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# Using Nash Equilibrium to Reduce Number of Attacks Between the Arguments in Dung's Argumentation Framework

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**Abstract**
For intelligent systems, argumentation is a very important factor to point out in Artificial Intelligence (AI) as it represents an essential component. It is one of the critical approaches to making a decision, whereas Dung introduces a mathematical model that classifies attacks among arguments based on ordered pairs. Furthermore, weights' addition to the arguments is one of the most important developments. It is done by several methods of weight calculation; hence, the Fuzzy weights method is a suitable method when working with game theory (GT). To this end, this paper introduced the GT in a Nash equilibrium method to redraw the acceptable arguments. It depends on the fuzzy weight for reducing the acceptable arguments and acceptable attacks between those arguments. This paper provides an automatic model for reducing the number of arguments and attacks between them called the shorthand model based on the gaming argumentation framework SGAF by extending the gaming argumentation framework GAF. This work uses the Cash on Delivery (COD) Payment Model as a case study.

**Keywords**:Argumentation, Game Theory, Nash Equilibrium, Fuzzy Weight.

# استخدام توازن Nash لتقليل عدد الهجمات بين الحجج في إطار حجج Dung

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**الخلاصة**
بالنسبة للأنظمة الذكية، يعد الجدل عاملاً مهماً للغاية يجب الإشارة إليه في الذكاء الاصطناعي (AI) لأنه يمثل مكوناً أساسياً. حيث إنه أحد الأساليب الحاسمة لاتخاذ القرار، قدم Dung نموذجاً رياضياً يصنف الهجمات بين الحجج بناءً على أزواج مرتبة. علاوة على ذلك، تعد إضافة الأوزان إلى الحجج من أهم التطويرات. يتم ذلك بعدة طرق لحساب الوزن ؛ ومن ثم، فإن طريقة الأوزان الضبابية هي طريقة مناسبة عند العمل مع نظرية الألعاب. تحقيقاً لهذه الغاية، قدمت هذه الورقة طريقة توازن ناش لإعادة رسم الحجج المقبولة. يعتمد ذلك على الوزن المبهم لتقليل الحجج المقبولة والهجمات المقبولة بين تلك الحجج. تقدم هذه الورقة نموذجاً آلياً لتقليل عدد الحجج والهجمات بينهما يسمى نموذج الاختزال استناداً إلى إطار عمل الألعاب SGAF من خلال توسيع إطار حجة الألعاب GAF. يستخدم هذا العمل نموذج الدفع نقداً عند الاستلام (COD) كدراسة حالة.

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## 1. Introduction

In recent years, Artificial Intelligence (AI) field witnessed controversy. Decision-making represents an important arguable point due to its significance in multiple areas of use to solve many problems [1, 2, 3]. It has been adopted in various fields of AI, for example, it has been applied to the legal field to identify the legitimacy of arguments, nonmonotonic thinking, and multi-specialist frameworks [3]. It provides appropriate solutions by identifying acceptable and unacceptable attacks and achieving convincing results [4]. Moreover, regarding discourse and influence [5, 6], The dung's argumentation framework was developed and extended with several ways for the reduction of attacks number and acceptable arguments as follows:

- It relies on the potentials of specific qualities, being assessed where there is a settlement on the beginning of the contentions even with subsequent values distinction. Persuading purposes are resolved, and vulnerability is considered through distinction influence of the recently surveyed values [2, 3, 4].

- Utilizing another sort of association among arguments managed by connection assistance. This resulting connection is considered as entirely autonomous of connection loss by the bipolar communications depiction among arguments [10].

- Assaults are related to weight, demonstrating the general strength of the assault. The idea of this system is the thought of mismatching budget, which describes the level of mismatching ready to endure given mismatching budget β ready to ignore assaults up to a complete load of β. The critical gain of this approach is the provision of a sufficient better grained degree of argument frameworks investigation, outperforming the non-weighted frameworks. It provides beneficial arrangements whenever they are missed in ordinary argument framework [11].

- Acceptance conditions cover any capacity, deciding the situation with a hub given the situation with its parent hubs. This incorporates area subordinate circumstances, and along these lines goes past the modest bunch of well-known legitimate principles. The last option will then, at that point, be presented given explicit properties/sorts of the connections in the diagrams. Acknowledgment conditions enable us to present different hub and connection types [1].

- Focusing on the fundamental ideas in deontic thinking, specific commitments, restrictions, and consents. Commitments centered on the deontic framework and restrictions are considered as a side-effect of commitments: 'something is precluded' is comparably communicated by expressing that its inverse is compulsory. Authorizations can be perceived as commitments, consent for something communicates while inverse is not mandatory. To maintain a choice regarding an argument and the related refutation, with satisfactory ¬X, it implies the X isn't OK and the other way around [12]**.**

- Including the loads framework within the framework ensures getting more reasonable outcomes by managing the weighting scale from one perspective, and then managing the component of utilizing those loads again. The game hypothesis is utilized to get the eventual outcome, which thus addresses an official choice. Come by one outcome, in the end, separates this framework and makes it extremely valuable in scanning vulnerabilities, ending with an ultimate choice. The end-product provides significant systems by utilizing Nash equilibrium [13].

