3 Formal Models of Language (PJB)

Consider the following grammar:

\[
\begin{align*}
S &\rightarrow NP \ VP \\
NP &\rightarrow N \ S \\
NP &\rightarrow N \\
VP &\rightarrow V \ N \\
VP &\rightarrow V \\
N &\rightarrow \{Alice, cats\} \\
V &\rightarrow \{saw, grinned\}
\end{align*}
\]

(a) The grammar can be used to generate the following sentences:

(i) Alice saw cats

(ii) Cats Alice saw grinned

Draw derivation trees for both of these sentences. [2 marks]

(b) What is the longest sentence that can be generated by the grammar? Describe this sentence. [2 marks]

(c) Is the language generated by the grammar a regular language? Provide a proof for your answer. [8 marks]

(d) A psycho-linguistic experiment shows that, by the 2nd word in the sentence, Part (a)(ii) is harder to process than the sentence Part (a)(i). Yngve hypothesised that a speaker’s short-term memory functions as a stack. Explain how this hypothesis might account for the experimental results by drawing the stack arising from a top-down parse of the two sentences. [4 marks]

(e) How might the sentence in Part (a)(ii) be altered so that it has the same meaning but is easier to process? Explain your reasoning. [4 marks]