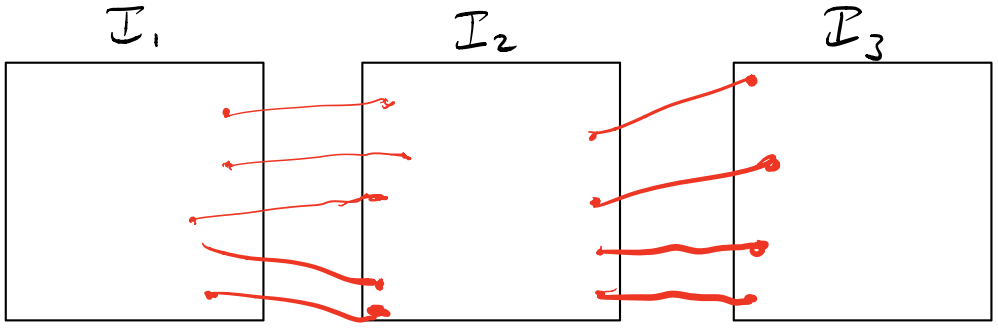
Panorama Stitching

We have most of the pieces now!

CAPTURE 1. Capture images with some overlap.

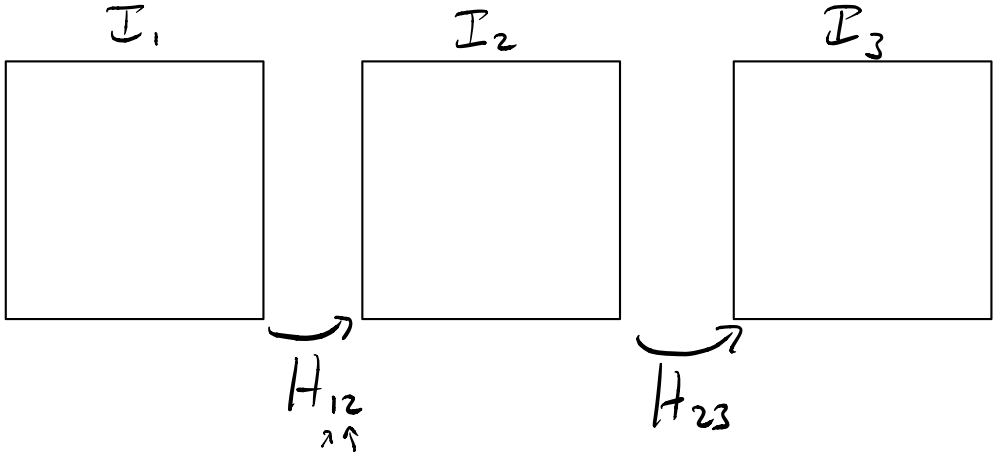
2. Detect, describe, and match features, yielding a set of feature correspondences between neighboring pairs.

MATCH



3. Fit a transformation to align neighboring pairs of images.

ALIGN PAIRWISE



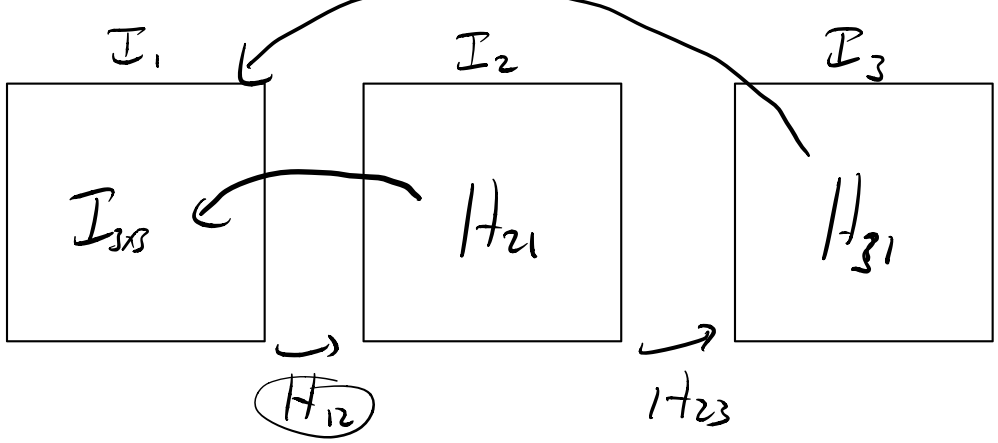
4. Compute each image's transform to the coordinates of some reference image (here: I_1)

ALIGN GLOBAL

$H_{21} = H_{12}^{-1}$

$H_{13} = H_{23} H_{12}$ $\begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$

