CSCI 497P/597P: Computer Vision

Lecture 19

The (correct) Pinhole Projection Matrix

360 (Spherical) Panoramas

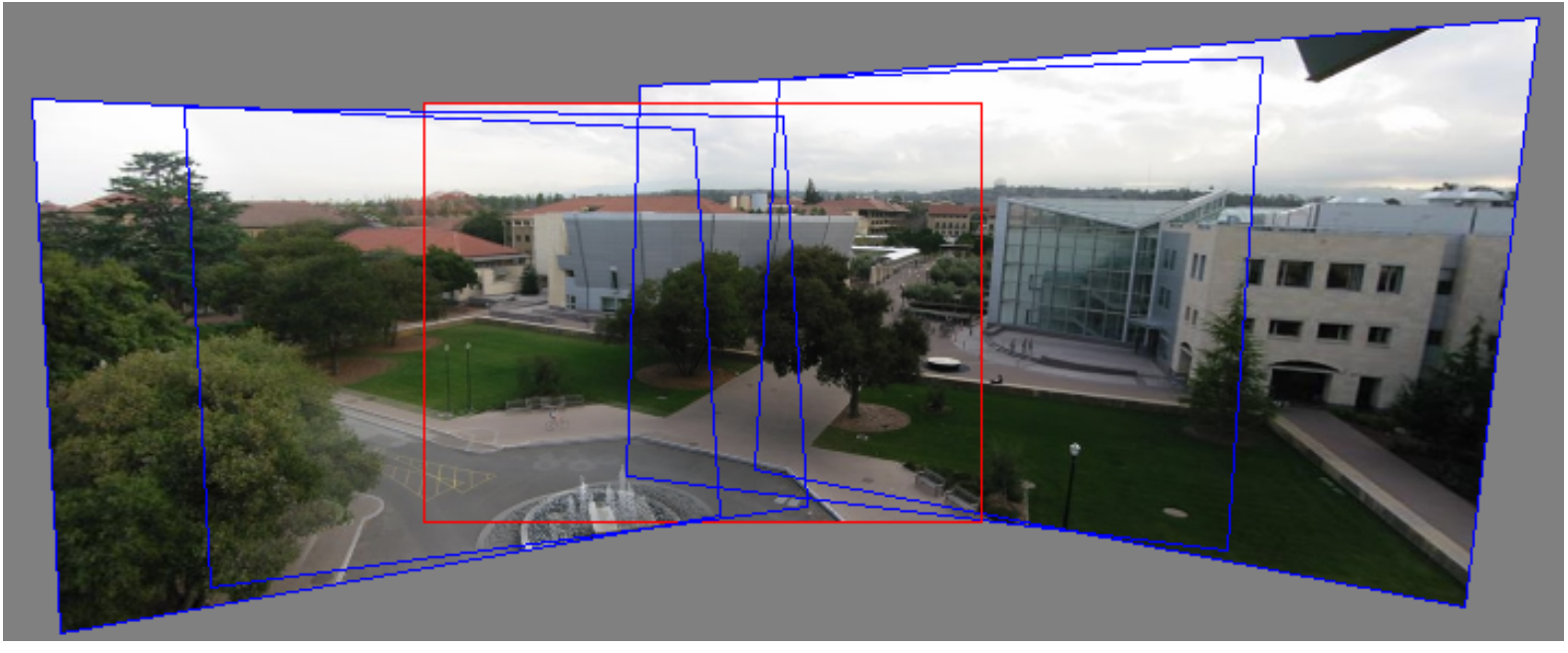
Announcements

- HW2 due tonight!
- How's P2 going?

