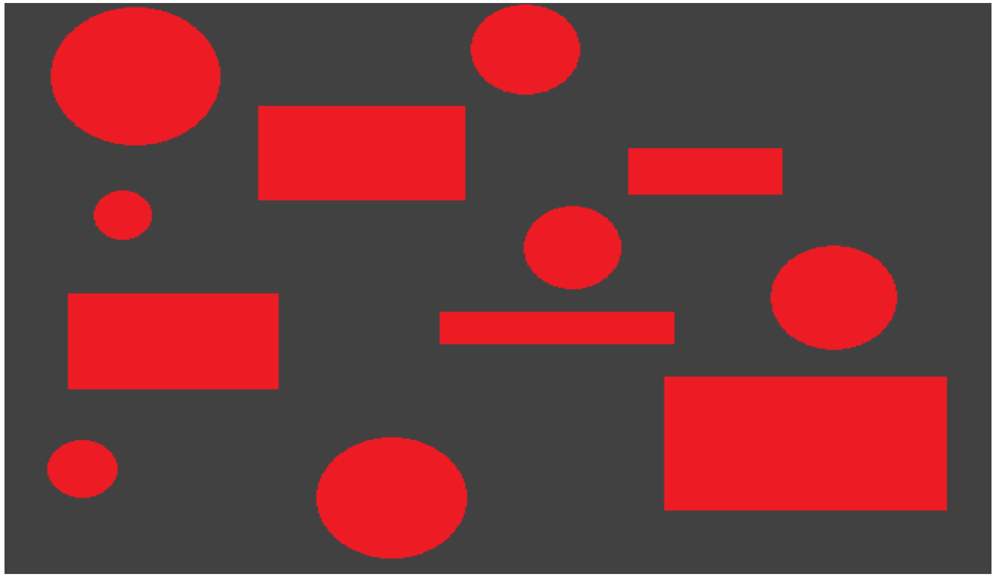
Image Segmentation Using DE

Problem: Objects Classification System

- Automated objects classification into two classes using supervised method

- Classes
  - Circle
  - Rectangle



Input Image

Automated object classification (Supervised method)

- TRAINING PHASE

Training Pattern → Pre-processing → Segmentation → Feature Extraction / Selection → Learning

- CLASSIFICATION PHASE

Test Pattern → Pre-processing → Segmentation → Feature Measurement → Classification

Training Phase

- **Image Acquisition**
  - To read an image into a matrix

    ```
    img = imread('input.bmp');
    ```
  - To view an image in MatLab

    ```
    imshow(img);
    ```
  - Convert the image into grayscale image

    ```
    img_gray = rgb2gray(img);
    ```
  - To view an image in MatLab

    ```
    imshow(img_gray);
    ```
  - To find the size of an image

    ```
    [M, N] = size(img_gray);
    ```
  - To save the image

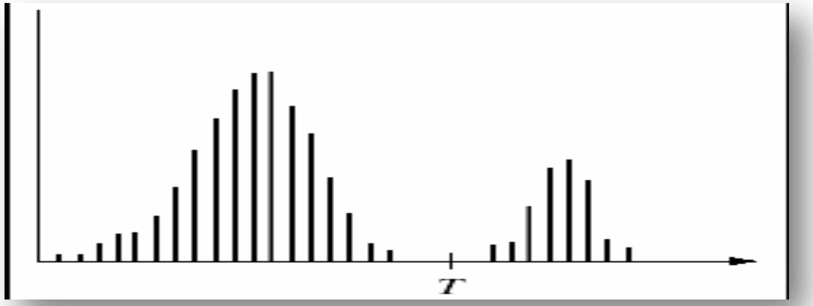
    ```
    imwrite(img_gray, 'output.bmp');
    ```

