3 Formal Models of Language (PJB)

Consider the following grammar:

$$
\begin{array}{rcl}
\text{S} & \rightarrow & \text{NP VP} \\
\text{NP} & \rightarrow & \text{N S} \\
\text{NP} & \rightarrow & \text{N} \\
\text{VP} & \rightarrow & \text{V N} \\
\text{VP} & \rightarrow & \text{V}
\end{array}
$$

$$
\begin{array}{rcl}
\text{N} & \rightarrow & \{\textit{Alice}, \textit{cats}\} \\
\text{V} & \rightarrow & \{\textit{saw}, \textit{grinned}\}
\end{array}
$$

(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]