Goals

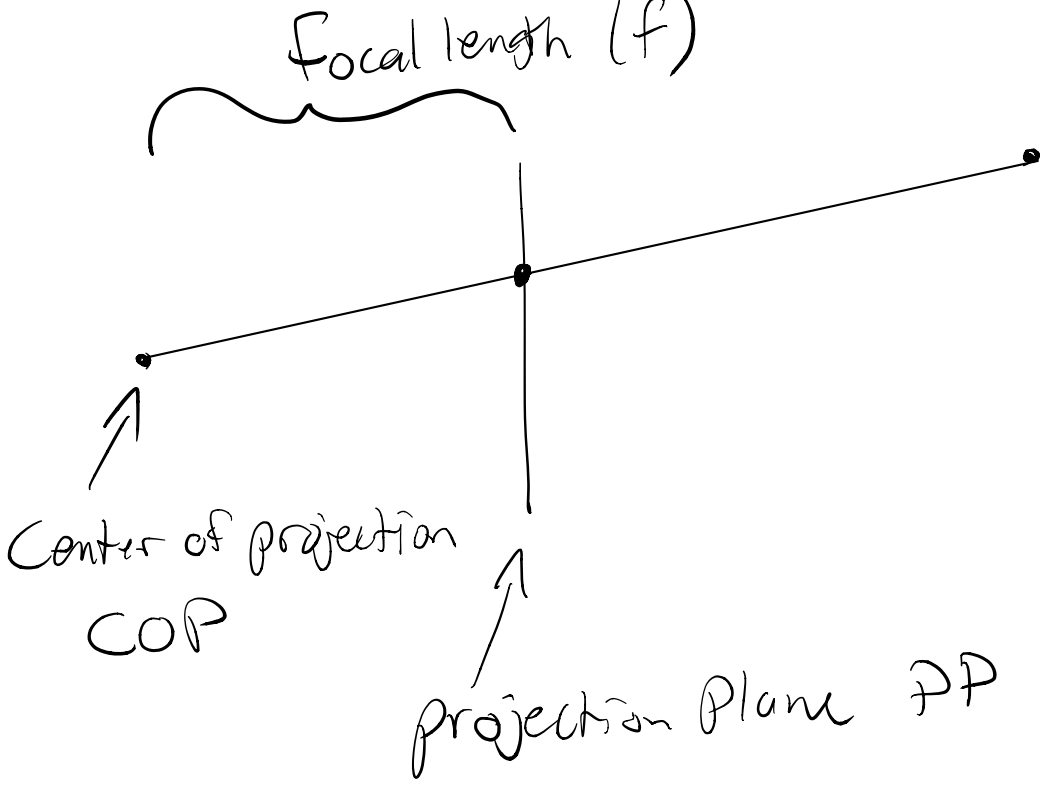
- Understand where images come from (under the pinhole camera model)
  - ~~Be able to derive~~ Understand the 3x4 pinhole projection matrix
- Know how to create 360 degree panoramas by mapping images onto a spherical surface instead.

Can we make 360 panoramas?



To answer this, we need to know how these images came to be.
Why can we even make **any** panoramas with homographies?

