

Task1:

Propose new or amended rules so that the grammar generates examples (i-viii) below, but not the ungrammatical (ix-xii).

Set of formal grammar rules: (R.Kibble, 2013) , (University of Pensilvania, 2019)

Determiner **Det** → The | a |

Noun **N** → trombones | parade | pass | end | wumpus | shamus | street | wood | way | students | professor |

Name **Name** → Spartans | Jana | Thermopylae | Fatima |

Verb **V** → led | defended | saw | chortled | whiffled | came | floated | agreed | was | see | should | be | dreamed |

Adverb **Adv** → hideously | as | most | very |

Adjective **Adj** → big | ugly | peculiar | tough | fair | careful | either |

Conjunction **Conj** → or | and | that | but | then | either |

Pronoun **Prn** → it | their | you | she |

Preposition **Prep** → at | of | through | in | If |

Digit **Digit** → 76 | 300 |

Sentences:

- i. 76 trombones led the big parade.
- ii. 300 Spartans defended the pass at Thermopylae.
- iii. Jana saw either a wumpus or a shamus at the end of the street.
- iv. The hideously ugly wumpus chortled and whiffled as it came through the wood.
- v. The wumpus floated in a most peculiar way.
- vi. The students agreed that their professor was tough but fair.
- vii. If you see a wumpus then you should be very careful.
- viii. Either Fatima saw a wumpus or she dreamed it.

- ix. *The Wumpus floated in a most way.
- x. *The students agreed that their professor was very.
- xi. *Ivan saw either a wumpus and a shamus.
- xii. *If Ali saw a wumpus or it was a shamus.

i. 76 trombones led the big parade.

Digit N V Det Adj N

S (S-> NP VP)
NP VP (NP)
NP (NP-> Digit N)
NP (NP-> 76 N)
76 N (N-> trombones)
76 trombones VP (VP-> VP NP)
76 trombones VP (VP-> led NP)
76 trombones led NP (NP-> Det Adj N)
76 trombones led NP (NP-> the Adj N)
76 trombones led the NP (NP-> big N)
76 trombones led the big N (N-> parade)
76 trombones led the big parade.

Change in Grammar:

Digit -> Digit | Digit Digit

NP-> Digit + N

ii. 300 Spartans defended the pass at Thermopylae.

Digit Name V Det N Prep Name

S (S-> NP VP)
NP VP (NP)
NP (NP-> Digit PN)
NP (NP-> 300 PN)
300 N (N-> Spartans)
300 Spartans VP (VP-> VP NP)
300 Spartans VP (VP-> defended NP)
300 Spartans defended NP (NP-> NP PP)
300 Spartans defended NP (NP-> Def N)
300 Spartans defended NP (NP-> the N)
300 Spartans defended the N (N-> pass)
300 Spartans defended the pass PP (PP-> Prep Name)
300 Spartans defended the pass PP (PP-> at Name)
300 Spartans defended the pass at Name (Name-> Thermopylae)
300 Spartans defended the pass at Thermopylae.

Change in Grammar:

NP -> Digit + Name

iii. Jana saw either a wumpus or a shamus at the end of the street.

Name V Adj Det N Conj Det N Prep Det N Prep Det N

S (S-> NP VP)
NP VP (NP)
NP (NP-> Name)
Name (Name-> Jana)
Jana VP (VP-> VP NP)

Jana VP (VP-> VP NP)
 Jana VP (VP-> saw Adj)
 Jana saw Adj(Adj-> either)
 Jana saw either NP (NP-> Det N)
 Jana saw either NP (NP-> a N)
 Jana saw either a N (N-> wumpus)
 Jana saw either a wumpus NP (NP-> NP PP)
 Jana saw either a wumpus NP (NP-> Conj Det N)
 Jana saw either a wumpus NP (NP-> or Det N)
 Jana saw either a wumpus or NP (NP-> Det N)
 Jana saw either a wumpus or NP (NP-> a N)
 Jana saw either a wumpus or a N (N-> shamus)
 Jana saw either a wumpus or a shamus PP (PP-> Prep NP)
 Jana saw either a wumpus or a shamus PP (PP-> at NP)
 Jana saw either a wumpus or a shamus at NP (NP-> Det N PP)
 Jana saw either a wumpus or a shamus at NP (NP-> the N PP)
 Jana saw either a wumpus or a shamus at the NP (NP-> end PP)
 Jana saw either a wumpus or a shamus at the end PP (PP-> Prep NP)
 Jana saw either a wumpus or a shamus at the end PP (PP-> of NP)
 Jana saw either a wumpus or a shamus at the end of NP (NP-> Det N)
 Jana saw either a wumpus or a shamus at the end of NP (NP-> the N)
 Jana saw either a wumpus or a shamus at the end of the N (N->
 street)
 Jana saw either a wumpus or a shamus at the end of the street.

