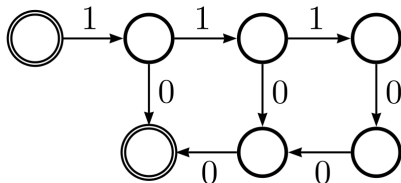


## Context Free Grammars

Apr 9, 2014

## Some things DFAs and REs can't do

The language of strings of a certain number of 1s followed by the same number of 0s.



$1^n 0^n$





# Fully parenthesized mathematical expressions

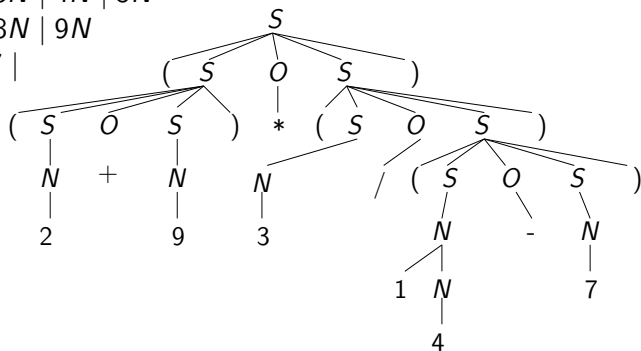
$S \rightarrow N \mid ( S O S )$

$N \rightarrow 0 \mid 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9$

$\mid 1N \mid 2N \mid 3N \mid 4N \mid 5N$

$\mid 6N \mid 7N \mid 8N \mid 9N$

$O \rightarrow + \mid - \mid * \mid / \mid$



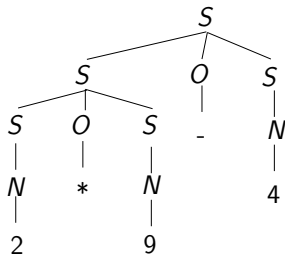
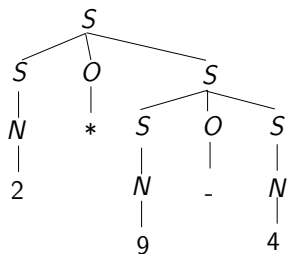
# Ambiguous parsing

$S \rightarrow N \mid S O S$

$N \rightarrow 0 \mid 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9 \mid$

$1N \mid 2N \mid 3N \mid 4N \mid 5N \mid 6N \mid 7N \mid 8N \mid 9N$

$O \rightarrow + \mid - \mid * \mid / \mid$



# Mini-English

- $T$  = {man, woman, dog, unicorn, ball, field, flea, tree, sky,  
a, the, big, bright, fast, beautiful, smart, red, smelly,  
in, on, through, with, quickly, slowly, dreamily,  
happily, chased, saw, bit, loved, ran, slept, sang, was,  
felt, seemed, knew, believed, proved}
- $NT$  = {*Sentence*, *NounPhrase*, *Predicate*, *VerbPhrase*, *PrepPhrase*,  
*Noun*, *Article*, *Adjective*, *Preposition*, *Adverb*,  
*TransitiveVerb*, *IntransitiveVerb*, *LinkingVerb*,  
*TransitivePropObjVerb*}

*Sentence* → *NounPhrase Predicate PrepPhrase*  
          | *NounPhrase Predicate*

*NounPhrase* → *Article Adjective Noun*  
              | *Article Noun*

*Predicate* → *Adverb VerbPhrase*

# Mini-English

<i>VerbPhrase</i>	→	<i>TransitiveVerb NounPhrase</i>   <i>IntransitiveVerb</i>   <i>LinkingVerb Adjective</i>   <i>TransitivePropObjVerb that Sentence</i>
<i>PrepPhrase</i>	→	<i>Preposition NounPhrase</i>
<i>Noun</i>	→	man   woman   dog   unicorn   ball   field   flea   tree   sky
<i>Article</i>	→	a   the
<i>Adjective</i>	→	big   bright   fast   beautiful   smart   red   smelly
<i>Preposition</i>	→	in   on   through   with
<i>Adverb</i>	→	quickly   slowly   dreamily   happily
<i>TransitiveVerb</i>	→	chased   saw   bit   loved
<i>IntransitiveVerb</i>	→	ran   slept   sang
<i>LinkingVerb</i>	→	was   felt   seemed
<i>TransitivePropObjVerb</i>	→	knew   believed   proved