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★**Marcus contextual grammars.**

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Contextual grammars were introduced by S. Marcus [Rev. Roumaine Math. Pures Appl. **14** (1969), 1525–1534; MR0262026 (41 #6636)] in order to model some linguistic phenomena related to context. Formally, a "contextual grammar" $G = (V, A, C, \varphi)$ consists of an alphabet V, a finite set A of axioms over V, a finite set C of contexts ($C \subseteq V^\star \times V^\star$) and a mapping $\varphi: V^\star \to 2^C$, called the "selection". Two derivation relations, viz. the "external" ($x \Rightarrow_{ex} y$ iff $\exists (u, v) \in \varphi(x)$: $y = uxv$) and the "internal" one ($x \Rightarrow_{in} y$ iff $\exists x_1, x_2, x_3 \in V^\star$, $(u, v) \in \varphi(x)$: $x = x_1x_2x_3$, $y = x_1ux_2vx_3$) give rise to corresponding languages $L_\alpha = \{x \in V^\star |\ w \Rightarrow_\alpha^\star x,\ w \in A\}$ for $\alpha \in \{ex, in\}$, where $\Rightarrow_\alpha^\star$ is the reflexive and transitive closure of $\Rightarrow_\alpha$.

Requiring that the languages S_i—defined by $S_i = \{x \in V^\star |\ C_i \subseteq \varphi(x)\}$ for each subset C_i of the finite set C—belong to a given family of languages F results in families of (internal or external) contextual languages parameterized by F. Frequently, the family F is restricted to the family of finite languages or to the family of regular languages.

The volume under review is an introduction as well as an overview, covering many results which are interesting from a formal language theory point of view or relevant to the study of natural languages. The first few chapters are introductory, dealing with (1) Origin and motivation, (2) Formal language theory prerequisites, and (3) Contexts adjoining everywhere. Chapter 4 is devoted to basic definitions (like the ones quoted above), some equivalent alternatives, a few generalizations, and to examples of contextual languages. In Chapter 5 the author establishes properties of several families of contextual languages (including characterization theorems), some hierarchy results, and relationships with families from the Chomsky hierarchy. Closure properties and decidability problems for various families of contextual languages are studied in Chapter 6: generally speaking, the former ones are poor, and with respect to the latter ones we have that emptiness is decidable trivially, inclusion and equivalence are undecidable (or open for some families), and other problems (finiteness and membership) show a mixed pattern. Chapter 7 (Linguistically relevant properties) is devoted to semilinearity, the complexity of recognizing contextual languages, descriptional complexity, several types of ambiguity, syntactical structures, and the characterization of (param-

eterized) families of contextual languages in terms of an automaton model. In Chapter 8 the generating power of families of contextual languages, parameterized by F, is investigated: emphasis is on their position in the extended Chomsky hierarchy while F takes any value from that hierarchy. Chapter 9 is devoted to modifying the internal derivation relation to achieve either minimal or maximal use of selectors. Then the language generating capacity of the corresponding contextual grammars is studied.

The second part of this monograph (Chapters 10–16) is concerned with variants and more advanced subjects: Variants of contextual grammars (Chapter 10; one-sided contexts, deterministic grammars, parallel derivations, marked derivations); Two-level contextual grammars (Chapter 11); Regulated contextual grammars (Chapter 12; matrix, programmed and controlled contextual grammars); n-contextual grammars (Chapter 13); A dual model: insertion grammars (Chapter 14; generative power, closure properties, descriptional complexity, regulated rewriting); Further topics (Chapter 15; grammar forms, growth functions, grammar systems, etc.); and Open problems and research topics (Chapter 16).

This monograph contains a wealth of results many of which are due to the author himself: he is (co-)author of 72 of the 223 references. It is of interest to researchers in formal language theory, computational linguistics, and to linguists interested in formal models of syntax.

{Reviewer's remarks: The author's definition of "sequential transducer" (nondeterministic finite-state transducer) on p. 13 is too restricted: it should allow λ-moves. Then it is more powerful than the nondeterministic generalized sequential machine (p. 13, l. +21). The statement "It is also known that *TAL* is a full AFL." (on p. 28, l. +4) is incorrect and should be removed. Everywhere the author writes "monotonous", one should read "monotonic".}

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