

CS4670 / 5670 : Computer Vision

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Lecture 18: Single-view modeling, Part 2



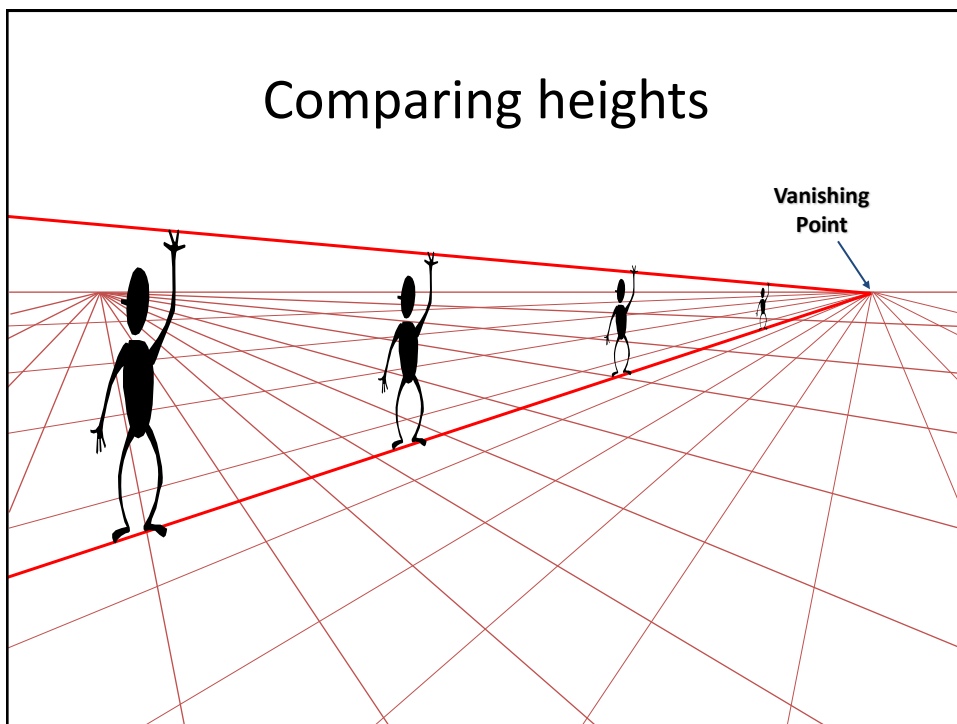
Announcements

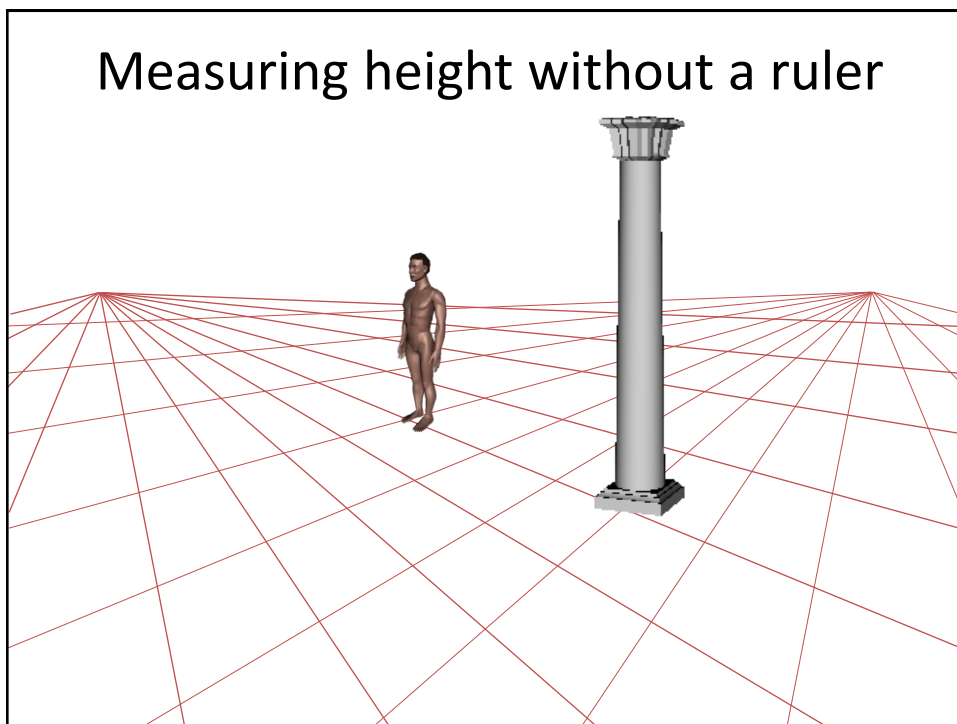
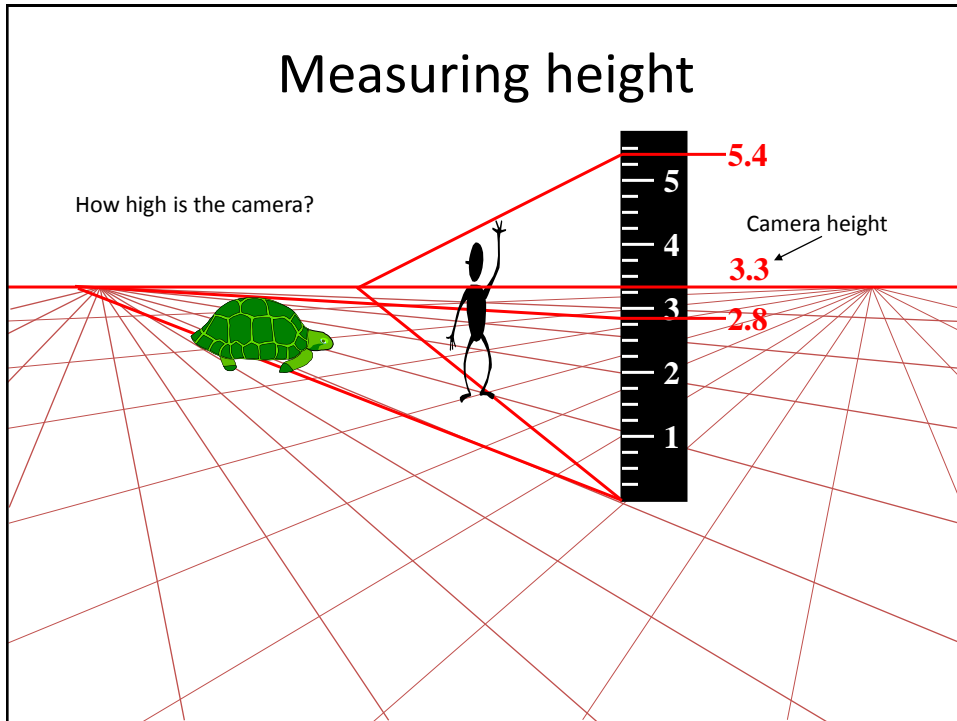
- Project 3 due this **Thursday** by 11:59pm
 - Demos on Friday (?)
- Project 3 artifacts due this **Friday** by 11:59pm
- Take-home prelim out Friday, due Wednesday 10/24 by the beginning of class
 - Please don't post on Piazza about the prelim, just email the staff

Quiz from last time

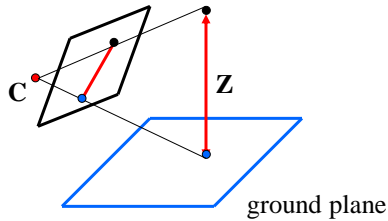
- How do you compute the image-space line l passing through two points p and q ?
- How do you compute the image-space point p at the intersection of two lines l and m ?

Comparing heights





Measuring height without a ruler



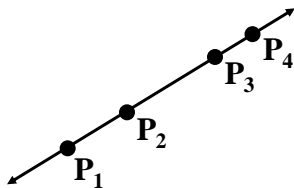
Compute Z from image measurements

- Need more than vanishing points to do this

The cross ratio

- A Projective Invariant
 - Something that does not change under projective transformations (including perspective projection)

The *cross-ratio* of 4 collinear points



$$\frac{\|P_3 - P_1\| \|P_4 - P_2\|}{\|P_3 - P_2\| \|P_4 - P_1\|}$$

$$P_i = \begin{bmatrix} X_i \\ Y_i \\ Z_i \\ 1 \end{bmatrix}$$

$$\frac{\|P_1 - P_3\| \|P_4 - P_2\|}{\|P_1 - P_2\| \|P_4 - P_3\|}$$

Can permute the point ordering

- $4! = 24$ different orders (but only 6 distinct values)

This is the fundamental invariant of projective geometry

Measuring height

$$\frac{\|T - B\| \|\infty - R\|}{\|R - B\| \|\infty - T\|} = \frac{H}{R}$$

scene cross ratio

$$\frac{\|t - b\| \|v_z - r\|}{\|r - b\| \|v_z - t\|} = \frac{H}{R}$$

image cross ratio

scene points represented as $P = \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$