Change in Grammar:

NP -> Conj + Det+ N

iv. The hideously ugly wumpus chortled and whiffled as it came through the wood.

Det	Adv	Adj	N	V	Conj	V	Adv	Prn	V	Prep	Det	V
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S (S-> NP VP)
 NP (NP-> Det AdjP N)
 NP (NP-> The AdjP N)
 The NP (NP-> AdjP N)
 The AdjP (AdjP-> Adv Adj)
 The AdjP (AdjP-> hideously Adj)
 The hideously Adj (Adj-> ugly)
 The hideously ugly N (N-> wumpus)
 The hideously ugly wumpus VP (VP-> VP PP)
 The hideously ugly wumpus VP (VP-> VP Prn V)
 The hideously ugly wumpus VP (VP-> VP Adv)
 The hideously ugly wumpus VP (VP-> V Conj V)
 The hideously ugly wumpus VP (VP-> chortled Conj V)
 The hideously ugly wumpus chortled VP (VP-> and V)
 The hideously ugly wumpus chortled and V (V-> whiffled)
 The hideously ugly wumpus chortled and whiffled Adv (Adv-> as)
 The hideously ugly wumpus chortled and whiffled as Prn (Prn-> it)
 The hideously ugly wumpus chortled and whiffled as it V (V-> came)
 The hideously ugly wumpus chortled and whiffled as it came PP (PP->
 Prep NP)
 The hideously ugly wumpus chortled and whiffled as it came PP (PP->
 through NP)

The hideously ugly wumpus chortled and whiffled as it came through
 NP (NP-> Det N)
 The hideously ugly wumpus chortled and whiffled as it came through
 NP (NP-> the N)
 The hideously ugly wumpus chortled and whiffled as it came through
 the N (N-> wood)
 The hideously ugly wumpus chortled and whiffled as it came through
 the wood.

Change in Grammar:

VP -> VP + Prn + V

AdjP -> Adv + Adj

NP -> Det + AdjP + N

VP -> V + Conj + V

VP -> VP + Prn + V

v. The wumpus floated in a most peculiar way.

Det	N	V	Prep	Det	Adv	Adj	N
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S (NP VP)

NP (NP-> Det N)

NP (NP-> The N)

The N (N-> wumpus)

The wumpus VP (VP-> VP PP)

The wumpus VP (VP-> floated)

The wumpus floated PP (PP-> Prep NP)

The wumpus floated PP (PP-> in NP)

The wumpus floated in NP (NP-> Det AdjP N)

The wumpus floated in NP (NP-> a AdjP N)

The wumpus floated in a AdjP (AdjP-> Adv Adj)

The wumpus floated in a AdjP (AdjP-> most Adj)

The wumpus floated in a most Adj (Adj-> peculiar)

The wumpus floated in a most peculiar N (N-> way)

The wumpus floated in a most peculiar way.

vi. The students agreed that their professor was tough but fair.

Det	N	V	Conj	Prn	N	V	Adj	Conj	Adj
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S (S Conj S)

S (NP VP)

NP (NP-> Det N)

NP (NP-> The N)

The N (N-> students)

The students VP (VP-> V)

The students V (V-> agreed)

The students agreed Conj (Conj-> that)

The students agreed that S (S-> NP VP)

The students agreed that NP (NP-> Prn N)

The students agreed that NP (NP-> their N)
 The students agreed that their N (N-> professor)
 The students agreed that their professor VP (VP-> V AdjP)
 The students agreed that their professor VP (VP-> was AdjP)
 The students agreed that their professor was AdjP (AdjP-> Adj Conj Adj)
 The students agreed that their professor was AdjP (AdjP-> tough Conj Adj)
 The students agreed that their professor was tough AdjP (AdjP-> but Adj)
 The students agreed that their professor was tough Adj (Adj-> fair)
 The students agreed that their professor was tough but fair.

Change in Grammar:

AdjP -> Adj + Conj + Adj

VP -> VP + AdjP

NP -> Prn + N

vii. If you see a wumpus then you should be very careful.