This paper presents a novel method for getting acceptable attacks from the game hypothesis perspectives utilizing Nash equilibrium. The Nash equilibrium is rehashed to get more outcomes (multi Nash equilibrium), relying on actual weight [13]. This method is based on accepting all arguments and attacks as a first stage before adopting GT. The output of the game is the results, which reduces the number of acceptable arguments and attacks, and gives the Cash on Delivery (COD) Payment Model as a case of study.

## 2. Related Works

The Gaming Argumentation Framework (GAF) consolidates the GT and the argumentation framework to deliver a new framework. It provides assistance to plan regarding a particular issue by applying CAD to the arguments, then accordingly to the GT with two players to accomplish the eventual outcomes essential for the chief to select the existing problem [13].

The Preferences-based Argumentation Frameworks (PAFs) is centered around worthiness resulting from providing interaction and circumstances to decide the preferences arguments. It provides numerous commitments to guarantee the permission of the utilized preferences. It characterizes joint and safeguards that occur between the different arguments, distinguishes two basic ampleness thoughts (solitary pleasantness and joint value) and sends a bound-together wide framework using the two considerations. It accordingly considers tendency relations of arguments, selecting those of the best acceptability [14].

Value-based Argumentation Frameworks (VAFs) deliver a levelheaded premise for tolerating or dismissing arguments by observing the attacked and upheld arguments and comparing them to select. The essential arrangement to VAFs is managed by providing an intelligent environment to decide the attacks partial arguments and other parts that make a fundamental conversation framework wherein to invest and foster arguments' values and energy [2].

A lengthy argumentation framework (EAF) is adopted to attack different arguments in order to permit contention to create a developed struggle connection. Its favored arguments are not acquired by outside orders, they are gotten instinctively by aggravating an argument with another i.e., contention (A) attacks contention (B). By then, reasonable contention (A) routs contention (B) whenever contention (S) is correctly devoted to containing no contention, ensuring that B has resembled A [15].

The Bipolar Argumentation Framework (BAF) provides a set of relationships of root and backing connections. It relies on the correspondence between arguments that tend to support the association. The resulting association is liberated from the misfortune association (e.g., it is not portrayed using the misfortune association). Hence, the framework depicts the arguments relationships bipolar. The bipolar argumentation does not necessarily tend to be an organized graph; however, it has two kinds of edges for the lost and helps associations [10].
Unique Persuasive Frameworks (ADFs) add a certain acknowledgment situation to each contention. The principal idea is to lay out a particular acknowledgment condition for arguments that consider conceptual arguments, concerning adaptable and dynamic connections. More formally, a convincing hypothetical construction is an organized outline whose center points address the arguments, explanations, or positions, which can be recognized or not. The guideline ADF adds a dedicated affirmation condition to all the contentions individually [1].

Control Argumentation Frameworks (CAFs) deliver a dynamic model, and might be changed after some time, mirroring environment dynamism. It assembles the methodologies, specifically the run-of-the-mill increase prerequisite by obliging the opportunity of weakness in exceptional circumstances. Section (A) of the CAF can oversee conditions where the arguments course of action is dark and ward per improvement, while the existence (or direction) of specific attacks is furthermore dark. It could be sent by experts to ensure that various arguments have significance for 1 or all of the increases, anything the attacks' and arguments' certifiable plans. CAF joined 3 segments, the initial portion is referred to as the part (F) representing CAF's fixed piece [14].

The Weighted Argument Framework (WAF) is responsible for extending Dung's model, adding a new element referred to as the weight. It has high importance for the determination of the winner of multiple arguments that have attacked one another. Within the system, an argument is associated with a weight value. 5210hat weight denotes the size and indicates the attacks impact on such system according to the budget inconsistency notion. The properties of inconsistency include the adaptability to being hindered with a mismatching budget (β), where attacks with total mismatching weight (β) will be disregarded. This method distinguishes former unweight systems as it provides an arrangement used in deciding the seriousness when unweighted argument models do not have any [11].

Finally, DAF (i.e., Deontic Argumentation Frameworks) focuses directly on the basic concepts of obligatory thinking, i.e., permissions, prohibitions, and obligations. Legal and preaching thinking are revealed from different perspectives and concepts, the most important of which are basic obligations and permit rights and freedoms. The main idea of this model focuses on the aforementioned concepts, as the validity of the obligation prevents other commitments [5].

## 3. Background

A. The dung's argumentation frameworks AF, AF has no particular attention paid to the arguments' infrastructure, but rather to attacks that will be ultimately arranged as ordered pairs [15].

