

Automi, Linguaggi e Traduttori. 24 February 2009.

Precision and clarity are important. The PARSER exercise is compulsory. Use comments to document your program of the PARSER exercise. Motivate your constructions and answers.

• PARSER [5]. Write a C++ or Java program whose time complexity is at most $O(n)$, for testing whether or not a word in $\{a, b\}^*$ of length n (≥ 0) is generated by the grammar with axiom S and the following productions:

$$S \rightarrow S A A \mid a \quad A \rightarrow a A a \mid A b \mid \varepsilon$$

• KURODA [2]. Construct the Kuroda normal form of a grammar with axiom S which generates all words of the form $a^n b^n c^n$, for $n \geq 1$.

• GREIBACH [3]. Compute the Greibach normal form of the following grammar:

$$S \rightarrow A S \mid a \quad A \rightarrow S \mid A S \mid a \mid \varepsilon$$

• LALR [3]. Construct an *LALR*(1) parser, if any, for the context-free grammar G with axiom S and the following productions:

$$S \rightarrow B B a \quad B \rightarrow B b \mid c$$

• LANGUAGES [3]. Define a set of 4 context-free languages, subsets of $\Sigma^* = \{a, b\}^*$, such that: (i) two of them are not regular, and (ii) they form a boolean algebra with respect to the three operations: (i) $\lambda X, Y. X \cup Y$ as lub, (ii) $\lambda X, Y. X \cap Y$ as glb, and (iii) $\lambda X. (\Sigma^* - X)$ as complement.

• DECIDABILITY [3]. Assume that a problem P is semidecidable. Prove that if the negation of P is semidecidable then the negation of P is also decidable.

• CORRECTNESS [3]. Let N denote the set of natural numbers. Write an iterative program using assignments, ‘;’, *if-then-else*, and *while-do* (but not recursive calls) for computing the function $h : N \rightarrow N$ which is recursively defined as follows:

$$h(0) = a \quad h(1) = b \quad h(n+2) = c(h(n))$$

where $a, b \in N$ and $c : N \rightarrow N$. Prove the correctness of that program by using Hoare’s triples.

Nota. Tra parentesi quadre sono indicati i punti per ogni esercizio. Le due prove in itinere valgono, di norma, 4+4 punti. Per la prova orale, si presenti: (i) il programma, fatto da solo/a, dell’Esercizio del PARSER con alcune prove di esecuzione, (ii) un elaborato con la soluzione degli altri esercizi fatti da solo/a e (iii) si venga, se possibile, con un computer portatile ove siano installati e pronti per l’esecuzione i programmi relativi alle due prove in itinere.
