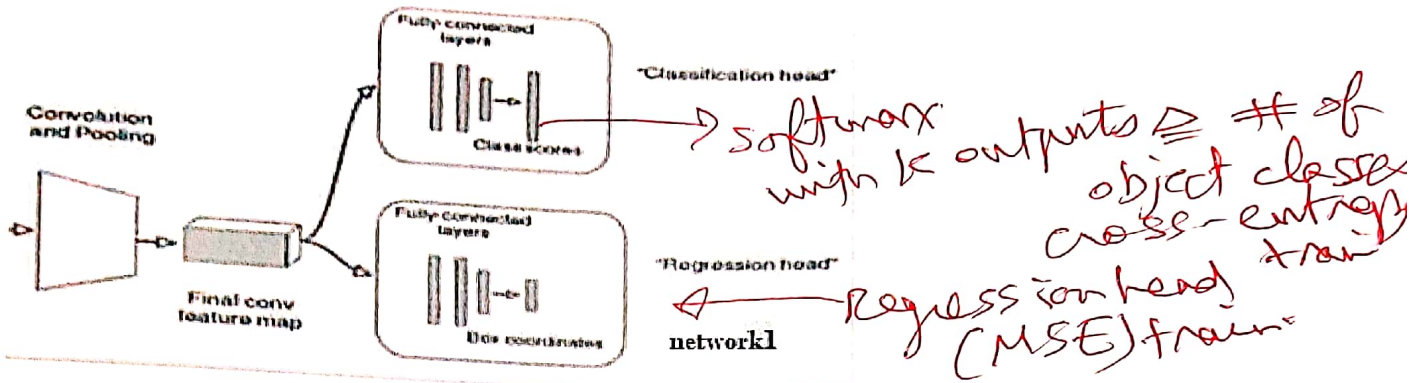**(d) For the Two deep learning networks shown below:**

(i) Explain what **network1** is used for? What the training data for this network should look like? (Show example of input and output data during training and testing) and how the network is trained and what is its expected output? **(2)**

Convolution and Pooling

Final conv feature map

Fully connected layers — "Classification head" — Class scores

Fully connected layers — "Regression head" — Box coordinates

network1

→ softmax with k outputs ≤ # of object classes
cross-entropy train
← Regression head
(MSE) train

(ii) Explain what **network2** is used for? What the training data for this network should look like? (Show example of input and output data during training and testing) and how the network is trained and what is its expected output? **(2)**
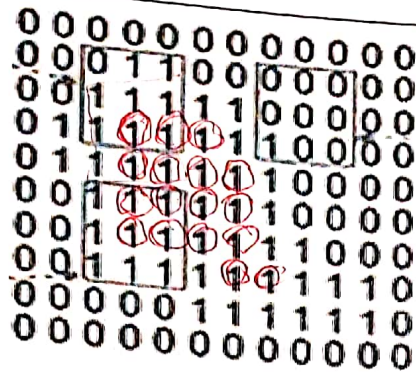

Convolution network   Deconvolution network
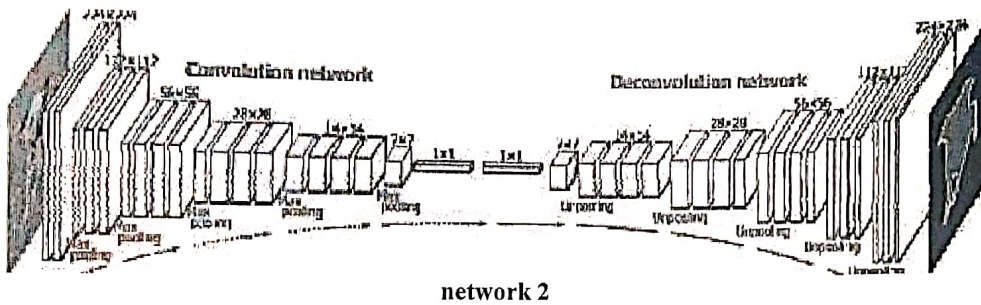
network 2

(i) net1 : object detection and classification

Training [image] → (class, (x, y, w, h) : bounding box.

