CSC 4170

Theory of Computation

Non-Context-Free Languages

Section 2.3

The pumping lemma for context-free languages

Theorem 2.34 (Pumping lemma for context-free languages)
If L is a context-free language, then there is a number p (the pumping length) where, if s is any string in L of length at least p, then s may be divided into five pieces s = **uvxyz** satisfying the conditions:

1. For each $i \geq 0$, $uv^ixy^iz \in L$;
2. $|vy| > 0$;
3. $|vxy| \leq p$.

uxz

uvxyz

uvvxyyz

uvvvxyyyz

uvvvvxyyyyz

uvvvvvxyyyyyz

The pumping lemma in work: example

S → "R" is a regular expression
R → 0 | (R)*

"0" is a regular expression
"(0)*" is a regular expression
"((0)*)*" is a regular expression
"(((0)*)*)*" is a regular expression
...

"((0)*)*" is a regular expression

u = "(
v = (
x = 0
y =)*
z =)*" is a regular expression

uv^0xy^0z: "(0)*" is a regular expression
uv^1xy^1z: "((0)*)*" is a regular expression
uv^2xy^2z: "(((0)*)*)*" is a regular expression
uv^3xy^3z: "((((0)*)*)*)*" is a regular expression