Oct 18

COMPSCI 3331

Fall 2022

What's next?

- Assignment 1: solutions available tomorrow. Marks available before A2 deadline.
- Assignment 2: due Oct 26.
- Quiz 2 marks available now.
- Quiz 4: up to end of Lecture 8.
- Midterm: October 25. Includes **at least** all of Lecture 8.

Assignment

A2 Q2

should not show a particular example.

- What does $p_a(L)$ do? show closure property
- What do we do for this question?

A2 Q3b

- Instead of using pumping lemma, use other facts you know.
- In particular, can use part (a).

$P_a(L) = \{ w \in \Sigma^* , \exists n \geq 0 . \ w a^n \in L \}$.

Showing languages aren't regular

- $L_5 = \{w \in \{a,b,c,d\}^* \ : \ \forall x \in \{a,b,c,d\}, |w|_x = 0 \text{ or } |w|_x \geq 5\}$ 5^4 states. $(a=0 \text{ or } |w|_a \geq 5) + (b=0 \text{ or } |w|_b \geq 5) + \ldots$ calculatable..
- $L_6 = L^*$ where $L = \{a^n b^n \ : \ n \geq 0\}$ L is not regular. $\Rightarrow L^*$ is not reg
- $L_7 = \{w \in \{a,b\}^* \ : \ |w|_a \equiv |w|_b (\bmod 10)\}$
- $L_8 = \{w \in \{a,b\}^* \ : \ \exists u \in \{a,b\}^*, w = uu^R\}$. informal.

requires too much memory.

L_6: pumping lemma: $a^n b^n$.

CFGs

S could be replaced with any other symbol.

Grammar 1

$V = \{S\}$ (start state)

$\Sigma = \{a, b, \#\}$

S is the start symbol

rules that apply

$$S \rightarrow aSb$$
$$S \rightarrow aSbb$$
$$S \rightarrow \#$$

update this statement with S itself until S is replaced.

Grammar 2

$V = \{S\}$

$\Sigma = \{a, b\}$

S is the start symbol

$$S \rightarrow aSa$$
$$S \rightarrow bSb$$
$$S \rightarrow SS$$
$$S \rightarrow \varepsilon$$

How do we prove that $L = L(G)$?

$\{a^i \# b^j : 0 \le i \le j \le 2i\}$.

$$
\begin{aligned}
S &\to aSb \\
S &\to aSbb \\
S &\to \#
\end{aligned}
$$

1) $L \subseteq L(G)$
prove by showing the derivation.
$S \Rightarrow$ steps of rules showing
2) $L(G) \subseteq L$: induction.

Writing Grammars

kelvin

- Nested dependencies are ok. $L = \{a^n b^m c^m d^n \ : \ n, m \geq 0\}$.
- "Serial dependencies are not. $L = \{a^n b^m c^n d^m \ : \ n, m \geq 0\}$.

S

{a, b, c, d}

S -> aSd

S -> T ← this step is essential!

T -> bTc

T -> ε.

More examples

- $L_1 = \{a^i b^j c^i \ : \ i,j \geq 0\}$.
- $L_2 = \{a^n b^m \ : n > m\}$
- $L_3 = \{a^n b^m \ : n \neq m\}$
- $L_4 = L_1^*$.
- $L_5 = \{a^i b^j c^k \ : \ i = j \text{ or } j = k\}$.

$S \to aSc$
$S \to T$
$T \to bT$
$T \to \varepsilon$.

$L_2 + \{a^n b^m \ n<m\} \Rightarrow$

$S_1 \to aS_1$
$S_1 \to aT_1$
$T_1 \to aT_1 b$
$T_1 \to \varepsilon$.
$S_2 \to S_2 b \Rightarrow$
$S_2 \to T_2 b$
$T_2 \to aT_2 b$
$T_2 \to \varepsilon$

$S \to S_1$
$S \to S_2$
$S_1 \to aT$
$S_2 \to Tb$
$S_1 \to aS_1$
$S_2 \to S_2 b$
$T \to aTb$
$T \to \varepsilon$

$S \to aT$
$T \to aTb$
$T \to \varepsilon$.
$S \to aS$

$X = L_1$.
$X \to \varepsilon$
$X \to XX$

Midterm prep.

- Your group is now available.
- To find it go to Dropbox (left hand side) and open the file in your dropbox.
- On the website there's an image of the lecture theatre.
- Shows your suggested meeting point for your group.

Midterm Format

- You must write both parts of the midterm.
- Individual Portion: 90 % of your grade.
- Group Portion: 10 % of your grade.
- But your mark will never go down because of the group portion (if you write it). $(\max(.9S_1 + .1S_2, S_1))$
- Time: 80 minutes for individual stage, 5 minutes to find groups, 20 minutes for group stage.