Q2(A)

given data $x = [3, 4]$ and $y = [4, 5]$ and $w = 0.5$ we have our goal to minimize the MSE (Loss function)

$$LF = \frac{1}{n}(y_{pred} - y)^2$$

$$y_{pred} = 0.5 \times 3 = 1.5$$

$$g_t = dL/dw = \frac{2}{1} * (y_{pred} - 4) * x = -15$$

$$g_t^2 = (-15)^2 = 225$$

$$m_1 = 0.9 * 0 + (1 - 0.9) * -15 = -1.5$$

$$v_1 = 0.999 * 0 + (1 - 0.999) * 225 = 0.225$$

$\cancel{\hat{m}_2 = -0.8947}$

$\cancel{\hat{v}_1 = 112.811}$

$$\hat{m} = \frac{-1.5}{1 - 0.9} = -15$$

$$\hat{v} = \frac{0.225}{1 - 0.999} = 225$$

$$\hat{m} = -15$$

$$w_{t+1} = w_t - \left[\alpha \cdot \frac{1}{\sqrt{\hat{v}_t + \varepsilon}}\right] \times \hat{m}_1$$

$$0.5 - 0.1 \left[\cancel{\frac{-15}{\sqrt{225} + 10^{-8}}}\right] = \cancel{0.04}$$

$$0.5 - \left[\frac{0.1}{\sqrt{225} + 10^{-8}}\right] \times 15$$

$$0.5 - (-0.1) = 0.5 + 0.1 = 0.6$$

$$w_{t+1} = 0.6$$

$y_{pred} = 0.5 \times 4$ — $y_{pred} = 0.6 \times 4 = 2.4$

$g_t = \frac{dL}{dw} = 2 * (2.4 - 5) \times 4 = -20.8$

$g_t^2 = (-20.8)^2 = 432.64$

$m_2 = 0.9 * -15 + (1 - 0.9) * (-20.8) = 11.42$

$$v_2 = 0.999 * 225 + (1 - 0.999) * (432.64)$$
$$= 224.775 + (0.001 * 432.64)$$
$$= 225.20$$

$$\hat{m}_2 = \frac{11.42}{1 - 0.9} = 114.2$$

$$\hat{v}_2 = \frac{225.20}{1 - 0.999} = 225200$$

$$0.6 - \left[\frac{0.1}{\sqrt{225200} + 10^{-8}} \right] \times 114.2$$

$$0.6 - 0.02$$

$$= 0.58$$

Q1B)

$$\Delta J(w) = \frac{1}{3}\left[2*(0.5\times[1-2])\times 1 + 2(0.5(2-4))\times 2 + 2(0.5(3-6)\times 3)\right.$$

$$= \frac{1}{3}[2\times(-1.5)\times 1 + 2\times(-3)\times 2 + 2\times(-5.5)\times 3)$$

$$= \frac{1}{3}[-3+(-12)+(-33)]$$

$$= \frac{1}{3}\times(-48) = -16$$

Initially $G=0$ we have $G = 0+(-16)^2 = 256$

update the w using Adagrad update rule

$$w = w - \frac{\alpha}{\sqrt{G+\varepsilon}} \times \nabla J(0)$$

$$0.5 - \frac{0.1}{\sqrt{256+10^{-8}}} \times (-16)$$

$$= 0.5 + 0.1 = 0.6$$

After one iteration using the Adagrad the update weight $w = 0.6$.

Total Marks of Question no.		Examiner	
		Moderator	
		Re-Assessor	

Space for Marks	Question No.	START WRITING HERE

Q2 A

LeNet Architecture

Lenet is the first CNN architecture. It was developed in 1998 by Yann LeCun Corinna Cortes for handwritten digit recognition problem. LeNet was one of the first successful CNN's. It is one of the earliest and most widely-used CNN architecture and has been sucessfully applied to tasks ~~as~~ such as handwritten digit recognition. At high level, Lenet consists of two parts

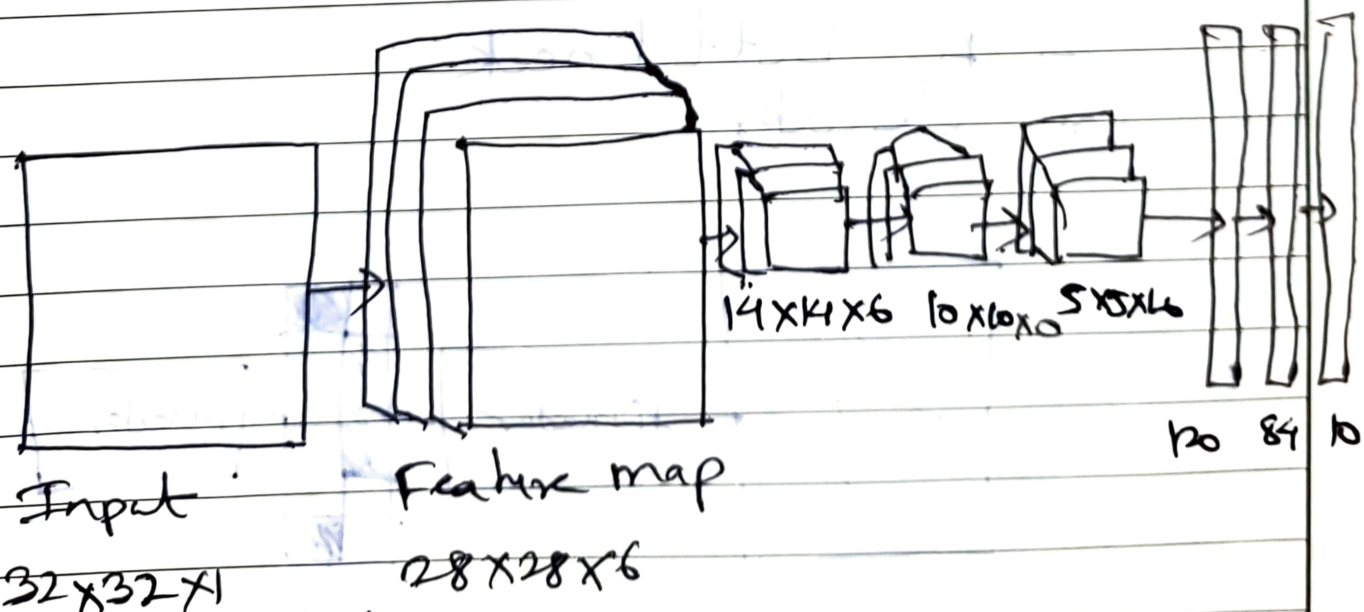
(i) a convolutional encoder consisting of two convolutional layers and