**Definition 1.** The **AF** represents two groups (i.e., arg and att)
Where arg represents a group of the arguments and att denotes a binary relation of arg.
For the two arguments **X** with **Y**, **attacks** are **arg × arg**, meaning the **attacks** occur whenever **X** attacks **Y** [15]**.** Dung's framework states that the argument ampleness depends on the related enlistment of specific sets, named sufficient sets or extensions; the latter or acceptable increases are depicted through unambiguous characteristics with its total crucial value. The various kinds of properties are:

- Conflict-free: where group (Z), which is a part of a group (X), is non-conflict iff, no $X_i$, $X_j$ in S, and $X_i$ $R_{def}$ $X_j$.
- Defends jointly: where group (Z), which is a part of a group (X) defends jointly argument ($X_i$ iff for every argument (y), where Y $R_{def}$ $x_i$ , C is included in (Z) and $CR_{def}Y$.

To this end, a number of semantics have several characteristics for acceptable arguments, as follows:
Assume (X, $R_{def}$) is the argumentation framework.

- Permissible: where group (Z) is a part of a group (X) as the permissible set iff (Z) is non-conflict and protects its components.
- Preferable: where group (Z) is a part of a group (X) as the preferable extension of (X, $R_{def}$) iff (Z) is the maximum of the set among X sets.

- Steady: where group (Z) is a part of a group (X) as the steady extension of (X, $R_{def}$) iff (S) is non-conflict and (Z) beats each argument that is not placed in (Z).
- Grounded: where group (Z) is a part of group (X) as a grounded extension of (X, $R_{def}$) iff S (the least characteristic function point in (X, $R_{def}$) (F: 2(X, $R_{def}$) → 2(X, $R_{def}$) and F(Z) = {X thus Z defends jointly X}) [15].

B. Game Theory

GT might be represented as a logical field for reviewing and examining a person's essential and regular choice cycles, as well as communications in a (social) environment [18]. CDA: GT is a mathematical model that focuses on solving a specific problem and delivers a result between two players. Loss and profit are essentially used in the decision-making process as there must be a winner [1] [18]. It was adopted in this system as the controversy required to be resolved, obtaining a winning argument that represents the arguments result. There are several types of games depending on the number of players; however, the proposed system depends on the game of two players.

C. Nash Equilibrium

The prevailing systems expresses ideal circumstances and arrangements for individual players, where a similar technique is ideal for the two players. In the shared use of prevailing procedures, it can be noticed that an equilibrium in which no player can benefit by one-sidedly changing a system (i.e., Nash equilibrium). J. F. Nash demonstrated that each limited game has around 1 such arrangement; these states are named harmonies [18][13][16].

D. Fuzzy weight FW

Since weighted systems are directly affected by the weighting method, two different methods can provide different weights, which affect the final result of resolving the argument. Thus, GAF has introduced the weighting method to represent an essential element of its components and as a result, the system has gained. Many arguments are weighted in a more realistic way, which achieves more realistic results. There are several methods to calculate the arguments weights:

**Weighted Majority Relations:** when multiple agents set 1 natural compilation, the weight denotes the votes' number, which supports an attack [15] [21].
**Weights as Ranking:** they are the weights that rank attacks' relevant strength among the arguments [21].
**FW:** to accomplish the arguments and loads, relying upon three-sections by combining two of the mentioned methods and adding another DL-based part. This method is called PW, it has three sections: the DL, HE, and PR, as shown in Figure (4). The PW framework was motivated by gravitations' frameworks, when the contention that the most elevated weight value is the nearest to accomplishing an objective relies on the expert's perspective [13]. The Fuzzy weight system is inspired by Fuzzy logic, where the argument that the highest weight is the closest to achieving the goal and so on depends on the expert's opinion.

## 4. Shorthand Model Based on the Gaming Argumentation Framework (SGAF)

The dung's argumentation framework uses the Cartesian multiplication among all arguments to produce an ordered pair from which the acceptable one will be chosen through the relationship. To make the relationship between arguments depend on the expert's opinion, experts determine acceptable attacks, meaning that the AF relies on the human factor twice; the first time when it identifies arguments while the second time when it decides to find the relationship between those arguments to determine the acceptable attacks.

This paper presents a novel GT-based method for obtaining acceptable attacks using Nash equilibrium called shorthand model based on the gaming argumentation framework SGAF (see Figure 1). The Nash equilibrium is repeated to achieve more results (i.e., multi-Nash equilibrium) to generate acceptable attacks.

