International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319 – 6505, Impact Factor: SJIF: 5.995
Available Online at www.journalijcar.org
Volume 6; Issue 7; July 2017; Page No. 4858-4860
DOI: http://dx.doi.org/10.24327/ijcar.2017.4860.0599

Research Article

A COMPARATIVE LITERATURE SURVEY OF COOPERATING DISTRIBUTED GRAMMAR SYSTEMS

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A R T I C L E I N F O

Article History:

Received 20th April, 2017
Received in revised form 10th May, 2017
Accepted 14th June, 2017
Published online 28th July, 2017

Key words:

Grammars, Languages, Non Synchronized Pattern Grammar System.

A B S T R A C T

This paper describes an extensive literature survey about Co-operative Distributed Grammar system.
The purpose of this paper is to group all the similar information, important results and its merits to know the relationship between different types of CD grammar systems. It helps to bring out new ideas to proceed for further developments.

INTRODUCTION

Operations in languages are intensively studied in formal languages theory. Angluin et al, while studying the problem of learning or inferring a pattern common to all strings in a given sample, introduced pattern languages.

Dassow et al, defined a new generative device, called a pattern grammar. The ideal here is to start from a finite set A of axioms which are over an alphabet of constants given a set P of patterns which are strings over constants and variables.
All strings generated in this grammar constitute the associated language called pattern language. A variety of grammar systems have been considered in the literature and among these a co-operating distributed(CD) grammar system by Csuhj-varju et al has been studied by many researchers. A compact account of many of these details is provided by Dassow et al.

Pattern grammar

A pattern grammar (PG) is a 4-tuple G= (Σ , X , A , P) where Σ is an alphabet whose elements are called constants, X is an alphabet whose elements are called variables. A $\subseteq$ Σ^* in a finite set of elements of Σ^* called axioms and P $\subseteq$ $(\Sigma \cup X)^+$ is a finite set of words called patterns. Where each word contains atleast one variable. The rewritings is done as follows:

$$P(A)=\left\{ \begin{array}{l} u_1 x_{i_1} u_2 x_{i_2} \cdots u_k x_{i_k} u_{k+1} / u_1 \delta_{i_1} u_2 \delta_{i_1} \cdots u_k \delta_{i_k} u_{k+1} \in P, \\ u_i \in \Sigma^*, 1 \le i \le k+1, x_{i_k} \in A, \delta_{i_k} \in X, 1 \le i \le k \end{array} \right\}$$

This means that P(A) contains words obtained by replacing the variables in the pattern by words from A and different occurrences of the same variable are replaced by the same word. Then the pattern language (PL) generated by G is L(G)= $P \cup A \cup P(A) \cup P(P(A)) \cup .....$

Cooperating Distributed Grammar System

A cooperating distributed grammar system (CD grammar system) is an (n+2) tuple $\Gamma = (T, G_1, G_2, ..., G_n, S)$ where,

For 1 ≤ i ≤ n, each G_i= (N_i , T_i , P_i) is a (usual) context – free grammar with the set N_i of non terminals, the set T_i of terminals, the set P_i of context – free rules, and without axiom,

T is a subset of $\cup_{i=1}^{n} T_i$,

$S \in \cup_{i=1}^{n} N_i$ =N

The grammars correspond to the agents solving the problem on the black board; any rule represents some pieces of knowledge which results in a possible change on the black board. The axiom S is the formal counterpart of the problem on the black board in the beginning. The alphabet T contains the letters which correspond to such knowledge pieces which are accepted as solutions / part of solutions.

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Background of Research Undertaken

Operations on cooperative grammar system have been used with different motivations in formal languages in Automata theory (grammar system) to generate with various components and modes etc.

Comparisons of Important Results

The static and a dynamic definition of nonincreasing competence in CDGSs working in=k-comp.-mode of derivation, for some $k \geq 1$,

$\mathbf{L}$ (ETOL)= $\mathbf{L}$(sni-CD, parCF,=1-comp.)=$\mathbf{L}$(CD, parCF,= 1-comp.dni)=$\mathbf{L}$(sni-CD, CF,=1-comp.) $\subset\mathbf{L}$(CD, CF,= 1-comp.dni)=$\mathbf{L}$(fRC,CF)$\subseteq\mathbf{L}$(sni-CD, parCF,=k-comp.)=$\mathbf{L}$(CD, parCF,=k-comp.dni)=$\mathbf{L}$(RC,ETOL)$\subseteq\mathbf{L}$(sni-CD,parCF,=K comp.)$\subseteq$ $\mathbf{L}$(CD, CF,=k-comp.dni)= $\mathbf{L}$(RE)

The power and descriptional complexity parameters of permitting and left-permitting CD grammar systems.

Rule $r : (A \rightarrow \alpha, per)$ was given in such a way that r is applicable to uAv if $per \subseteq alph(uv)$, that is, if $A \in per$. i.e., $uAv \Rightarrow u\alpha v$ provided that there is a production $r : (A \rightarrow \alpha, per)$, $per \subseteq alph(uAv)$ that is, if $A \in per$, then r may be applicable even in the case when $A \notin alph(uv)$.

For all $n \geq 2$, the Chomsky hierarchy $\mathbf{L}_{CF} \subset \mathbf{L}_{CS} \subset \mathbf{L}_{RE}$ in terms of left-forbidding distributed grammar systems: $\mathbf{L}_{LF}(1, f) = \mathbf{L}^{\varepsilon}_{LF}(1, f) \subset \mathbf{L}_{LF}(n, f) \subset \mathbf{L}^{\varepsilon}_{LF}(n, f)$, for all $f \in \{t\} \cup \{= k, \geq k : k \geq 2\}$.

