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# A HS-HYBRID GENETIC IMPROVED FUZZY WEIGHTED ASSOCIATION RULE MINING USING ENHANCED HITS ALGORITHM

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**ABSTARCT**

Earlier the uninteresting rules can be shortened through the fuzzy weighted association rule mining with enhanced HITS algorithm that satisfies downward closure property as a consequence of assigning weights to items manually, which can reduce the execution time. In this FWARM there are two main issues of weight calculation, the foremost one is that the algorithm may not find out customers to describe the suitable membership function all the time, as a result it leads to spend lot of time and increases the profit loss. The next reason is that the customer's wants to purchase items based on their requirements which are not to be fixed. Thus some more mechanisms are required to adapt the membership functions to these changes automatically and the demand decides on the number of optimum fine-tuning constraints. Also they should find out all predetermined membership functions of all items. To achieve this goal the genetic algorithms are often utilized to obtain a set of appropriate membership functions according to the designed fitness function. The main drawback of GA approach is making the new vector from the existing parent vectors. Also GA is not well suited for fine-tuning constraints and it is essential to incorporate local search methods into GAs. To overcome this problem in proposed work, genetic local search with the support of harmony search with fuzzy weighted association rule mining with enhanced HITS algorithm were performed. The main advantage in HS is from all existing vectors it makes a new vector. This will increase the flexibility in finding the better solutions. The experimental results shows that the proposed genetic based fuzzy weighted association rule mining with enhanced HITS algorithm is more effective when compared with the existing FWARM with enhanced HITS algorithm.

**Keywords:** HS-Hybrid genetic algorithm, fuzzy, association rule mining, HITS, harmony search optimization algorithm, frequent item set generation.

## 1. INTRODUCTION

The objective of data mining is to find out significant associations along with items such as the occurrence of various items in a transaction will entail the occurrence of some other items. To accomplish this principle, a lot of mining algorithms depends on the perception of large item sets to discover association rules in transaction data mining process into two stages. In the first stage, candidate item sets were produced and calculated through scanning the transaction data. The value is called as minimum support if the amount of an item set emerging in the transactions be larger than a pre-defined threshold value then the item set is considered as a large item set. At the second stage the association rule, rules are generated from the first stage's result of large item sets. For each large item set all feasible association permutations were formed and the value is called as minimum confidence the output will be as association rules, when individuals calculated with confidence values larger than a predefined threshold.

It determines large item sets whose support values were superior to the user-specified minimum-support stages. That large item sets are practiced to produce association rules and rules of significance to users will be the output. On the whole, the fuzzy mining algorithms initially used membership functions to renovate every quantitative importance into a fuzzy set in linguistic terms. The algorithm then computes the scalar cardinality of every linguistic term on all the transaction data. Then the extraction process based on fuzzy calculations was performed to discover fuzzy association rules. All algorithms derived and implemented in earlier days having the disadvantage of automatic detection of the optimal fuzzy membership function which leads to produce efficient fuzzy weighted association rule. To attain this goal in our proposed work genetic algorithm based FWARM is used to tune the membership value and find optimal membership value to bring more appropriate association rules. In this work, new genetic improved fuzzy weighted association rule mining using enhanced HITS algorithm were developed.

This is also compared with fuzzy weighted association rule mining with enhanced HITS algorithm. However GA will choose only two existing vectors to create a new vector from the existing parent vectors at the same time it consumes higher average time per iteration. To overcome this problem in our proposed work harmony search optimization algorithm were included at the crossover method to improve the optimal selection of fuzzy membership function. In this the first-rate ideas of mutation and crossover approaches exercised and approved in scheming the discrepancy growth algorithm and achieved great result for fuzzy membership selection. The enhanced HITS are used here with FWARM to compute the weightage of the items. These enhanced HITS bring up to date weight value in online manner to each of item set in particular transaction. Fuzzy weighted association rule mining with enhanced HITS convinces downward closure property that reduces working out time; unexciting rules can be shortened as a consequence of


conveying weights to items that decrease the execution time.

