Exam Date & Time: 06-Jan-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

FIFTH SEMESTER B.TECH MAKEUP EXAMINATIONS, JANUARY 2024

DEEP LEARNING [DSE 3151]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) A) With suitable examples, explain the problem of Vanishing and Exploding gradients in Deep Learning models. Explain any three solutions for dealing with the unstable gradients in Deep Learning models. (5)

B) With suitable diagram or example, compare and contrast the following:

a. Sigmoid vs RELU activation function

b Mean Square Error vs. Mean Absolute Error (3)

c. RMS Prop vs. Adam Optimizer

C) With suitable diagram, explain how overfitting is detected in Deep Learning models? Illustrated how dropouts work to preventing overfitting? (2)

2) A) Consider a Convolutional Neural Network (CNN) denoted by the layers in the first column of Table Q4 (given below). The CNN is being used to classify a given image into any one of 10 classes. Construct the Table Q4 by filling in the shape of the output volume (activation shape) and the number of parameters at each layer (including the bias). You can write the activation shape in the format **H x W x C**, where H, W and C are the height, width and channel dimensions, respectively. Clearly explain all the computations. (5)

Notations:
* CONV **F-K** denotes a convolutional layer with **K filters** with **height and width equal to F.**
* **Pool-R** denotes a **R x R** max-pooling layer with **stride of R** and **0-padding**.
* FLATTEN flattens its inputs.
* FC-**N** denotes a **fully-connected** layer with **N neurons**.
* Softmax denotes the output layer.

Table Q4:

Layer	Activation Shape	Number of Parameters
Input	**16 x 16 x 5**	
CONV 5-6 (Padding=2, Stride =1)		
ReLU		
Pool-2		
CONV 5-16 (Padding=0, Stride =1)		
ReLU		
Pool-2		
FLATTEN		
FC-120		
FC-84		
Softmax		

B) Explain the following in the context of CNN:

a. Sparse Connectivity

b. Shared Weights

c. Equivariance to translation

(3)

C) Illustrate the significance of 1x1 convolutions, with respect to Deep Convolutional Neural Network architectures. (2)

3) You have been given the task of designing a Deep Learning based model for predicting the next character in an English word. Given the following: (5)

A)

- The vocabulary consists of only 5 alphabets.
- One-hot encoding of input is being used.
- The loss function is Cross Entropy.
- Make assumptions for initial weights and biases.
- Each hidden state has 2 neurons.

a. Construct an appropriate RNN based architecture for the task.

b. Demonstrate the working of 1 feed forward for 3-time steps.

c. List the dimensions of the input, output, hidden state, weights and bias.

B) Compare the working of LSTM vs the GRU cell with neat diagrams and necessary computations. (3)

C) In a Deep Neural Network, explain why a constant learning rate is not ideal. What are the learning schedule strategies that can be adopted? (2)

4) Explain the need for attention in Sequence Models? With suitable example, Explain the following: Self Attention, Cross Attention, Visual Attention, Hierarchical Attention (5)

A)

B) For each of the following tasks, Design an encoder-decoder based model. Draw a neat diagram and explain the computations.

a. Given a video as input produce a caption for the video as an output by understanding the action and the event in the video. (3)

b. Given an image and a query based on the image as input, produce an answer to the query as an output.

C) With the help of a neat diagram and necessary computations explain how the encoder part of the Transformer architecture is used for machine translation. (2)

5) Briefly explain the following:

a. Sparse autoencoder,

A) (5)

b. Contractive autoencoder,

c. Equivalence of PCA and autoencoders.

B) For the given Hidden Markov Model in Figure Q14, compute the following: (3)

a. The Probability of the observed sequence [work, work, jog, clean , jog]

b. The most likely hidden sequence which generates the observed sequence.

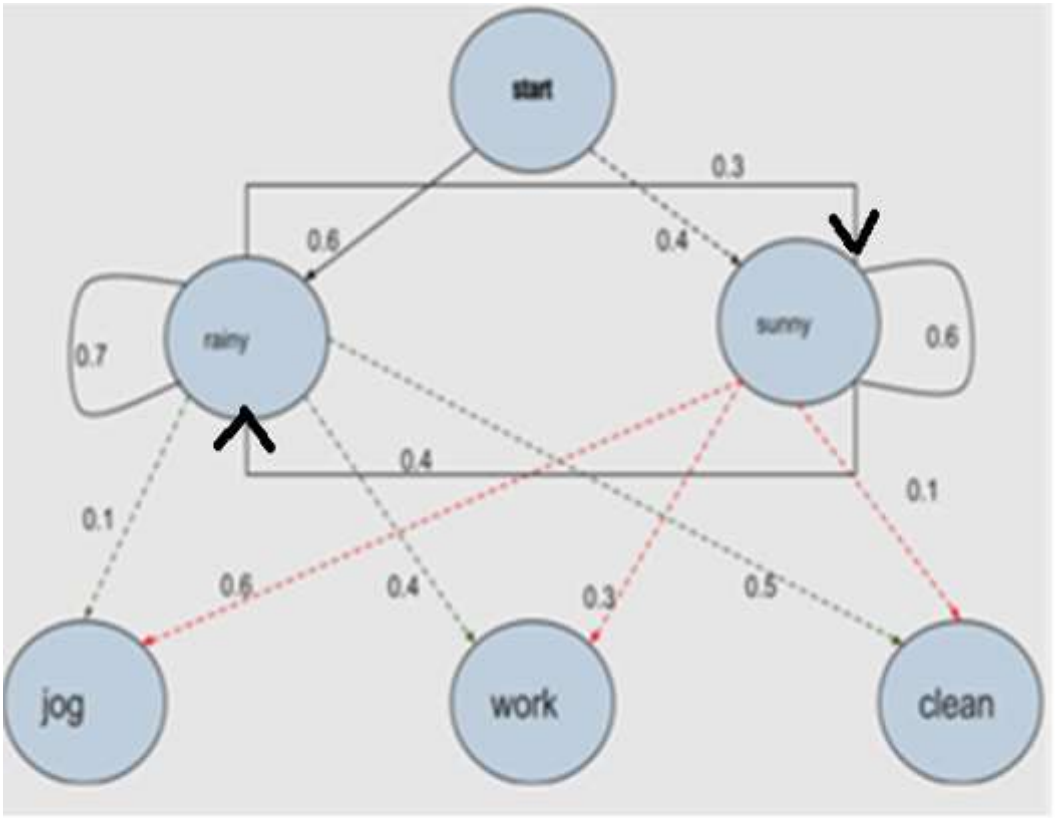

Figure Q14

C) Explain the role of a language models in Automatic Speech Recognition system. (2)

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