भारतीय विज्ञान शिक्षा एवं अनुसंधान संस्थान भोपाल
Indian Institute of Science Education and Research Bhopal

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PROGRAMME BS-MS SECTION DSE

COURSE Computer Vision (DSE - 312)

DATE IISER, BHOPAL 28 SEP 2024 Lecturer Hall Complex

I PLEDGE MY HONOUR AS A GENTLEMAN/LADY THAT DURING THE EXAMINATION I HAVE NEITHER GIVEN ASSISTANCE NOR RECEIVED ASSISTANCE

Amaan Pasi.

Signature

Marks Obtained	
Q-01	
Q-02	
Q-03	
Q-04	
Q-05	
Q-06	
Q-07	
Q-08	
Q-09	
Q-10	
Q-11	
Q-12	
Q-13	
Q-14	
Q-15	
Total	

Signature of Invigilator/Instructor

16-Pages

Tᵣᵤₑ/False

1) False

2) Tᵣᵤₑ

3) False

4) False

5) Tᵣᵤₑ

6) Tᵣᵤₑ

7) False

8) Tᵣᵤₑ

9) Tᵣᵤₑ

10) Tᵣᵤₑ

11) Tᵣᵤₑ

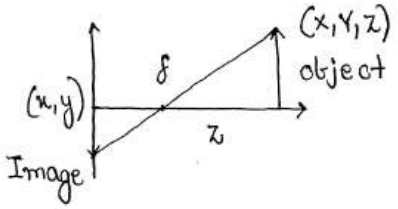
12) Tᵣᵤₑ

13) False

14) Tᵣᵤₑ

Question - 15)

The camera features intrinsic and extrinsic, illumination of the object, distance from the focal point.



Perspective projection

$z \rightarrow$ depth of the object

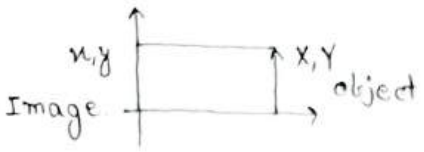
$-f$ as the image is inverted.

$$\frac{y}{Y} = \frac{-f}{z}$$

$$y = \frac{-fY}{z} \qquad x = \frac{-fX}{z}$$

In perspective projection we have $x = \frac{-fX}{Z}$ and $y = \frac{-fY}{Z}$

for orthographic projection $x = X$ and $y = Y$



Question - 16

Stereo, Motion, Contour, Texture

Question - 17

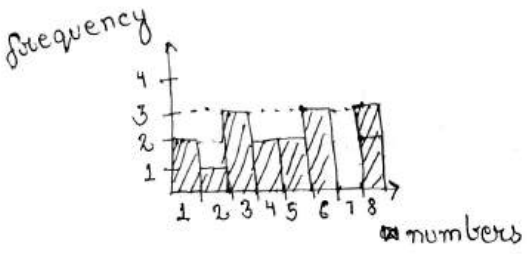
Face recognition - we extinsively use computer vision and its features in face-recognition

Security cameras, - we use the features of a face for the security purposes.

Number plate recognition - we use computer vision for recognising number plates on some anonymous vechiles.

Question - 18

3	6	6	8
5	3	1	4
8	6	5	1
4	8	2	3



Question - 19

Illumination invariant – the illumination should not highly affect the edges.

Good localisation – the localisation of the detector should be precise and notice the edges nicely.

Question - 20

$$E_{contour} = E_{elastic} + E_{smooth}$$

$$E_{elastic} = \left|\left|\frac{dv}{ds}\right|\right|^2$$

$$E_{smooth} = \left|\left|\frac{d^2v}{ds^2}\right|\right|^2$$

Question - 21

i) Input 32x32x3

filter = 5x5

stride - 1, pad - 2

output volume size - 32x32x10

ii) [redacted] F^2CK

[redacted]

iii) Without padding convolution [redacted]

stride = 1

4	3	4
2	4	3
2	3	4

Question-22

62	95	82	52	62
32	53	42	67	54
120	58	62	57	38
58	62	68	110	65
75	25	39	65	34
54	36	28	64	42

Integral image

62	157	239	291	353
94	242 (A)	366 (B)	485 (E)	601 (F)
214	418	604	780	934
272	540	794	1080	1299
347	640 (C)	933 (D)	1348 (G)	1601 (H)
401	730	1051	1466	1761

Area of white region

$= D - C - B + A$

$= 933 - 640 - 366 + 242$

$= 169$

Area of black region

$= H - G - F - E$

$= 1601 - 1348 - 601 + 485$

$= 137$

value of Haar filter = Area of white region - Area of black region

$= 169 - 137$

$= 32$

Question - 23

1	2	3	8	10
4	5	9	10	3
2	7	12	3	4
12	13	0	2	9
0	1	5	2	21

GBP without padding.

