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Advances in practical optimal coalition structure algorithms

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Advances in Practical Optimal Coalition Structure Algorithms

A thesis submitted in fulfillment of the
requirements for the award of the degree

Doctor of Philosophy

from

UNIVERSITY OF WOLLONGONG

by

Chattrakul Sombatheera

School of CS and SE.
June 2010

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Dedicated to

My Parents

Declaration

This is to certify that the work reported in this thesis was done by the author, unless specified otherwise, and that no part of it has been submitted in a thesis to any other university or similar institution.

Chattrakul Sombattheera
June 20, 2010

Abstract

This thesis presents a number of algorithms for forming coalitions among cooperative agents in pragmatic domains where traditional cooperative game theory solution concepts do not apply due to bounded rationality of agents. While previous work in coalition formation in multi-agent systems research operated on relatively small number of agents, e.g. less than 30 agents, this work explores coalition formation among 100 agents, this is due to limited computational resources not the performance of the our algorithms. We explore a best-first search centralized algorithm for optimal coalition structures which is based on a novel idea of deciding what is the best coalition to put into coalition structure being generated. Empirical results show that the solution reaches optimality quickly and terminates quickly in pragmatic domains. We further explore on optimal coalition structures with distributed algorithms in linear and non-linear domains. For the linear domains, we explore linear production and integer programming. For the non-linear domains we explore logistic providers. Based on existing algorithms, we explore a novel environment of forming coalitions in supply networks involving buyers, sellers and logistics providers agents. In this setting, buyers form coalitions to increase their negotiation power while sellers and logistics providers form coalitions to aggregate their supply power and optimize their resources usage.

List of Publications

The material of this thesis is based on the following publications:

1. Chattrakul Sombattheera, Aditya Ghose: A best-first anytime algorithm for computing optimal coalition structures. *AAMAS* (3) 2008: 1425-1428
2. Chattrakul Sombattheera, Aditya Ghose: A Pruning-Based Algorithm for Computing Optimal Coalition Structures in Linear Production Domains. *Canadian Conference on AI* 2006: 13-24
3. Chattrakul Sombattheera, Aditya Ghose: A Distributed Algorithm for Coalition Formation in Linear Production Domain. *ICEIS* (2) 2006: 17-22
4. Chattrakul Sombattheera, Aditya Ghose: Supporting Dynamic Supply Networks with Agent-Based Coalitions. *IEA/AIE* 2006: 1127-1137
5. Chattrakul Sombattheera, Aditya K. Ghose: A Distributed Branch-and-Bound Algorithm for Computing Optimal Coalition Structures. *SETN* 2006: 334-344
6. Chattrakul Sombattheera and Aditya Ghose: Agent-based Coalitions in Dynamic Supply Chains. the international conference 9th Pacific Asia Conference on Information Systems (PACIS 2005).
7. Chattrakul Sombattheera, Aditya Ghose, Peter Hyland: A Framework to Support Coalition Formation in Supply Chain Collaboration. *ICEB* 2004: 1-6

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Contents

Abstract	v
List of Publications	vi
Acknowledgements	vii
1 Introduction	1
1.1 Introduction	1
1.2 Background	2
1.3 Structure of the thesis	4
2 Background	6
2.1 Introduction to Coalition Formation	6
2.1.1 Cooperative Game Theory	6
2.1.2 Example of Cooperative Game	8
2.1.3 Solution Concepts in Cooperative Games	9
2.2 Coalition Formation in Multi-agent Systems	16
2.2.1 Impractical Issues in Cooperative Game Theory	16
2.2.2 Early Dynamic Coalition Formation	17
2.2.3 Kernel in Multi-Agent Systems	19
2.2.4 Bounded Rational and Time-Constrained Coalition Formation	21
2.2.5 Strategic Coalition Formation	22
2.3 Algorithms for Computing Optimal Coalition Structures	23
2.3.1 The Analysis of the Problem	24
2.3.2 Coalition Value Distribution	25
2.4 Previous Centralized Algorithms in Optimal Coalition Structures	26
2.5 Coalition Formation in Combinatorial Settings	30
2.5.1 Linear Production Games	30

2.6	Coalition Formation in Supply Networks	32
2.6.1	Coalitions of Buyers	32
2.6.2	Coalitions of Buyers and Sellers	36
2.6.3	Coalitions of Logistics Providers	37
2.7	Qualitative Coalition Formation	39
2.8	Other Coalition Formation Work	41
2.9	Motivation to the Thesis and Research Question	41
2.9.1	Motivation	41
2.9.2	Research Questions	42
3	Computing Optimal Coalition Structures	45
3.1	Introduction	45
3.2	The CH Algorithm	46
3.2.1	Main Function	49
3.2.2	Working Functions	51
3.2.3	Proof Completeness and Systematicity of the CH algorithm	54
3.2.4	Example of Coalition Structures Generation	57
3.2.5	Applying Branch and Bound Method	58
3.2.6	Example of Applying Branch and Bound	59
3.3	Experimental Results	59
3.3.1	Empirical Results	61
3.4	Conclusion	65
4	Computing OCS in Linear Production Domain	66
4.1	Introduction	66
4.2	Coalition in a Linear Production Domain	67
4.3	Distributed Algorithm for Coalition Formation	69
4.3.1	Deliberating Process	69
4.3.2	Coalition Formation Algorithm	74
4.3.3	Best Coalition and Coalition Structure Pattern	77
4.3.4	Generating Coalition Structures	78
4.3.5	An Example of Generating Coalition Structure	78
4.4	Experiments	80
4.4.1	Generating Coalitions	80
4.4.2	Generating Optimal Coalition Structures	82
4.5	Conclusion	83

