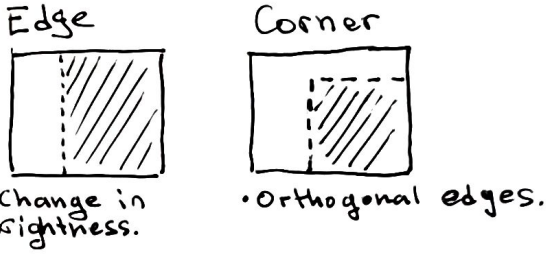
Feature Points (Keypoints + Descriptors)

- A feature is composed of a keypoint and a descriptor.
- A keypoint will contain the 2D point position, and sometimes scale, and orientation.
- A descriptor will contain a visual description of the keypoint, it can be used to compare similarities between feature points.
- Keypoint include corners, edges



- Keypoint detection methods:
  1. Harris
  2. Shi-Tomasi
  3. Forstner
  4. Difference of Gaussian (DoG)

- Structure matrix (tensor).

$$M = \begin{vmatrix} \sum_w I_x I_x & \sum_w I_x I_y \\ \sum_w I_x I_y & \sum_w I_y I_y \end{vmatrix}$$

- Also called second moment matrix.
- Can be derived by taking a gradient, of a sum of squared differences (SSD) denoted by $f(x,y)$.

$$f(x,y) = \sum_{(x',y') \in W_{xy}} [I(x',y') - I(x'+dx', y'+dy')]^2$$

- M describes the distribution of a gradient in the window W around point x, y.
- I is an image.
- W is a window around point x, y, that we are shifting by dx, dy.
- J_x is a derivative of I with respect to x. J_y with y.

Actually, let me derive it quick...

Taylor of $I(x'+dx, y'+dx)$ is...

$\sim I(x',y') + I_x(x',y') + I_y(x',y')...$

$[dI/dx \; dI/dy]$ so, $I(x',y') + [J_x J_y]\begin{bmatrix} dx' \\ dy' \end{bmatrix}$ will cancel out.

Cool this is similar to Jacobian

$$f(x,y) \approx \sum_w \left[[J_x J_y] \begin{bmatrix} dx' \\ dy' \end{bmatrix} \right]^2$$

Will result in M, change in I in local area.