ISSN 2303-4521
Periodicals of Engineering and Natural Sciences *Original Research*
Vol. 9, No. 4, October 2021, pp.692-707

Gaming argumentation framework (GAF): Pfizer or AstraZeneca Vaccine of The COVID-19 as a case study

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ABSTRACT

Dung's argumentation frameworks (AF) were introduced in the last century it works with the justification of the argument. This framework analyzes attacks of arguments, it works away on the characteristics of arguments structures and words was used in the attack between each other, etc. These properties make this model attractive as it decreases most of the complexities included when applying the argumentation system. This system can be applied to different states such as to evaluate the arguments or with the supported argument to be defense and attacked arguments. In addition, the group of experts may be making argumentation about some cases. In the latter scenario, agents with potentially dissimilar arguments and/or opinions are used to evaluate the arguments, allowing for the consideration of several sets of arguments and attack relations. This framework is extended to propose a new system called gaming argumentation framework (GAF). It helps to make a decision about the current problem by making claims and attack determination to the arguments, then putting the result of these claims and attack determination to the game theory with two players to achieve the final results that help the decision-maker to decide about the current problem. Finally, compare this framework with other frameworks, and provide an example to explain how the proposed framework performs its intended purpose, where decision making is very important in the medical field therefore this paper taking the confusion on the COVID-19 vaccines as a case study to solve Pfizer or AstraZeneca problem and make the decision about this case.

Keywords: Argumentation frameworks, game theory, physical weight, dynamic list, vaccine.

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1. Introduction

Argumentation is a viable model for communicating with inconsistent knowledge because it is focused on the building and comparison of arguments. It is also considered a different way for dealing with uncertainty since it is based on the construction and comparison of arguments. The explanation for a fact's validity must be analyzed in conjunction with these arguments in order to determine that certainty. Consolidation is a way of thinking that aims to arrive at the most accepted position, which is designed to provide support for or against a conclusion, as well as a global perspective that aims to define the admissible arguments. [1]. The value-based argumentation frameworks (VAFs) extended the standard argumentation frameworks (AFs) by establishing that the rationale for evaluating arguments is contingent on the strength of the particular values being evaluated. Where there is agreement on the origin of the arguments despite the difference in values, points of convincing are determined and uncertainty is discussed through persuasion in the difference of previously assessed values [2, 3, 4]. By introducing a new type of interaction between arguments represented by the support relation, an abstract bipolar argumentation framework (ABAF) expands the standard of (AFs). By virtue of the bipolar representation of the interactions between arguments, this new relation is considered to be independent of the defeat relation [5]. The weighted argument framework (WAF) was developed as a natural extension of Dung's concept of argument systems, in which attacks are assigned a weight that indicates their relative power. The notion of this framework is an inconsistency budget, which typifies how much inconsistency that is organized to tolerate by specified inconsistency budget β, that is being prepared to disregard attacks up to a total weight of β. The primary advantage of this technique is that it enables considerably finer-grained analysis of argument systems than unweighted systems and provides viable solutions in cases where conventional (unweighted) argument systems do not. This approach begins by examining Dung's abstract argument systems and the motivations for attack weights (instead of the alternative possibility, which is to attach weights to arguments). It introduces the architecture of weighted argument systems and studies the complexity of computing solutions for weighted argument systems, with a special emphasis on weighted variations of grounded extensions without focusing on how those weights are computed [6]. The abstract dialectical frameworks (ADFs) extend the Dung frameworks by introducing the more abstract concept of an acceptable condition. Acceptance conditions encompass any function that determines a node's status in relation to its parent nodes. This encompasses domain-specific conditions and so extends beyond the few well-known legal norms. After that, the latter will be introduced based on the properties/types of the links in our graphs. Acceptance requirements enable the addition of new node and link types [7]. This article proposes a novel method for determining the preference argumentation. To begin, the argument's weight is more than zero. Second, it should proceed through the heart of the arguments and counter-arguments to each argument that is appropriate following the two difficulties described above. Additionally, we assess the attack's strength and calculate the tie point at which the values of the arguments equalize by employing a specific equation to ascertain the attack's true worth and quantify the quantity of profit and loss with high precision. The frameworks for deontic reasoning concentrate on the fundamental principles of deontic reasoning, namely obligations, prohibitions, and permissions. The deontic system is founded on obligations, and prohibitions are regarded as a by-product of obligations: to argue that something is prohibited is equivalent to asserting that its inverse is mandatory. Permissions can be regarded as duties; permission to do something indicates that the alternative is unnecessary. To determine whether an argument and its negation are acceptable, that is, whether the X is acceptable or not, and vice versa [8]. The suggested system provides the following solutions in addition to the frameworks mentioned previously: - The proposal framework depends on the support relation and defeats relation to deciding by using game theory to determine the final result between argument and negation.

1. The suggested core of the arguments and attacks runs the core of the arguments and attacking arguments and determines what is acceptable or not. That depends on how many arguments move through this core of the arguments and attacks. Therefore, the output arguments number not equals the input arguments that lead to reducing arguments size. Consequently, it reduces the Claims and attacks determination time.
2. The weight of the arguments is very important also, the way of calculating this weight is very important to avoid the zero weight arguments and give the real weight to each argument. Therefore, we introduce the novel way to calculate the argument weight called physical weight using a dynamic list depending on the expert opinion.
3. Finally, the proposed framework focuses on the argument and negation argument to decide on concept if an argument is acceptable. The negation argument is not acceptable and vice versa by using game theory to get that concept and make a final decision representing the final result to the argumentation game.

