

$$\square f_1 > f_2$$

Question: Would it be possible to digitally transform the right to look the same as the left? Find  $M: p_i \rightarrow Mq_i$ .

but this can transform only the ground  $\nabla$  (I can do that

without knowing  $f$  or the position of camera)

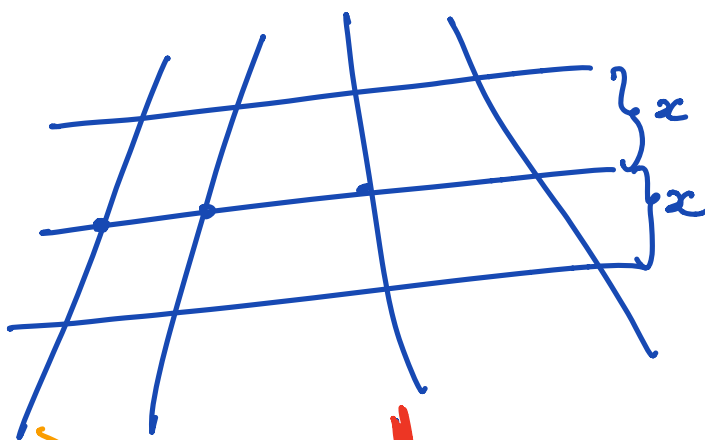
What can we infer from a single image?

1. horizon  $\Rightarrow$  tilt (qualitatively)
2. from 3 orthogonal V.P.  
we can compute  $f, u_0, v_0$
3. What else?

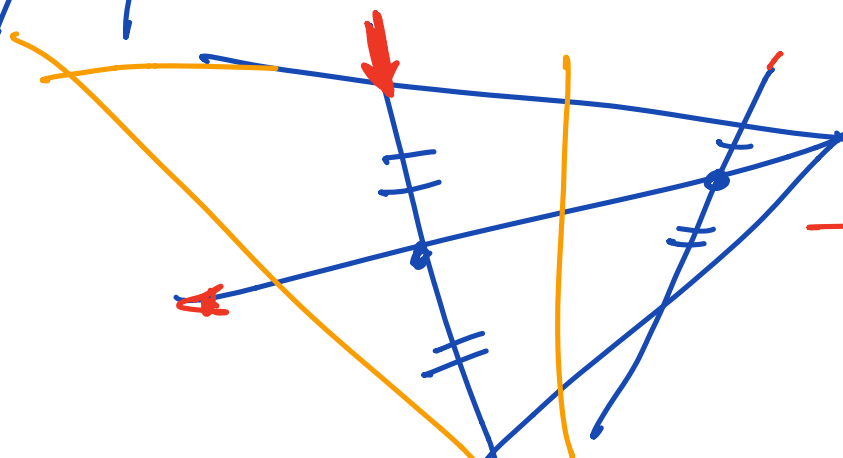
What stays the same between the world and its image?



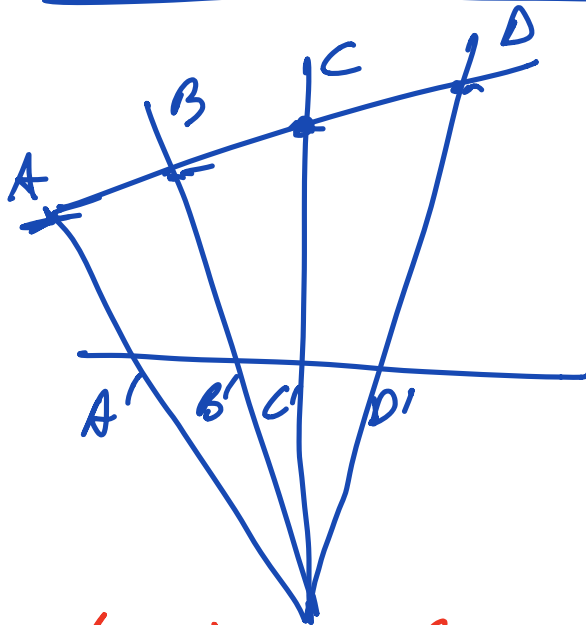
Middle point of a segment  
(or center of circle)



