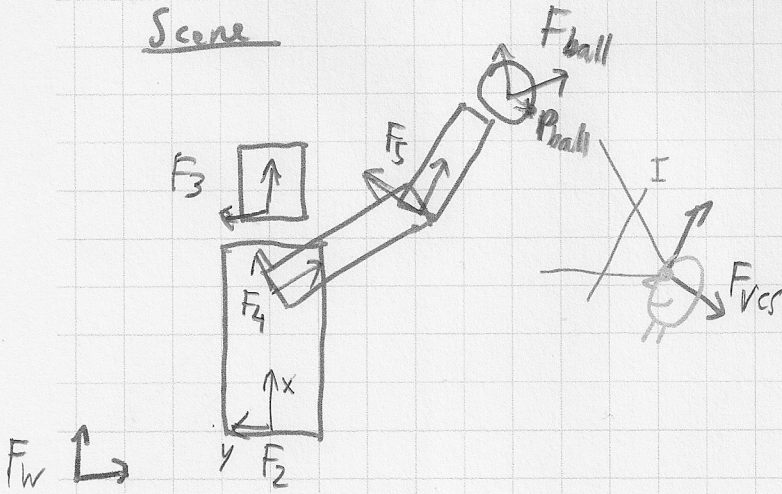
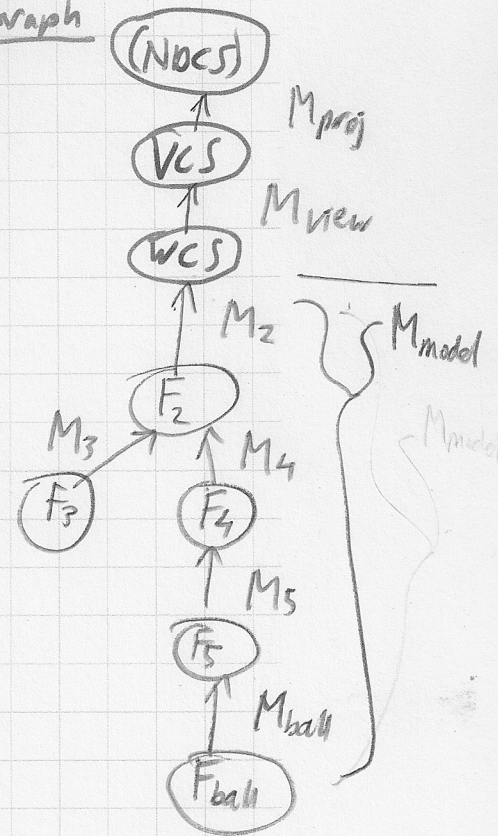


# Transformations in Scene Graphs



# Scene Graph



# Transforming Vertices

e.g., point on ball,  $P_{ball}$

$$P_{(NDCS)} = M_{proj} M_{view} \overbrace{M_2 M_4 M_5}^{M_{model}} M_{ball} P_{ball}$$

# Graphics API code

$m.setPerspective();$   
 $m.lookAt();$   
 $m.translate();$   
 $m.rotate();$   
 $m.scale();$   
 ...

$$M \leftarrow M_{proj}$$

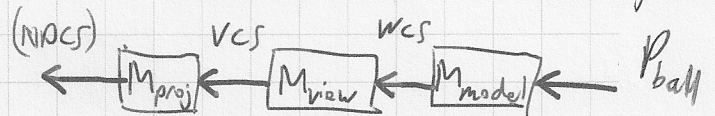
$$M \leftarrow M \cdot M_{view} = M_{proj} \cdot M_{view}$$

$$M \leftarrow M \cdot M_{model} = M_{proj} \cdot M_{view} \cdot M_{model}$$

Also: use a matrix stack to save (push) and restore (pop) coordinate frames as needed.

# Graphics Pipeline

Drawn to reflect the matrix algebra order.



Eg. More typical figure (equivalent!)

