Object Detection

Image regions need to be found and assigned with semantic labels from a space of object classes.

Shape detection and segmentation of their own rarely work for real-world object detection because of the following:

- High intra-class variance
- Low inter-class variance
- Classes are rarely well-defined
- Changes in illumination, scale, pose, deformation, occlusion

Terms:

Classification - Program tells you what is in the image

Localisation - Program tells you where the object is

Object Detection = Classification + Localisation

Colour Based Detection:

Map 3D spacec to RGB space and cluster. Map this clustering back to image space.

Morphological Operations:

Erosion:

$$A\Theta B = \{z|B_z \subseteq A\} = \text{Set of pixel locations z that overlap with foreground pixels in A}$$

Dilation:

$$A \oplus B = \{z|\hat{B}_z \cap A \neq \phi\}$$

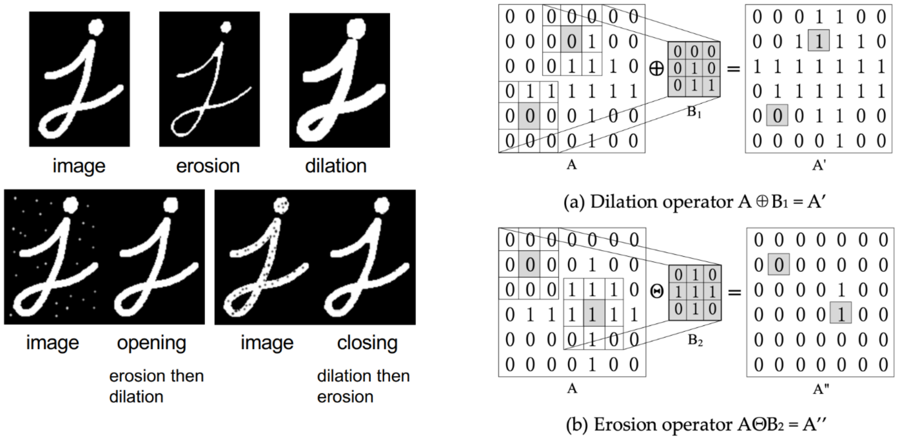
Template Matching:

A window is scaled and slided through an image, each resulting window is judged w.r.t. an object model giving a response indicating object prescence or abscence.

Find the maximum similarity or the minimum difference within the defined threshold.

- Maximum:

$$\text{corrolation} = \frac{1}{N}\sum_{i=1}^{N}(\frac{y_i - \mu_y}{\sigma_y})(\frac{\hat{y}_i - \mu_{\hat{y}}}{\sigma_{\hat{y}}})\text{Pixel i in box y in the image, y is the same size as y, multplied by pixe}$$



$$\underset{A}{\begin{bmatrix}0&0&0&0&0&0&0\\0&0&0&0&1&0&0\\0&0&0&1&1&1&0\\0&1&1&1&1&1&1\\0&0&0&0&1&0&0\\0&0&0&0&1&0&0\end{bmatrix}} \oplus \underset{B_1}{\begin{bmatrix}0&0&0\\0&1&0\\0&1&1\end{bmatrix}} = \underset{A'}{\begin{bmatrix}0&0&0&1&1&0&0\\0&0&1&1&1&1&0\\1&1&1&1&1&1&1\\0&1&1&1&1&1&1\\0&0&0&1&1&0&0\\0&0&0&0&1&0&0\end{bmatrix}}$$

(a) Dilation operator $A \oplus B_1 = A'$

$$\underset{A}{\begin{bmatrix}0&0&0&0&0&0&0\\0&0&0&0&1&0&0\\0&0&0&1&1&1&0\\0&1&1&1&1&1&1\\0&0&0&0&1&0&0\\0&0&0&0&1&0&0\end{bmatrix}} \Theta \underset{B_2}{\begin{bmatrix}0&1&0\\1&1&1\\0&1&0\end{bmatrix}} = \underset{A''}{\begin{bmatrix}0&0&0&0&0&0&0\\0&0&0&0&0&0&0\\0&0&0&0&1&0&0\\0&0&0&0&1&0&0\\0&0&0&0&0&0&0\\0&0&0&0&0&0&0\end{bmatrix}}$$

(b) Erosion operator $A \Theta B_2 = A''$

Figure 1: Untitled

- Minimum:
  - Mean Absolute Error
  - Mean Squared Error

Disadvantages:

- Doesnt work in other orientations
- Not very performant
- The objects in the image must be pixel by pixel similiar

Optical Character Recognition:

- First use Adaptive Gaussian Thresholding

$$dst(x,y) = \begin{cases} maxValue & \text{if src(x,y)>T(x,y)} \\ 0 & \text{otherwise} \end{cases}$$

$$T(x,y) = \text{Mean of neiborhood the area + a constant}$$

- Then deskew the image, detect straight lines and straighten
- Then segmentation to seperate characters + Erosion and Dilation
- Finally we can use feature mapping (Polygonal Approximation) to detect letters.