Ratio not  
preserved  
under  
perspective



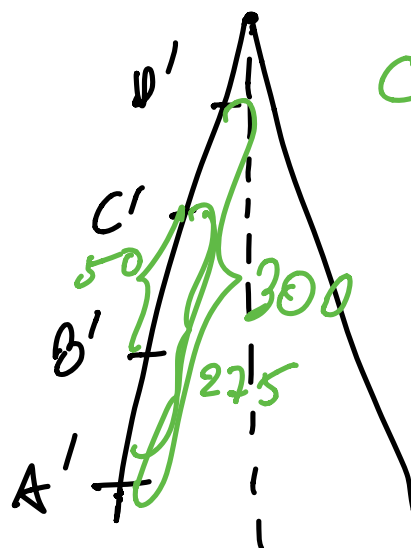
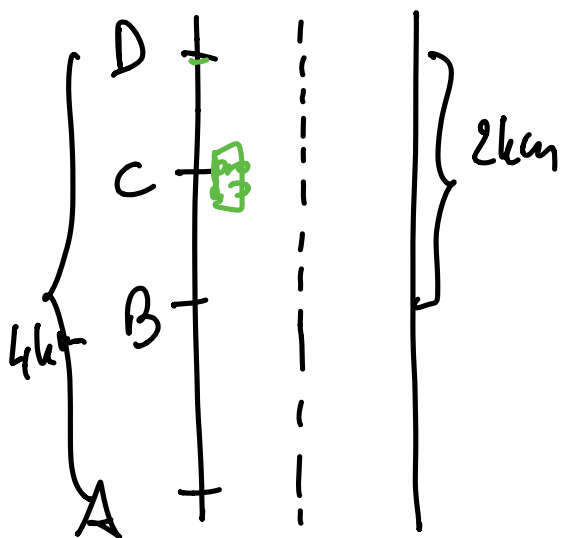
What is preserved?



$$CR(A, B, C, D) = \frac{AC}{AD} : \frac{BC}{BD}$$

divided

Most useful when  $A, B, C, D$  are along a line that has other lines parallel to it!



$CD = ?$



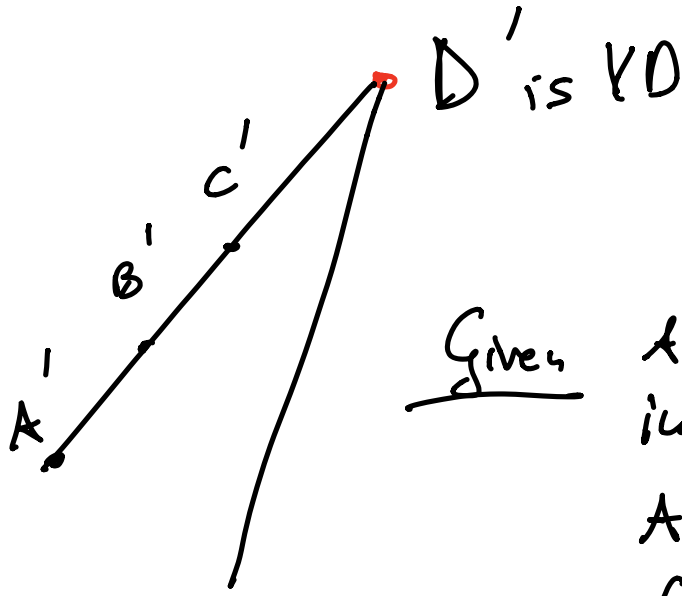
$$\frac{AC}{AD} : \frac{BC}{BD} = \frac{A'C'}{A'D'} : \frac{B'C'}{B'D'}$$

ground plane [m]

image is [pixels]

$D$  is at infinity!  $\Rightarrow CR = \frac{AC}{BC}$

$$\lim_{D \rightarrow \infty} \frac{AC}{AD} : \frac{BC}{BD} = \lim_{D \rightarrow \infty} \frac{AC \cdot BD}{BC \cdot AD} = \frac{AC}{BC} \lim_{D \rightarrow \infty} \frac{BD}{AD} = \frac{AC}{BC} \cdot 1$$



$$\lim_{d \rightarrow \infty} \frac{d-b}{d-a} = 1$$

Given A', B', C', D' in the image and

AC is the world

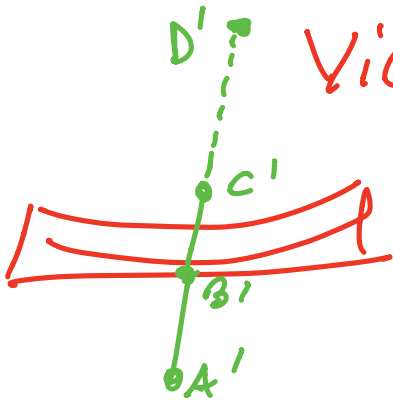
find BC?