2. Related works

The Preferences based argumentation frameworks (PAFs) focus on acceptability by making a process and give conditions to determine the preferences arguments, it gives many contributions to ensure the use of these preferences is allowed. Defining defense and joint defense that takes place between the various arguments; identify two integral ideas of adequacy (singular agreeableness and joint worthiness) and to introduce a bound together broad system where the two thoughts are utilized, consider inclination relations between arguments to choose the most satisfactory of them [1]. The value-based argumentation frameworks (VAFs) provide a rational basis for the acceptance or rejection of arguments by making the comparison between the attacked argument and supported arguments and choose between them, it fundamental plan is to the value-based argumentation frameworks. It is based on providing a logical environment in which to make a comparison between the arguments that play the role of the attack and those that defend, by creating a basic discussion framework in which to put values of the arguments and work to develop values for those arguments [2]. The extended argumentation framework (EAF), not only to attack other arguments but also on other attacks and same time allow the argument to generate a more advanced conflict relation, it preferred arguments are not obtained through external orders but are obtained intuitively through arguments that irritate each other like when argument (A) attack on argument (B). At that point, one would reason argument (A) defeats argument (B) if the arguments S that one is right now dedicated to, contain no argument guaranteeing that B is liked to A [9]. bipolar argumentation framework (BAF), gives to set of relationship defeat relation and support relation, it depends on the communication between arguments addressed by the supporting connection. This new connection is thought to be free of the loss connection (like it is not characterized utilizing the loss connection). Thus, this framework has a bipolar portrayal of the associations between arguments. A bipolar argumentation structure can in any case be addressed by a coordinated diagram, with two sorts of edges, one for the lost connection and another for the support connection. [5]. Abstract dialectical frameworks (ADFs), adding to each argument a specific acceptance condition, the main idea is to establish a specific acceptance condition for arguments that allows for abstract arguments as well as for flexible and abstract relationships. More officially, a theoretical persuasive structure is a coordinated chart whose hubs address arguments, statements, or positions which can be acknowledged or not. All in all, the principle thought to the ADF is adding to every argument a particular acknowledgment condition [7]. control argumentation frameworks (CAFs), provides a dynamic model, it can change over time reflecting the dynamics of the environment, it sums up the strategies, in particular the typical augmentation requirement, by obliging the chance of vulnerability in unique situations. Part (A) in the CAF can manage circumstances where the specific arrangement of arguments is obscure and dependent upon development, and the presence (or bearing) of certain attacks is additionally obscure. It very well may be utilized by a specialist to guarantee that several arguments are important for one (or each) augmentation whatever the genuine arrangement of arguments and attacks, the CAF incorporates three sections the initial segment called part (F) is the fixed piece of the CAF [10]. Weighted argument framework (WAF), extends the dung's framework by adding a new element called weight it very important to determine the winner from several arguments that attacked between each other, this system the argument is linked to a weight that represents its size and indicates the relative strength of the attack this system is based on the concept of budget inconsistency. The characteristic of the inconsistency is its adaptation to be hampered by an inconsistent budget (β) where attacks with a total weight of inconsistency (β) are ignored. The vital benefit of this methodology is that it allows a lot better-grained level of examination of argument frameworks than unweighted frameworks and gives valuable arrangements when customary (unweighted) argument frameworks have none [6]. While deontic argumentation frameworks (DAF) emphasize fundamental notions in deontic reasoning, such as responsibilities, prohibitions, and permissions, legal and deontic reasoning exposes a variety of concepts, spanning from fundamental obligations and permissions to freedoms and rights. For our purposes, the framework's central premise is to concentrate on fundamental deontic principles, notably obligations, prohibitions, and permissions. The system's essence is obligations, and the rules are a by-product of these obligations, prohibiting the contrary and vice versa [8].

3. Background

3.1. Argumentation framework

The initial framework for argumentation is defined as a pair of arguments and a binary connection expressing the attack relationship among the arguments. In this context, an argument is a purely abstract entity whose role is decided completely by its relationships to other arguments. No distinct attention is paid to the inner structure of the arguments. An argumentation framework, as presented in Dung's 1995, is a pair AF = (ARG, RE), where: ARG stands for a set of arguments, $RE \subseteq A \times A$ is an attack relation, the relation (r_1) attacks (r_2) are denoted by $(r_1, r_2) \in RE$ [11].

3.2. Argumentation in the medical

Medical judgment research has raised serious concerns about how physicians make decisions and plan treatment, especially in the face of uncertainty and information overload. Recent work has proposed applying normative numerical methods such as probabilistic inference to diagnosis and risk assessment, as well as anticipated utility theory to therapy selection, in order to solve the issues doctors encounter. Sometimes While we cannot deduce both p and p from the same database in classical logic, various arguments might simultaneously support or oppose propositions in the argumentation system. This is because knowledge can be inconsistent in complicated disciplines such as medicine and science. To address this discrepancy, we can subdivide a knowledge base into internal but not necessarily mutually consistent parts (theories). These subsets can serve as the foundation for arguments that are valid on their own yet justify contradicting conclusions in specific settings [12].

4. Gaming argumentation framework (GAF)

In this section, Dung's argumentation framework (AF) is extended to another framework called the gaming argumentation framework (GAF). It makes Claims and attack determination and then inserts the result of these Claims and attack determination to the game theory with two players to decide the current problem. The winner is determined between two main arguments by dividing the input set into two sets, each set includes the main argument and its supporting arguments. The proposed framework gives a clear result better than different types of last frameworks such as value-based argumentation frameworks (VAFs), abstract dialectical frameworks (ADFs), weighted argument framework, and abstract dialectical frameworks (ADFs); because it gives a clear result and determines the exact winner, that thing makes it easier for the decision-maker to decide about the current problem were all above frameworks and dung's itself give set of acceptable arguments as the final result. thus framework consists of three main stages Claims and attacks determination, game theory with two plyers, and finally, it determines the outcome of the game see figure (1).
Definition 1: gaming argumentation framework(GAF) is a triple element (A, P, G) where:
- A: is a set of arguments.
- P: the Claims and attack determination on A, the output of this Claims and attack determination ⊆ A × A.
- G: refer to the process of gaming between supporting arguments for each main argument.

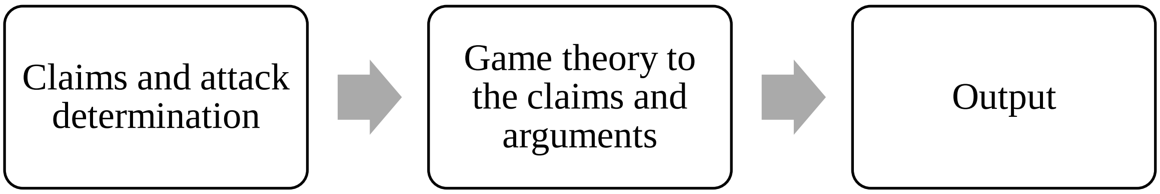

Figure 1. Gaming argumentation framework

4.1. Claims and attack determination

The Claims and attack determination includes three parts; the first part is called a core of the arguments and attacks. It works as the gate to reduce the number of arguments by removing the weak arguments and zero-weight arguments by using three types of lists, initial list (IL), dynamic list (DL), and final list (FL). The core of the arguments and attacks makes proximity rate to avoid the zero weight arguments. Finally, it calculates the weight of each argument under a new weight system called the physical weight(PHW) system. The second part called the power of an attack, uses an equation to calculate the strength of the attack. The third part is called the result of the attack. uses an equation to calculate the result of the attack and determine the profit and loss value of the attack.