Projection


focal length (f)
Center of projection
COP
projection Plane PP


MAKE POVERTY HISTORY
JULIAN BEEVER
CoolOpticalIllusions.com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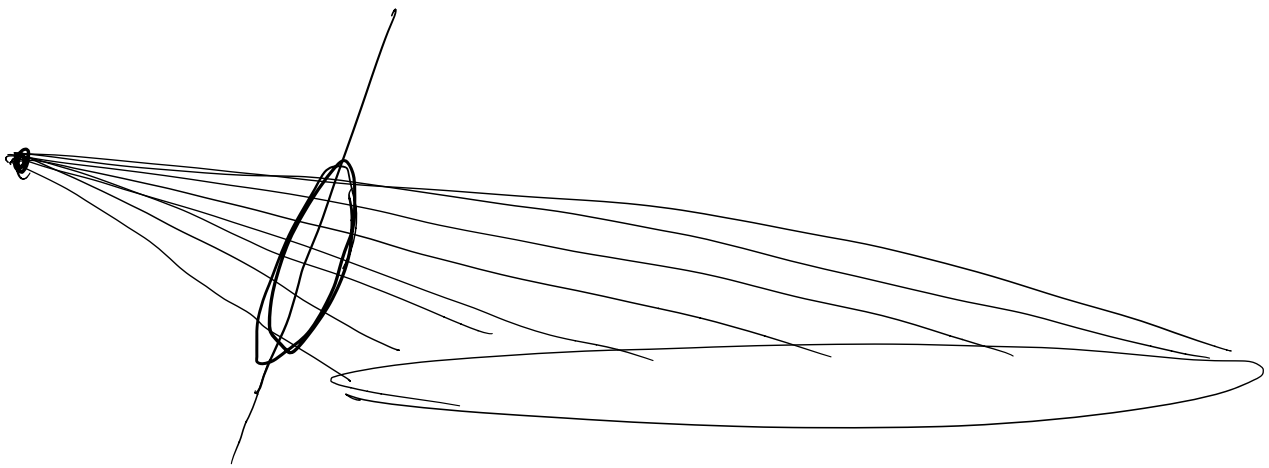
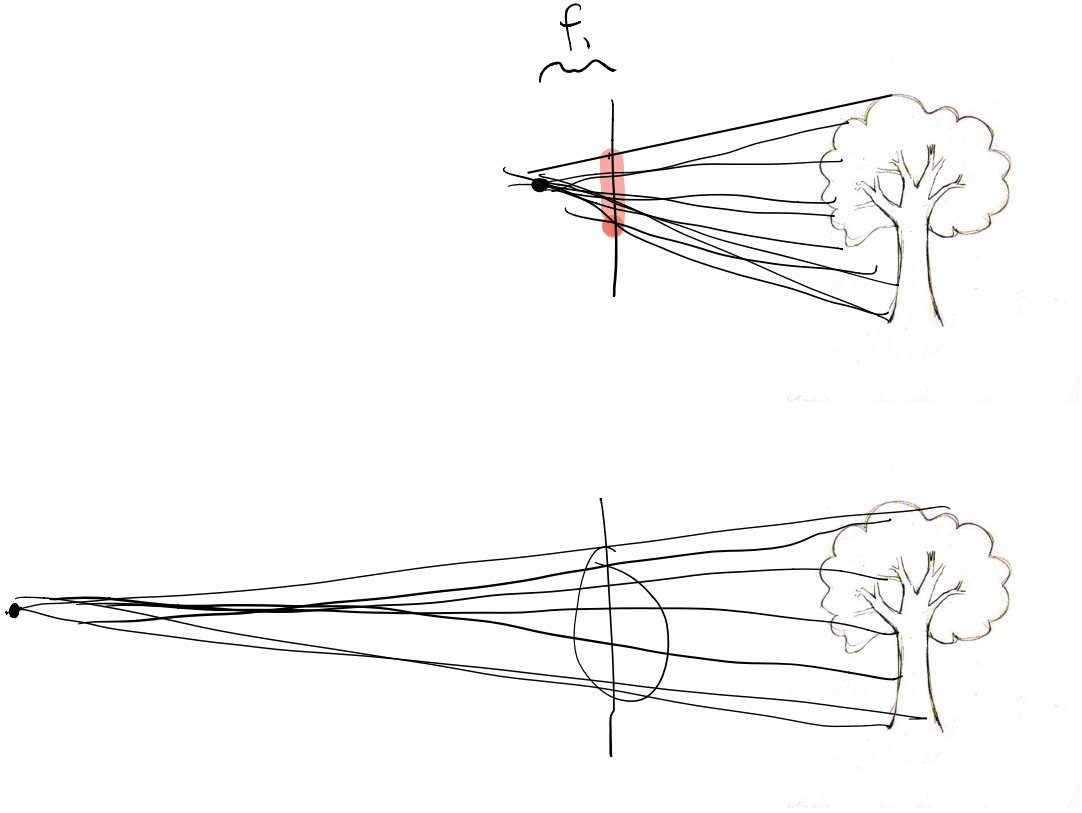


