Imperial College London

COURSEWORK 1

IMPERIAL COLLEGE LONDON

DEPARTMENT OF COMPUTING

Computer Vision

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1 Question 1

The following is the m-c plot of the points that appear in an edge map (differentiated image):
[0, 5.5], [1, 6], [2.5, 6.5], [3.5, 7], [4.5, 7.5], [6, 8], [7.5, 8.5], [9, 9], [11.9, 9.5], [14.3, 10]

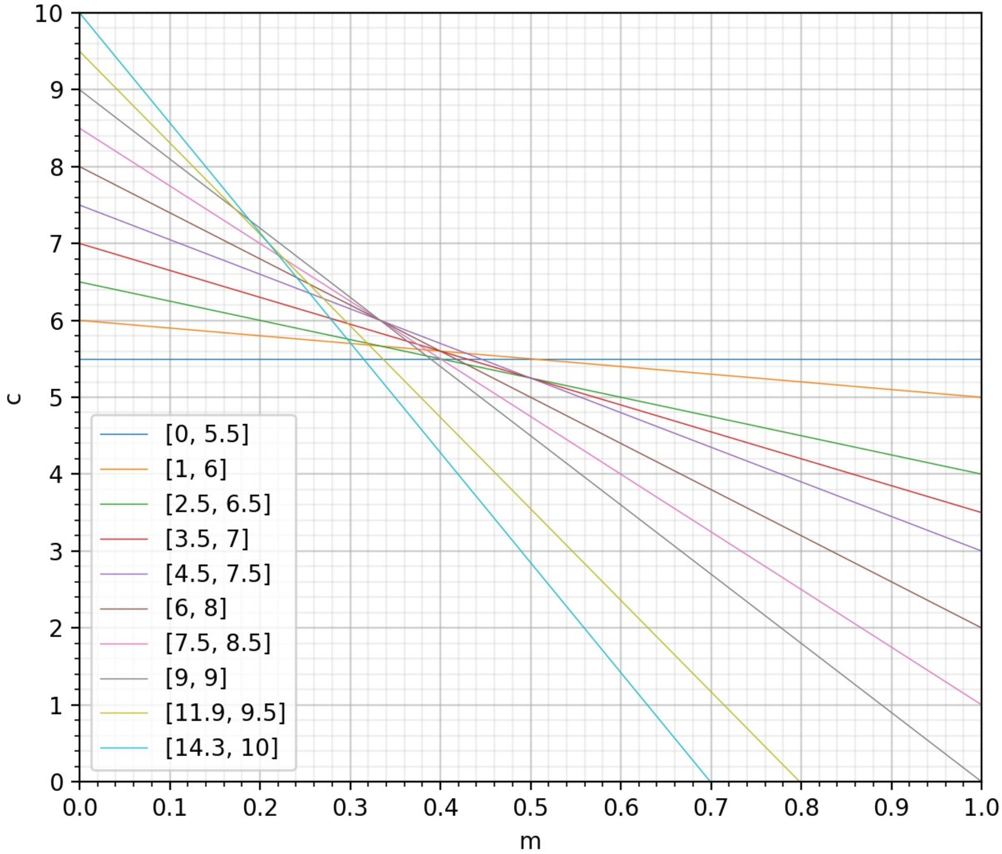

Figure 1: The m-c plot of the points that appear in an edge map

The intersection between two lines on the m-c plot represents the m-c value of the straight line that goes through the two points in the image represented by the two lines. If all the points in the image are colinear, all the lines on the m-c plot will have a single intersection, meaning a single straight line can go through all of the points in the image. It can be seen from Figure 1 that the most of the intersections are relatively close to each other within the range of $m = 0.2$ to 0.5 and $c = 5$ to 7, and is most clustered within the range of $m = 0.32$ to 0.44 and $c = 5.5$ to 6.2 by inspection. The best approach to approximate a line in the image space is to define a line with the m-c value at the centre of the area with the most intersections, and in this case can be estimated to be $m = 0.38$ and $c = 5.85$. However, upon further inspection, it can be seen that there are two main clusters, suggesting a small bend in the line in the image space, and is therefore best to define two separate lines for the two clusters. Which by inspection is $m = 0.4$ and $c = 5.6$ and $m = 0.32$ and $c = 6.0$.