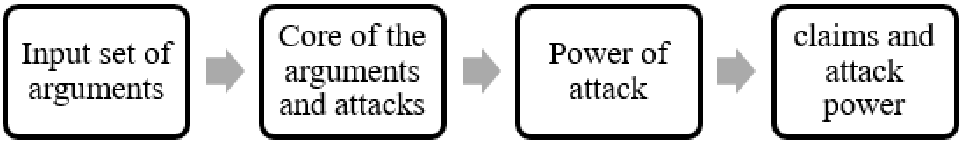

Figure 2. Claims and attack determination workflow

4.1.1. The Input set of arguments

Where the main aim of the proposed technique is to make a decision. the system works to divide the input set of arguments into two tuples each tuple is called the main argument with its supported set called initial list.
Definition 2 (main arguments): where the tuple A is the input set of arguments the set X and set ¬X ∈ A and set X ∩ set ¬X = ϕ where: -

- Set A is the input set of arguments.
- Set X ⊆ A, the X is the main argument, and elements of this set support the main argument X.

- Set ¬X ⊆ A, the ¬X is the main argument elements of this set supports to the main argument ¬X.

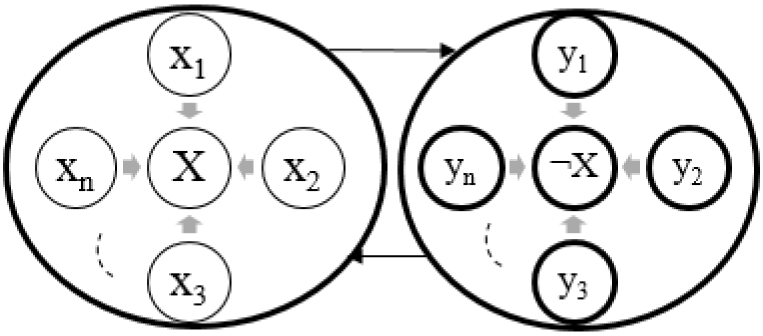

Figure 3. Attack between the main arguments

4.1.2. The core of the arguments and attacks

The core of the arguments and attacks is a second part of the Claims and attack determination procedure and it represents the core of the gaming argumentation framework because it gives the arguments weight.
The core of the arguments and attacks characteristics: -

1. Each argument will move through the core of the arguments and attacks to be acceptable or not.
2. This core of the arguments and attacks removes the zero-weight argument.
3. By using the dynamic list, the core of the arguments and attacks gives weight to each argument.
4. gives the real strength to each of them by given weight to the argument via the dynamic list.
5. Finally, its proximity rate procedure is to used generate the final list.

The core of the arguments and attacks has five components: -

1. initial list: includes the main arguments that are randomly arranged.
2. Human expert: it evaluates arguments depends on his opinion.
3. dynamic list: it makes rearranged to the initial list depend on the expert opinion.
4. Proximity rate: procedure uses to converting the weights between zero and one.
5. Final list: rearranged the initial list depend on proximity rate and remove the zero weight arguments the number of set elements in the final list may equal or not equal the number of elements in the initial list.

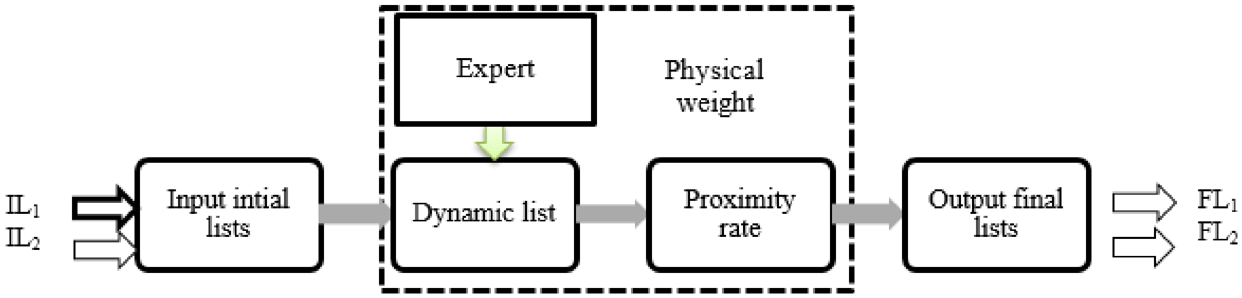

Figure 4. GAF core workflow

4.1.2.1. The Input initial list (IL)

This system includes two initial lists; each list has a set of arguments are support the main argument mentioned in definition 2.

Definition 3 (initial list): the elements in set X and elements in set ¬X that were mentioned in definition 2 is called initial list where: -

- The elements in set X are called the initial list 1 (IL_1)
- The elements in set ¬X are called the initial list 2 (IL_2)
- The length of IL_1 may equal or not equal the length of IL_2.

4.1.2.2. Physical weight (PHW)

There are two famous ways to achieve the weight of the arguments depends on voting and ranking: -
Weighted Majority Relations: In a multi-agent environment, one natural interpretation is that weight corresponds to the number of votes in favor of the attack. This perspective connects argumentation and social choice theory to voting system and collective decision-making theory [5][13].
Weights as Ranking: A straightforward and reasonable interpretation is to use weights to rate the relative strength of arguments. In other words, a larger weight indicates a more powerful attack, and thus the absolute weight allocated to an attack is irrelevant; only the relative weight assigned to other attacks is. We can use subjective or objective criteria for rating attacks in this interpretation [13].
Physical weight: This paper is introducing a new way to achieve the arguments weights depend on three-part by mixed between two above ways and add a new component called dynamic list this way called a Physical weight. the Physical weight has three parts shown in figure (4), dynamic list, human expert, and Proximity rate. The physical weight system is Inspired by the gravitational system, where the argument that the highest weight is the closest to achieving the goal and so on that is depending on the expert's opinion.