Focal Length



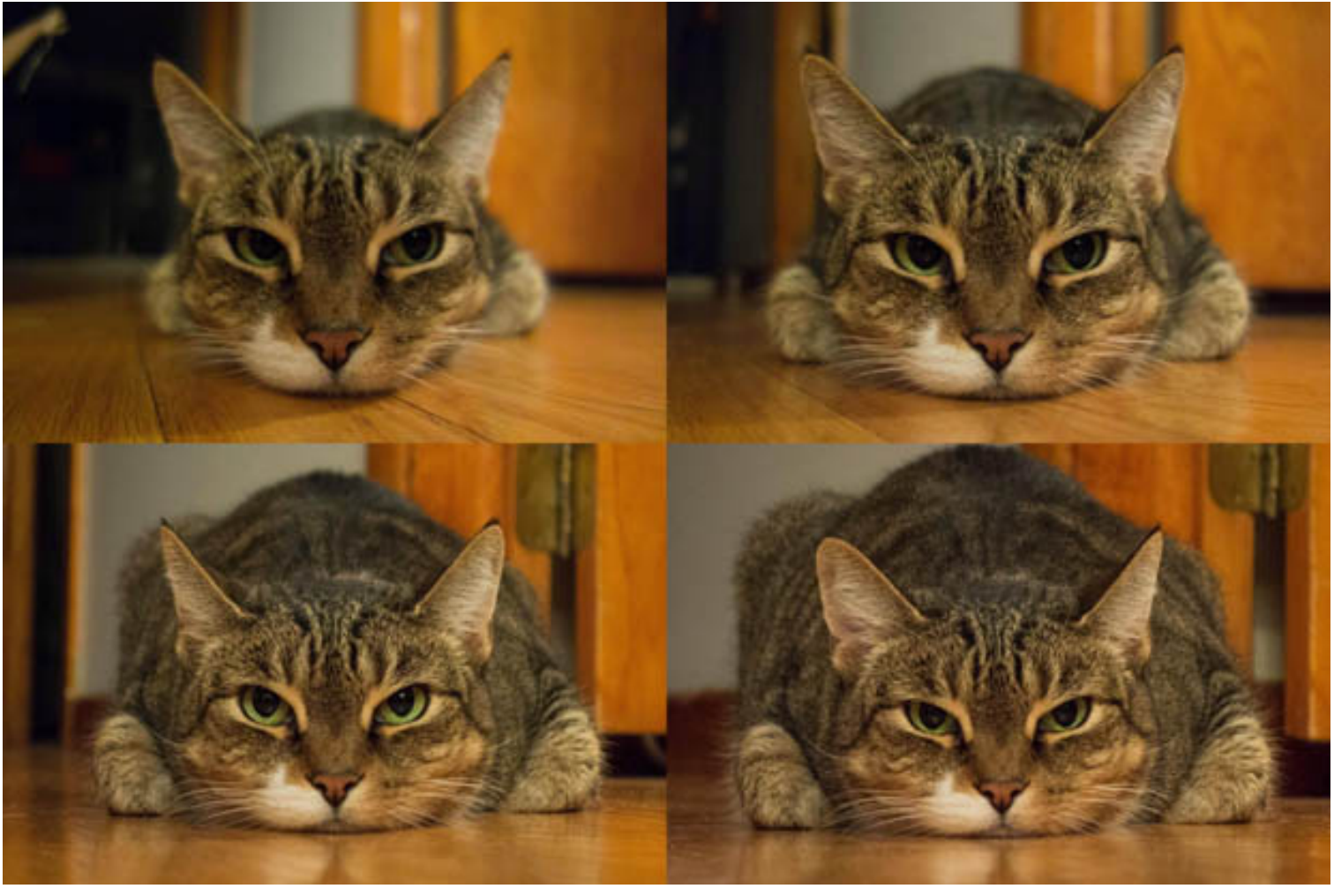
The effect of Focal Length

24 mm

70mm

105 mm

300mm



Pinhole Projection Matrix

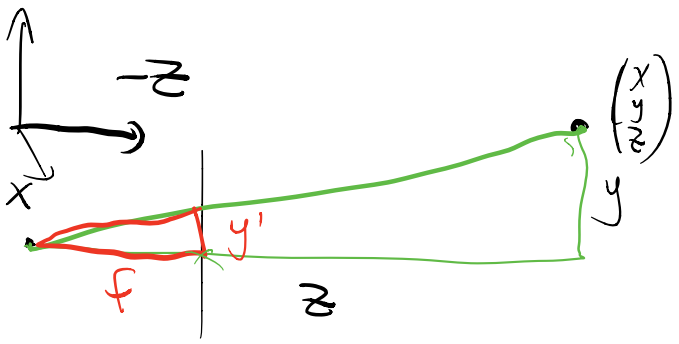
take 2

$$\begin{bmatrix} -fx \\ -fy \\ z \end{bmatrix} \begin{bmatrix} -f & 0 & 0 & 0 \\ 0 & -f & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