Testing. input Imgs ⇒ class prob. and BBox coordinate

⇒ Car plate detection, person, bicycle, ...

(ii) FCN → fully-conv.-Network → semantic segm.
does pixel-level segment.

Train ⇒ [Img] → [MASK] ← each pixel has a label (0 → k) # of categories

Testing [img] → [img] semantic segm per pixel

$$S = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

```
0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 1 1 0 0 0 0 0 0 0 0
0 0 1 1 1 1 0 0 0 0 0 0 0
0 1 1 1 1 1 1 0 0 0 0 0 0
0 1 1 1 1 1 1 0 0 0 0 0 0
0 0 1 1 1 1 1 0 0 0 0 0 0
0 0 1 1 1 1 1 0 0 0 0 0 0
0 0 1 1 1 1 1 1 0 0 0 0 0
0 0 1 1 1 1 1 1 1 0 0 0 0
0 0 0 0 0 1 1 1 1 1 1 0 0
0 0 0 0 0 0 1 1 1 1 1 0 0
0 0 0 0 0 0 0 0 0 0 0 0
```

(1)

(e)

i- Do an **"Erosion"** operation on the Binary image shown using the shown structuring element **(1)**

ii- Do a **"Dilation"** operation using the same structuring element on the Eroded image **(outcome of (i)) (1)**

iii- What is the name of the **process (i) followed by (ii)?** And what it is usually used for? **(1)**

(1)
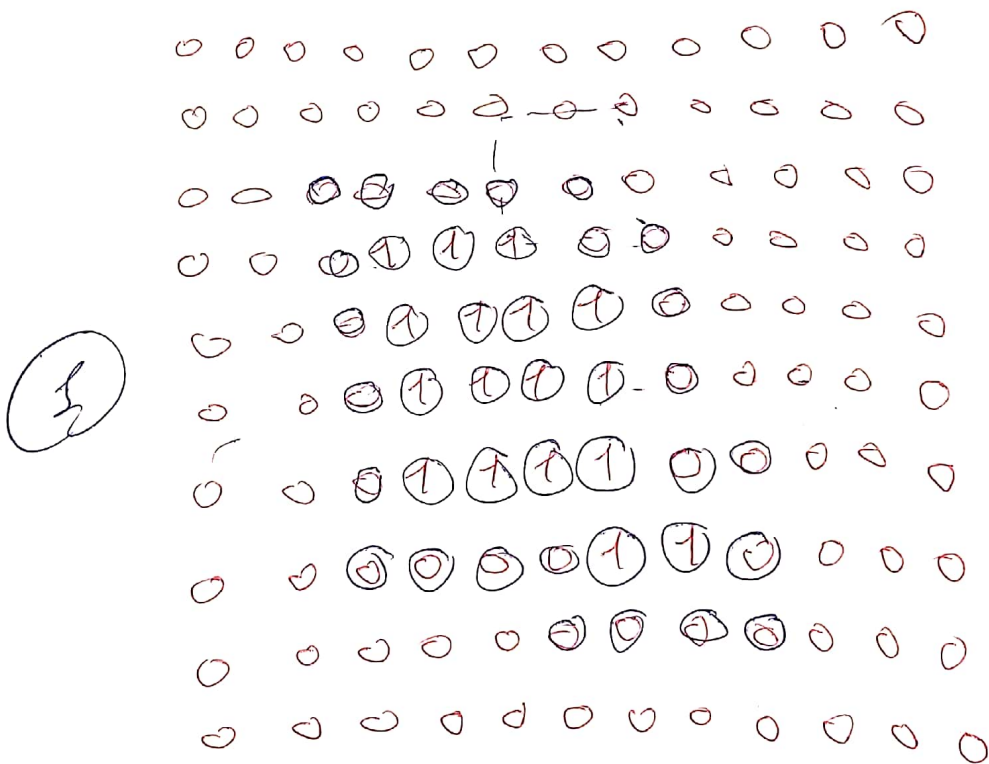
(i) The ovals ↔ after erosion (i)

(ii) The circles ← after dilation of eroded i

(iii) This is called opening operation
(erosion followed by dilation)
usually used for; spot and noise removal
search for specific shapes, based on the
structuring element.