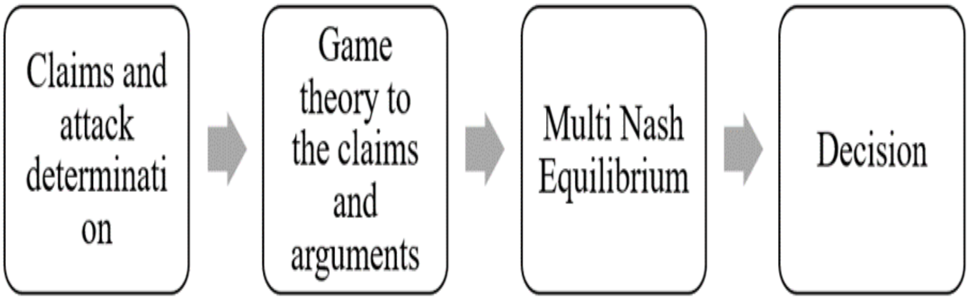


**Figure 1:** Shorthand Model Based on the Gaming Argumentation Framework

**Definition 2 (SGAF):** Shorthand model based on the gaming argumentation framework (SGAF) is of four elements (A, C, G, M) where:

- A: is a set of arguments.
- C: The Claims and attack determination on A, the output of this Claims and attack determination ⊆ A × A.
- G: refer to the gaming process between supporting arguments for each main argument.
- M: refer to the multi-Nash equilibrium process.

I. Claims and attack determination.

Numerical GT was developed and modeled for conflict status. Such situations and collaborations are named games, whereas the game participants are named players. Only two-player games are considered in this study. The two competitors contest to win a prize that a player pays to the other. Because one player's misery is the benefit of the other player, and the benefit to the two players for some random event equals zero, these games are known as zero-sum games. [17].

II. Input Set of Arguments (ISA)

Each MA represents one of the players with its supporting group (see Figure 2) from which the system determines their victory or loss. The main winning argument is calculated using the GT with 2 players, whereas the final result of resolving this argument represents the victory of one of these two competing arguments. Thus, this system helps with the decision-making process. The system ISA has two tuples: -

1- The First MA and its supported set (IL).
2- The second MA and its supported set ($IL_{2)}$.

**Definition 3 (main argument (MA)):** where group A represents the argument input set, sets X and ¬X ∈ A and sets X ∩ ¬X = ф where: A represents the arguments' input set, X ⊆ A, X represents MA, and this set's elements support MA X, and ¬X ⊆ A, ¬X represents MA elements of that set support MA ¬X.

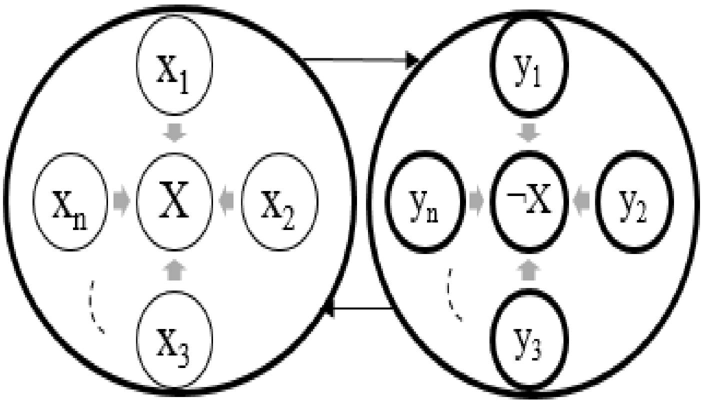


**Figure 2:** Main Arguments Inter-Attack

**Core of Arguments and Attacks (CAA):** CAA represents the second part of CAD, where it denotes the GAF core as it provides the arguments' weights. Its central component in the proposed system, the weighted system depends on the weight of arguments. Thereby, CAA plays an important role in this framework, while assessing the impact of the weight on the outcome argument and resolving the argument of the main winning argument. The CAA has five components (IL, HE, DL, PR, and FL), see Figure 3 [13].

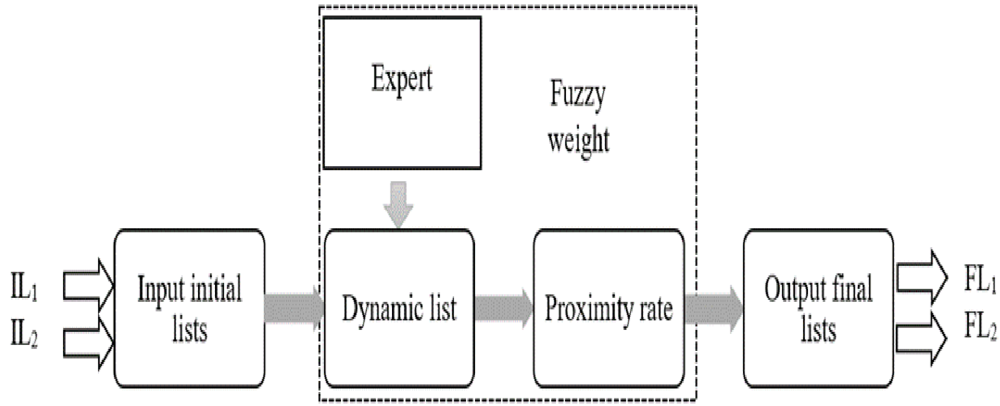


**Figure 3:** Fuzzy Weight Diagram

I. Input Initial List (IL)

The proposed system consists of 2 ILs; every IL represents the supporting argument of the main argument. IL contains a set of randomly arranged arguments. The experts have a critical opinion in ordering them ascending from the strongest to the weakest, representing the FL. Arranging the arguments represents the first stage of the weighing process [13], as follows:

1- The set of arguments supports the first MA called $IL_1$.

