DSE 3151 DEEP LEARNING

SOLUTION FOR MISAC-1 : SET1

DATE: 31-08-2023 **DURATION: 20 MINS** **MAX. MARKS: 5**

1. Consider a Convolutional Neural Network (CNN) applied to gridded weather data. The input consists of 7-channels (corresponding to the value of 7 atmospheric variables) of size 16 x 16 corresponding to spatial grids in the region of interest. Answer the following questions:
   - **a.** Compute the size of the feature map obtained as a result of applying a convolution operation on the input data. To perform the convolution, eight filters each of size 3 x 5 is used. The stride length is 1 in the horizontal direction, and 2 in the vertical direction, and no padding is applied. **[1 mark]**
   - **b.** Compute the number of parameters and the total number of connections (including the bias) between the input layer and the convolution layer (whose details are same as described in 1.a). **[1.5 marks]** **CO2 APPLICATION**

Answer:

1.a.

W2 = ((W1 – F + 2P)/S) + 1 => W2 = ((16 – 3 + 0)/1) + 1 = 13 + 1 = 14

H2 = ((H1 – F + 2P)/S) + 1 => H2 = ((16 – 5 + 0)/2) + 1 = floor (5.5) + 1 = 6

D2 = 8

Feature map size: 14 x 6 x 8

1.b.

Number of parameters = ((3 * 5 * 7) + 1) * 8 = 848

Do the following to calculate the no. of connections:

--Each neuron of one plane of the feature map (in the convolution layer) is connected to

(3*5*7) +1 = 106 neurons in the input layer.

--Total connections for 1 plane of feature map in the convolution layer = 14*6*106 = 8904

--Total connections for 8 planes of feature maps in the convolution layer = 8904*8 = 71232

Total no. of connections = ((3*5*7) +1) * (14*6) *8= 71232

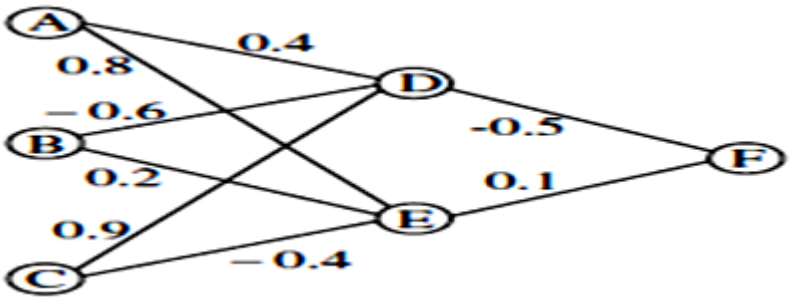
2. For the following Neural Network:

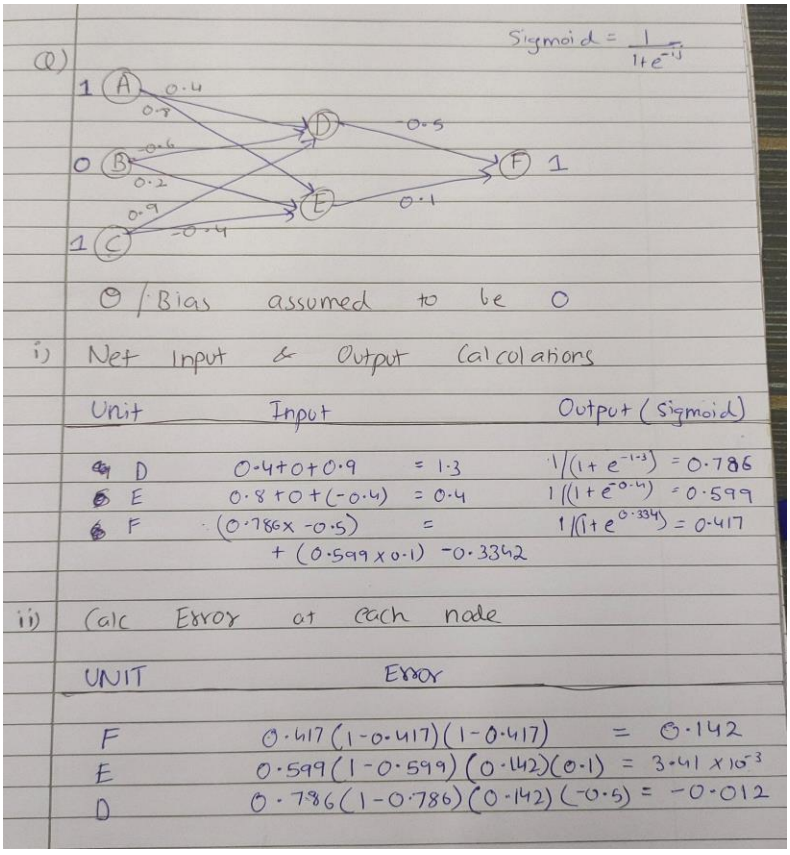
a. Consider a training instance [1,0,1,1]. Compute the Output at F after feed of the training instance to the neural network.