The result of weight values is to express the significance of attribute regarding customers' perception and incorporate the opportunities by taking out weighted fuzzy association rule algorithm to generate the association rules in effective manner. The contribution of proposed work is consisting of three steps as follows:

a) From the input transaction data the fuzzy membership function is proceeded to find the optimal membership value through automatic value calculation that is done using genetic algorithm. By providing genetic based fuzzy weighted association rule mining with enhanced HITS to tune the membership value and find optimal membership value and provide appropriate results according to user requirements.
b) To improve the genetic algorithm the harmony search optimization algorithm is used at the crossover step in GA from this the optimal membership value is found. HS will provide the best optimum results than the GA.
c) Based on the following two steps the weight value is found using the FWARM with enhanced HITS technique. This enhanced HITS algorithm will compute weights to express the significance of quality with respect to users' perception and incorporate the decisions into taking out weighted fuzzy association rule algorithm.
d) The experimental result shows that the proposed scheme is much better than the existing methods in the sense of producing the effective association rules.

The remaining of this work is as follows: The section 1 is about the introduction of the work. In section 2 the related work is described. Section 3 contains the information of the genetic based FWARM with the HS (Harmony search) optimization algorithm. In section 4 the FWARM with enhanced HITS algorithm is described. The experimental results are compared with the graph in section 5. The conclusion work is described in section 6.

## 2. RELATED WORK

In large databases the assignment of mining Association Rules (ARs) is essentially to find out the association rules (with strong support and high confidence). Traditional Association Rule Mining (ARM) covenants by the way of associations along with items nearby in transactional databases consisting binary attributes. From all large (frequent) item sets the usual approach is to produce (attribute sets) the set of ARs. A huge item set is distinct as one takes place more commonly in the specified data set than a user abounding support threshold. Maybin Muyeba *et al*. address the issue of invalidation of downward closure property presented a fuzzy weighted support and confidence skeleton to extract weighted boolean and quantitative data through fuzzy means. Still there are some problems with unusual procedures for authorizing DCP, normalization of values which are importance exploring. Reda Alhajj and Mehmet Kaya proposed Genetic Algorithms (GAs) is based on clustering method to make available highest profit based on customer particular linguistic minimum support and confidence provisions enthusiastically regulates the fuzzy sets.

This is accomplished by fine-tuning the support values of the membership functions for each quantitative attribute regarding two different assessment functions maximizing the number of large item sets and average of the confidence distances of created rules. Chun-Hao Chen *et al*. proposed an algorithm to obtain minimum support values, membership functions and association rules that unites the clustering, fuzzy and genetic models. The clustering approach utilizes the k-means to assemble related items into groups. For initializing a better population that are believed to have comparable individuality and are consigned similar significances. The significances comprise a suitable number of linguistic conditions for each item, its sensible membership functions and possible minimum support values. Lotfi *et al*. information-theory was implemented to take out fuzzy association rules and the frequent item sets has been exposed. Through this new measure an efficient results can be produced.

Rules with more past history would be produced during combination of 1-dimentional rules with rules of each step. Jesus Alcala- Fdez *et al*. presented a learning of the genetic withdrawal of quantitative association rules via GAs. Velvadivu *et al*., produced a method by estimating the upper bound of perturbation and postponing applying the updates whenever possible that can compute the results of mutual reinforcement voting efficiently in case of frequent updates called an online eigenvector calculation method. Online HITS algorithm, turn over the differences is within the applicable limit. Ren Diao *et al*. produced an improved hybrid fuzzy-rough rule orientation method based on harmony search. The projected approach distributed much recovered outcome than the greedy hill-climbing based quick rules. There is a need of additional investigations to utilize the collection of rule sets to offer as a fuzzy-rough rule ensemble, similar to the ones created by a assortment of fuzzy-rough reducts, where the subsets may be utilized to produce divisions of the preparation data to facilitate construct various classification models.

