COMP9414: Artificial Intelligence
Solutions Week 8: Language Processing

1. **sentence:** This
   constituents:
   PRO1: PRO → *this* from 0 to 1 by lexicon entry 1
   NP1: NP → PRO1 from 0 to 1 by Rule 2
   active-arcs:
   ARC1: S → NP1 • VP from 0 to 1 by Rule 1
   ARC2: NP → NP1 • REL S from 0 to 1 by Rule 5

   sentence: This is
   constituents:
   VERB1: VERB → *is* from 1 to 2 by lexicon entry 2
   VP1: VP → VERB1 from 1 to 2 by Rule 6
   S1: S → NP1 VP1 from 0 to 2 from Rule 1 from ARC1
   active-arcs:
   ARC3: VP → VERB1 • NP from 1 to 2 by Rule 7

   sentence: This is the
   constituents:
   ART1: ART → *the* from 2 to 3 by lexicon entry 3
   active-arcs:
   ARC4: NP → ART1 • NOUN from 2 to 3 by Rule 3

   sentence: This is the house
   constituents:
   NOUN2: NOUN → *house* from 3 to 4 by lexicon entry 4
   NP2: NP → ART1 NOUN2 from 2 to 4 by Rule 3 from ARC4
   active-arcs:
   ARC4: NP → ART1 • NOUN from 3 to 4 by Rule 3
   ARC5: S → NP2 • VP from 2 to 4 by Rule 1
   ARC6: NP → NP2 • REL S from 2 to 4 by Rule 5

   sentence: This is the house that
   constituents:
   PRO2: PRO → *that* from 4 to 5 by lexicon entry 5
   REL1: REL → *that* from 4 to 5 by lexicon entry 5
   NP3: NP → PRO2 from 4 to 5 by Rule 2
   active-arcs:
   ARC7: S → NP3 • VP from 4 to 5 by Rule 1
   ARC8: NP → NP2 REL1 • S from 2 to 5 from ARC6

   sentence: This is the house that Jack
   constituents:
   NAME1: NAME → *Jack* from 5 to 6 by lexicon entry 6
   NP4: NP → NAME1 from 5 to 6 by Rule 4
   active-arcs:
   ARC9: S → NP4 • VP from 5 to 6 by Rule 1
   ARC10: NP → NP4 • REL S from 5 to 6 by Rule 5

sentence: This is the house that Jack built
constituents:
VERB2: VERB → *built* from 6 to 7 by lexicon entry 7
VP2: VP → VERB2 from 6 to 7 by Rule 6 and constituent VERB2
S2: S → NP4 VP2 from 5 to 7 by Rule 1 from ARC9
NP3: NP → NP2 REL1 S2 from 2 to 7 by Rule 5 from ARC8
VP3: VP → VERB1 NP3 from 1 to 7 by Rule 7 from ARC3
S3: S → NP1 VP3 from 0 to 7 by Rule 1 from ARC1
active-arcs:
ARC11: VP → VERB2 • NP from 6 to 7 by Rule 7

2. (i) S → S and S
NP → NP and NP
VP → VP and VP
PP → PP and PP
ADJP → ADJP and ADJP
ADVP → ADVP and PP

(ii) *Him and she went to the park.
*John and Jack drinks coffee.
*John went to the park and drink coffee.
*John went to he.

S → S and S	# Do not have to agree
NP(plu, Case) → NP(Case) and NP(Case)	# LHS is plu and Case has to agree
VP(Case) → VP(Case) and VP(Case)	# Case has to agree
PP(acc) → PP(acc) and PP(acc)	# Case must be acc
PP(acc) → PREP and NP(acc)	# Case must be acc
ADJP → ADJP and ADJP	# Do not have to agree
ADVP → ADVP and PP	# Do not have to agree

(iii) S(P ∧ Q) → S(P) and S(Q)
NP(X^Y^F) → NP(X^F) and NP(Y^F)
VP(X^F ∧ Y^(F ∧ G)) → VP(X^F) and VP(Y^G)
PP(X^(F ∧ G)) → PP(X^F) and PP(X^G
ADJP(X^(F ∧ G)) → ADJ(X^F) and ADJP(X^G)
ADVP(X^(F ∧ G)) → ADVP(X^F) and PP(X^G)

(iv) For "A but B" there is generally a presupposition that the hearer would not believe B (or even believe ¬B) having accepted A.