Automata and Formal Languages

Non-Regular Languages

$L = \{w \mid w = 0^n 1^n, n \geq 0\}$

No NFA/DFA exists, such that it recognises this language: the states required would be infinite. Thus, this is **not** a regular language.

How do we know when a language is not regular?

$A = \{w \mid w$ has an equal number of 0s and 1s$\}$ **NOT REGULAR**

$B = \{w \mid w$ has an equal number of occurences of 01 and 10 as substrings$\}$ **REGULAR**

For B the difference between the occurrences is bounded by the interval $[-1,1]$, whereas A is unbounded and thus not recognisable.

Pumping Lemma

Informally: If a language is regular,

then all strings in the language at least as long as a certain special value **can be pumped**.

Can be pumped: each string contains a section that can be repeated any number of times, with the resulting string remaining in the language.

If A is a regular language, then there is a number p (pumping length) where, if s is any string in A of length at least p, then s may be divided into three pieces, $s = xyz$, satisfying the following conditions:

1. $xy^iz \in A, \qquad \forall i \geq 0$
2. $|y| > 0$
3. $|xy| \leq p$