Cairo University
Faculty of Engineering
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Sheet 5: Sequence Labeling

1) Having only 3 POS tags that are Noun (N), Modal (M) and Verb (V), and the following corpus of sentences:
   - Mary Jane can see Will
   - Spot will see Mary
   - Will Jane spot Mary?
   - Mary will pat Spot

   Where each sentence is POS tagged as follows:
   - Mary/N Jane/N can/M see/V Will/N
   - Spot/N will/M see/V Mary/N
   - Will/M Jane/N spot/V Mary/N?
   - Mary/N will/M pat/V Spot/N

   C(ti,wi) / C(ti)

   a) Calculate the emission probabilities.
   b) Calculate the transition probabilities, adding a start tag and an end tag at the start and end of each sentence respectively.
   c) Using Viterbi algorithm, mention the computed tag sequence for "Will can spot Mary". Show your calculations.

2) The following matrices specify a Hidden Markov model in terms of costs (negative log probabilities). The marked cell gives the transition cost from BOS to PL.

	PL	PN	PP	VB	EOS
BOS	11	2	3	4	19
PL	17	3	2	5	7
PN	5	4	3	1	8
PP	12	4	6	7	9
VB	3	2	3	3	7

	hen	vilar	ut
PL	17	17	4
PN	3	19	19
PP	19	19	3
VB	19	8	19

+

When using the Viterbi algorithm to calculate the least expensive (most probable) tag sequence for the sentence 'hen vilar ut' according to this model, one gets the following matrix. Note that the matrix is missing three values (marked cells).

		hen	vilar	ut	
BOS	0				
PL		A	27	21	
PN		5	B	35	
PP		22	27	20	
VB		23	14	36	
EOS					C

8 + 1 + 5 = 14

PL

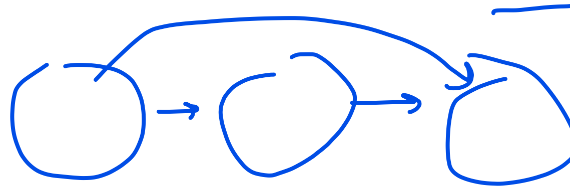
C =

BOS PN VB PL EOS

a) Calculate the value for the cell A. Explain your calculation.
b) Calculate the values for the cells B and C. Explain your calculations.
c) Starting in cell C, draw the backpointers that identify the most probable tag sequence for the sentence. State that tag sequence.

3) Show the NER tags of the following sentence using IO, BIO and BIOES tagging.
"John Alex is going to New York after having an appointment at the Artificial Intelligence Corporate in Rome".

4) Mention which of the following feature templates can be used in linear chain CRF.
a) <yi,xi,yi-1>
b) <yi-2,yi-1,yi>
c) <xi-2,yi,xi+2>
d) <yi-1,xi-1,xi-2,xi+1>



the rule is -> yi-1, yi, X, i