Formal languages and compilers – June 12, 2012

Exercise 1

Let the regular expression r be defined as follows:

$$r = (\ a(ab|bb)^*(aa\ |\ c)\ )^*$$

1. Provide the minimum DFA that recognizes $\mathcal{L}(r)$.
2. Provide a regular grammar $\mathcal{G}$ such that $\mathcal{L}(\mathcal{G}) = \mathcal{L}(r)$.

ok

Exercise 2

Let $\mathcal{G}$ be the following grammar:

$$S \rightarrow A \mid \epsilon$$

$$A \rightarrow AB \mid B \mid bB$$

$$B \rightarrow dA \mid d \mid ABe \mid Be$$

ok

1. Show the grammar $\mathcal{G}'$ obtained from $\mathcal{G}$ by removing left recursion, either immediate or not.
2. Compute the set of *first* and *follow* for $\mathcal{G}'$. Ok
3. Say, justifying your answer, whether $\mathcal{G}'$ is LL(1) or not. ok

Exercise 3 (only after Ex. 1 and Ex. 2)

Say whether or not the language

$$\mathcal{L} = \{a^i a^i b^j \mid i, j \geq 0 \text{ and if } i, j > 0 \text{ then } i \neq j\}$$

is a context-free language. Justify your answer.

?

Formal Languages and Compilers – session 3, 2012

Exercise 1

Let $r = r_1 r_1{}^*$ with

$$r_1 = (\,a(ab \mid bb)^*(aa \mid c)\,).$$

Provide the minimum DFA that recognizes the complement of $\mathcal{L}(r)$ over the alphabet $\{a, b, c\}$, namely the minimum DFA that recognizes the language

$$\mathcal{L}(\,(a \mid b \mid c)^*\,) \setminus \mathcal{L}(r).$$

Exercise 2

Let $\mathcal{G}$, where R is the single non-terminal symbol, be the following grammar for regular expressions over $\{a, b\}$:

$$R \;\rightarrow\; R + R \mid R \bullet R \mid R^* \mid (R) \mid a \mid b$$

1. Show that $\mathcal{G}$ is ambiguous.
2. Define a SLR grammar $\mathcal{G}'$ for regular expressions over $\{a, b\}$ by imposing the usual rules for regular expression operators, i.e. by imposing that all the operators are left associative, and that:
   - the unary Kleene-star operator "$\_^*$" has highest precedence;
   - the binary concatenation operator "$\_\bullet\_$" has the second highest precedence;
   - the binary operator "$\_+\_$" has the lowest precedence.

   For example, $r = a + b^* \bullet a$ stands for $(a) + ((b^*) \bullet (a))$.
3. Show the SLR parsing steps on input r and draw the resulting parse tree.

Formal Languages and Compilers – 2012, session 4

Exercise 1

$\frac{n+m}{2} = k$

Say whether

$$\mathcal{L} = \{a^n b^m \mid n + m = 2k \text{ for } n, m, k \geq 0\}$$

is a regular language or not. Justify your answer.

Exercise 2

Let $\mathcal{G}$ be defined as follows:

G non è LL(1)

$$S \rightarrow TUTU$$
$$T \rightarrow aT \mid bT \mid \epsilon \quad (a|b)^*$$
$$U \rightarrow bU \mid cU \mid \epsilon \quad (b|c)^*$$

Say whether $\mathcal{G}$ is LL(1) and in case it is not, define a LL(1) grammar $\mathcal{G}'$ such that $\mathcal{L}(\mathcal{G}') = \mathcal{L}(\mathcal{G})$.