2- M: The set of arguments supports the second MA called $IL_2$.

**Definition 4 (IL):** elements in X and ¬X that are stated in the definition2, refer to IL where: Elements in X are referred to as $IL_1$, Elements in ¬X refer to $IL_2$, $IL_1$ length could be equal to $IL_2$ length or vice-versa.

II. Dynamic list (DL)

The DL was represented by a 2-D array. The quantity of lines relies on $IL_1$ and $IL_2$ lengths, whereas segment quantities rely on the quantity of HEs. It is utilized to improve contentions by their closeness to accomplishing the objective, as indicated by their capacity of accomplishment, where the more grounded contention is greater. In the wake of contrasting $L_1$ and $L_2$ lengths. DL length has approached double the length of the most comprehensive rundown [13].

**Definition 5 (DL):**

it can be defined as a 2D matrix, where rows' number is dependent on $IL_1$, and $IL_2$ lengths, whereas the columns' number depends on the HEs number. The arguments' scores number is dependent on their location as an expert judgment.

Where:

- DL length = max (IL-1, IL-2) x2.
- DL width = the HEs number.
- There is an argument that is referred to ($x_i$).

the number of the scores for that argument becomes= $\sum_{i=1}^{n} \text{scores}(x_i)$ depends on the location (1)

The way for the generation of DL, Input $IL_1$ & $IL_2$.DL length = max ($IL_1$, $IL_2$) $x_2$. Determination of HE number. DL width = the HEs number. The number of the scores = DL length. Experts re-arrange the arguments IL and specify the arguments location as the opinion. The distribution of the scores is performed in ascending order from top to bottom. The result is Argument $x_i$, number of scores of $x_i$ = $\sum_{i=1}^{n} \text{scores}(x_i)$ depending on the location.

**DL Characteristics:** The DL has a few attributes, making it essential in explaining the genuine argument strength and providing extraordinary adaptability to the master in selecting the genuine argument area. That is indicated by its nearness to accomplishing the objective and supporting the primary argument. Furthermore, the DL has more qualities: It was known as DL because its size could increment or decrease, implying the capability of adding the quantity of the support arguments. In addition, it is the capability of the specialists' quantity addition. It does not include the relative multitude of support arguments, depending on the well-qualifiers' viewpoint. It shows the arguments' genuine strength organized in slipping requests from the nearest to accomplishing the objective to the farthest. However, the most grounded argument might be in the first group, and the following argument does not require re-arranging to the second group. For instance, it could be in the fifth group or a different group, contingent on the well-qualifier's viewpoint. The argument area relies on a well-qualified assessment.

- The score's determined number relies on the argument area.
- The DL length approaches pair the longest length last enlists the supporting principle arguments (X, ¬X), as L1 addresses the group X (incorporating the upheld components of the fundamental argument X), L2 addresses the group ¬X (incorporating the upheld components of the primary argument ¬X).
- The DL implies that it may be extending and contracting to rely on the contribution of the underlying list and last list.

**DL Benefits**: DL has several advantages, e.g., assisting the zero-gauged arguments elimination and assisting with eliminating pointless arguments with a frail impact on the framework result. Moreover, it performs the following:

- Assures only the non-zero weight assault since it eliminates the zero-gauged arguments [17].
- Highlights the genuine argument force, addressing its nearness to the objective. That dodges powerless and zero-esteem arguments [11].
- Reduces arguments' number that prompt diminishing the number of attacks' prompts to speed up and upgrade the presentation of the argumentation framework.

III. Human Expert HE

HEs have the superior ability to analyze problems in their work field because of their knowledge that enables them to infer the correct methods in that field. They can infer by practice, thus they were used to build effective systems [18]. In this work, HEs play a significant role in generating arguments' weights [13].

