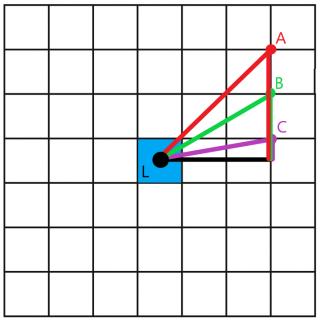
Computer Vision **(17 /02/22)**

Quiz 2 - Solutions

Problem 1

PART 1)



For the given, assume that our blob is centered at point L. We consider three corners *(A,B,C)* as shown in the figure as possible points which lie in the blob or not. For a corner 'D' the condition that it lies inside the blob is that the distance $LD \leq 3$.

- dist(LA): $\sqrt{(2.5)^2 + (2.5)^2} = 3.535$
- dist(LB): $\sqrt{(1.5)^2 + (2.5)^2} = 2.915$
- dist(LC): $\sqrt{(0.5)^2 + (2.5)^2} = 2.54$

As $dist(LA) > 3$, A clearly lies outside the blob. Similarly B and C lie inside the blob. If we consider the 5x5 grid around 'L', we'll have 4 corners *like A* which will lie outside the blob. So we have $25 - 4 =$ 21 pixels that lie inside the blob

PART 2) σ is given by the following formula:

$$\sqrt{2} \cdot \sigma = r$$

using the above expression (plugging $r = 3$), we get

$$\sigma = \frac{3}{\sqrt{2}} \; or \; 2.12$$

Problem 2

Given a data with two channels say d_1 and d_2 as follows:

d_1

1	2	3	4
5	6	7	8
9	10	11	12
3	14	15	16

d_2

16	15	14	13
12	11	10	9
8	7	6	5
4	3	2	1

Following above, we apply SPP in three Spatial Partitions, first calculating for 1, then for 4 and finally 16

1. For 1, we get (as each partition only contains the element itself) a 16x1 vector.

d_1

1	2	3	4	5	6	7	8	9	10	11	12	3	14	15	16

d_2

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

2. For 4, we get (as each partition is of 2 x 2, we get an additional 4 x 1 vector that is appended to the end of 16 x 1 vector, giving a net of 20 x 1 vector.)

d_1

1	2	3	4	5	6	7	8	9	10	11	12	3	14	15	16	6	8	14	16

d_2

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	16	14	8	6

3. Finally we take a Partition of 16 for which we finally get a feature vector of 21 x 1.

d_1

1	2	3	4	5	6	7	8	9	10	11	12	3	14	15	16	6	8	14	16	16

d_2

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	16	14	8	6	16

The final answer could be either combined i.e. both channels together or segmented as above.

Problem 3

Manhattan distance between two points $(x_1, x_2, ...x_k)$ and $(y_1, y_2, ...y_k)$ is given by

$$L_m = |x_1 - y_1| + |x_2 - y_2| + ... + |x_k - y_k|$$

Calculating Manhattan distances between every patch pixel (P1 - P7) and Key Patch Feature (KP1 - KP3) in the BoW model, we select the Key Patch Feature with the least distance. (In case of conflicts we can pick any Key Patch Feature.)

	KP1	KP2	KP3	Selected
P1	26	26	26	KP1
P2	15	7	37	KP2
P3	33	25	25	KP2
P4	51	35	3	KP3
P5	43	45	61	KP1
P6	35	27	29	KP2
P7	45	39	39	KP2

Final BoW Feature: [2,4,1]

Can have variations due to how cases with same minimum Manhattan Distance are handled.

Problem 4

We know that Sum of Eigen Values is the trace of a Matrix. i.e.

$$\lambda_1 + \lambda_2 = tr(A)$$

We are also given tha $tr(A) = 6$ and one of the eigen values say λ_1 is 2. So we can calculate the value of λ_2 as 4 using the above formula.

Once we know that, to calculate Harris and Shi Thomsi's ranking scores we are given that $k = 0.05$.

1. **Harris**

   $R = \lambda_1 \cdot \lambda_2 - k \cdot (\lambda_1 + \lambda_2)^2$

   i.e. $R = 2 \cdot 4 - 0.05 \cdot (2 + 4)^2$

   $R = 6.2$

2. **Shi Thomsi**

   $R = min(\lambda_1, \lambda_2)$

   i.e. $R = min(2, 4)$

   $R = 2$