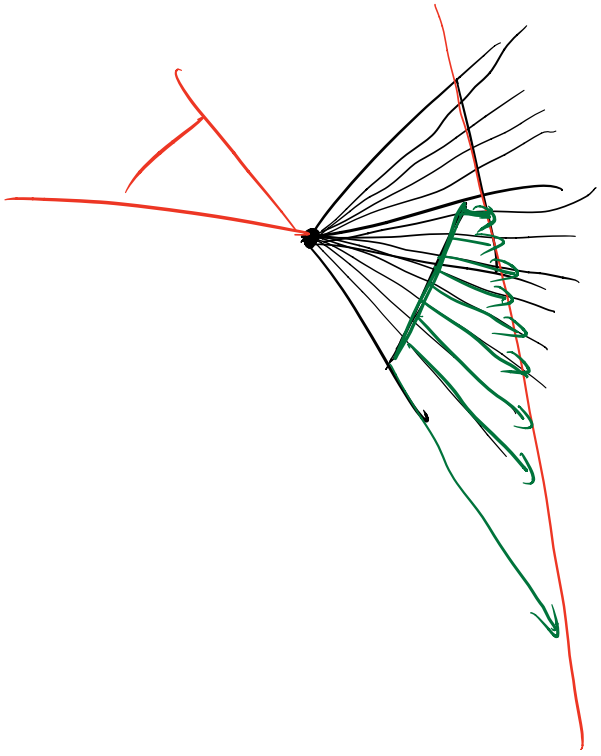
$$x' = \frac{-fx}{z} \qquad y' = \frac{-fy}{z} \qquad z' = -f$$

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1/f & 0 \end{bmatrix}$$



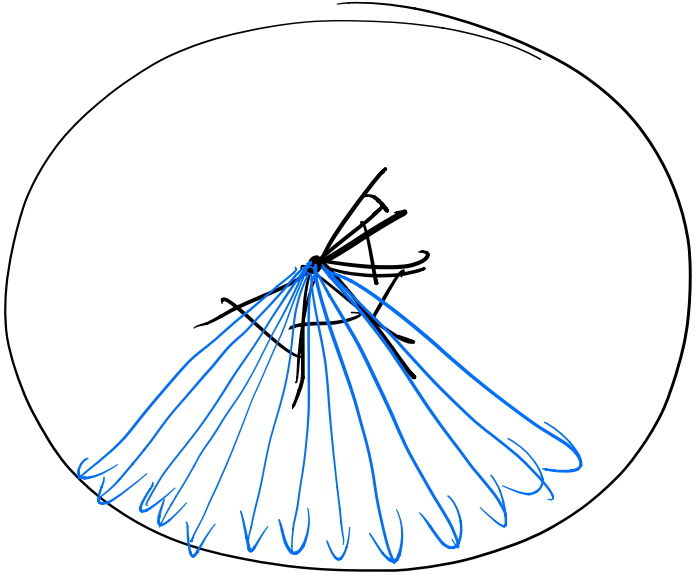
Planar Panoramas



We can't make 360 panoramas with homographies.