Center at 5 = 00011100

$= 2^0.0 + 2^1.0 + 2^2.0 + 2^3.1 + 2^4.1 + 2^5.1 + 2^6.0 + 2^7.0$

$= 8+16+32$

$= 56$

center at 9 = 00010100

$= 2^3.1 + 2^5.1$

$= 8 + 32$

$= 40$

center at 10 = 00100010

$= 2^2.1 + 2^6.1$

$= 4 + 64$

$= 68$

center at 7 = 00110110

$= 2^2.1 + 2^3.1 + 2^5.1 + 2^6.1$

$= 4 + 8 + 32 + 64$

$= 108$

center at 12 = 00000010

$= 2^6.1$

$= 64$

center at 3 = 11111001

$= 2^0 \cdot 1 + 2^1 \cdot 1 + 2^2 \cdot 1 + 2^3 \cdot 1 + 2^4 \cdot 1 + 2^7 \cdot 1$

$= 1 + 2 + 4 + 8 + 16 + 128$

$= 159$

center at 13 = 00000000

$= 0$

center at 0 = 11111111

$= 2^0 \cdot 1 + 2^1 \cdot 1 + 2^2 \cdot 1 + 2^3 \cdot 1 + 2^4 \cdot 1 + 2^5 \cdot 1 + 2^6 \cdot 1 + 2^7 \cdot 1$

$= 1 + 2 + 4 + 8 + 16 + 32 + 64 + 128$

$= 255$

center at 2 = 11111110

$= 2^0 \cdot 1 + 2^1 \cdot 1 + 2^2 \cdot 1 + 2^3 \cdot 1 + 2^4 \cdot 1 + 2^5 \cdot 1 + 2^6 \cdot 1 +$

$= 1 + 2 + 4 + 8 + 16 + 32 + 64$

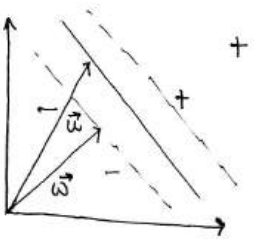
$= 127$

LBP image

56	40	68
108	64	159
0	255	127

Question- 24

SVM → Support Vector Machine



in support vector machine we make a street with a width such that any values on either side of the width compulsory belong to that class for a 2-class classifier.

$\vec{w}$ → vector from origin perpendicular to street.

$\vec{u} \rightarrow$ [redacted] vector to a point we want to measure.

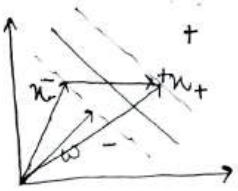
Let c be a value s.t. it lies on other side of street

$\vec{w}.\vec{u} \geq c$

$\vec{w}..\vec{u} + b \geq 0$

$c = -b$

$y_i(\vec{w}.\vec{x}_i + b) - 1 = 0$ is the decision rule.



for width of the margin

$= x_+ - x_-$

width of the [redacted] margin $= (x_+ - x_-) \cdot \frac{1}{||w||}$

width of the margin $= \frac{2}{||\vec{w}||}$

[as $x_+ = 1 - b$

$x_- = b - 1$

so, $x_+ - x_- = 2$]

we have to maximize $\frac{2}{||\vec{w}||}$

or maximize $\frac{1}{||\vec{w}||}$

Question - 25

The scale invariant properties of the blob

the [redacted] illumination resistive properties

of the blob.

For blob to be an interesting point the neighbouring values of the blob should be less than that. The blob should have high edge difference, effect of rotation

scaling down should not affect it.

Question - 26

1st order

second order

Question - 27

1) Image resolution - 100 x 100

eq ⇒ $y = \sqrt{3}x + 10$

$y = mx + c$

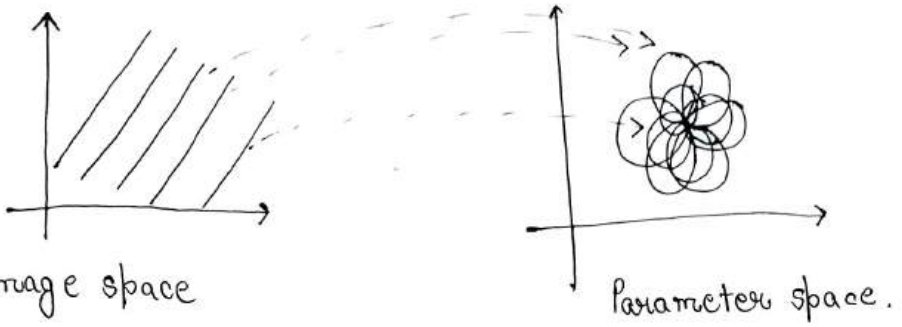
$m = \sqrt{3}$, $c = 10$

$\rho = 10$, $\tan\theta = \sqrt{3}$

$\theta = 60°$

as $\tan 60° = \sqrt{3}$

- 3) Multiple parallel lines with same slope



Question - 28

a)

Question - 29

d)