IV. Proximity rate PR

The PR is calculated using probability (2) [1] to set the argument weight between zero and one.

$$PR = \frac{\sum_{i=1}^{n} Scores(X_i)}{1st\ Score(X_i)\ Number\ of\ Experts} \tag{2}$$

V. Output final list (FL)

Whenever IL is added to CAA, it is organized haphazardly. Despite considering all the issues, after the arguments load, they will be modified by the higher loads in sliding request by utilizing the last rundown. However, this rundown is not equivalent to the IL since it scanned the zero-weight argument to generate a CAD [1]. Accordingly, each adjusted IL has an FL. After presenting the arguments in IL to a group of experts, they are arranged ascending from the strongest to the least influential. Thereby their weight is more available than before, urging that FL represents the final arrangement of the arguments according to their influence and the strength of their support for the main argument.

**Definition 6 (FL):** FL ⊆ initial list IL where: FL could have the same value as IL length or not.

**Power of attack (PR):** PA represents an essential part of the system as the result of the attack is used in GT, and therefore has the most important role in determining the main winning argument. It basically works on assault strength. When strong contentions have traded the assault between each other, the assault's force is determined by the condition (2) [13], [19]. PR is given by:

$$PHW(r_i, r_j) = \frac{PHW(r_i)}{1 + PHW(r_j)} \tag{3}$$

**Claims and attack power:** For RA calculation, PA equation is extended through the addition of TP or tie case parameter, then making a difference between PA and TP. TP may be utilized as a threshold through cases below. In the case where there are 2 arguments $r_1$ & $r_2$, where k represents RA, then [13]:

- Case1: if $r_1 = r_2$ resulting in attack = 0.
- Case2: if $r_1 > r_2$ resulting in attack = +k.
- Case3: if $r_1 < r_2$ resulting in attack = -k.

Results of attachment can be computed from Eq. (4):

$$PHW(r_i, r_j) = \frac{PHW(r_i)}{1 + PHW(r_j)} - \frac{PHW(r_j)}{1 + PHW(r_i)} \tag{3}$$

**Balance Point (B):** When all attacks have the same weight, they coincide with Dung's ones in the corresponding flat graph, where an argument attack on another argument has the same weight, that is mean the strength of attack and defense is the same, in this case is called the balance point. Using the following equations to calculate the result of the attack depending on two parameters: the first parameter is the power of attack, see equation (4), and the second is Balance Point (5) [13].

$$B(R_i) = \frac{FW(R_i)}{1+FW(R_j)} \quad (4)$$

$$B(R_i) = \frac{FW(R_i)}{1+FW(R_i)} \quad \dots (5)$$

**Definition 7 (Balance Point):** The arguments $R_1$ and $R_2$ have the same weight s (FW). Therefore, the strength of the attacks between them is the same[13].
Let $R_1$ and $R_2$ be two arguments, and FW ($R_1$) = FW ($R_2$) then the strength of the attacks ($R_1$, $R_2$) = the strength of the attack ($R_2$, $R_1$).

**Proof**: When the weight of $R_1$ = weight of $R_2$ and each one is equal to 0.5, and they are attacking each other, as shown in Figure (4), that means each argument is not acceptable with dung's argumentation framework, and the weight is not necessary because it does not give any result. Here, we are taking advantage of the above case by using it to calculate the strength of the attack and determine the amount of profit and loss for each attack to be used as a threshold under the three cases mentioned above by using equation (5).
- Case 1: ($R_1 = R_2$) let $R_1 = 0.5$ and $R_2 = 0.5$ when using equation (3.3), the result of attach is = 0.
- Case 2: ($R_1 > R_2$) let $R_1 = 0.5$ and $R_2 = 0.4$ when using equation (3.3), the result of attach is = 0.048.
- Case 3: ($R_1 < R_2$) let $R_1 = 0.5$ and $R_2 = 0.6$ when using equation (3.3), the result of attach is = - 0.042

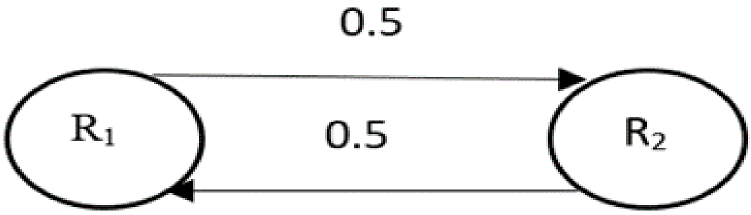


**Figure 4:** The Two Attacking Arguments in Case of R1-Weight = R2-Weight

A. Decision by using game theory with Nash equilibrium.
The SGAF suggests a set of arguments automatically by depending on the multi-Nash equilibrium procedure. This model makes a decision by calculating the final result between the acceptable attacks of the arguments that supported the two main arguments. The system performs the summation to each ROA, the biggest supporting arguments represent the final decision.
**Multi-game-based:** this stage of making, re-game or Multi Nash Equilibrium, works by deleting the row and column found in the Nash equilibrium. The re-game process continues until getting all the results, making this procedure to obtain all the results and to ensure fairness between the contestants, also to get all attacks are acceptable, this stage work as follows: -
1. This model Gets the first result using a Nash equilibrium.
2. Delete the row and column containing the first result.
3. This model Creates a Re-game, the game with fewer rows and columns than at the start of the game.
4. This model Gets the second result using a Nash equilibrium.
5. Delete the row and column containing the second result.
6. Repeat the process for all remaining rows and columns in the same way.
7. Each attack represented the Nash equilibrium as an acceptable attack.

