A GENETIC BASED ALGORITHM FOR CONFLICT RESOLUTION

By

Sandra Wahid Amin Rizkallah

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE

in

Computer Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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A Genetic Based Algorithm for Conflict Resolution

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Summary:

This work presents a genetic based algorithm for conflict resolution. The solution is generated by assigning resources' shares for the conflicting parties based on their preferences. The proposed algorithm obtains optimal solutions that satisfy Nash equilibrium. We have successfully implemented and tested our algorithm. The implementation is flexible in the sense that the conflict can involve multiple weighted conflicting parties and multiple weighted resources whether those resources are divisible or not. Moreover, it allows for both text and image data to be incorporated. The implementation also permits users to participate in the solution generation process through the use of the F-mode option. In addition to comparing our results with those of similar publications, we have used the Grand Ethiopian Renaissance Dam conflict as a proof of concept.

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Nomenclature

Acronym	Stands for
AI	Artificial Intelligence
AW	Adjusted Winner
BCM	Billion Cubic Meters
EEPCo	Ethiopian Electric Power Corporation
FISA	Framework for Intelligent Situation Analysis
GA	Genetic Algorithm
GERD	Grand Ethiopian Renaissance Dam
NN	Neural Network
POC	Proof of Concept
TNC	Tripartite National Committee

Abstract

This work presents a genetic based algorithm for conflict resolution. The solution is generated by assigning resources' shares for the conflicting parties based on their preferences. The proposed algorithm obtains optimal solutions that satisfy Nash equilibrium. We have successfully implemented and tested our algorithm. The implementation is flexible in the sense that the conflict can involve multiple weighted conflicting parties and multiple weighted resources whether those resources are divisible or not. Moreover, it allows for both text and image data to be incorporated. The implementation also permits users to participate in the solution generation process through the use of the F-mode option. In addition to comparing our results with those of similar publications, we have used the Grand Ethiopian Renaissance Dam conflict as a proof of concept.

Chapter 1 : Introduction

Conflicts happen frequently in various fields and due to various reasons. Conflict resolution is not an easy task. It is an NP-complete problem with the possibility of having hidden variables. Moreover, a conflict resolution approach has to be general. If a conflict is not well managed, a crisis can be transformed into a disaster.

1.1. Motivation

Conflicts commonly arise between parties. It is normal not to expect that any two parties would agree about everything. Conflicts may be due to various reasons. These reasons include [1]: competing goals meaning that the involved parties cannot satisfy all their goals at the same time, contradictory interests in the sense that the involved parties disagree on their interests, disagreement about strategy meaning that the involved parties do not agree on the policies adopted for achieving their goals, absence of focus to resolve the real conflict, struggle for resources meaning that the involved parties are competing to acquire resources, limited resources meaning that the conflict may arise due to insufficient resources that can satisfy all parties and finally miscommunication in the sense that the involved parties fail to find a way to communicate their ideas and intentions.

If a conflict is not well managed, this may lead to critical situations. As a result, great care should be taken in dealing with conflicts. The process of conflict resolution should aim at satisfying all the involved conflicting parties. An optimal resolution for a conflict may also lead to strengthening the relations between the conflicting parties. However, reaching an optimal solution that satisfies all the involved parties is not an easy task. It consumes time, effort and may lead to breaking down the relations between the conflicting parties during that process. Moreover, relying on only one source of information about the conflict may lead to sub-optimal or unacceptable resolutions. Therefore, great attention should be given to collecting the data related to a certain conflict before trying to resolve it.

This happens for all sorts of conflicts that may arise in various fields including politics, economics, family, sales, commerce and others. Hence, it is of interest to achieve generality in the conflict resolution approach.

1.2. Problem Definition and Proposed Approach

This work aims at solving the problem of resolving conflicts among multiple parties over multiple divisible and non-divisible resources. It is an optimization problem. The resolution is in the sense of reaching an agreement acceptable to all parties.