b. After 1 instance of the training, compute the loss. **[1 mark]**

c. Compute the change in weights of the Neural Network using back propagation. (Assume learning rate of 0.7)

[1.5 marks] **CO2 APPLICATION**





iii) Weights adjust & updation $\boxed{lr = 0.7}$

$$\Delta w_{ij} = (lr)\, Err_j \cdot O_i$$
$$w_{ij} = w_{ij} + \Delta w_{ij}$$

$$w_{DF} = (-0.5) + ((0.7)(0.146^2)(0.786)) = -0.422$$

$$w_{EF} = (0.1) + ((0.7)(0.146^2)(0.599)) = 0.16$$

$$w_{AD} = (0.4) + ((0.7)(-0.012)(1)) = 0.4$$

$$w_{AE} = (0.8) + ((0.7)(3.41 \times 10^{-3}) \times 1) = 0.802$$

$w_{BD} = -0.6$ } since $O_i = 0$

$w_{BE} = 0.2$

$$w_{CD} = (0.9) + ((0.7)(-0.012)(1)) = 0.89$$

$$w_{CE} = (-0.4) + ((0.7)(3.41 \times 10^{-3})(1)) = -0.397$$

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SOLUTION FOR MISAC-1: SET2

DATE: 31-08-2023 **DURATION: 20 MINS** **MAX. MARKS: 5**

1. Consider a Convolutional Neural Network (CNN) applied to gridded weather data. The input consists of 5-channels (corresponding to the value of 5 atmospheric variables) of size 8 x 16 corresponding to spatial grids in the region of interest. Answer the following questions:
   - **a.** Compute the size of the feature map obtained as a result of applying a convolution operation on the input data. To perform the convolution, eight filters each of size 3 x 3 is used. The stride length is 2 in the horizontal direction, and 1 in the vertical direction, and no padding is applied. **[1 mark]**
   - **b.** Compute the number of parameters and the total number of connections (including the bias) between the input layer and the convolution layer (whose details are same as described in 1.a). **[1.5 marks]** **CO2 APPLICATION**

Answer:

1.a.

W2 = ((W1 – F + 2P)/S) + 1 => W2 = ((8 – 3 + 0)/2) + 1 = floor (2.5) + 1 = 3

H2 = ((H1 – F + 2P)/S) + 1 => H2 = ((16 – 3 + 0)/1) + 1 = 13 + 1 = 14

D2 = 8

Feature map size: 3 x 14 x 8

1.b.

Number of parameters = ((3 * 3 * 5) + 1) * 8 = 368

Do the following to calculate the no. of connections:

--Each neuron of one plane of the feature map (in the convolution layer) is connected to

(3*3*5) +1 = 46 neurons in the input layer.

--Total connections for 1 plane of feature map in the convolution layer = 3*14*46 = 1932

--Total connections for 8 planes of feature maps in the convolution layer = 1932*8 = 15456

Total no. of connections = ((3*3*5) +1) * (3*14) *8= 15456

2. For the following Neural Network:

d. Consider a training instance [1,1,0,1]. Compute the Output at F after feeding the training instance to the neural network.

e. After 1 instance of the training, compute the loss. **[1 mark]**

f. Compute the change in weights of the Neural Network using back propagation. (Assume learning rate of 0.5)

[1.5 marks] **CO2 APPLICATION**