CS310

Non-Context-Free Languages

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Pumping Lemma

- For regular languages

- Fundamentally, how does it work?

Pumping Lemma (take two)

Theorem: For any CFG there is an equivalent grammar in CNF.

Pumping lemma (CFG): Suppose A is a CFG. There exists a number *p* such that

if $s \in A$ and $|s| \geq p$

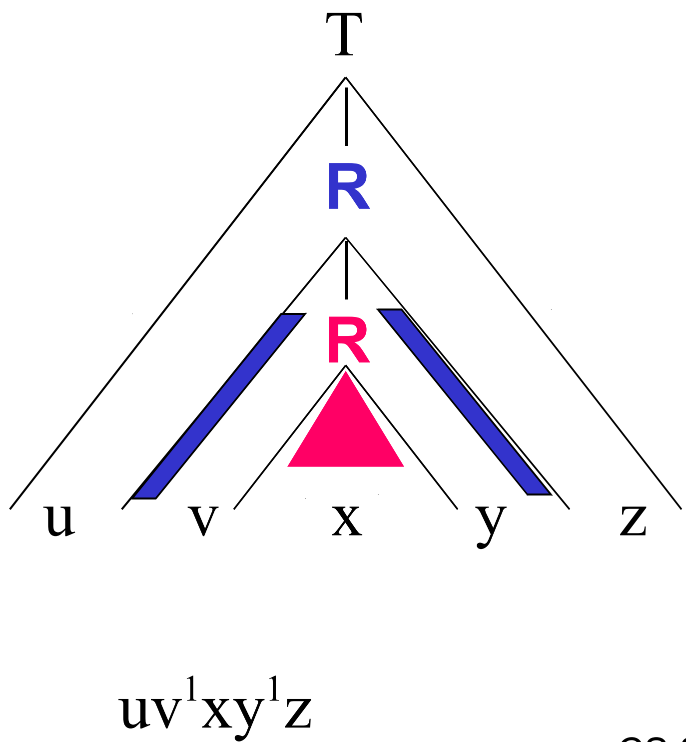
then $s = uvxyz$ where

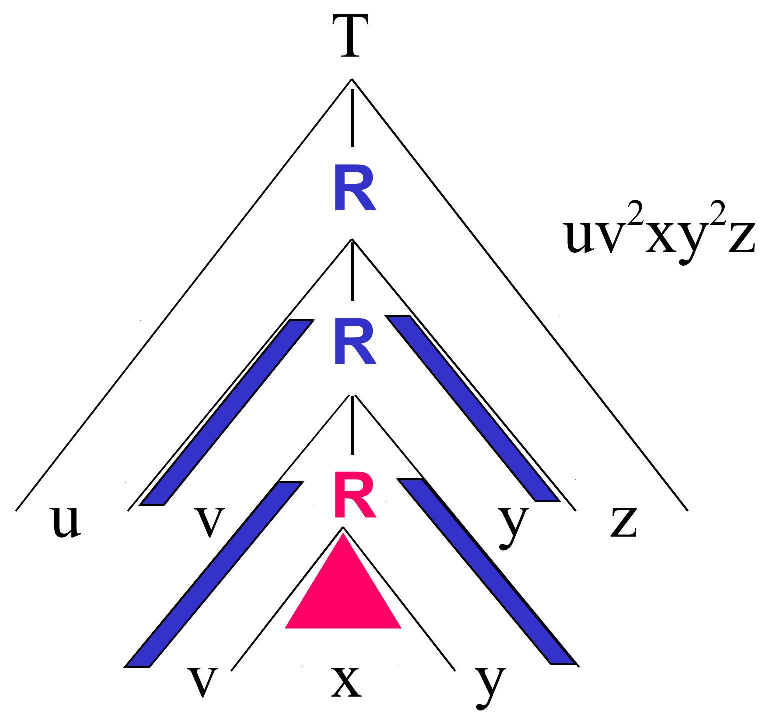
$uv^ixy^iz \in A, i \geq 0$

$|vy| > 0$

$|vxy| \leq p$

Pumping a Parse Tree





Proof

Suppose A is a CFG in CNF and $s \in A$,

$|s| \geq p = 2^{|V|+1}$

2 ? |V|?

The height of the parse tree for s is ?

Example

$L = \{a^i b^i c^i \mid i \geq 0\}$

a PDA cannot represent this. Why?

Pumping Lemma:

s =

u=

v=

x=

y=

z=

Example

$L = \{a^i b^j c^k \mid k \geq j \geq i \geq 0\}$

a PDA cannot represent this. Why?

Pumping Lemma:

s =

u=

v=

x=

y=

z=

Example

$L = \{ ww \mid w \in \{0, 1\}^* \}$ Pump-able?

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s =

Example

$L = \{ w \# x \mid w^R \text{ is substring of } x;\ w,x \in \{0, 1\}^* \}$

Pump-able?

s=