60006 - Tutorial 5

Object Detection, Motion

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Question 1

Question 1.1: Calculate the aspect ratio (width to height ratio) of the ROIs.

Aspect ratio:

- A: 1 : 1
- B: 2 : 1
- C: 1 : 2

Question 1.2:

1. Count the number of ground truth persons in the figure.

   Number of ground truth person: 7

2. Calculate TP, FP, FN, precision and recall with a threshold of 0.9.

   - TP: 3
   - FP: 0
   - FN: 4

   Precision: 1

   Recall: $\frac{3}{7}$

Question 1.3: Calculate TP, FP, FN, precision and recall using thresholds of 0.6, 0.7, 0.8, 0.9 and 0.95. Fill in the following table.

Threshold	TP	FP	FN	Precision	Recall
0.6	7	2	0	0.78	1
0.7	6	1	1	0.86	0.86
0.8	4	0	3	1	0.57
0.9	3	0	4	1	0.43
0.95	1	0	6	1	0.14

Question 1.4: Plot the precision-recall curve using the previous table.

Question 1.5: Estimate the average precision using the precision-recall curve.

Question 2

Question 2.1: Calculate the spatial and temporal image gradients at the shaded pixel using the finite differences.

$$I_x = \frac{I(x+1,y,t) - I(x-1,y,t)}{2} = \frac{1}{2}$$
$$I_y = \frac{I(x,y+1,t) - I(x,y-1,t)}{2} = \frac{1}{2}$$
$$I_t = I(x,y,t+1) - I(x,y,t) = -1$$

Question 2.2: Write down the optic flow constraint equation at the shaded pixel.

$$I_x u + I_y v + I_t = 0$$
$$u + v = 0$$

Question 2.3: Can you solve the equation? If not, assume that the flow is constant with in 3×3 neighbourhood, add an additional equation at the striped pixel and solve the flow.

Question 3

Video denoising is a process to remove noise and other imaging artefacts such as scratches from videos. Unlike single image denoising, where the only information available is in the current picture, video denoising can borrow information from adjacent time frames. In order to do this without introducing blur, video denoising requires accurate pixel-wise motion estimates. Describe your idea of a possible video denoising algorithm. The input is a noisy video of a moving object and the expected output is a clean video

1. Estimate the optic flow between adjacent time frames using the Lucas-Kanade method.
2. For each image to be denoised, warp its adjacent frames to this image according to the optic flow field
3. Perform denoising by averaging the current frame with the warped adjacent frames