Conj	Prn	V	Det	N	Conj	Prn	V	V	Adv	Adj
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S (S Conj S)
 S (NP VP)
 NP (NP-> Conj Prn)
 NP (NP-> if Prn)
 If Prn (Prn-> you)
 If you VP (VP-> VP NP)
 If you VP (VP-> see NP)
 If you see NP (NP-> Det N)
 If you see NP (NP-> a N)
 If you see a N (N-> wumpus)
 If you see a wumpus Conj (Conj-> then)
 If you see a wumpus then S (NP VP)
 If you see a wumpus then NP (NP-> Prn)
 If you see a wumpus then Prn (Prn-> you)
 If you see a wumpus then you VP (VP-> VP AdjP)
 If you see a wumpus then you VP (VP-> V V)
 If you see a wumpus then you VP (VP-> should V)
 If you see a wumpus then you should V (V-> be)
 If you see a wumpus then you should be AdjP (AdjP-> Adv Adj)
 If you see a wumpus then you should be AdjP (AdjP-> very Adj)
 If you see a wumpus then you should be very Adj (Adj-> careful)
 If you see a wumpus then you should be very careful.

Change in Grammar:

NP -> Conj + Prn

VP -> V + V

viii. Either Fatima saw a wumpus or she dreamed it.

Conj Name V Det N Conj Prn V Prn

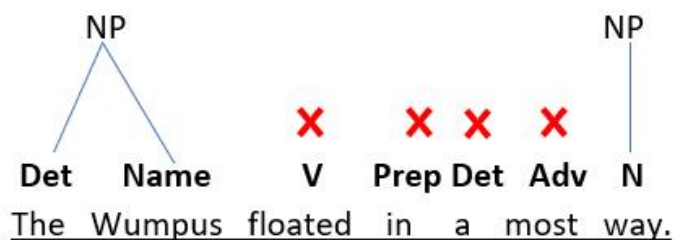
S (S Conj S)
 S (S-> NP VP)
 NP (NP-> Conj Name)
 NP (NP-> Either Name)
 Either Name (Name -> Fatima)
 Either Fatima VP (VP-> V NP)
 Either Fatima VP (VP-> saw NP)
 Either Fatima saw NP (NP-> Det N)
 Either Fatima saw NP (NP-> a N)
 Either Fatima saw a N (N-> wumpus)
 Either Fatima saw a wumpus Conj (Conj-> or)
 Either Fatima saw a wumpus or S (S-> NP VP)
 Either Fatima saw a wumpus or NP (NP-> Prn)
 Either Fatima saw a wumpus or NP (NP-> she)
 Either Fatima saw a wumpus or she VP (VP-> VP NP)
 Either Fatima saw a wumpus or she VP (VP-> dreamed NP)
 Either Fatima saw a wumpus or she dreamed NP (NP-> Prn)
 Either Fatima saw a wumpus or she dreamed NP (NP-> it)
 Either Fatima saw a wumpus or she dreamed it.

Change in Grammar:

NP-> Conj +Name

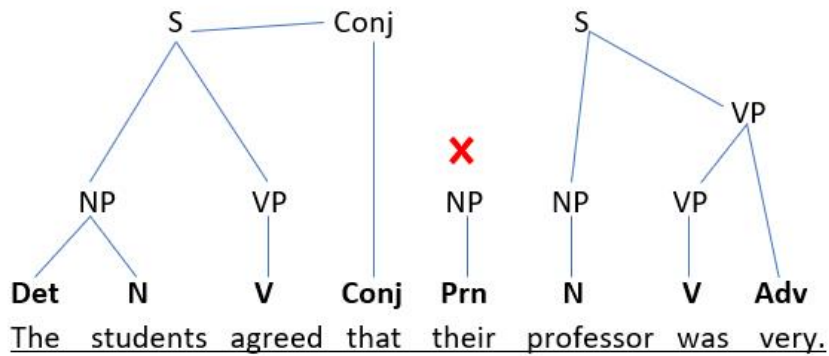
ix. *The Wumpus floated in a most way.