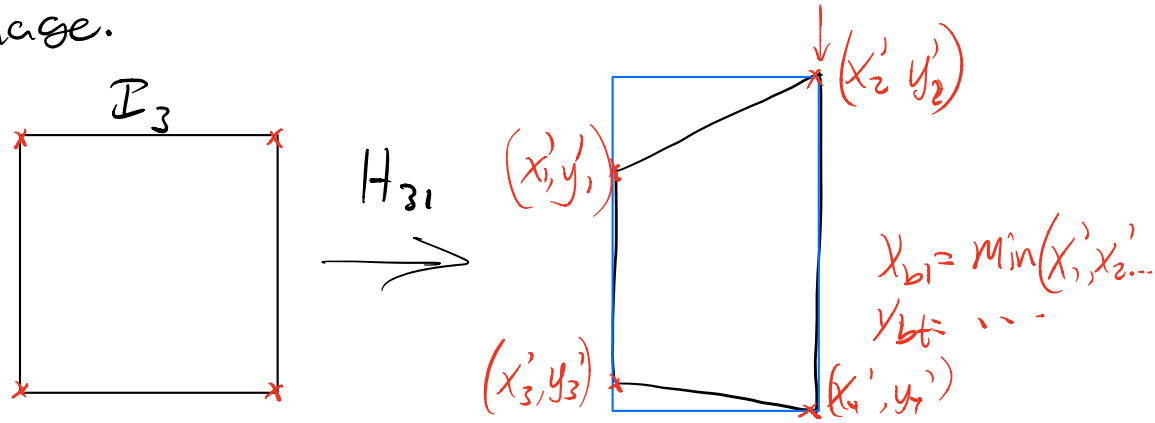
$H_{31} = H_{13}^{-1}$



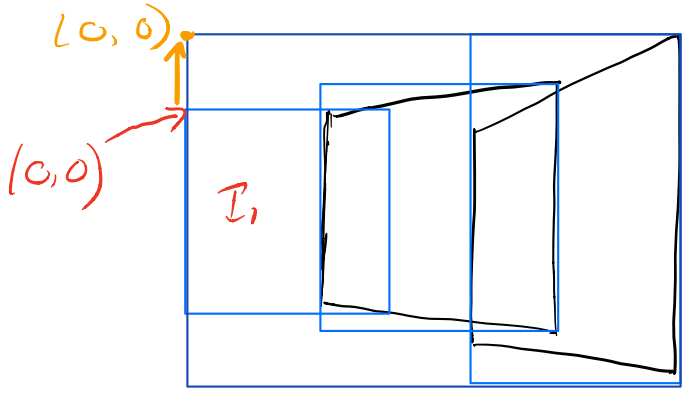
5. Create an accumulator to store the output panorama: Needs to fit all warped images.

SET UP OUTPUT IMAGE

5a. Compute the bounding box of each warped image.



5b. Bounding box of all the bounding boxes.

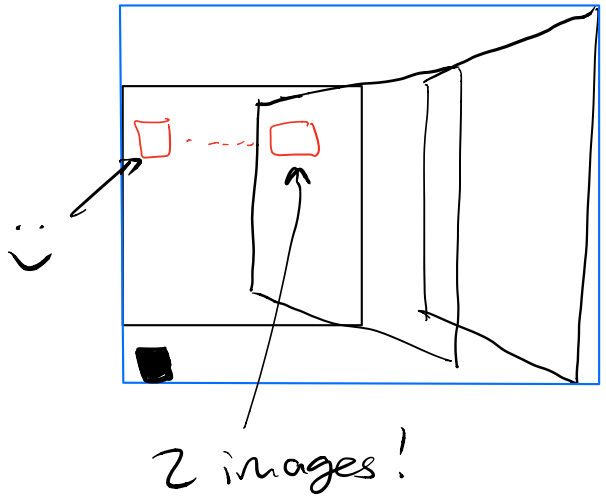


5c. Adjust transformations to put the accumulator origin in the top left.

WARP

6. Warp each image and add it into acc

↳ use inverse warping!