(ii) a dense block consisting of three fully connected layers. The architecture is summarized in Fig.

The basic units in each convolutional block are a convolutional layer a sigmoid activation function and a subsequent average pooling operating. Each convolution layer uses a 5x5 kernel and a sigmoid activation function.

These layers map spatially arranged inputs to a number of two-dimensional feature maps. typically increasing the number of channels. The first convolutional layer has 6 output channels while the second has 16. Each 2x2 pooling operation (stride 2) reduces dimensionality by a factor of 4 via spatial down sampling

Finally, we flatten the output of second convolution layer to 120 features of size 1x1 ~~following~~ followed by fully connected layer of 84 units and last layers uses softmax to produce 10 outputs corresponding to 10 digits. (0-9)



Q2
(B) L

Q2(B)

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Input

Kernel

0.2	0.2	0.2
0.2	0.2	0.2
0.2	0.2	0.2

After performing CNN operation the final o/p is

14.4	16.5	18.6
24.9	27.0	29.1
35.4	37.5	39.6

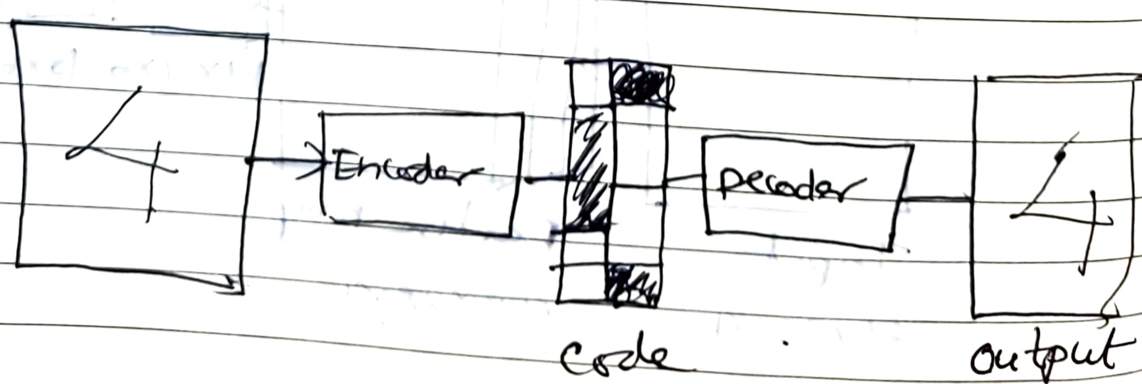
Marks	No.	START WRITING HERE

Q2(B) Autoencoder are map high dimensional data to lower dimensional data to compress data or image.

Application of Autoencoder are
(1) Image Compression
(2) Image Denoising
(3) Dimension reductionality
(4) Recommendation System
(5) Anamoly detection
(6) Image Production
(7) Image Colorization

Architecture of Autoencoder

An autoencoder consists of three parts
(1) An encoder
(2) A bottel neck
(3) decoder.



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		Encoder:- A module that compresses the input data into an encoded representation that is typically several orders of magnitude smaller than the input data.
	(2)	Bottelneck:- A module that contains the compressed knowledge representation and is therefore the most important part of the network
	(3)	Decoder: A module that help the network decompress the knowledge representations and reconstructs the data back from its encoded form. The output is then compared with ground truth.
		The encoder compress the input and the decoder attempts to recreate the input from the compressed version. provided by the encoder. Auto encoder ~~compress~~ compress the input into a lower-dimensional code and then reconstruct the output from this representation. The ~~c~~ code is a compact "summary" or "compression" of the input also called the latent space representation.

Q2 (B) 1

Q2 (B)

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Input

Kernel

0.2	0.2	0.2
0.2	0.2	0.2
0.2	0.2	0.2

After performing CNN operation the final o/p is

14.4	16.5	18.6
24.9	27.0	29.1
35.4	37.5	39.6

Q3 A) $x = 1$

$w_1 = 0.5 \quad w_2 = 0.8$

$b_1 = 0 \quad b_2 = 0$

$\eta = 0.1$

AF = Sigmoid

$y = 1$

$z = 0.5 \times 1 + 0 = 0.5$

$AF = a_1 = \sigma(0.5) = \frac{1}{1+e^{-0.5}}$

$a_1 = 0.6225$

$y_{pred} = 0.622$

$Loss = \cancel{\Sigma} \frac{1}{2m}(y-\hat{y})^2$

$= \cancel{0.378} \; \frac{1}{\cancel{2}4}(1-0.622)^2$

$= \frac{(1-0.622)^2}{4}$

$= 0.0718$

Backpropagation

$-(1-0.222) = -0.378$

$z_2 = -(0.378) \times 0.235$

$= -0.089$

$w_2 = (-0.089) \times 0.622$

$= -0.055$

updated weight $w_1 = 0.5017$

$w_2 = 0.8055$