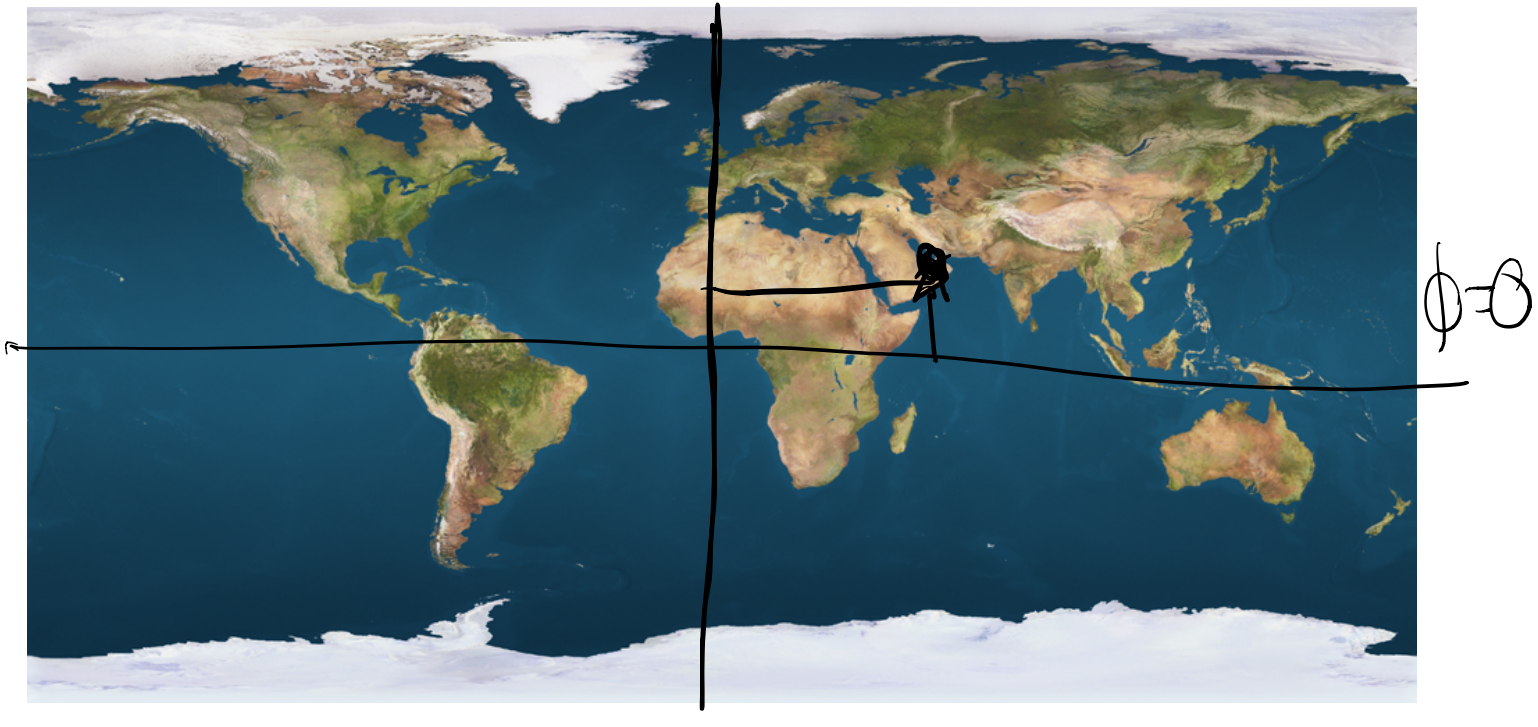
Spherical Panoramas

Idea: project images onto a **sphere** instead of a plane.



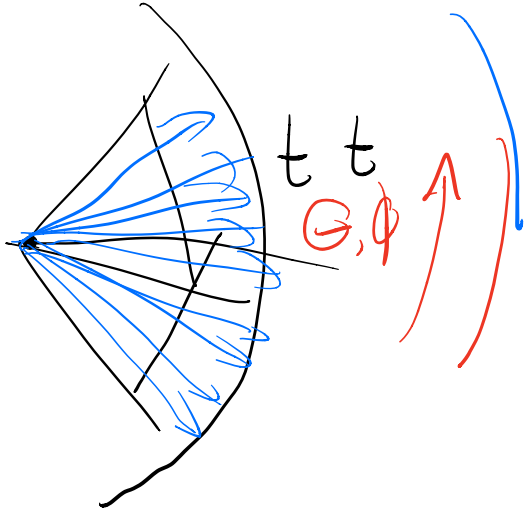
Example: Google Street View

Unwrapping a Sphere



Spherical Panoramas

What motion model should we use?



Spherical Panoramas

1. Warp planar images onto the surface of a sphere

2. Align with **translational** motion model.

3. Stitch and blend as usual.