For any $n \geq 1$, derivation modes $f \in \{*, =1, \geq 1\} \cup \{\leq k : k \geq 1\}$, and any language families $X \in \{$**RC**$_{\lambda}$, **RC, FOR, PER**$_{\lambda}$, **PER, lRC**$_{\lambda}$, **lRC, lPER**$_{\lambda}$, **lPER, lFOR**$_{\lambda}$, **lFOR**$\}$,

CD $_f$ (**X,** n)=**X,**

And for any $n \geq 2$ and derivation modes $f \in \{t\} \cup \{= k, \geq k : k \geq 2\}$.

The effect of three natural competence-based cooperation strategies for CDGSs with context-free components that rewrite the sentential form in a sequential manner, on the generative power of parCDGSSs.

Table Literature Review Summary Table

Topic	Ref	Year	Study Purpose	Key Findings
Deterministic Cooperating Distributed Grammar Systems	[1]	1996	Some syntactical conditions considered for strict deterministic grammars are extended to CDGS, restricted to the terminal derivation mode.	The local variant, results in local unambiguity of the derivations. The total variant results in some cases in global unambiguity of the derivations.
On Competence and Completeness in CD Grammar Systems	[2]	1996	Different concepts of t-mode derivations in CDGS which can be encountered in the literature and generalizations thereof are considered both in generating and in accepting case.	Influence of completeness of the components to the derivational capacity of CD grammar systems is investigated.
Cooperating Distributed Grammar Systems: A Comparison of generative Power	[3]	2002	CDGS have been introduced for describing multi-agent systems by means of former grammars and languages.	Summarize definitions of selected CD grammar systems and comparison of their generative power among themselves and against to languages of other systems.
Hybrid Modes Distributed Grammar System: Combining the t-mode with the modes $\leq$ k and = k	[4]	2002	CD grammar systems working in the mode ($t \wedge = 1$), characterize the context-free programmed languages with finite index.	Obtain a characterization of ordered languages within the framework of CD grammar systems.
On the Number of Components in cooperating Distributed Grammar System	[5]	2004	The sf-mode of derivation id compared with other well known cooperation protocols with respect to the hierarchies induced by the number of components.	The number of components in context-free CD grammar systems can be reduced to 3 when they are working in the so called sf-mode of derivation.
On the Competence in CD Grammar Systems with Parallel Rewriting	[6]	2007	Investigation of the generative power of CDGS using the $\leq$ k-, =k- and $\geq$k- competence based cooperation strategies and context free components.	Leads to new characterizations of the languages generated by (random context) ETOL systems and recurrent programmed grammars.
Cooperating Distributed Grammar Systems with Permitting Grammars as Components	[7]	2009	To study CDGS working in the terminal derivation mode where the components are variants of permitting grammars.	It is shown that the number of permitting components can be bounded, in the case of left-permitting components with erasing rules eve together with the number of non-terminals.
On the terminating Derivation Mode in Cooperating Distributed Grammar Systems with Forbidding Components	[8]	2009	The terminating derivation mode in CDGS where components are forbidding grammars instead of context-free grammars.	The number of their components can be reduced to two without changing the generative power and that these systems are computationally complete.
Left-Forbidding Cooperating Distributed Grammar System	[9]	2010	Discuss cooperating distributed grammar systems with left-forbidding grammar as components.	A new characterization of the Chomsky hierarchy in terms of left-forbidding cooperating distributed grammar systems.
Cooperating Distributed Grammar Systems: Components with Non-increasing Competence	[10]	2011	Study the generative power of CD grammar systems.	Introduce a static and dynamic definition to impose this restriction.
Cooperating Distributed Grammar Systems with Random Context Grammars as Components	[11]	2011	Discuss CDGS where components are random context grammar.	An overview of known results and open problems and prove some further results.
CDP Grammar Systems – A New Model	[12]	2012	Introduce a new grammar system called CDPGS	Learning algorithm for cooperating distributed pattern grammar system.
Cooperating Distributed Grammar Systems of Finite Index Working in Hybrid Modes	[13]	2014	Study cooperating Distributed grammar systems working in hybrid modes in connection with the finite index restriction in two different ways.	Showing specific relations to programmed grammars of finite index.

The chain of inclusions

L(ETOL)= **L**(CD, parCF, ≥1-comp.)
⊆ **L**(CD, parCF, f -comp.)
⊆ **L**(CD, parCF, g -comp.)
= **L**(RC, ETOL).

Application of Cooperative Distributed Grammar System

Cooperative distributed problem solving is the subfield of multi agent system that is concerned with how large-scale problems can be solved using systems of agents, distributed among a set of networked computers, working cooperatively. There are a wide variety of potential applications for CDPS techniques, including: sensor interpretation in distributed sensor networks; vehicle traffic monitoring and control; detection and diagnosis of faults in computer and telecommunications networks; information retrieval from distributed information source; computer supported cooperative work, and various kinds of situation assessment. CDPS approaches can potentially offer increased processing power, flexibility and reliability and reduced hardware costs.

CONCLUSIONS

This paper describes the scenario of the review papers which helps the researchers to proceed further. Here we conclude that some open problems are yet to solve in the above mentioned papers. Cooperative distributed grammar system is a tool applied in various fields such as artificial life systems, robotics, DNA computing, computer science and Automaton Research.

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How to cite this article:

Sindhu J Kumaar *et al* (2017) 'A Comparative Literature Survey of Cooperating Distributed Grammar Systems', *International Journal of Current Advanced Research,* 06(07), pp. 4858-4860. DOI: http://dx.doi.org/10.24327/ijcar.2017.4860.0599

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