Definition 0.1 (Context Free Grammar). A Context Free Grammar (CFG) G is a 4-tuple (V, Σ, R, S) where:

1. V finite set of variables

2. Σ finite set of terminal symbols

3. R finite set of RULES $(V \to (V \cup \Sigma)^*)$

4. S the start variable

Definition 0.2 (Pumping Lemma for CFLs). For every CFL A, there is a p such that if $s \in A$ and $|s| \geq p$ then $s = uvxyz$ where

1. $uv^i xy^i z \in A$ for all $i \geq 0$

2. $vy \neq \sigma$

3. $|vxy| \leq p$

Definition 0.3 (Turing Machine). A Turing machine is a three-tuple, (Σ, Λ)