Training Phase

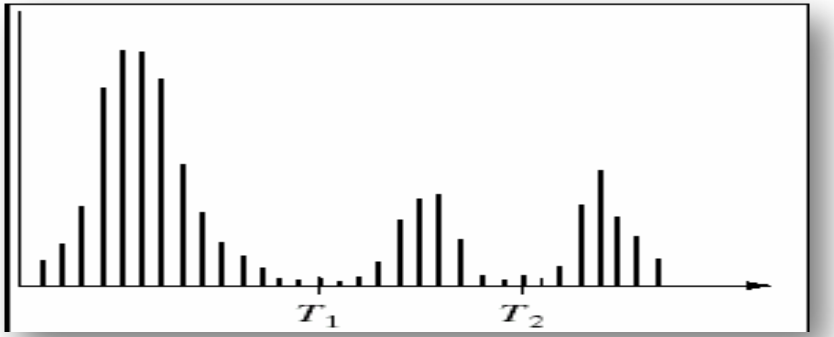
- **Image Segmentation**
  - Segmentation is to subdivide an image into its constituent regions or objects
  - Segmentation algorithms generally are based on one of 2 basis properties of intensity values
    - Discontinuity: to partition an image based on abrupt changes in intensity (such as edges)
    - Similarity: to partition an image into regions that are similar according to a set of predefined criteria

Image Segmentation: Thresholding

- Single Thresholding: image with a background and an object



- Multilevel Thresholding: image with a background and two or more objects



Problem Formulation

- To classify the pixels of the image into n classes {D1,D2, ...,Dn}, n − 1 thresholds, (t1, t2, ..., tn−1), are to be generated

$$f(x,y) = \begin{cases} 0, & f(x,y) \le t_1 \\ \frac{t_1+t_2}{2}, & t_1 < f(x,y) \le t_2 \\ & . \\ & . \\ & . \\ \frac{t_{n-2}+t_{n-1}}{2}, & t_{n-2} < f(x,y) \le t_{n-1} \\ L-1, & f(x,y) > t_{n-1} \end{cases}$$

- The probability of occurrence of class Dj for each plane is

$$w_j = \sum_{i=t_{j-1}+1}^{t_j} p_i .$$

Problem Formulation

- The inter-class variance can be generally defined as

$$\sigma^2 = \sum_{j=1}^{n} w_j (\mu_j - \mu)^2.$$

- The objective function for the multilevel thresholding is to maximize the following fitness function

$$\phi = \max_{1 < t_1 < \ldots < t_{n-1} < L} \{\sigma^2(t)\}.$$

TRAINING PHASE

- **Image Segmentation**
  - DE-based Segmentation

Training phase

- **DE-based Segmentation**
  - Read Image
    ```
    img=imread('input.bmp');
    ```
  - Show Image
    ```
    imshow(img);
    ```
  - Convert into grayscale
    ```
    img_gray=rgb2gray(img);
    ```
  - Show image
    ```
    imshow(img_gray);
    ```
  - Calculate Threshold
    ```
    [T,variance1,no_of_evaluation] = run1(img_gray);
    ```
  - Convert into binary image
    ```
    img_seg = im2bw(img_gray,T(1)/255);
    ```
  - Show the Segmented Image
    ```
    imshow(img_seg);
    ```

Feature extraction

- Find the Connected Components

```
cc = bwconncomp(img_seg);
```

- Calculate the Properties

```
stats = regionprops(cc, 'Area','ConvexArea', 'Eccentricity', 'EulerNumber',
'MajorAxisLength', 'MinorAxisLength', 'Perimeter', 'Solidity', 'Orientation');
```

- Prepare the Feature Vector

```
F=zeros(cc.NumObjects,9);
for i=1:cc.NumObjects
    F(i,1)=stats(i,1).Area;
    F(i,2)=stats(i,1).ConvexArea;
    F(i,3)=stats(i,1).Eccentricity;
    F(i,4)=stats(i,1).EulerNumber;
    F(i,5)=stats(i,1).MajorAxisLength;
    F(i,6)=stats(i,1).MinorAxisLength;
    F(i,7)=stats(i,1).Perimeter;
    F(i,8)=stats(i,1).Solidity;
    F(i,9)=stats(i,1).Orientation;
end
```

Recognition using svm

- **Phase 1: Training**
  - Import the Training Data if Required

```
load training_data
xdata = data(:,1:9);
group = data(:,10:10);
```

  - Train the Model

```
svmStruct = svmtrain(xdata,group);
```

- **Phase 2: Testing**

```
output = svmclassify(svmStruct,F);
```