→ **Theorem:** for any CFG G, there is a CFG G' in CNF st $L(G') = L(G) - \{\varepsilon\}$

1) Claim 1: For any CFG $G = (N, \Sigma, P, S)$ there is a CFG G' with no ε or unit prodⁿ st $L(G') = L(G) - \{\varepsilon\}$

2) Claim 2: For any non-null $x \in \Sigma^*$, any derivation $S \xrightarrow[G]{*} x$ of min length does not use ε or unit prodⁿ

→ CFLs are closed under intersection with regular sets. if $A \subseteq \Sigma^*$ is a CFL and $B \subseteq \Sigma^*$ is regular then $A \cap B$ is a CFL.

→ Pumping Lemma

$L(U) = \{M \# x \mid x \in L(M)\}$

M → encoded as Σ_U

x ⇓ can be any encoded string

↓

U accepts x if $x \in L(M)$

$0^n 1 0^m 1 0^k 1 0^s 1 0^t 1 0^r 1 0^u 1 0^v 1$

0^n: no. of states; 0^s: start; 0^t: accept; 0^r: reject; 0^u: left delimiter; 0^v: blank