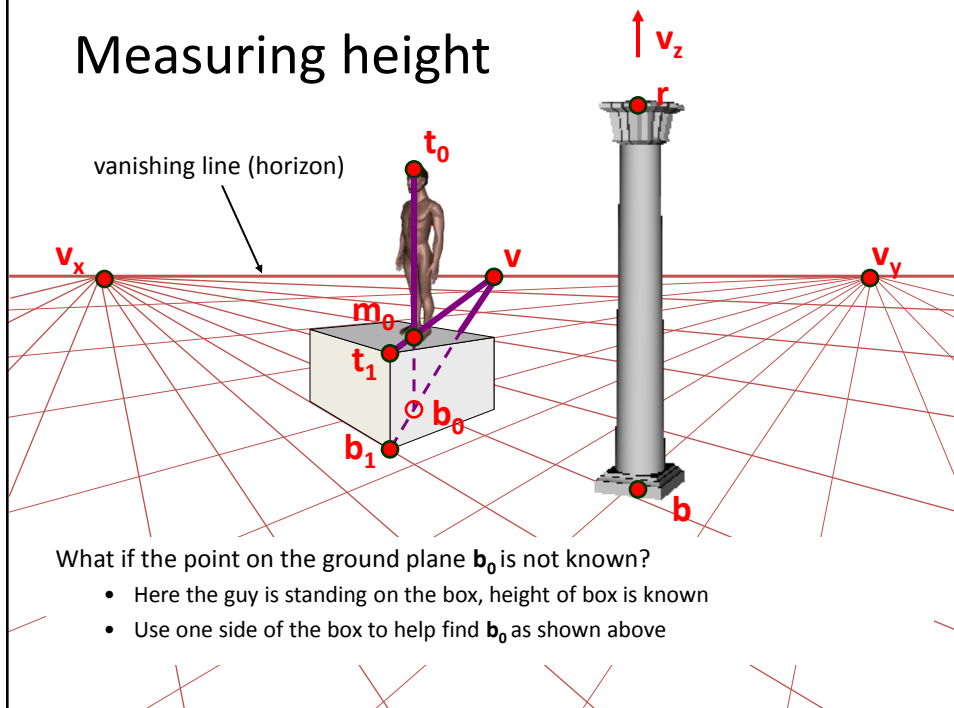
image points as $p = \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$

Measuring height

$$\frac{\|t - b\| \|v_z - r\|}{\|r - b\| \|v_z - t\|} = \frac{H}{R}$$

image cross ratio

Measuring height



3D Modeling from a photograph

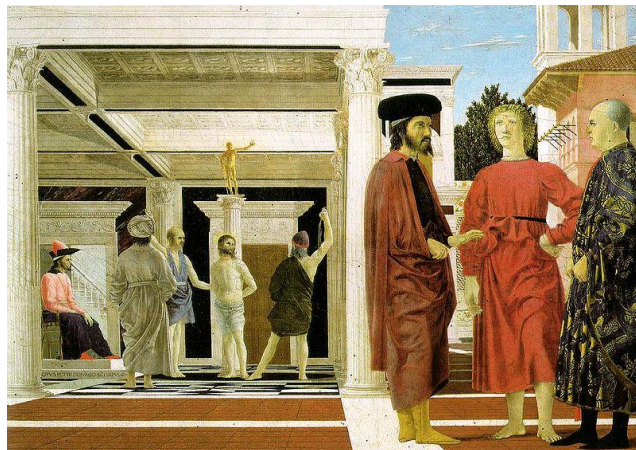


St. Jerome in his Study, H. Steenwick

3D Modeling from a photograph

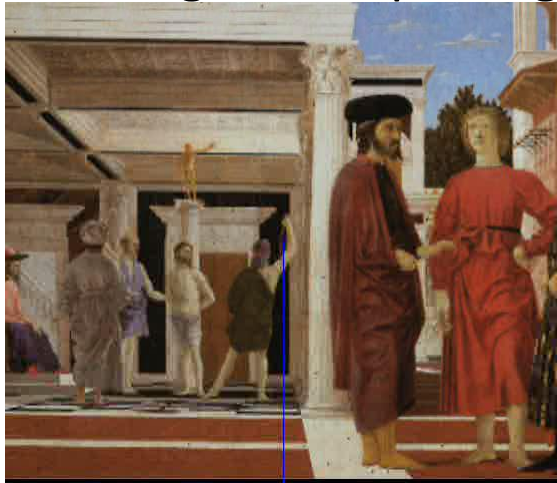


3D Modeling from a photograph



Flagellation, Piero della Francesca

3D Modeling from a photograph



video by Antonio Criminisi

3D Modeling from a photograph

