Tai Duc Nguyen - CS 435 - HW3 - 05/04/19

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    - Fail (both are recognized as cars):
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    - Success (first on is car second one is not)
    - Fail (both are recognized as cars)

Assignment 4 Theory

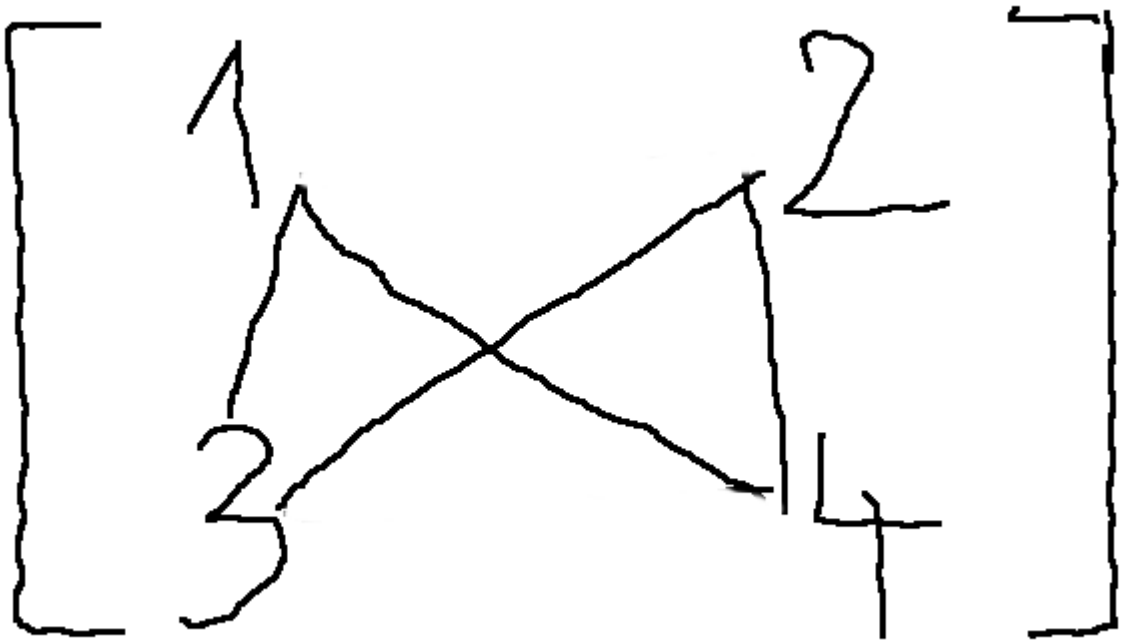
Q1

Given the following image:

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

Q1a

Draw a fully connect graph representation of this image



Compute the similarity/weight between pixels:

$w(a,d) = e^{-((a_i-d_i)^2+(a_x-d_x)^2+(a_y-d_y)^2)} = e^{-(9+1+1)} = e^{-11}$ $w(a,c) = e^{-((a_i-c_i)^2+(a_x-c_x)^2+(a_y-c_y)^2)} = e^{-(4+0+1)} = e^{-5}$ $w(c,b) = e^{-((c_i-b_i)^2+(c_x-b_x)^2+(c_y-b_y)^2)} = e^{-(1+1+1)} = e^{-3}$ $w(b,d) = e^{-((b_i-d_i)^2+(b_x-d_x)^2+(b_y-d_y)^2)} = e^{-(4+0+1)} = e^{-5}$

$$W = \begin{bmatrix} w(a,d) & w(a,c) \\ w(c,b) & w(b,d) \end{bmatrix} = \begin{bmatrix} e^{-11} & e^{-5} \\ e^{-3} & e^{-5} \end{bmatrix}$$

Q1b

Using matrix formulation, the equation is:

$$|A \cup B| W^{-1} D y = \lambda y$$

$$D = \begin{bmatrix} w(a,d)+w(a,c) & w(c,b)+w(b,d) \\ w(a,c)+w(c,b) & w(a,d)+w(b,d) \end{bmatrix} = \begin{bmatrix} e^{-11}+e^{-5} & e^{-3}+e^{-5} \\ e^{-5}+e^{-3} & e^{-11}+e^{-5} \end{bmatrix}$$

$$P = 4W^{-1}D = \begin{bmatrix} 4.0000 & -4.0000 \\ 4.0000 & 33.5661 \end{bmatrix}$$

Since the trivial solution is where everything remains in one group, this eigenvector is associated with an eigenvalue of $|A \cup B|$

Eigenvalue of $|A \cup B| = 4$ is 4

The eigenvalues of P is $\begin{bmatrix} 4.5514 \\ 33.0147 \end{bmatrix}$

Hence, we choose the eigenvector that has the eigenvalue of 4.5514 to form the sub-groups = $\begin{bmatrix} -0.9906 \\ 0.1366 \end{bmatrix}$

Hence, we cut the connection between a&d and c&b, forming 2 groups: a, c and b, d

Assignment 4 Programming

Program Output:

```
root_path =

    '/mnt/windows/Users/b3nnyth3d3g/Dropbox/MATLAB_workspace/CS435_HW4'


folder_path =

    '/mnt/windows/Users/b3nnyth3d3g/Dropbox/MATLAB_workspace/CS435_HW4/CarData


images_file =

    '/mnt/windows/Users/b3nnyth3d3g/Dropbox/MATLAB_workspace/CS435_HW4/images.


seed =

     0

Classifying an Image using Grayscale Histograms
Accuracy: 0.578797

bin_num =

     8

Classifying an Image using Gist
Accuracy: 0.879656
```

Part 1: Classifying an Image using Grayscale Histograms

Success (these are cars):


Fail (both are recognized as cars):


Part 2: Classifying an Image using Gists

Success (first on is car second one is not)


Fail (both are recognized as cars)