Shaikh Nikhat Fatma *et al*. suggested cluster-based fuzzy-genetic mining algorithm is exercised for removing equal fuzzy association rules and membership functions from quantitative transactions. The offered algorithm can fine-tune membership functions by genetic algorithms and exploits them to fuzzify quantitative communication. It can also speed up the assessment procedure and maintain approximately the equal quality of keys by clustering chromosomes. Yusuke Nojima *et al*., suggested a straightforward other than efficient scheme to get better the scalability of genetic fuzzy rule assortment to large data sets. However this is not sustaining the multiobjective optimization. Mansoor Zolghadri Jahromi *et al*. proposed a technique with the implementation of rule weight as a straightforward method to fine-tune the

rule-base. With that they recommended a learning algorithm that endeavors to reduce the total cost of the classifier on train data, presuming that class-to-class misclassification expenses are recognized.

Jesus Alcala-Fdez *et al*. for high-dimensional misfortunes supported on three phases to attain just right and dense fuzzy rule based on classifier with a less computational cost, projected a fuzzy association rule-based on classification method. This method limits the order of the connections in the association rule mining and thinks the use of subgroup discovery based on an improved weighted relative accuracy appraise to preselect the most interesting rules ahead of a genetic post-processing process for rule selection and parameter tuning. However genetic process in support of selection and tuning does not establish an extreme computational cost into the entire process. Rafael Alcala *et al*. proposed an innovative rule demonstration method via the two- tuples linguistic symbol form has been measured to mining both MFs and fuzzy association rules from quantitative contracts through an evolutionary learning of the MFs and fundamental technique is used to extract fuzzy association rules. But it is not well suited for complex problems.

## 3. PROPOSED WORK TO OPTIMIZE MEMBERSHIP FUNCTIONS

In this proposed work two main concepts are discussed. First is genetic based FWARM where the optimal membership value is calculated is to increase the efficiency of FWARM dynamically fine-tunes the fuzzy sets to present maximum profit depends on customer individual linguistic minimum support and confidence items. By tuning the base values of the membership functions for each quantitative attribute this first technique is accomplished with regard to two unusual assessment functions maximizing the number of large item sets and the common of the confidence periods of the rules produced. GAs is iterative processes that effort on a population of individuals. With a limited string of symbols every individual is signified, known as the genome. It is an encoding possible solution in a given problem space. This space is referred as the search space that contains all probable results to the trouble in dispense. The standard GA proceeds as follows. It starts with an initial population of randomly or heuristically generated individuals, and advances toward better individuals by applying genetic operators modeled on the genetic processes occurring in nature.

The population undertakes evolution in a structure of ordinary collection. For each duration of consecutive iterations, called productions, individuals in the population is charged for their alteration as solutions for the foundation of these fitness valuations. Therefore, a new population of individuals is outlined by means of a selection method and particular genetic operators such as crossover and mutation. To form a new population, individuals are chooses according to their fitness. As a result, an estimation or fitness function must be developed for each dilemma to be resolved. Known a particular individual, a potential solution, the fitness function allows a decoded chromosome as an input and constructs an objective value as a measure of the routine of such input chromosome. Their objective is just to enhance the match of rules extracted from data exclusive of interruptions and the suggestion rule set diminishes the similarity of rules mined from interruption data and mentions the rule set. In this paper, GA is used to regulate the membership functions for mining fuzzy weighted association rules excessively. But our assessment criteria are entirely different from the preceding ones as exhaustive that follow-up.

