

INTRODUCTION TO DEEP LEARNING

Question 01

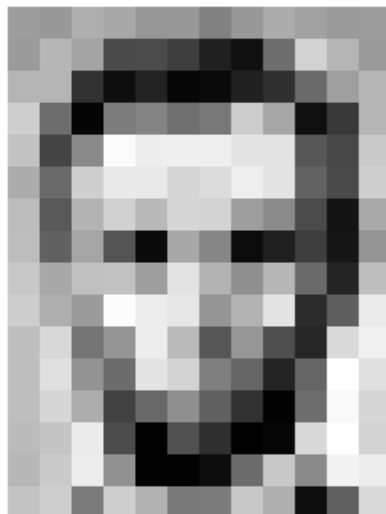
(3)

Linear Algebra is one of the foundational subjects of Artificial Intelligence and matrix operations are the essence of Linear Algebra. You are required to ask the dimensions of two matrices A & B. Then input both matrices from the user and ask the user if they want to perform addition or subtraction on the given matrices. The result should be displayed in the form of a matrix as well.

Question 02

(5)

An image is a 2D array or simply a matrix of $m \times n$ dimensions. Where each cell of the matrix represents the value of a single pixel. In case of a gray scale image the minimum value a pixel can have is 0 and the maximum value a pixel can have is 255 hence the range for grayscale is [0 - 255]. You are required to generate a grayscale image with random values for the user specified dimensions. Following is a sample grayscale image along with its numeric values.



157	153	174	168	150	152	129	151	172	161	155	156
155	182	163	74	75	62	33	17	110	210	180	154
180	180	50	14	34	6	10	33	48	106	159	181
206	109	5	124	131	111	120	204	166	15	56	180
194	68	137	251	237	239	239	228	227	67	71	201
172	105	207	233	233	214	220	239	228	98	74	206
188	88	179	209	185	215	211	158	139	75	20	169
189	97	165	84	10	168	134	11	31	62	22	148
199	168	191	193	158	227	178	143	182	106	36	190
205	174	155	252	236	231	149	178	228	43	95	234
190	216	116	149	236	187	86	150	79	38	218	241
190	224	147	108	227	210	127	102	36	101	255	224
190	214	173	66	103	143	96	90	2	109	249	215
187	196	235	75	1	81	47	0	6	217	255	211
183	202	237	145	0	0	12	108	200	138	243	236
195	206	123	207	177	121	123	200	175	13	96	218

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180	180	50	14	34	6	10	33	48	106	159	181
206	109	5	124	131	111	120	204	166	15	56	180
194	68	137	251	237	239	239	228	227	67	71	201
172	105	207	233	233	214	220	239	228	98	74	206
188	88	179	209	185	215	211	158	139	75	20	169
189	97	165	84	10	168	134	11	31	62	22	148
199	168	191	193	158	227	178	143	182	106	36	190
205	174	155	252	236	231	149	178	228	43	95	234
190	216	116	149	236	187	86	150	79	38	218	241
190	224	147	108	227	210	127	102	36	101	255	224
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Question 03

(3)

From the above figure we can see that 0 represents the black color and 255 represents the white color. For this reason the number closer to the 0 will be dark while the number closer to 255 will be light. For our understanding we declare the pixel from 0 - 100 as dark and pixel from 200-255 as light. You are required to write a function which will return true if the randomly generated image is light and false if the image is dark. *Later this program can be upgraded to generate a histogram for the given grayscale image.*

Question 04

(5)

Once you have developed enough expertise to handle matrix addition and subtraction, you are further encouraged to perform matrix multiplication on user given matrices. Make sure matrix multiplication rules are followed. The result should be displayed as a proper matrix as well.

Note: You should allow matrix and vector multiplication as well as vector and matrix multiplication.

Question 05

(5)

Congratulations on reaching this question. Here you will further extend your skills and provide the additional functionality of Transpose of a matrix as well as identify if the given matrix is identity matrix or not. The dimensions of the matrix are still provided by the user.

Question 06 (Carries Bonus Marks)

(25)

Convolutional Neural Networks perform convolution operations on the given image [A simple image is a 2D array stored in a computer]. And are extremely helpful in extracting useful features which are then used for classification and other purposes. Following figure shows a convolution operation. You are required to generate a 5 x 5 image using random values and then use a 3 x 3 kernel to perform the convolution operation on the given image. As you can see from the below image the resultant output would be 3 x 3 matrix. You are required to solve this problem in a function base approach. Define a function for generating image, for inputting kernel and for convolution finally display the output using a function as well. Which takes an array as input along with its dimensions and prints the array.

1x1	1x0	1x1	0	0
0x0	1x1	1x0	1	0
0x1	0x0	1x1	1	1
0	0	1	1	0
0	1	1	0	0

4		

Question 07

To further explore the realm of Deep Learning you will enjoy programming another useful function which is used more redundantly in every deep learning model known as activation function. The purpose of activation function is to decide which neuron should participate in the prediction process and which should be stopped. Activation functions are used after convolution operation. The two most famous activation functions include Rectified Linear Unit (ReLU) and Sigmoid. Their mathematical equations are given below you are required to write two functions, one for ReLU and one for Sigmoid which will perform user given activation on the matrix.