$$\frac{A'C'}{A'D'} : \frac{B'C'}{B'D'} = \frac{AC}{BC}$$

image measurable

AC → known

BC → solve for it because D at infinity



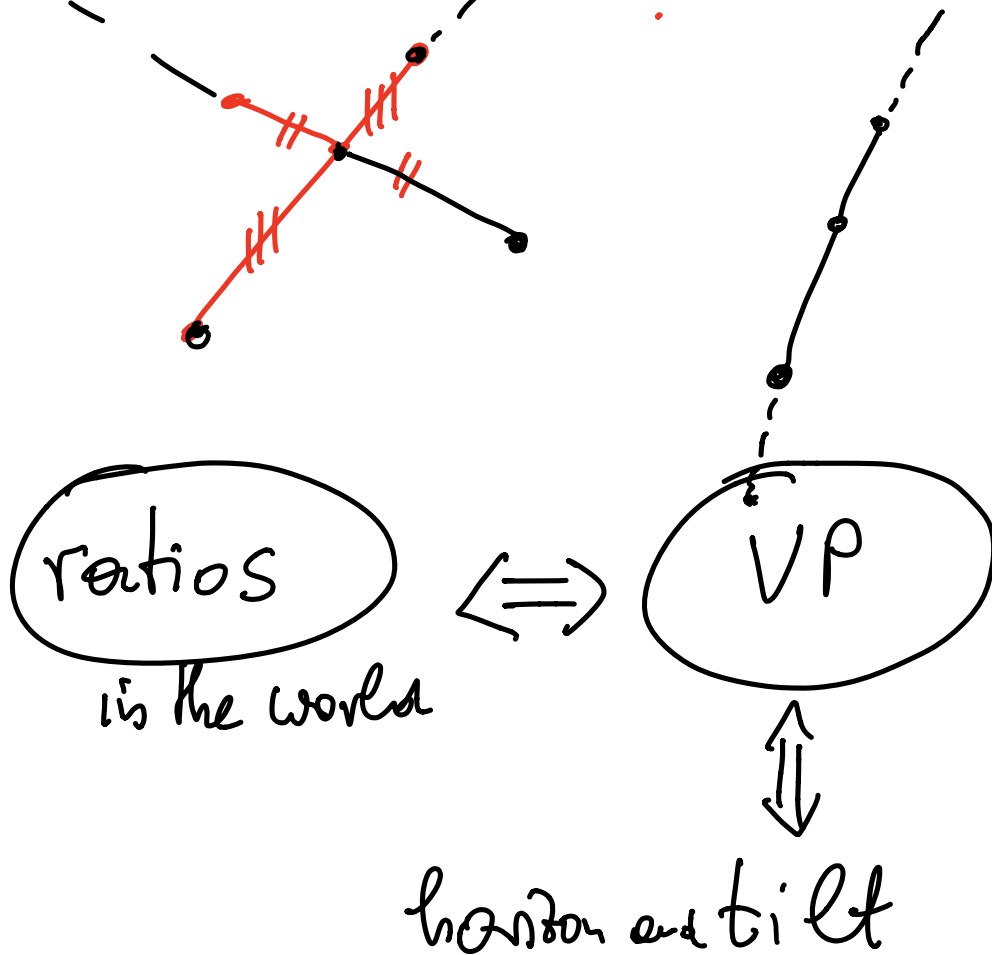
VICE VERSA

$$AB = BC \Rightarrow D'?$$

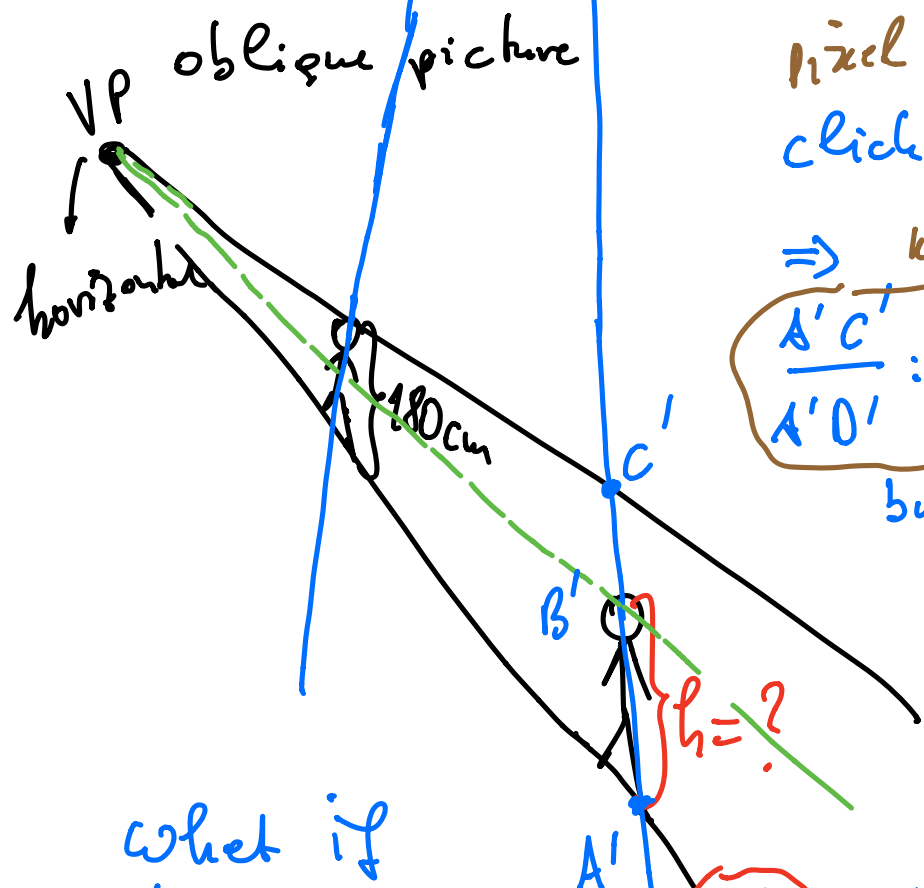
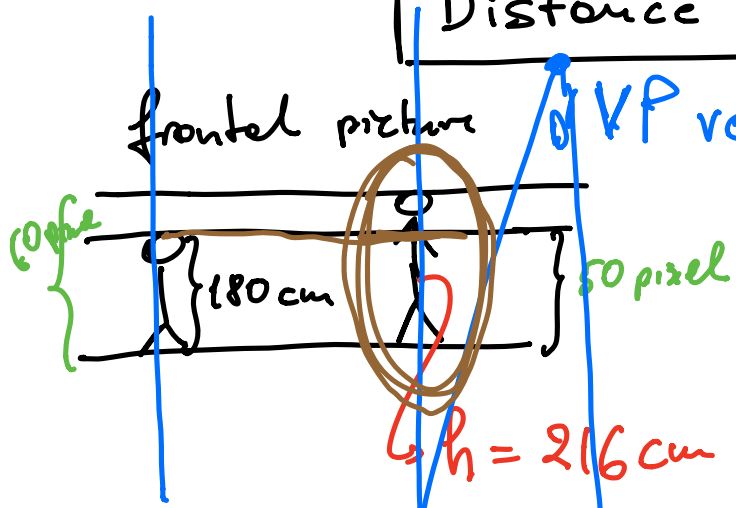
We can find VP

without seeing parallel lines?

Question: find horizon  
from the picture of a cross?



# Distance Transfer



pixel  
click  $A', B', C', D'$

$$\Rightarrow \frac{A'C'}{A'D'} : \frac{B'C'}{B'D'} = \frac{AC}{BC}$$

but  $AC = 180$

$$\downarrow$$

$$\frac{180}{180 - h} \Rightarrow h$$

what if  
 $D'$  is at infinity  
(blue lines parallel)

$$\frac{B'D'}{A'D'} = 1 \quad \frac{A'C'}{B'C'} = \frac{AC}{BC}$$