4.1.2.3. Dynamic list (DL)

The dynamic list (DL) is a two-dimension (2D) matrix. The number of rows depends on the length of initial lists L1 and L2, and the numbers of columns depend on the number of human experts. It uses to rearrange arguments according to their proximity to achieving the goal and according to their ability to achieve it, where the stronger argument is higher and so on. After comparing the length of the L1 and L2. The length of the dynamic list is equaled twice the length of the longest list.
Definition 3 (dynamic list (DL)): is a two-dimension (2D) matrix, the number of rows depends on the length of initial lists L1 and L2 and the number of columns depends on the number of human experts, the number of scores to each argument depends on its location as expert opinion where: -

- the length of the dynamic list (DL) = max (IL1, IL2) * 2.
- The width of the dynamic list (DL) = the number of human experts.
- Where we have an argument called (x_i), then the number of scores to this argument is= $\sum_{i=1}^{n} \text{scores}(x_i)$ depend on its location. How to generate the dynamic list?
- Input two initial lists (IL_1) and (IL_2).
- The length of the dynamic list (DL) = max (IL_1, IL_2) * 2.
- Determine the number of human experts.
- The width of the DL = number of human experts.
- The number of scores = length of DL.
- the experts to rearrange the initial list of arguments and determine the argument location as its opinion.
- The scores are distributed from top to bottom.
- Where we have an argument x_i, the number of scores of x_i = $\sum_{i=1}^{n} \text{scores}(x_i)$ depend on its location.

Table 1. The dynamic list (8,10) when ten human experts and max (IL_1=4, IL_2=3) * 2=8

No.	scores	Exp_1	Exp_2	Exp_3	Exp_4	Exp_5	Exp_6	Exp_7	Exp_8	Exp_9	Exp_{10}
1	8										
2	7										
3	6										
4	5										
5	4										
6	3										
7	2										
8	1										

4.1.2.4. Characteristics of the dynamic list

The dynamic list has several characteristics that make it essential in clarifying the true strength of the argument and give great flexibility to the expert in choosing the true location of the argument. This is according to its proximity for achieving the goal and supporting the main argument the dynamic list has more characteristics: -

a. It is called a dynamic list because its size can increase or decrease, meaning that it is open to adding the number of supporting arguments and is also open to adding the number of experts.
b. It does not necessarily to including of all the supporting arguments; this is up to the expert's opinion.
c. Show the true strength of the arguments as they are arranged in descending order from closest to achieving the goal to least nearby. This means that the strongest argument may be in sequence number one, and the argument that follows that does not have to be in sequence number two, for example, it may be in sequence number five or closer or later, depending on the expert's opinion.
d. The location of an argument depends on expert opinion.
e. The number of the calculated scores depends on argument location.
f. The length of the dynamic list equals doubles the length of the longest final lists of supporting the main arguments (X, ¬X), where L_1 represents the tuple X (it includes all elements that are supported the main argument X) and L_2 represents the tuple ¬X (it includes all elements that are supported the main argument ¬X).
g. The dynamic list is an open list that means, it can be expanding and shrinking depending on the input of the initial list and final list. therefore, it is called a dynamic list.

4.1.2.5. Benefits of dynamic list

The dynamic list has many benefits, it helps to remove the arguments that have weighing zero and helps to remove useless arguments that are weak effect in the system result.

a. Ensure only a non-zero weight attack because it removes the arguments that have zero weights [13].
b. Highlight the real power of the argument and how it is close to the target. this helps avoid weak and zero-value arguments [6].
c. Reducing the number of arguments which leads to reducing the number of attacks leads to an increase in the speed and enhancement of the performance of the argumentation system.

4.1.2.6. Human expert

Human experts share two critical characteristics: substantial subject knowledge and effective strategies for rapidly sorting through that information when confronted with problems-strategies that include logical rules, formal heuristics, and intuitions (or gut feelings). Human specialists solve difficulties in all of these instances by efficiently using a repository of domain-specific knowledge and experience [14]. Human experts contribute significantly to the weight of the arguments in this work.

4.1.2.7. Proximity rate

To make the weight between zero and one and give the real proximity to the target rate, this procedure is the very important part because it is using to determine the weights of arguments, and then the arguments with zero weights are eliminated, which helps to reduce the number of arguments and then reduce the claims and attack determination time, the proximity rate calculates by using the probability (1).

$$\text{Proximity rate} = \left(\sum_{i=1}^{n} \text{scores}(x_i) \right) / (\text{First score} * \text{number of experts}) \quad \ldots (1)$$

4.1.2.8. Output final list

When the initial list was entered into the core of the arguments and attacks, it was arranged randomly. Still, after the arguments were given weights, they should be rearranged according to the higher weights in descending order by using the final list, this list is not equal to the initial list because it eliminated the zero-weight argument from it after making Claims and attack determination. Therefore, each initial list has a final list after being rearranged.

Definition 4 (final list): the final list FL ⊆ initial list IL where: -
The FL may equal or not equal the length of IL length.

4.1.3. Power of attack

It is imperative to calculate the strength of the attack, when supportive arguments have exchanged the attack between each other, the power of the attack is calculating by equation (2) [15].

$$\mathrm{PHW}(r_i, r_j) = \frac{\mathrm{PHW}(r_i)}{1+\mathrm{PHW}(r_j)} \dots (2)$$

4.1.4. Claims and attack power

To calculate the result of the attack here, we are extending the power of attack equation by add a tie point or tie case parameter and make a difference between the power of attack and tie point, also can use the tie point as a threshold by the following cases, if we have two arguments r_1 and $r_{2,}$ where k is the result of the attack, then: -

- Case one: if $r_1 = r_2$ the result of attack = 0.
- Case two: if $r_1 > r_2$ the result of attack = +k.
- Case three: if $r_1 < r_2$ the result of attack = -k.