8. The ROA of the supporting attacks is summed for each main argument, and the largest attacks represent the victory of the main argument.

## 5. Experimental Results of SGAF: Obligation Problem in the Cash on Delivery (CoD) Payment Model Abstract

After the spread of electronic shopping at a very rapid rate, it has become a lifestyle for many people nowadays. Some companies that sell online have relied on the Cash on Delivery (COD) Payment Model. This method has many advantages, but the most important of which is gaining the customer's confidence, as they will see on the ground the goods they intend to buy and may reject it for many reasons, some of which are logical and others illogical. Also, this method was subjected to numerous attacks by competing companies at one time and by some fraudulent at other times, as the rejection of the goods is a problem, and in order to determine the successful deal from the other unsuccessful deal, using the artificial intelligence techniques, and will use the argumentation method to solve this problem.

**Example:** There is a company working in the field of delivery that wants to distinguish the serious customer from the non-serious. As it requests additional information from the non-serious customer, such as a second phone number or specifying the exact address and others, by depending on the following arguments.

**serious customer: -**

- Give the mobile number
- Answers the test call
- Submit your current location
- Confirm the request with a confirmation message

**Non-serious customer: -**

- No, give the mobile number
- No, answers to the test call
- No, submit your current location
- No, confirm the request with a confirmation message

**Solution**: Generate the main arguments: -

- Serious customer = X.
- Non-serious customer = ¬X.

**Generate the $IL_1$, $IL_2$: -**

- Give the mobile number = $x_1$.
- Answers the test call = $x_2$.
- Submit your current location = $x_3$.
- Confirm the request with a confirmation message = $x_4$.
- No, give the mobile number = $y_1$.
- No, answers to the test call = $y_2$.
- No, submit your current location = $y_3$.
- No, confirm the request with a confirmation message = $y_4$.

**Determine the FW:** depends on ten experts let the DF = 2, see Table 1.

**Table 1:** Proximity Rate

| x | Proximity rate | y | Proximity rate |
|---|---|---|---|
| 43 | 0.538 | 42 | 0.525 |
| 40 | 0.500 | 39 | 0.488 |
| 53 | 0.663 | 52 | 0.650 |
| 48 | 0.600 | 55 | 0.688 |

Calculate the POA, B, and ROA, see Table 2.

**Table 2:** POA, B & ROA

| attack | x | y | B | POA | ROA | attack | y | x | B | POA | ROA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $(x_1, y_1)$ | 0.538 | 0.525 | 0.350 | 0.352 | 0.003 | $(y_1, x_1)$ | 0.525 | 0.538 | 0.344 | 0.341 | -0.003 |
| $(x_1, y_2)$ | 0.538 | 0.488 | 0.350 | 0.361 | 0.012 | $(y_1, x_2)$ | 0.488 | 0.500 | 0.328 | 0.325 | -0.003 |
| $(x_1, y_3)$ | 0.538 | 0.650 | 0.350 | 0.326 | -0.024 | $(y_1, x_3)$ | 0.650 | 0.663 | 0.394 | 0.391 | -0.003 |
| $(x_1,y_4)$ | 0.538 | 0.688 | 0.350 | 0.319 | -0.031 | $(y_1, x_4)$ | 0.688 | 0.600 | 0.407 | 0.430 | 0.022 |
| $(x_2, y_1)$ | 0.500 | 0.525 | 0.333 | 0.328 | -0.005 | $(y_2,x_1)$ | 0.525 | 0.538 | 0.344 | 0.341 | -0.003 |
| $(x_2, y_2)$ | 0.500 | 0.488 | 0.333 | 0.336 | 0.003 | $(y_2, x_2)$ | 0.488 | 0.500 | 0.328 | 0.325 | -0.003 |
| $(x_2, y_3)$ | 0.500 | 0.650 | 0.333 | 0.303 | -0.030 | $(y_2, x_3)$ | 0.650 | 0.663 | 0.394 | 0.391 | -0.003 |
| $(x_2, y_4)$ | 0.500 | 0.688 | 0.333 | 0.296 | -0.037 | $(y_2, x_4)$ | 0.688 | 0.600 | 0.407 | 0.430 | 0.022 |
| $(x_3, y_1)$ | 0.663 | 0.525 | 0.398 | 0.434 | 0.036 | $(y_3,x_1)$ | 0.525 | 0.538 | 0.344 | 0.341 | -0.003 |
| $(x_3, y_2)$ | 0.663 | 0.488 | 0.398 | 0.445 | 0.047 | $(y_3, x_2)$ | 0.488 | 0.500 | 0.328 | 0.325 | -0.003 |
| $(x_3, y_3)$ | 0.663 | 0.650 | 0.398 | 0.402 | 0.003 | $(y_3, x_3)$ | 0.650 | 0.663 | 0.394 | 0.391 | -0.003 |
| $(x_3, y_4)$ | 0.663 | 0.688 | 0.398 | 0.393 | -0.006 | $(y_3, x_4)$ | 0.688 | 0.600 | 0.407 | 0.430 | 0.022 |
| $(x_4, y_1)$ | 0.600 | 0.525 | 0.375 | 0.393 | 0.018 | $(y_4,x_1)$ | 0.525 | 0.538 | 0.344 | 0.341 | -0.003 |
| $(x_4, y_2)$ | 0.600 | 0.488 | 0.375 | 0.403 | 0.028 | $(y_4, x_2)$ | 0.488 | 0.500 | 0.328 | 0.325 | -0.003 |
| $(x_4, y_3)$ | 0.600 | 0.650 | 0.375 | 0.364 | -0.011 | $(y_4, x_3)$ | 0.650 | 0.663 | 0.394 | 0.391 | -0.003 |
| $(x_4, y_4)$ | 0.600 | 0.688 | 0.375 | 0.356 | -0.019 | $(y_4, x_4)$ | 0.688 | 0.600 | 0.407 | 0.430 | 0.022 |

