CS6320, Fall 2017
Dr. Mithun Balakrishna
Homework 3
Due Wednesday, October 11th, 2017 11:59pm

A. Submission Instructions:

- Submit your solutions via eLearning.
- Please submit a single zip file with the following files:
  - For programming questions:
    - Source code file(s) in C/C++, Java, or Python. For using any other programming language, please get prior approval from the TA.
    - A ReadMe file with instructions on how to compile/run the code.
  - For all other questions, a PDF/Doc/PS/Image file with the solutions.
- Late Submission Penalty:
  - up to 2 hours late — 10% deduction
  - 2 - 4 hours late — 20% deduction
  - 4 - 12 hours late — 35% deduction
  - 12 - 24 hours late — 50% deduction
  - 24 - 48 hours late — 75% deduction
  - more than 48 hours late — 100% deduction (zero credit)

B. Problems:

1. HMM Decoding: Viterbi Algorithm (70 points):

Programmatically implement the Viterbi algorithm and run it with the HMM in Figure 1 to compute the most likely weather sequence and probability for a given observation sequence. Example observation sequences: *331*, *122313*, *331123312*, etc.

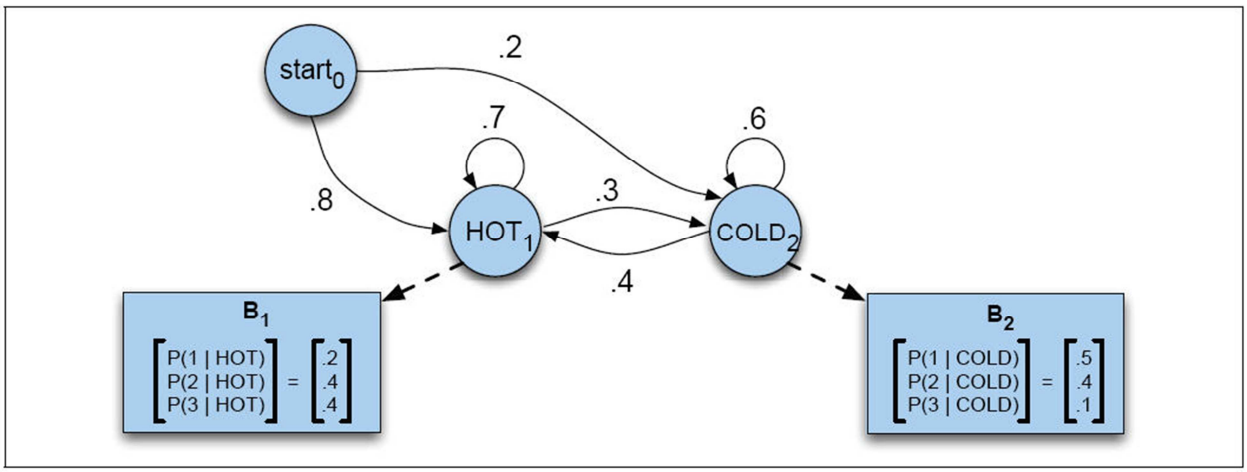

Figure 1. HMM

2. Parse Trees (30 points):

Draw tree structures for the following sentences:

1. Does American Airlines have a flight between five a.m. and six a.m.?
2. I would like to fly on American airlines.
3. Please repeat that.
4. Does American 487 have a first-class section?
5. I need to fly between Philadelphia and Atlanta.
6. What is the fare from Atlanta to Denver?

You can use and expand the CFG rules from the Formal Grammars lecture and Chapter 12. More specifically, you can start from the sample grammar rules specified in Figure 2 and Figure 3 . If required, please expand the CFG rulesets for building the parse trees for the example sentences.

Grammar	Lexicon
S → NP VP .	*PRP → we | he*
S → NP VP	*DT → the | that | those*
S → " S " , NP VP .	*JJ → cold | empty | full*
S → -NONE-	*NN → sky | fire | light | flight | tomorrow*
NP → DT NN	*NNS → assets*
NP → DT NNS	*CC → and*
NP → NN CC NN	*IN → of | at | until | on*
NP → CD RB	*CD → eleven*
NP → DT JJ , JJ NN	*RB → a.m.*
NP → PRP	*VB → arrive | have | wait*
NP → -NONE-	*VBD → was | said*
VP → MD VP	*VBP → have*
VP → VBD ADJP	*VBN → collected*
VP → VBD S	*MD → should | would*
VP → VBN PP	*TO → to*
VP → VB S	
VP → VB SBAR	
VP → VBP VP	
VP → VBN PP	
VP → TO VP	
SBAR → IN S	
ADJP → JJ PP	
PP → IN NP	

Figure 2. CFG Rules Set 1

$S \rightarrow NP\ VP$
$S \rightarrow Aux\ NP\ VP$

$S \rightarrow VP$

$NP \rightarrow Pronoun$
$NP \rightarrow Proper\text{-}Noun$
$NP \rightarrow Det\ Nominal$
$Nominal \rightarrow Noun$
$Nominal \rightarrow Nominal\ Noun$
$Nominal \rightarrow Nominal\ PP$
$VP \rightarrow Verb$
$VP \rightarrow Verb\ NP$
$VP \rightarrow Verb\ NP\ PP$

$VP \rightarrow Verb\ PP$
$VP \rightarrow VP\ PP$
$PP \rightarrow Preposition\ NP$

Figure 3. CFG Rules Set 2