The result of attaching is calculating by equation (3): -

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

tie point: When all attacks have the same weight, they coincide with Dung's ones in the corresponding flat graph [16][AAMAS-19 (1)], Where an argument attack on another argument has the same weight that is mean the strength of attack and defense is the same this case called tie point. By using the following equation can calculate the result of the attack depending on two parameters, the first parameter is the strength of attack see equation (2), and the second parameter is tie point see equation (4): -

$$\mathrm{PHW}(r_1, r_1) = \frac{\mathrm{PHW}(r_1)}{1+\mathrm{PHW}(r_1)} = t \dots (4)$$

Definition (tie point): the arguments r_1 and r_2 have the same weights (PHW). Therefore, the strength of the attacks between each other is the same: -
Let r_1 and r_2 are two arguments and, PHW (r_1) = PHW (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 see figure (5) and they are attacking each other as showing in figure 5 that is mean each argument is not acceptable with dung's argumentation framework [11], and the weight is not necessary because it does not give any result [6]. Here, we are taking the advantage of the above case by using it to calculate the strength of 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 (3).

- Case 1: ($r_1 = r_2$) let $r_1 = 0.5$ and $r_2 = 0.5$ when using equation (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), the result of attach is = 0.048.
- Case 3: ($r_1 < r_2$) let $r_1 = 0.5$ and $r_2 = 0.6$ whe [illegible] equation (3), the result of attach is = - 0.042

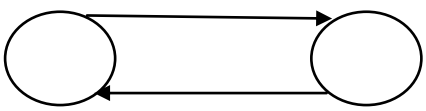

Figure 5. Weight of r_1 = weight of r_2 and these arguments attack each other

When two arguments r_1 and r_2 before inserting these arguments should make a try by calculating the power of attack when r_1 attacks himself let the power of attack, in this case, is t that is tie point, see following example: -

When an argument r_1 attacks argument r_2 we have two steps: -

a. Determine the tie point by calculating the power of the attack when r_1 attacks himself using the power of attacks such as: -
b. $\mathrm{PHW}(r_1, r_1) = \frac{\mathrm{PHW}(r_1)}{1+\mathrm{PHW}(r_1)} = t \dots (4)$

c. Calculate the result of the attack, it is represented by calculating the difference between the power of attack and tie point such as: -

$$\mathrm{PHW}(r_1, r_2) = \frac{\mathrm{PHW}(r_1)}{1+\mathrm{PHW}(r_2)} - t \ldots (3)$$

4.2. Game theory to the claims and arguments

Game Theory (GT) is a branch of mathematics concerned with the study and analysis of an individual's strategic, rational decision-making processes and their interactions with his or her (social) environment. It is concerned with the manner in which "strategic interactions between economic agents yield outcomes concerning the actors' preferences (or utilitarianism)," regardless of whether the agents intended the outcomes. Thus, we are primarily concerned with "the study of mathematical models of conflicts and partnerships between rationally deciding beings." "Game theory provides a general mathematical framework for analyzing situations in which two or more persons make choices that affect the status of one or more of them" [17].

4.2.2. Claims and attack determination

Mathematical game theory was established to serve as a model for conflict situations. These settings and interactions will be referred to as games, and the participants will be referred to as players. We will concentrate on games with a maximum of two players. These two players compete for a payment made by one player to the other. These games are referred regarded as zero-sum games since one player's loss equals another player's gain and the profit earned by both players in any given circumstance equals zero [17].

4.3. Output

The result of the game is the final result of the argument, which is used to make a decision, there is more technique the gate the game result in the game theory such as Nash equilibrium.

Nash equilibrium:

Individual players' dominant strategies indicate the ideal resolutions to problems. Both players benefit from the same tactic. When dominating tactics are used mutually, we see an equilibrium in which no party gains an advantage by unilaterally changing a strategy (Nash equilibrium). John Forbes Nash established that any finite game has at least one of these solutions, which we refer to as equilibrium states [17].

5. Gaming argumentation framework (GAF) versus other frameworks

5.1. The GAF versus dung's (AF)

Dung's in 1995 has proposed a theoretical structure for argumentation in which he centers around the meaning of the situation with arguments. For that reason, it tends to be expected that a bunch of arguments is given, just as the various struggles among them. An argument is only an entity in an independent case, but if it is compared to the other arguments here, then its role and effect on the rest of the arguments are highlighted [11][18]. The GAF depends on the weight and game theory to active the final result, in another word the GAF extend the AF from the population solution to single solution by using the game theory, also its use in the decision-making field.

5.2. The GAF Versus PAFs

The PAFs presented here concern the acceptability of arguments in PAFs. It makes numerous contributions to ensuring that these choices are used to permit both a defined concept of individual defense and a concept of collective defense: -Define two complementary notions of acceptability (individual acceptability and joint acceptability) and propose a unified general framework in which both are applied, taking preference relations between arguments into account when selecting the most acceptable argument. This paper introduced a new way to determine the preference argumentation. First, the argument weight is non-zero. Second, it should be moved through the core of the arguments and attacks of each argument acceptable after the two issues mentioned above.

5.3. GAF versus VAFs

The VAFs expanded the standard of AFs by demonstrating how they might be used to justify the acceptance or rejection of arguments based on the strength of the values at stake. This means that opponents can agree on the acceptance of arguments even though their beliefs are diametrically opposed. As a result, we may identify moments at which persuasion should be conceivable and the extent to which factual considerations can be included into this framework. Persuasion is possible in the presence of uncertainty and disagreement about values [2][4][3]. The GAF determines the strength of the attack and calculates the tie point when the value of arguments is equaled using the special equation to determine the real result of the attack and to know the true value of the attack then calculate the size of profit and loss with high accuracy.

5.4. GAF versus BAF

A framework for abstract bipolar argumentation expands traditional AFs by introducing a new type of interaction between arguments represented by the support relation. By virtue of the bipolar representation of the interactions between arguments, this new relation is considered to be independent of the defeat relation [5]. The proposed framework is based on the support and defeats relations in order to establish the final conclusion between argument and negation argument utilizing game theory.

5.5. GAF versus WAF

The weighted argument framework was developed as a natural extension of Dung's model of argument systems, in which attacks are assigned a weight that indicates their relative strength. This framework's premise is that of an inconsistency budget, which defines the amount of inconsistency that is tolerable. Given an inconsistency budget, it is prepared to disregard attacks up to a total weight of. The primary advantage of this technique is that it enables considerably finer-grained analysis of argument systems than unweighted systems and provides viable solutions in cases where conventional (unweighted) argument systems do not. This approach begins by examining Dung's abstract argument systems and the motivations for attack weights (as opposed to the alternative possibility, which is to attach weights to arguments). It introduces the architecture of weighted argument systems and studies the complexity of computing solutions for weighted argument systems, with a special emphasis on weighted variations of grounded extensions and without focusing on how those weights are calculated [6].

