2.1

$$I_{corr}(x,y) = \int_t \int_s I(x+s, y+t)\, k(s,t)\, ds\, dt$$

1D $\quad I_{corr}(x) = \int_s I(x+s)\, k(s)\, ds$

$I =$ 9 5 2 1 3 4 6 2 4

$k =$ 1 2 1

$\downarrow$

21 10 7 ...

2.2

let $s = -a$, $t = -b$

$$corr(I,k) = \int_b \int_a I(x-a, y-b)\, k(-a,-b)\, \underbrace{|J|}_{=1}\, da\, db = conv(I, k')$$

where $k'(a,b) = k(-a,-b)$ flip in x,y == rotate 180°

2.3

$\frac{1}{4}[1\ 2\ 1] * [72\ 88\ 62\ 52\ 37]$

$$= \frac{1}{4}\begin{bmatrix} 1 & 2 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 2 & 1 & 6 & 0 & 0 \\ 0 & 0 & 1 & 2 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 2 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 2 & 1 \end{bmatrix} \begin{bmatrix} 0 \\ 72 \\ 88 \\ 62 \\ 52 \\ 37 \\ 0 \end{bmatrix}$$

linear,

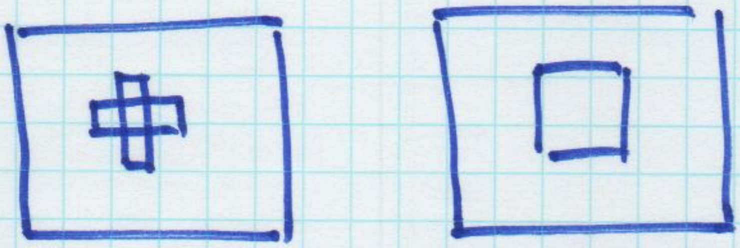
associative $\quad a*(b*c) = (a*b)*c$

$$I' = \int_s \int_t I(x-s, y-t)\, k(s,t)\, ds\, dt \qquad \begin{aligned} a &= x-s \\ b &= y-t \end{aligned}$$

$$\int_a \int_b I(a,b)\, k(x-a, y-b)\, db\, da$$

$I * k = k * I \rightarrow$ commutative

<u>2.4</u>



$2n$ $*/+$ $\qquad$ n^2 $*/+$

$$I(x,y) * g(x,y) = I(x,y) * g(x) * g(y)$$

$$\parallel$$

$$g(x)g(y) = g(x) * g(y)$$

$$g(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{1}{2}\left(\frac{x}{\sigma}\right)^2}$$

2.5

$$SSD = \sum_R |I(x+\Delta x) - I(x)|^2$$

$$I(x+\Delta x) = I(x) + \nabla I^T \Delta x + \dots$$

$$SSD \simeq \sum_R |\nabla I^T \Delta x|^2 = \Delta x^T \left(\sum_R \nabla I \nabla I^T \right) \Delta x$$

$H = \sum_R \nabla I \nabla I^T$ corner if 2 large eigval.

$$\nabla I = \begin{bmatrix} I_x \\ I_y \end{bmatrix}$$

$$H = \sum_R \begin{pmatrix} I_x^2 & I_x I_y \\ I_x I_y & I_y^2 \end{pmatrix}$$

$$f_{Harris} = \det(H) - k \, Tr(H)^2$$

derivative scale σ_D used for $I_x I_y$

integration scale σ_I used for conv of $I_x^2, I_x I_y$..

2.6 Normalised correlation $\frac{I^T J}{|I||J|}$

$$SSD = |I-J|^2 = (I-J)^T(I-J)$$

$$= |I|^2 + |J|^2 - 2I^T J$$

so if $|I| = |J| = 1$

$$SSD = 2 - 2\,\mathrm{CORR}$$