AQA Computer Science A-Level

4.4.3 Context-free languages

Concise Notes

Specification:

4.4.3.1 Backus-Naur Form (BNF)/syntax diagrams

Be able to check language syntax by referring to BNF or syntax diagrams and formulate simple production rules

Be able to explain why BNF can represent some languages that cannot be represented using regular expressions

Context-free languages

- Sets of strings and symbols that follow the rules of a context-free grammar
- Context-free grammars describe which strings are and are not possible in a language by laying out production rules
- A production rule is a simple as replacing one character for another
- Examples of production rules include:

$a \rightarrow ab$	$a \rightarrow aa$	$b \rightarrow a$
The a character can be replaced by the two characters ab.	The character a can be replaced by two a characters.	A b character can be replaced by an a character.

Backus-Naur form

- A way of notating context-free languages
- Uses statements in which the left hand side is defined by the right hand side

Non-terminals

- Text which is placed inside of angle brackets represents a non-terminal
- Sometimes also called meta-components or syntactic variables
- Can be broken down further into either more non-terminals, terminals or a combination of the two

Terminals

- Text without any brackets represents a terminal
- Cannot be broken down any further
- Must be taken to be the written value
- The pipe symbol, which looks like a straight vertical line, represents the OR operator

Recursion in Backus-Naur form

- Backus-Naur form can make use of recursion
- A non-terminal can be defined in terms of itself, allowing for recursion to occur
- Backus-Naur form is capable of representing some strings that cannot be represented by regular expressions as regular expressions cannot support recursion like Backus-Naur form can

Syntax Diagrams

- A visual representation of a regular language
- Non-terminals are represented by rectangles
- Terminals are represented by ellipses
- The shapes are joined by arrows which indicate how strings can be formed from the definitions
- Each non-terminal is defined by its own syntax diagram