COMSATS University Islamabad, Attock Campus

Department of Computer Science

Program: BS(AI)

Fall 2023: Assignment 3		**Course: Deep Learning (AIC467)**
Dated: 23/10/2023	**Due Dated: 28/11/2023**	**Marks: 30**
Name:		
Note: - Don't write anything on Question Paper except your Name & Reg. No.		

The student will submit the hard copy to CR before the due timing. The CR is responsible for submitting the class assignments till the due date in the office.

Question#1 [CLO-3(SO:1-4)] [10 Marks]

A) Index Encoding: Assign unique indices to each word. What are the indices for "Cat," "Dog," and "Bird"?
B) One-Hot Encoding: Assume one-hot encoding with vectors of length 3 (for simplicity). Provide the one-hot encoding representation for each of the three words: "Cat," "Dog," and "Bird.".
C) Encode the following documents using Bag of Words (BoW) technique:
   Documents:
   1. "I like natural language processing. It is fascinating to see how computers can understand and generate human-like text."
   2. "Natural language processing involves the interaction between computers and humans using natural language. It is a field of study that focuses on making computers understand and process language."
   3. "I find the field of natural language processing very interesting. The ability of machines to comprehend and generate human-like language is a significant advancement in technology."
D) Encode the following documents using Term Frequency-Inverse Document Frequency (TF-IDF) scheme:
   Documents:
   1. "I like natural language processing."
   2. "Natural language processing is interesting."
   3. "I find natural language processing fascinating."

Question#2 [CLO-3(SO:1-4)] [10 Marks]

Word2Vec has two main architectures: Continuous Bag of Words (CBOW) and Skip-Gram. Using both architectures and encode the words given the document "Lisa is my pet dog.".
Take a window size of 1 (one word behind and after the center word) which will give you targets with related context words. Randomly initialize the initial weights of the model. Train the model for two iterations. **The encoded word must have a size of 3 (E.g., Lisa=[0.1, 0.2, 0.9]**. Consider the initial feature representation of each word (one hot encoding), as

Word	Initial Feature Vector	Word	Initial Feature Vector
Lisa	[1, 0, 0, 0, 0]	my	[0, 0, 0, 1, 0]
is	[0, 1, 0, 0, 0]		
pet	[0, 0, 1, 0, 0]	dog	[0, 0, 0, 0, 1]

Question#3 [CLO-3(SO:1-4)] [10 Marks]

Apply Recurrent Neural Network (RNN) on the following semantic prediction problem.

Sentence	Semantic
It is warm outside.	1
It is raining.	0

Word	One hot encoding
It	[1, 0, 0, 0, 0]
is	[0, 1, 0, 0, 0]
outside	[0, 0, 1, 0, 0]
raining	[0, 0, 0, 1, 0]
warm	[0, 0, 0, 0, 1]

Consider the RNN **Architecture** as:
Input Layer: Size depends upon the input. **Hidden Layer**: 2 Neurons, Activation Function = tanh. **Output Layer**: 1 Neuron, Activation Function = Sigmoid, Loss = Binary Cross Entropy.

Weight initialization: //ignore bias
Input-to-hidden weight matrix U=[1, 0, 0.1, 0.2, 0; 1, 1, 0.1, 0, 0.5]
Hidden-to-hidden weight matrix W=[0.1, 1; 0, 0.2]= ,
Hidden-to-output weight matrix V=[0.1, 0.6].

Calculate: 1. Forward pass the data through the model. 2. Calculate Loss. 3. Back propagate the Loss. 4. Forward pass again. 5. Calculate the Loss and compare with the previous loss value.