The weight of the arguments is very significant also, the way of calculating this weight is most important to avoid the zero weight arguments and give the real weight to each argument. Therefore, we introduce a new way to calculate the argument weight called physical weight using a dynamic list, which is depending on the expert opinion.

5.6. GAF versus ADFs

The more abstract concept of an acceptable condition was proposed by ADFs and incorporated into Dung frameworks. Acceptance conditions encompass any function that determines a node's status in relation to its parent nodes. This encompasses domain-specific conditions and so extends beyond the few well-known legal norms. The latter will subsequently be introduced based on the links' unique attributes kinds. Acceptance requirements enable the addition of new node and link types [7]. The recommended core of the arguments and attacks affects their acceptability or not. This is contingent upon the number of arguments that are advanced through this core of arguments and attacks. As a result, the number of output arguments does not equal the number of input parameters, resulting in a reduction in the size of the arguments. As a result, the time required to determine claims and assaults is reduced.

5.7. GAF versus DAFs

DAFs concentrate on deontic reasoning's fundamental notions, notably obligations, restrictions, and permissions. The deontic system is based on obligations, and prohibitions are considered as a by-product of obligations:'something is banned' is equal to asserting that its inverse is compulsory. Permissions can also be interpreted in terms of obligations: permission for something indicates that the inverse is not required. To decide about the argument and its negation when the $\neg X$ is acceptable means, X is not acceptable and vice versa [8]. Finally, this proposed framework focuses on the argument and negation argument to decide whether an argument is acceptable. The negation argument is not acceptable and vice versa. Game theory is used to get that concept and make a final decision representing the final result of the argumentation game.

6. The case of study Pfizer or AstraZeneca

Example: A person was confused about whether gates Pfizer vaccine or AstraZeneca, the arguments below was presented to a group of specialized experts to decide this case: -

- Pfizer: Immunity appears at 14 days.
- AstraZeneca: Immunity appears at 22 days.
- Pfizer: Storage conditions are five days with -70c.
- AstraZeneca: Storage conditions are six months between 2c and 8c.
- Pfizer: After one dose 94% effective and after two doses, 96% effective.
- AstraZeneca: After one dose 71% effective; and after two doses, 92% effective.
- Pfizer: Use the Messenger RNA (mRNA) vaccine technique
- AstraZeneca: Use the Vector vaccine technique.

Solution

1. Generate the main arguments

let A is a set of arguments = {X, x_1, x_2, x_3, x_4, ¬X, y_1, y_2, y_3, y_4}.
Here we have we have two main arguments
Pfizer = X
AstraZeneca = ¬X

2. Generate initial lists

the argument X has supported by tuple called initial list IL_1= {x_1, x_2, x_3, x_4}, as following: -
Immunity appears at 14 days = x_1.
Storage conditions is five days with -70c = x_2.
After one dose 94% effective and after two doses, 96% effective = x_3.
Use the Messenger RNA (mRNA) vaccine technique = x_4.
the argument ¬X has supported by tuple called initial list IL_2= {y_1, y_2, y_3}, as following:
Immunity appears at 22 days = y_1.
Storage conditions is six months between 2c and 8c = y_2.
After one dose 71% effective; and after two doses, 92% effective =y_3.
Use the Vector vaccine technique = y_4

3. Generate the dynamic lists and physical weight

Where we have ten experts and the IL_1 has 4 elements and the IL_2 has 4 elements Then: -
The length of DL = max (4,4) * 2 = 8 and.
The width of DL = number of experts = 10.
The first score = 8 and last score = 1.
Arguments were presented to ten experts now generate the physical weight and dynamic list (DL_1) to the initial list (IL_1) {x_1, x_2, x_3, x_4}.
Generate the dynamic list (DL1) depend on the expert's opinion: -

Table 2. Dynamic list (DL1)

No.	scores	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10
1	8										
2	7	x_3	x_1	x_3	x_4	x_4		x_3	x_1	x_3	x_3
3	6	x_1	x_3			x_1			x_4	x_1	x_4
4	5	x_4		x_1	x_3	x_3		x_4			x_1
5	4			x_4	x_1		x_4	x_1	x_3		
6	3			x_2			x_1		x_2	x_4	
7	2		x_2		x_2		x_3			x_2	
8	1	x_2	x_4			x_2	x_2	x_2			x_2

Generate the physical weight to the initial list (IL1) depend on the dynamic list (DL1): -
The physical weight x_i = $\sum_{i=0}^{n} \text{scores}(x_i)$ depend on location

To make the weight between zero and one should be making
Proximity rate =($\sum_{i=1}^{n} \text{scores}(x_i)$) / (First score * number of experts)
number of experts = 10
First score = 8
x_1 = 53 / (10*8) = 0.6625
x_2= 17 / (10*8) = 0.2125
x_3= 57 / (10*8) = 0.7125
x_4= 48 / (10*8) = 0.6

Table 3. Physical weight

arguments	scores	weight	Proximity rate
x_1	(6+7+5+4+6+3+4+7+6+5)	53	0.6625
x_2	(1+2+3+2+1+1+1+3+2+1)	17	0.2125
x_3	(7+6+7+5+5+2+7+4+7+7)	57	0.7125
x_4	(5+1+4+7+7+4+5+6+3+6)	48	0.6

Arguments were presented to ten experts now we generate the physical weight and dynamic list (DL2) to the initial list (IL2) {y_1, y_2, y_3}.
Generate the dynamic list (DL_2) depend on the expert's opinion: -

Table 4. Dynamic list (DL_2)

No.	scores	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10
1	8										
2	7	y_4	y_3	y_4	y_3	y_2	y_1	y_3	y_4	y_4	y_2
3	6	y_2	y_4	y_2	y_1	y_4	y_4		y_1	y_3	
4	5	y_3			y_2	y_3	y_3	y_4	y_2		y_3
5	4	y_1	y_2	y_1			y_2	y_1	y_3	y_2	y_1
6	3							y_2		y_1	
7	2			y_3		y_1					y_4
8	1		y_1		y_4						

Generate the physical weight to the initial list (IL_2) depend on the dynamic list (DL_2): -
Proximity rate = (First score * number of experts) / $\sum_{i=1}^{n} \text{scores}(y_i)$
number of experts = 10
First score = 8
y_1= 53 / (10*8) = 0.5125
y_2= 17 / (10*8) = 0.6375
y_3= 57 / (10*8) = 0.6625
y_4= 48 (10*8) = 0.675

Table 5. Physical weight

arguments	scores	weight	Proximity rate
y_1	(4+1+4+6+2+7+4+6+3+4)	41	0.5125
y_2	(6+4+6+5+7+4+3+5+4+7)	51	0.6375
y_3	(5+7+2+7+5+5+7+4+6+5)	53	0.6625
y_4	(7+6+7+1+6+6+5+7+7+2)	54	0.675

4. Generate the final lists

Generate the final list (FL_1) to the initial list (IL_1) depend on the physical weight by making rearranged to the (IL_1) elements.