**Decision:** Great the game matrix to perform a multi-Nash equilibrium, identifying proposed attacks see Table (3). The SGAF Suggests attacks automatically; it works to shorthand the arguments and attacks. This model uses the **multi-game:** based to determine the decision. The multi Nash equilibrium suggested set of relationship R for this example is $\{(x_2, y_1), (x_4, y_2), (x_1, y_3), (x_3, y_4), (y_1, x_2), (y_2, x_4), (y_3, x_1), (y_4, x_3)\}$ see Figure (5).

**Table 3:** Game Matrix

| | $y_1$ | $y_2$ | $y_3$ | $y_4$ |
|---|---|---|---|---|
| $x_1$ | 0.0029, -0.0028 | 0.0118, -0.0028 | **-0.0238, -0.0028** | -0.0311, -0.0028 |
| $x_2$ | **-0.0055, -0.0027** | 0.0028, -0.0027 | -0.0303, -0.0027 | -0.0370, -0.0027 |
| $x_3$ | 0.0359, -0.0030 | 0.0469, -0.0030 | 0.0030, -0.0030 | **-0.0059, -0.0030** |
| $x_4$ | 0.0184, 0.0223 | **0.0284, 0.0223** | -0.0114, 0.0223 | -0.0194, 0.0223 |

To determine the final decision-making summation of all x attacks and y attacks as follows.

$(x_2, y_1) + (x_4, y_2) + (x_1, y_3) + (x_3, y_4) = -0.0055 + 0.0284 + -0.0238 + -0.0059 = -0.007$

$(y_1, x_2) + (y_2, x_4) + (y_3, x_1) + (y_4, x_3) = -0.0027 + 0.0223 + -0.0028 + -0.0030 = 0.014$

Since the 0.014 > -0.007, then the $\neg X$ is a decision.

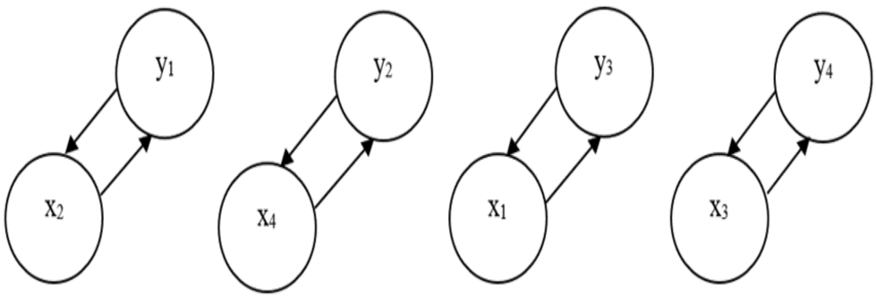


**Figure 5:** The SGAF Suggested Attacks

## 6. Conclusion

Integrating Dung's model and GT using weighted arguments with the PHW method enabled us to significantly shorten the number of acceptable attacks and arguments, which clearly facilitated achieving the results. It greatly reduced the dependence on the human factor existence. Furthermore, the proposed system was able to transform Dung's model from population solutions to a single solution. Moreover, this model is distinguished from other weighted models as it does not require a traditional weighting method where it presented the weighting method as part of the system based on the PHW method. Since the weighting method has a direct impact on the result, it is recommended to use this method in future work for the decision-making due to its capabilities that help to reach the final result sufficiently, and thereby it considerably helps with decision-making.

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