2 images!

```
for each img
  for (y,x) in acc:
    iy,ix = H_img^-1 (y,x)
    acc[i,j,:] += interp(img,ix,iy)
```

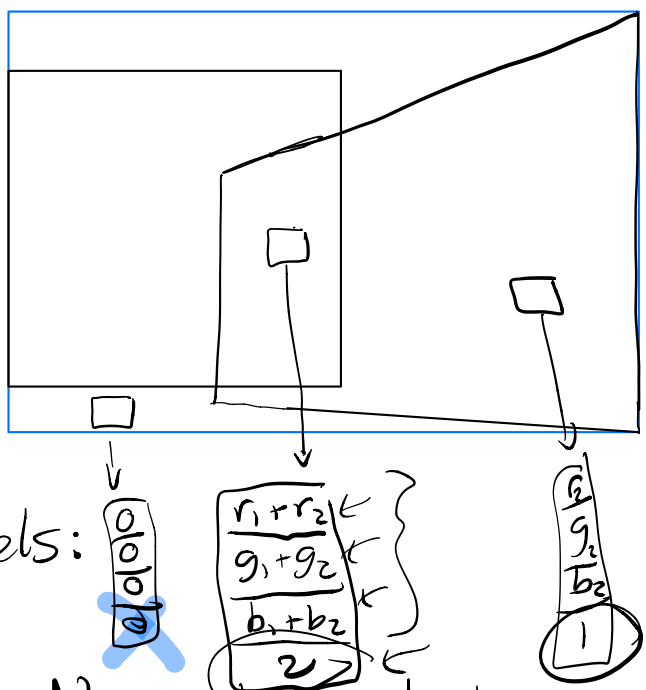
BLEND

6a. Accumulate weighted pixel contributions.

Store weight in 4th channel of input and acc.

Input Pixel:

r	g	b	1



Same as above, but:

acc(y,x) += interp(I,ix,iy)

Output pixels:

6b. Normalize: divide each pixel by its total weight.

```
a[a>0] += 10
```

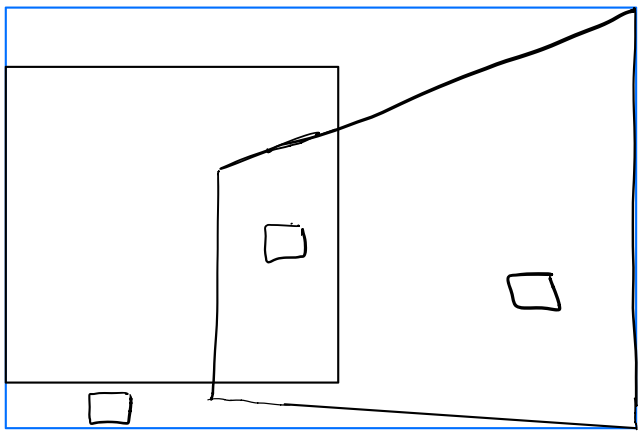
NP Magic!

```
acc /= acc[:,:,3]
```

↑ be careful! don't divide by 0

6' (Refinement): Hide the seams!

BLEND W/ FEATHERING



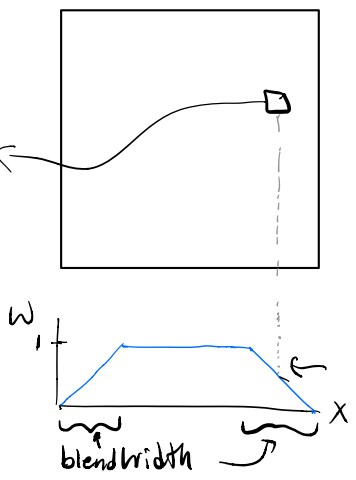
Trick: weight images less near the edges.

How? Use the same 4th channel!

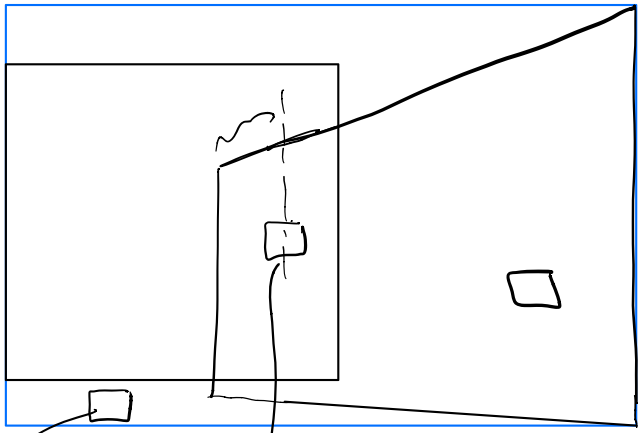
Inputs:

I_1

$0.5\,r_1$
$0.5\,g_1$
$0.5\,b_1$
0.5



Output:



0
0
0
0

$\frac{1}{2}r_1 + 0.7r_2$
$\frac{1}{2}g_1 + 0.7g_2$
$\frac{1}{2}b_1 + 0.7b_2$
$\frac{1}{2} + 0.7$

≥ 1.2

after normalizing

r'
g'
b'
1

GoTo Slides - 360?