Det Name V Prep Det Adv N



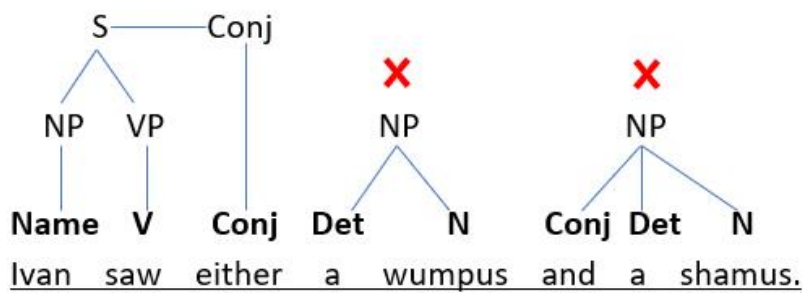
x. *The students agreed that their professor was very.

Det N V Conj Prn N V Adv



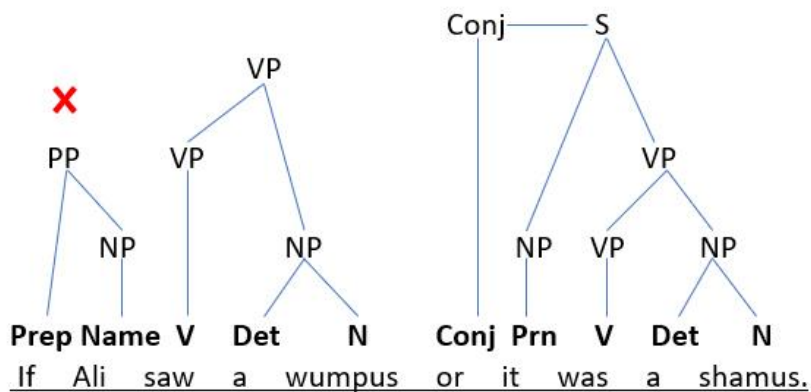
xi. *Ivan saw either a wumpus and a shamus.

Name V Conj Det N Conj Det N



xii. *If Ali saw a wumpus or it was a shamus.

