Automi, Linguaggi e Traduttori. 22 February 2008.
Precision and clarity are important. Document your program of Exercise 1 and motivate your constructions and answers. Exercise 1 is compulsory. 1. (6) Write a C++ or Java program for testing whether or not a word in $\{a, b\}^*$ is generated by the grammar with axiom S and the following productions:

$S \to b \mid A\, S$

$A \to a\, b\, A \mid A\, b \mid \varepsilon$

Determine the time complexity and space complexity of your program.

2. (4) Construct a pushdown automaton which recognizes *by final state* the language generated by the grammar with axiom S and the following productions:

$S \to S\ S \mid a\ S\ b \mid \varepsilon$

Show that no deterministic pushdown automaton exists that can recognize that language *by empty stack*.

3. (4) Construct the Greibach normal form of the grammar with axiom S and the following productions:

$S \to b \mid S\ A$

$A \to a\ b\ A \mid A\ b \mid \varepsilon$

4. (4) Construct an SLR(1) parser, if any, for the context-free grammar G with axiom E and the following productions:

$E \to E + T \mid T$

$T \to T * a \mid a$

5. (4) Determine the set of all predicates $p(x)$ and functions $f(x)$ which satisfy the triple
$\{x > 0\}$ **while** $p(x)$ **do** $x = f(x)$ $\{x > 0\}$.

6. (4) 6.1 Show that the set of all context-free languages is not a boolean algebra with respect to the three operations: (i) $\_ \cup \_$ as lub, (ii) $\_ \cap \_$ as glb, and (iii) $\Sigma^* - \_$ as complement.
6.2 Give an example of a decidable problem, a semidecidable problem, and undecidable problem.

7. (4) 7.1 Prove that $(\forall x(A(x) \to B)) \leftrightarrow ((\exists x A(x)) \to B)$.
7.2 Define an ambiguous type 1 grammar with exactly one terminal symbol and one nonterminal symbol.

Nota. Tra parentesi 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 di cui all'Esercizio 1 con alcune prove di esecuzione, (ii) un elaborato con la soluzione degli altri esercizi fatti da solo/a e (iii) se possibile, si venga con un portatile ove siano istallati e pronti per l'esecuzione i programmi relativi alle due prove in itinere.