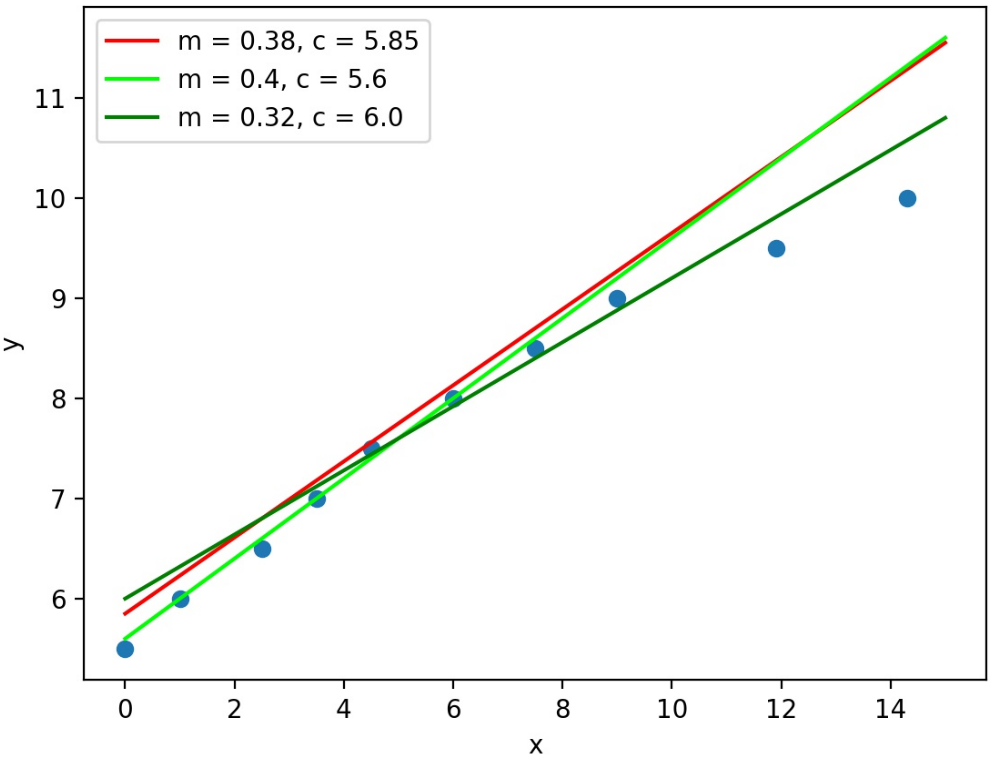

Figure 2: The plot of the points and the line estimations on the image space. The red line being the single line estimation of the points, and the combination of the two green lines estimates the bend in the series of points better

2 Question 2

If p is the probability of a pixel being an edge, then the probability of the pixel not being an edge is $1 - p$. Below are the edge probability matrices after two iterations for the initial probability matrices and assumptions given in a), b) and c):

a)

0.0	0.0	0.0	0.0	0.0
0.0	0.1	0.1	0.1	0.0
0.0	0.1	0.9	0.0	0.0
0.0	0.1	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0

b)

0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.1	0.0	0.0
0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0

c)

0.000	0.000	0.000	0.000	0.000
0.000	0.128	0.134	0.128	0.000
0.000	0.134	1.000	0.134	0.000
0.000	0.128	0.134	0.128	0.000
0.000	0.000	0.000	0.000	0.000

It can be seen that there is no change in the first two cases of relaxation labelling. In the case of a), all the compatibility coefficients have been set to 1, meaning that each pixel is just as compatible with adjacent pixels regardless if they are edges or not, mathematically, the contextual support from each adjacent pixel will always be 1, and the probability will therefore not change.
In the case of b), the compatibility coefficient of neighbouring edges have been set to 2, while the other combinations remain 1, this means that a pixel is more compatible with another edge pixel. However there is only one pixel in the centre with a probability of being an edge greater than 0, mathematically, it gives the centre pixel no contextual support and the probability will therefore not change.
The probability matrix finally changes through iteration in the case of c), as there is a higher compatibility coefficient between neighbouring edges (2) and neighbouring pixels with positive edge probability. It can be concluded that the change in the pixel's label probability depends largely on the context of the image and the predefined compatibility coefficients and initialised probability.