Table 6. Final list (FL_1)

No.	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10
1	x_3	x_1	x_3	x_4	x_4	x_4	x_3	x_1	x_3	x_3
2	x_1	x_3	x_1	x_3	x_1	x_1	x_4	x_4	x_1	x_4
3	x_4	x_2	x_4	x_1	x_3	x_3	x_1	x_3	x_4	x_1
4	x_2	x_4	x_2	x_2	x_2	x_2	x_2	x_2	x_2	x_2

Generate final list (FL_2) to the initial list (IL_2) depend on the physical weight by making rearranged to the (IL_2) elements.

Table 7. Final list (FL_2)

No.	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10
1	y_4	y_3	y_4	y_3	y_2	y_1	y_3	y_4	y_4	y_2
2	y_2	y_4	y_2	y_1	y_4	y_4	y_4	y_1	y_3	y_3
3	y_3	y_2	y_1	y_2	y_3	y_3	y_1	y_2	y_2	y_1
4	y_1	y_1	y_3	y_4	y_1	y_2	y_2	y_3	y_1	y_4

5. Calculate the power of attack

Calculate attack strength and defense by using the following equation

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

when the $FL_1 = \{x_1, x_2, x_3, x_4\}$. And the $FL_2 = \{y_1, y_2, y_3, y_4\}$ after delete the x3 and y3 because their weight for each one is equal zero.
Where PHW (x_1) = 0.6625, PHW(x_2) = 0.2125, PHW(x_3) = 0.7125, PHW(x_4) = 0.6
and PHW (y_1) = 0.5125, PHW (y_2) = 0.6375, PHW (y_3) = 0.6625, PHW (y_4) = 0.675
$FL_1 \times FL_2 = \{(x_1, y_1), (x_1, y_2), (x_2, y_1), (x_2, y_2), (x_4, y_1), (x_4, y_2)\}$

Table 8. The power of attack (x, y)

Attack	Power of attack	result
(x_1, y_1)	PHW (x_1, y_1) = x_1 / 1+ y_1 = 0.6625/1+0.5125	0.438017
(x_1, y_2)	PHW (x_1, y_2) = x_1 / 1+ y_2= 0.6625/1+0.6375	0.40458
(x_1, y_3)	PHW (x_1, y_3) = x_1 / 1+ y_3= 0.6625/1+0.6625	0.398496
(x_1,y_4)	PHW (x_1, y_4) = x_1 / 1+ y_4= 0.6625/1+0.675	0.395522
(x_2, y_1)	PHW (x_2, y_1) = x_2/ 1+ y_1= 0.2125/1+0.5125	0.140496
(x_2, y_2)	PHW (x_2, y_2) = x_2/ 1+ y_2= 0.2125/1+0.6375	0.129771
(x_2, y_3)	PHW (x_2, y_3) = x_2/ 1+ y_3= 0.2125/1+0.6625	0.12782
(x_2, y_4)	PHW (x_2, y_4) = x_2/ 1+ y_4= 0.2125/1+0.675	0.126866
(x_3, y_1)	PHW (x_3, y_1) = x_3/ 1+ y_1= 0.7125/1+0.5125	0.471074
(x_3, y_2)	PHW (x_3, y_2) = x_3/ 1+ y_2= 0.7125/1+0.6375	0.435115
(x_3, y_3)	PHW (x_3, y_3) = x_3/ 1+ y_3= 0.7125/1+0.6625	0.428571
(x_3, y_4)	PHW (x_3, y_4) = x_3/ 1+ y_4= 0.7125/1+0.675	0.425373
(x_4, y_1)	PHW (x_4, y_1) = x_4/ 1+ y_1= 0.6/1+0.5125	0.396694
(x_4, y_2)	PHW (x_4, y_2) = x_4/ 1+ y_2= 0.6/1+0.6375	0.366412
(x_4, y_3)	PHW (x_4, y_3) = x_4/ 1+ y_3= 0.6/1+0.6625	0.360902
(x_4, y_4)	PHW (x_4, y_4) = x_4/ 1+ y_4= 0.6/1+0.675	0.358209

Where PHW (x_1) = 0.6625, PHW(x_2) = 0.2125, PHW(x_3) = 0.7125, PHW(x_4) = 0.6
and PHW (y_1) = 0.5125, PHW (y_2) = 0.6375, PHW (y_3) = 0.6625, PHW (y_4) = 0.675
$FL_2 \times FL_1$= {(y1, x1), (y1, x2), (y1, x4), (y2, x1), (y2, x2), (y2, x4)}

Table 9. Power of attack (y, x)