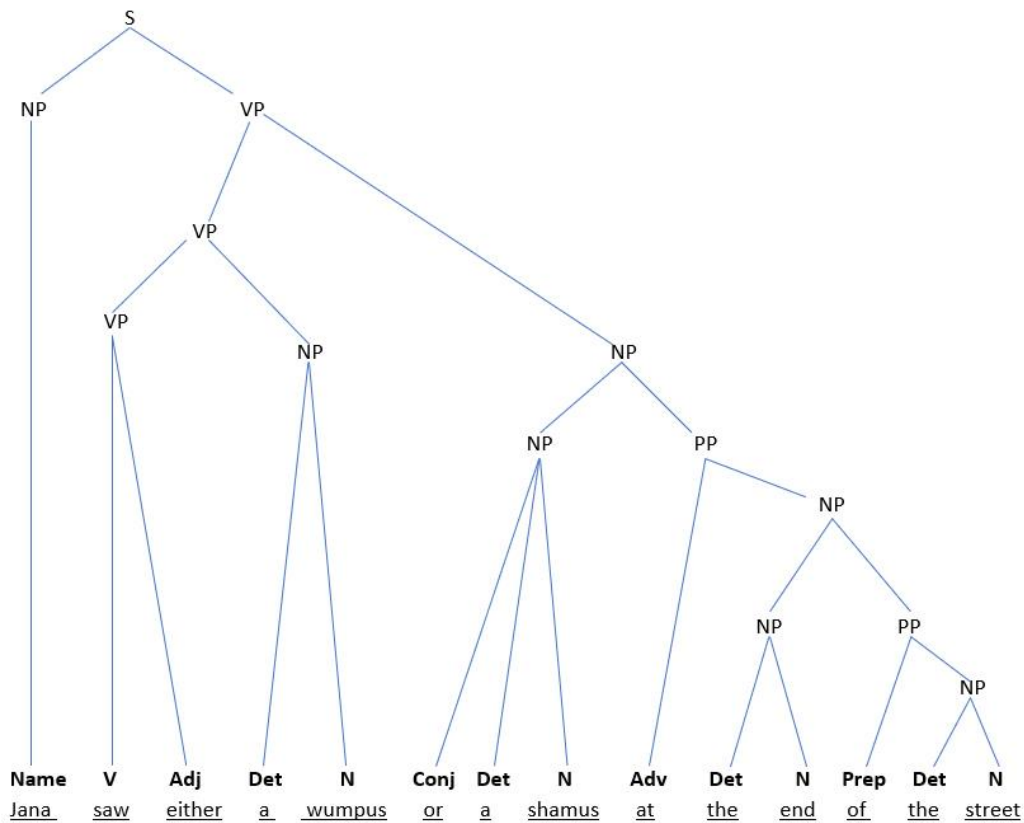
Prep Name V Det N Conj Prn V Det N



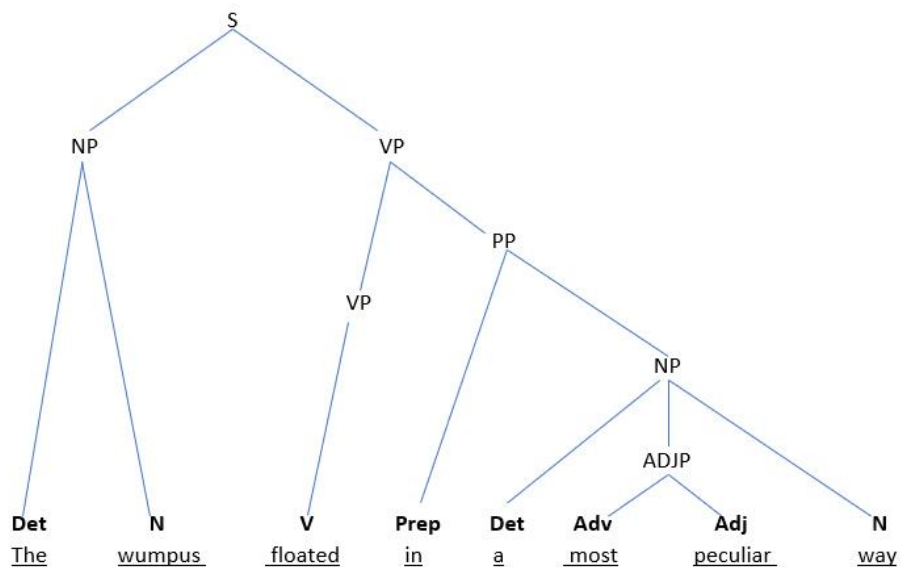
Task2:

Draw syntax trees for (iii), (v) and (vii) using your amended grammar.

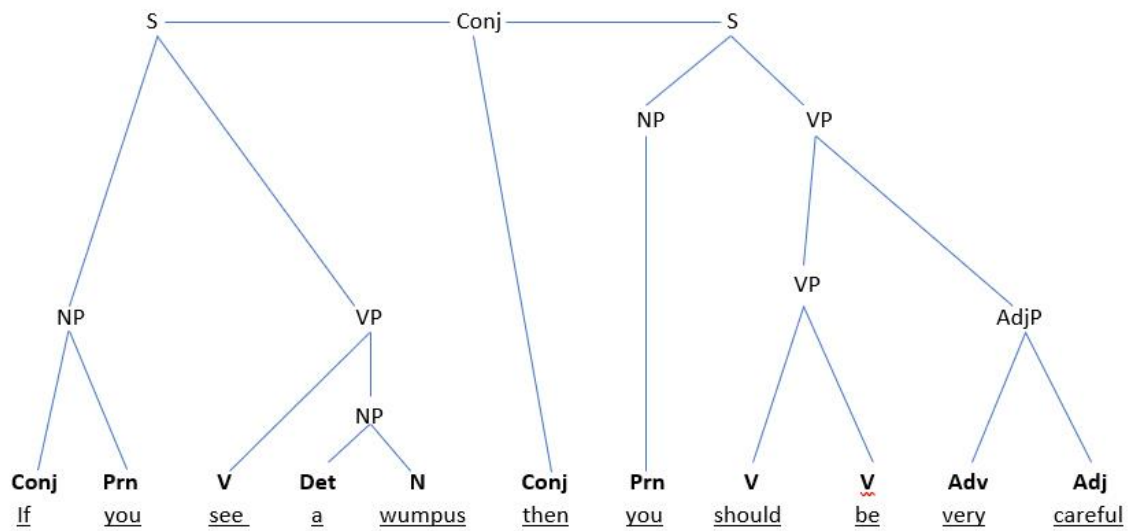
iii. Jana saw either a wumpus or a shamus at the end of the street.



v. The wumpus floated in a most peculiar way.



vii. If you see a wumpus then you should be very careful.



References

R.Kibble, 2013. *Introduction to natural language processing*. London: University of London.

University of Pensilvania, 2019. *Alphabetical list of part-of-speech tags used in the Penn Treebank Project*; Philadelphia: s.n.