

10 Natural Language Processing (SHT)

Consider the following context-free grammar:

S → NP VP	N → dog	V → sees
NP → Det N	N → cat	V → hates
VP → V	N → mouse	V → sneezes
VP → V NP	Det → the	

(a) Which of the following sentences are recognised by this grammar, and why? [4 marks]

- (i) the dog sneezes the cat
- (ii) the mouse hates
- (iii) the cat the mouse hates
- (iv) the mouse hates the mouse

(b) Modify the grammar so that the following sentence is now accepted in addition:

*the dog the cat the mouse sees hates sneezes*

Your modification should express the linguistic phenomenon as efficiently and elegantly as possible. Justify your choice. [6 marks]

(c) The semantics of natural language expressions can be expressed in first order predicate logic (FOPL). For instance, “the dog sneezes” can be approximately expressed as

$$\exists x \text{dog}(x) \cap \text{sneeze}(x)$$

Following this pattern, express the semantics of the sentence in part (b) in FOPL. [4 marks]

(d) Consider the following sentence:

*the mouse that sees the cat that hates the dog that sneezes*

Contrast this construction to the one in part (b) in terms of semantics and syntax. How would you modify the original grammar in part (a) to account for this construction? [6 marks]