attack	Power of attack	
(y_1,x_1)	$PHW(y_1,x_1)= y_1/ 1+ x_1= 0.5125/1+0.6625$	0.308271
(y_1, x_2)	$PHW(y_1, x_2)= y_1/ 1+ x_2= 0.5125/1+0.2125$	0.42268
(y_1, x_3)	$PHW(y_1, x_3)= y_1/ 1+ x_3= 0.5125/1+ 0.7125$	0.29927
(y_1, x_4)	$PHW(y_1, x_4)= y_1/ 1+ x_4= 0.5125/1+0.6$	0.320313
(y_2,x_1)	$PHW(y_2,x_1)= y_2/ 1+ x_1= 0.6375/1+0.6625$	0.383459
(y_2, x_2)	$PHW(y_2, x_2)= y_2/ 1+ x_2= 0.6375/1+0.2125$	0.525773
(y_2, x_3)	$PHW(y_2, x_3)= y_2/ 1+ x_3= 0.6375/1+ 0.7125$	0.372263
(y_2, x_4)	$PHW(y_2, x_4)= y_2/ 1+ x_4= 0.6375/1+0.6$	0.398438
(y_3,x_1)	$PHW(y_2,x_1)= y_3/ 1+ x_1= 0.6625/1+0.6625$	0.398496
(y_3, x_2)	$PHW(y_2, x_2)= y_3/ 1+ x_2= 0.6625/1+0.2125$	0.546392
(y_3, x_3)	$PHW(y_2, x_3)= y_3/ 1+ x_3= 0.6625/1+ 0.7125$	0.386861
(y_3, x_4)	$PHW(y_2, x_4)= y_3/ 1+ x_4= 0.6625/1+0.6= 0.25$	0.414063
(y_4,x_1)	$PHW(y_2,x_1)= y_4/ 1+ x_1= 0.675/1+0.6625$	0.406015
(y_4, x_2)	$PHW(y_2, x_2)= y_4/ 1+ x_2= 0.675/1+0.2125$	0.556701
(y_4, x_3)	$PHW(y_2, x_3)= y_4/ 1+ x_3= 0.675/1+ 0.7125$	0.394161
(y_4, x_4)	$PHW(y_2, x_4)= y_4/ 1+ x_4= 0.675/1+0.6$	0.421875

6. Calculate the result of the attack Using the following equation

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

to determine the result of attack where $r_i = x_i$ and $r_j = y_i$.

Table 10. The result of the attack (x, y)

Attack	Power of attack	Tie case	result of attack
(x_1, y_1)	0.438017	0.398496	0.03952
(x_1, y_2)	0.40458	0.398496	0.006084
(x_1, y_3)	0.398496	0.398496	0
(x_1,y_4)	0.395522	0.398496	-0.00297
(x_2, y_1)	0.140496	0.175258	-0.03476
(x_2, y_2)	0.129771	0.175258	-0.04549
(x_2, y_3)	0.12782	0.175258	-0.04744
(x_2, y_4)	0.126866	0.175258	-0.04839
(x_3, y_1)	0.471074	0.416058	0.055016
(x_3, y_2)	0.435115	0.416058	0.019056
(x_3, y_3)	0.428571	0.416058	0.012513
(x_3, y_4)	0.425373	0.416058	0.009315
(x_4, y_1)	0.396694	0.375	0.021694
(x_4, y_2)	0.366412	0.375	-0.00859
(x_4, y_3)	0.360902	0.375	-0.0141
(x_4, y_4)	0.358209	0.375	-0.01679

to determine the result of attack where $r_i = y_i$ and $r_j = x_i$.

Table 11. The result of the attack (y, x)

attack	Power of attack	Tie case	result of attack
(y_1,x_1)	0.308271	0.338843	-0.03057
(y_1, x_2)	0.42268	0.338843	0.083837
(y_1, x_3)	0.29927	0.338843	-0.03957

attack	Power of attack	Tie case	result of attack
(y_1, x_4)	0.320313	0.338843	-0.01853
(y_2,x_1)	0.383459	0.389313	-0.00585
(y_2, x_2)	0.525773	0.389313	0.13646
(y_2, x_3)	0.372263	0.389313	-0.01705
(y_2, x_4)	0.398438	0.389313	0.009125
(y_3,x_1)	0.398496	0.398496	0
(y_3, x_2)	0.546392	0.398496	0.147896
(y_3, x_3)	0.386861	0.398496	-0.01163
(y_3, x_4)	0.414063	0.398496	0.015566
(y_4,x_1)	0.406015	0.402985	0.00303
(y_4, x_2)	0.556701	0.402985	0.153716
(y_4, x_3)	0.394161	0.402985	-0.00882
(y_4, x_4)	0.421875	0.402985	0.01889

7. Using the game theory with two players to determine the winner between the main arguments

Using the physical weight (PHW) system and the result of the attack to generate the gaming argumentation framework (GAF)

Table 12. The game theory (Nash equilibrium)

	y_1	y_2	y_3	y_4
x_1	0.03952, -0.03057	0.006084, -0.00585	0, 0	-0.00297, 0.00303
x_2	-0.03476, 0.083837	-0.04549, 0.13646	-0.04744, 0.147896	-0.04839, 0.153716
x_3	0.055016, -0.03957	0.019056, -0.01705	0.012513, -0.01163	0.009315, -0.00882
x_4	0.021694, -0.01853	-0.00859, 0.009125	-0.0141, 0.015566	-0.01679, 0.01889

When using Nash equilibrium: where the pair (-0.03476, 0.083837) is representing the Nash equilibrium then we have two strategies: -

The first strategy is Attack (x_2, y_1) when argument $x_2$attack on the argument $y_1$the result of this attack = -0.03476.

The second strategy is Attack (y_1, x_2) when argument y_1 attacks the argument $x_2$the result of this attack = 0.083837.

Finally, the game theory is determining the winner by making the comparison between the above strategy: -

When the result of the attack (y_1, x_2) > (x_2, y_1) that is men the $y_1$is winner, and when the y_1 is support the main argument ¬X that is mean the main argument ¬X is the winner over the main argument X.

Where Pfizer = X and AstraZeneca = ¬X the final result or final decision the personal is the gate the AstraZeneca vaccine

7. Conclusions and future work

this paper, presented a new argumentation framework called GAF, by taking advantage of another framework like the AF and WAF and DAF and others, to generate a new framework uses to decide the current state by using the game theory to gives final solution about this state. It may also be considered as a different method for handling uncertainty, finding a final decision is very important, especially in medical applications, because these applications are in a race against time to find the appropriate treatment as soon as possible. The GAF gives the final result depending on its procedures. When the GAF depends on weighted argument therefore it was considered that weight is an important element in the weighted argument systems, so a new weighing system was developed and added to this model as an important part of it. Putting the weights system within the system guarantees to obtain more realistic results by controlling the weight scale on the one hand and controlling the mechanism of using those weights on the other hand. Game theory is used to obtain the final result, which in turn represents the final decision. Getting one result, in the end, is what distinguishes this system and makes it very useful in eliminating uncertainty and reaching a final decision. The final result gives two important strategies by using Nash equilibrium. Sometimes the evaluate the argument varies from time to time depending on some external influences this forces experts to re-evaluate this behavior is very similar to continuous systems therefore, in the future we can develop the GAF to generate the continuous model work with the continuous systems.

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