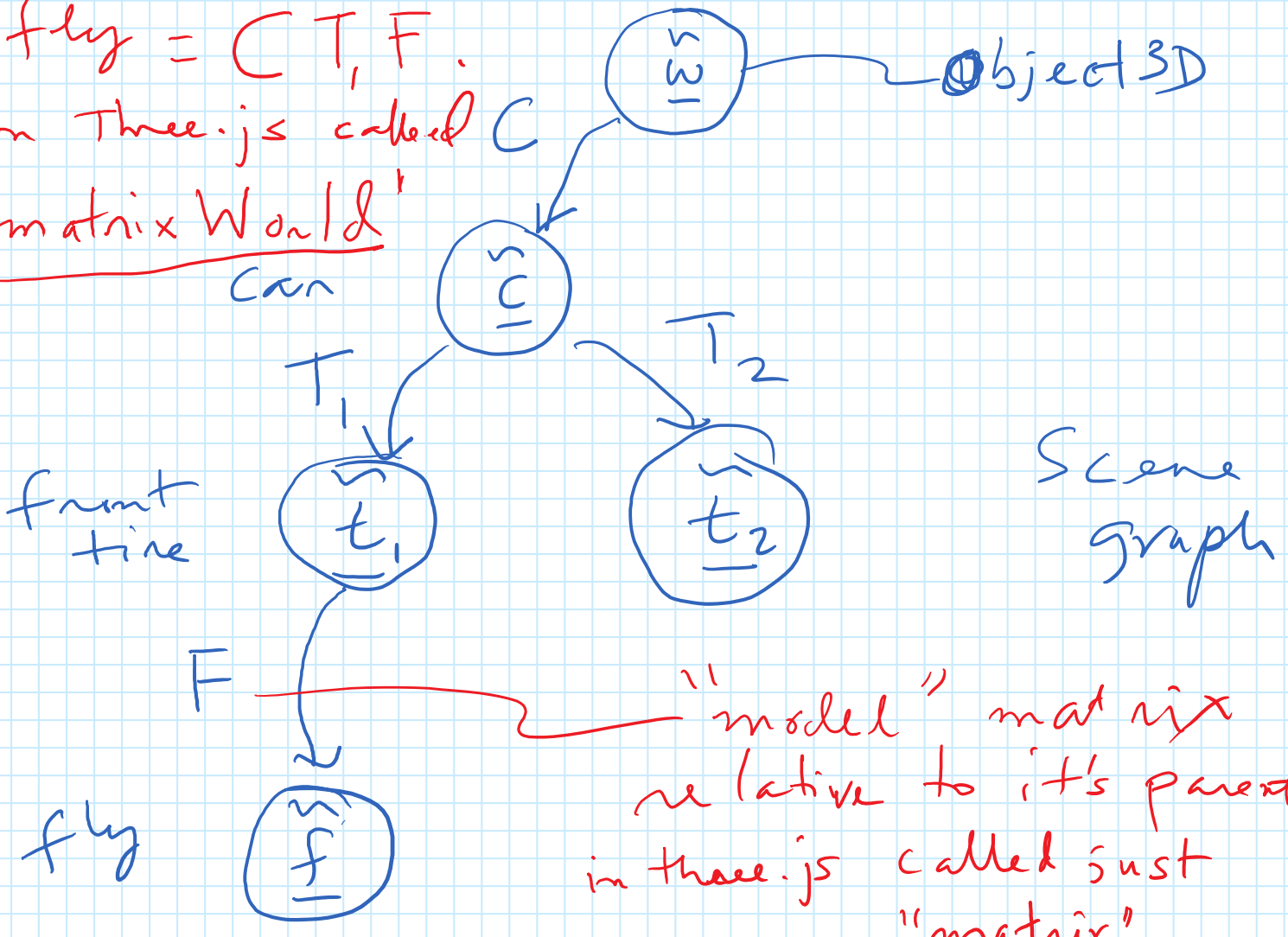
Scene Graphs

example:



model Matrix of fly = C T, F.

In Three.js called C "matrix World" can



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In Three.js "scene" ≡ world

"Object3D" ≡ node in scene graph.

Add an edge of the graph

Object3D.add

Mesh is a subclass of Object3D

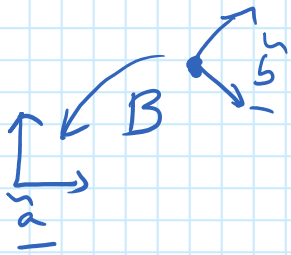
§ Specifying the transformation matrix

A standard way (in Three.js too) is to specify, separately,

T translation (position)

R rotation

S scale



The local matrix assumes a fixed order

$$M = TRS$$

(1) Translation

$$T = \begin{bmatrix} 1 & & & b_1 \\ & 1 & & b_2 \\ & & 1 & b_3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

(2) Scale

$$S = \begin{bmatrix} s_1 & & & 0 \\ & s_2 & & 0 \\ & & s_3 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$S \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix} = \begin{pmatrix} s_1 x \\ s_2 y \\ s_3 z \\ 1 \end{pmatrix}$$

§ Rotation

$$M = \begin{bmatrix} & 3 & \\ 3 & R & \begin{matrix}0\\0\\0\end{matrix} \\ \hline & \begin{matrix}0 & 0 & 0\end{matrix} & 1 \end{bmatrix} \qquad M \begin{pmatrix} v \\ 0 \end{pmatrix} = \begin{bmatrix} Rv \\ \hline 0 \end{bmatrix}$$

Focus on 3x3 part of matrix

Rotations don't change the size of the vector