5	Non-Linear Optimal Coalition Structure	85
5.1	Introduction	85
5.2	Distributed Algorithm for Distributing Goods	87
5.2.1	Setting	88
5.2.2	Main Algorithm	95
5.2.3	Algorithm to Deliberate Task-Plan	96
5.2.4	Algorithm to Deliberate Task-Agent	98
5.2.5	Algorithm to Choose the Best Assignment	98
5.3	Example	99
5.3.1	Combinations of Tasks, Plans, Execution and Access Costs	100
5.3.2	Example of Run	102
5.4	Experiments	104
5.5	Conclusion	106
6	Coalition Formation in Dynamic Supply Networks	108
6.1	Introduction	108
6.2	Coalitions in Dynamic Supply Networks	110
6.3	Coalition Formation	111
6.3.1	Setting	112
6.3.2	Forming Primary Coalitions	113
6.3.3	Secondary Coalitions	117
6.3.4	Decision Mechanism	118
6.3.5	Algorithm	120
6.4	Experiments	121
6.5	Conclusion	126
7	Conclusion and Future Work	127
7.1	Introduction	127
7.2	Contribution	127
7.3	Significance of the Research	130
7.4	Limitations	130
7.5	Future directions	131
7.6	Conclusion	131
	Bibliography	132

List of Tables

2.1 Search Space in Coalition Structure where “ B_n ” is the number of coalition structures, “Largest L_i ” is the largest layer i , “ $S(n, i)$ ” is the number of CS in that layer i , “# of Config.” is the number of configuration, “Conf Max” is the configuration which has the largest number of CS s, “CS Max” is the number of CS s in “Conf Max”. 25

4.1 This table compares the average deliberation time of each agent using our algorithm against exhaustive search. Our algorithm outperforms exhaustive search after the number of agents exceeds 35 (exhaustive time not available—NA). 81

List of Figures

2.1	Configuration Bounds	24
2.2	Search Direction in Divided Search Space	27
2.3	Configuration Bounds	28
3.1	Data Structure Coalitions are stored in 2-dimension array \mathcal{C} . Available candidate coalitions for all layers are kept tracks by 2-dimension array \mathcal{B} . The CS being constructed is kept in 1-dimension array \mathcal{CS} . The remaining agents, which can be candidates for the best coalition at the present layer l of \mathcal{CS} , are kept track by 1-dimension array \mathcal{R}	48
3.2	Generating Coalition Structure Coalitions are stored in array \mathcal{C} , where rows represent the position of the coalitions in each cardinality, represented by column. Candidate coalitions for each layer l in \mathcal{CS} are stored in array \mathcal{B} , whose rows represent the layer of \mathcal{CS} and columns represent the cardinality. Attached to the left of the array are two additional columns. The first one indicates the execution round, while the second one represents the respective layer of \mathcal{CS} . The coalition structure is stored in one dimensional array \mathcal{CS} . As it appeared here, multiple rows are the current state of \mathcal{CS} with respect to the corresponding execution round appears in \mathcal{B} . Remaining agents are stored in array \mathcal{R} . Each row represents remaining agents after a candidate coalition has been chosen for \mathcal{CS} in the same execution round in the corresponding rows of \mathcal{B} and \mathcal{CS}	56
3.3	Empirical Results on STD Distribution The graphs show convergence and termination times of Algorithm CH against that of algorithm RN on STDF1, STDF5 and STDF10 distributions.	61
3.4	Empirical Results on IND Distribution The graphs show convergence and termination times of Algorithm CH against that of algorithm RN on INDF1, INDF5 and INDF10 distributions.	62

3.5	Empirical Results on DCD Distribution The graphs show convergence and termination times of Algorithm CH against that of algorithm RN on DCDF1, DCDF5 and DCDF10 distributions.	62
3.6	Empirical Results on CCD Distribution The graphs show convergence and termination times of Algorithm CH against that of algorithm RN on CCDF1, CCDF5 and CCDF10 distributions.	63
3.7	Empirical Results on CVD Distribution The graphs show convergence and termination times of Algorithm CH against that of algorithm RN on CVDF1, CVDF5 and CVDF10 distributions.	63
3.8	Empirical Results on RDD, NMD and UNI Distribution The graphs show convergence and termination times of Algorithm CH against that of algorithm RN.	64
4.1	Ranking Agents Agents are ranked by their potential profit per each resource of a good.	70
4.2	Empirical Results This graph shows the number of coalition structures generated and elapsed time for generating the optimal coalition structures of our algorithm against those of exhaustive search.	83
5.1	Empirical Results NLRP-NLRP The graphs show reduced cost in raw figure and percentage achieved from the seven time allocation strategies as per elapsed time.	106
5.2	Empirical Results NLRP-NLDL The graphs show reduced cost in raw figure and percentage achieved from the seven time allocation strategies as per elapsed time.	107
5.3	Empirical Results NLDL-NLRP The graphs show reduced cost in raw figure and percentage achieved from the seven time allocation strategies as per elapsed time.	107
6.1	Empirical Results of V(CS) against FEV(CS) The graphs show convergence versus termination time, and V(CS) versus FEV(CS) of the V(CS)-Oriented versus FEV(CS)-Oriented search.	125