(This Question paper contains 2 printed pages) Roll No. _____

S.No. of Question Paper : 7975
Unique Paper Code : 2513010024
Name of the Course : B.Sc.(H) Electronics (DSE)
Name of the Paper : Natural Language Processing
Semester : VIII (Under NEP UGCF Mode)
Duration : 03
Maximum Marks : 90

Instruction for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question 1 is compulsory.
3. Attempt any 5 questions including question 1.
4. All questions carry equal marks.

Q1 (a) Identify and briefly explain any three major challenges faced in Natural Language Processing. (3)

(b) Differentiate between Morphology and Lexical Semantics in the context of word forms. (3)

(c) Define Information Retrieval. How does it serve as a key application of NLP? (3)

(d) What are Stop Words? Give 5 examples (3)

(e) What is Tokenization? Give example of sentence tokenization. (3)

(f) Differentiate Term Frequency vs Document Frequency. (3)

Q2 (a) Discuss the various phases of Natural Language Processing (such as Morphological, Syntactic, Semantic, and Pragmatic analysis). Using the sentence *"The old man read a book,"* illustrate how the output of the syntactic phase acts as the input for the semantic phase. (6)

(b) Formulate the Trigram Language Model. Assume a training corpus yields the following specific frequency counts: (6)

- C({I, love}) = 200
- C({I, love, NLP}) = 80
- C({I, love, coding}) = 120

Based on this data, calculate the trigram probabilities P({NLP} | {I, love}) and P({coding} | {I, love}). Explain the Markov assumption utilized in this calculation.

(c) What does it mean to conduct an empirical comparison of smoothing techniques? Discuss how applications of Language Modelling evaluate the effectiveness of these different smoothing algorithms. (6)

Q3 (a) Describe the application of the Markov Model and the Maximum Entropy model in the context of Part of Speech Tagging. How do these models use probability to resolve tagging ambiguities? (6)

(b) Elaborate on the architectures of Continuous Bag-of-Words (CBOW) and skip-gram models. Detail how these models generate dense vector representations for words. (6)

(c) In a skip-gram model with a window size of 2, identify the training pairs (input, output) generated for the target word "NLP" in the sentence: "The field of NLP is rapidly developing". Show the mathematical objective function that the model tries to maximize during training. (6)

Q4 (a) Discuss the process of Natural Language Generation and its reliance on Lexical Semantics. (6)

(b) Differentiate between Knowledge-Based WSD (using lexical resources) and Supervised WSD (using annotated corpora) (6)

(c) Describe the Maximum Entropy model for POS tagging. Discuss how it differs from a standard Markov Model in terms of the features it considers for classification. (6)

Q5 (a) Explain the difference between Extractive and Abstractive Text Summarization with one example each. (6)

(b) Define Term Frequency (TF). Calculate TF for word "cat" in document "the cat the cat dog" showing all steps. (6)

(c) Explain Document Frequency Weighting with formula. Why do common words get zero weight? (6)

Q6 (a) What is Named Entity Recognition (NER)? List any four named entity types with examples. (6)

(b) Explain Stemming. Apply stemming to words: "running", "connection", "fairly". Show step-by-step reduction using stemming algorithm. (6)

(c) What is Sentiment Analysis? Classify sentiment of these 3 reviews using simple keyword method. Show steps. (6)

Reviews:
"Excellent product, very happy!"
"Average quality, okay service"
"Poor product, very disappointed"

The given Keyword List is as follows:
Positive words: excellent, good, happy, great, love
Negative words: poor, bad, disappointed, hate, terrible
Neutral words: average, okay, fine

Q7 (a) What is Knowledge-Based MT System? Compare Direct Machine Translation with Rule-Based MT using example. (6)

(b) Define Neural Machine Translation (NMT). What is seq2seq learning in NMT? (6)

(c) Explain Expectation-Maximization (EM) algorithm for parameter learning in IBM Model 1 with simple numerical example. (6)