Week: 11-12 Segmentation

segmentation : vital first step

* How to assign pixels to a set of related pixels?

- Edge/boundary : look for differences
- Region : look for similarities

qualities of image

(1) color
(2) texture
(3) motion
*(4) shape
*(5) proximity
*(6) affordance

A case study: robot motion

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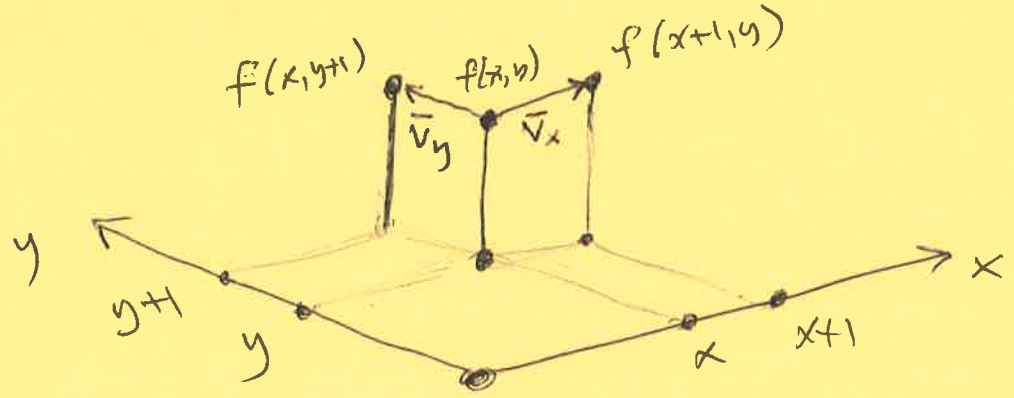
Surface normals can be found:

$$\frac{\partial f(x,y)}{\partial x} = \frac{f(x+1,y)-f(x,y)}{\Delta x} = f_x(x,y)$$

$$\frac{\partial f(x,y)}{\partial y} = \frac{f(x,y+1)-f(x,y)}{\Delta y} = f_y(x,y)$$



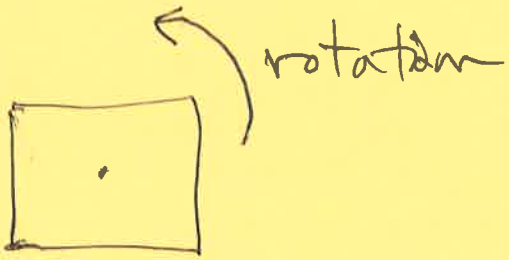
Let $\bar{v}_x = [x+1, y, f(x+1,y)] - [x,y,f(x,y)] = [1, 0, f_x(x,y)]$

$\bar{v}_y = [x, y+1, f(x,y+1)] - [x,y,f(x,y)] = [0, 1, f_y(x,y)]$

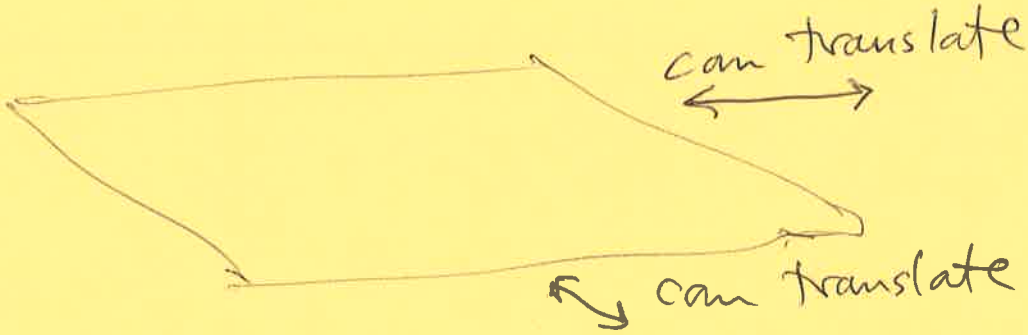
normal $\bar{n} = \bar{v}_x \times \bar{v}_y$

$$= \begin{vmatrix} 0 & f_x(x,y) \\ 1 & f_y(x,y) \end{vmatrix} \bar{i} - \begin{vmatrix} 1 & f_x(x,y) \\ 0 & f_y(x,y) \end{vmatrix} \bar{j} + \begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix} \bar{k}$$

$$= -f_x(x,y)\,\bar{i} - f_y(x,y)\,\bar{j} + 1\,\bar{k}$$



Consider a plane



Consider affordance to move forward on flat surface

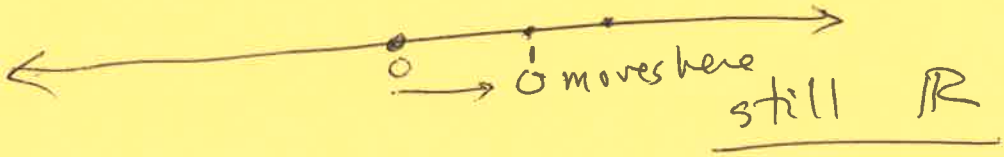
Assume a range map $f(x,y)$ = distance to surface
(called a Monge patch)

The Notion of Symmetry

Given a point set, some operation on the set results in the same set.

Example:

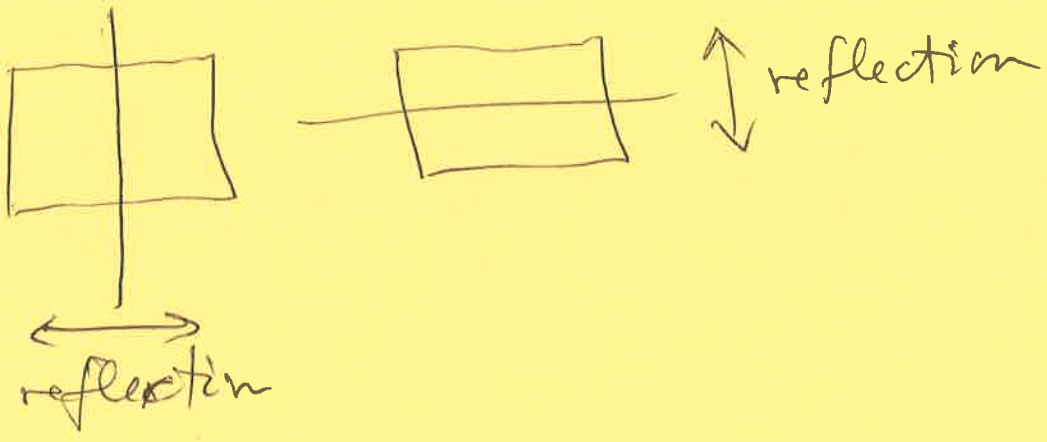
operation: slide the line to the right 1 unit
($\ell_2(x) = \ell_1(x) + 1 = x + 1$)



combine action + perception in representation

Consider a square:

some symmetries:



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affordance

something a physical feature offers in terms of action

↖ handle : human can hold it

← roof : shelter from ...

← flat surface : can walk

how can image be converted to affordance info ?