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**

\[ I_1 \quad I_2 \quad I_3 \]

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

**ALIGN**

\[ I_1 \quad I_2 \quad I_3 \]

\[ H_{12} \quad H_{23} \]

4. Compute each image's transform to the coordinates of some reference image (here: \( I_1 \)).
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.
6. Warp each image and add it into acc for each img:
for \((y, x)\) in acc:
\[y' \times x = H^{-1}(y, x)\]
\[\text{acc}(i, j, k) \leftarrow \text{interp}(I, i, j, y')\]

**WARP**

2 images!

**BLEND**

6a. Accumulate weighted pixel contributions.
Store weight in 4th channel of input and acc.

Input Pixel:
\[1961\]

Output pixels:
\[\begin{align*}
0 & \quad 0 \\
0 & \quad 0 \\
0 & \quad 0 \\
\end{align*}\]

\[\begin{align*}
\frac{r_1+r_2}{g_1+g_2} & \quad \frac{b_1+b_2}{2} \\
\frac{b_1+b_2}{2} & \quad 1 \\
0 & \quad 0 \\
\end{align*}\]

6b. Normalize: divide each pixel by its total weight.
\[\alpha[a > 0] \leftarrow 10\]

NPD Magic!

**Note:** 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:**

- \( I_0 \)
- \( I_0, \)
- \( I_0, \)
- \( I_0, \)
- \( I_0, \)

**Blendwidth**

**Output:**

\[
\begin{align*}
&\frac{1}{2} I_1 + 0.7 I_2 \\
&\frac{1}{2} I_1 + 0.7 I_2 \\
&\frac{1}{2} I_1 + 0.7 I_2 \\
&\frac{1}{2} I_1 + 0.7 \\
&\frac{1}{2} I_1 + 0.7 \\
\end{align*}
\]

After normalizing

\[
\begin{align*}
&\frac{1}{2} I_1 \\
&I_1 \\
&I_1 \\
&\frac{1}{2} I_1 \\
&\frac{1}{2} I_1 \\
\end{align*}
\]
GOTO Slides- 360?