Conflict resolution is the process of reaching a peaceful ending for a certain conflict between a number of parties. The term dispute resolution can be used interchangeably with the term conflict resolution [2]. Experts reside on discovering conflicts upfront by performing a situation analysis. Situation analysis is the process of inspection of the different elements of a situation and the relations between them to be fully aware of the situation. As shown in figure 1.1 a situation is composed of some elements that constitute other elements. The basic two elements are entity and event. An entity is a self-contained

existing thing. An event is something that is occurring. A group is an ensemble of entities and/or events that are related to each other. Activity refers to notions of action when something has the state of being active. A fact is a piece of information that actually exists and is characterized by being truthful and real. Data is considered factual information that is used in reasoning, discussion or calculation. Cues are the perceived features indicating the nature of something. Cues are generated from the various data sources e.g. text and/or images. Situation analysis process is then concerned with handling data and information that are inferred based on the input facts that are obtained from various sources in order to identify conflicts. [2]

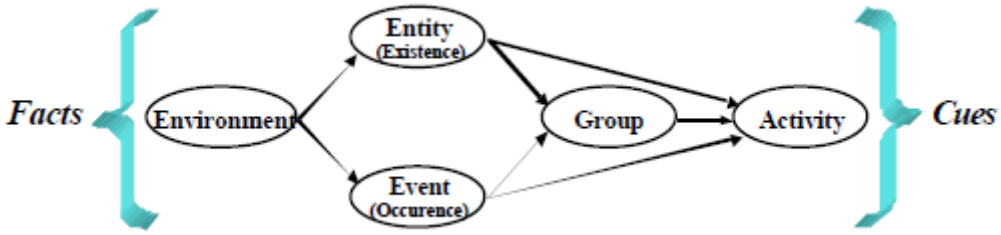

Figure 1.1: Situation Elements [22]

Resolution of conflicts will then be attempted peacefully by communicating information about the conflicting motives and engaging negotiation between conflicting parties. A model for conflict resolution is the dual concern model which assumes that the preferred method for parties to deal with a conflict is based on two dimensions [3, 4]: concern for self and concern for others. A balance between these two dimensions is needed in order to reach a satisfactory resolution for the underlying conflict that balances between satisfying personal needs and the needs of others. This model states five conflict resolution strategies that parties may adopt:

- Avoidance conflict style:

  Avoidance conflict style is characterized by avoiding the conflict topic and denying the existence of a problem. This may be because one party does not want to deal with another party, when a party is not comfortable with the conflict or due to cultural issues. The conflicting parties wait to see what the conflict will reach without involvement. However, in case of high conflict levels this ignorance may lead to losing control [5].

- Yielding conflict style:

  Yielding conflict style is characterized by high concern for others and low concern for oneself. This may be due to the desire of keeping stable and positive relationships [33].

- Competitive conflict style:

  Competitive conflict style is characterized by high concern for oneself and low concern for others. Generally, competitive parties seek dominance over others [3].

- Cooperation conflict style:

  Cooperation conflict style is characterized by cooperating parties making effort in order to reach a resolution that satisfies all the conflicting parties. Usually these parties have high concern for oneself and also for others [5].

- Conciliation conflict style:

  Conciliation conflict style -also referred to as compromising style- is characterized by parties having intermediate level of concern for both oneself and others. Generally, compromisers are concerned with fairness and so they are willing to make compromises and accept trade-offs [5].

Proceeding from the fact that resolving conflicts involves many problems, computers were introduced to automate the task of conflict resolution. One proposed approach involves using genetic algorithm (GA) for resolving the underlying conflict. Genetic algorithms are suitable for the task of conflict resolution due to the following reasons:

- It is domain independent so it can be used to resolve conflicts from different fields.
- It gives a ranked number of generated solutions.

Nevertheless, GA based solutions are optimal relative to their fitness functions but do not take into account Nash Equilibrium which is an important factor for usually accepted conflict resolution solution.

We propose a genetic based algorithm for conflict resolution that achieves Nash equilibrium. The input to our algorithm includes the resources involved in the conflict, their categories and their importance. Moreover, the input includes the conflicting parties, the weights[1] of these parties in the conflict and their preferences for the resources in the conflict. The output is an optimal solution for the conflict that satisfies Nash equilibrium (NE). As a proof of concept, we have successfully applied our proposed approach on the Grand Ethiopian Renaissance dam (GERD) conflict.

1.3. Thesis Organization

The thesis document is organized into seven chapters as follows. The current chapter is the introduction. Chapter two includes others' work done in the field of conflict resolution using various techniques. Chapter three contains the necessary background needed to fully understand our proposed approach. Chapter four includes the details of the approach we have devised. Chapter five shows the performance evaluation of the proposed approach and the results obtained when comparing our approach with that of others. Chapter six includes details about our case study: Grand Ethiopian Renaissance Dam and the results of applying our approach to this case. Chapter seven concludes the work done and shows the future work directions. Throughout the chapters the term resource and issue can be used interchangeably.

[1] In this context "Weight of the party" refers to the power of the party to achieve its interests.