# BRAC UNIVERSITY
## Department of Computer Science and Engineering

Examination: Final | Semester: Spring 2025
Duration: 90 minutes | Full Marks: 30

CSE 440: Natural Language Processing II

Figures in the right margin indicate marks.

**Answer all 3**

1. A. You need to assign PoS tags for the sentence **I love good movies**. You only have four tags: noun (NN), verb (VB), adjective (ADJ) and pronoun (PN). During your training of an HMM, it learns these emission probability and tag transition probability matrices (appendix A: on the other side). Using the Viterbi algorithm, calculate the Viterbi values for **love** (i.e. fill up the second column). [6]

   B. Write the three approximations Hidden Markov Models use for PoS tagging. Write two disadvantages of Hidden Markov Model PoS taggers. [4]

2. A. Write short notes (equation, graph characteristics, advantages, disadvantages) on these three activation functions: [6]
      a. Leaky ReLU
      b. Sigmoid
      c. TanH

   B. Calculate the updated cell state vector of an LSTM unit for the provided data given in Appendix B (on the other side). [4]

3. A. Write the process of attention based Seq2seq RNN translation model. [4]

   B. Complete two full iteration of EM algorithm on the given language: [6]
      a b c → x y z
      a → x
      b → z

**Appendix A:**

A:

| | NN | VB | PN | ADJ |
|---|---|---|---|---|
| <s> | 0.3 | 0.2 | 0.4 | 0.1 |
| NN | 0.05 | 0.7 | 0.15 | 0.1 |
| VB | 0.1 | 0.05 | 0.1 | 0.75 |
| PN | 0.05 | 0.70 | 0.1 | 0.15 |
| ADJ | 0.8 | 0.1 | 0.1 | 0 |

B:

| | I | good | love | movies |
|---|---|---|---|---|
| NN | 0.1 | 0.1 | 0.1 | 0.7 |
| VB | 0.1 | 0 | 0.8 | 0.1 |
| PN | 0.9 | 0.1 | 0 | 0 |
| ADJ | 0 | 0.8 | 0.2 | 0 |

**Appendix B:**

Equations:

$f_t = \sigma(W_f x_t + U_f h_{t-1} + b_f)$

$i_t = \sigma(W_i x_t + U_i h_{t-1} + b_i)$

$\hat{C}_t = \tanh(W_c x_t + U_c h_{t-1} + b_c)$

$C_t = f_t * C_{t-1} + i_t * \hat{C}_t$

Matrices:

$W_f = [1\ 0, 0\ 1]$

$U_f = [1\ 1\ , 2\ 2]$

$b_f = [1\ 1]^T$

$W_i = [0\ 1, 1\ 0]$

$U_i = [1\ 0\ , 0\ 4]$

$b_i = [0\ 0]^T$

$W_c = [1\ 3, 0\ 1]$

$U_c = [1\ 4\ , 0\ 0]$

$b_c = [1\ 0]^T$

$x_t = [2\ 1]^T$

$h_{t-1} = [4\ 1]^T$