In our testing, membership functions are applied in triangular form. Towards the demonstration of encoding procedure, consider as a quantitative attribute $i_k$ and it has three equivalent fuzzy sets and there are three membership functions, one per fuzzy weighted set. Membership functions for attribute $i_k$ and their support variables are exposed. Every support variable receives predetermined values, such as, the search space of support value $s^1_{i_k}$ lies at the intermediate point of the minimum and maximum values of attribute ($i_k$), indicated and max ($D_{i_k}$), correspondingly. The intermissions of all the support values and intersection point $R_{i_k}$ of attribute $i_k$ are itemized beside Figure-1. So, based on the statement of having three fuzzy weighted sets per attribute, it is the case with attribute, a chromosome consisting of the support lengths and the connection points is characterized in the subsequent form:

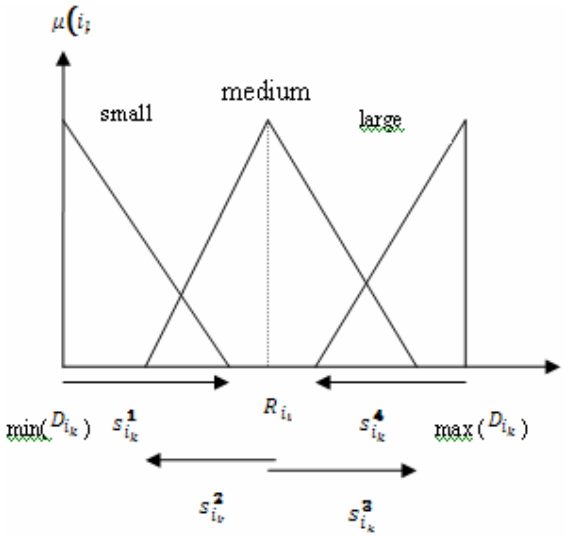


**Figure-1.** Membership functions and support variables of attribute $i_k$.

The practice of mining fuzzy weighted association rules starts by employing GA for tuning membership functions in each generation. On the other hand, although fine-tuning membership functions of attribute $i_k$ by GA, every value of $i_k$ intersects with one


or more of the membership functions committed to $i_k$. Consequently, membership functions generally do not have a uniform constitution. Throughout every generation, individuals that satisfy the selection criteria to endure while others with lower fitness values are ruined. The fitness value considered here is the confidence value of the attribute $i_k$. After deciding on chromosomes concerning the evaluation purpose, genetic operators for instance, crossover and mutation are applied to these individuals. In crossover, acquires two individuals as input, chooses a random point, and interactions the sub individuals following the selected point. Whereas the length of the chromosomes is extended, the multi-point crossover strategy has been utilized with the crossover points resolute at random; especially three point cross-over has been adjusted.

Alternatively, mutation denotes a random transform in the information of an individual. It is significant for a population that identifies a local or global difference in an individual. Mutation is conventionally performed with the purpose of increasing the assortment of the genetic information. However in genetic algorithm it decides two existing vectors to create a new vector and the number of iterations is high. The harmony search is applied at the point of cross over strategy to produce the optimal membership value which produce the fuzzy weighted association rules. The harmony search (HS) algorithm is comparatively new population-based metaheuristic optimization algorithm. It emulates the music creativeness procedure where musicians improve their instruments' pitch by searching for an ideal state of harmony. This algorithm is used to improve the application with the optimal results.

Just like musical harmony is improved time by time, solution vector is improves iteration by iteration. The optimization problem is defined as follow:

$$\text{minimize\maximize } f(a),$$
$$\text{Expose to } a_i \in A_i, \; i = 1,2,\ldots,N$$

Where f (a) is an objective function; a is the set of each decision variable ($a_i$ ); $A_i$ is the set of possible range of values for every decision variable, $La_i \leq A_i \geq Ua_i$ ; and *N* is the number of decision variables.
The Harmony Search process is as follows:

- Initialize a Harmony Memory (HM)
- Compose a new harmony from HM
- If New Harmony is better than the minimum harmony in HM, restore it
- If the ending condition has not been fulfilled, then compose a new harmony.

Essential parameters for Harmony Search consist of:

- Harmony Memory Size (HMS) to be exact the number of resolution vectors in harmony memory
- Harmony Memory Considering Rate (HMCR) everyplace HMCR ∈ [0, 1]
- Pitch Adjusting Rate (PAR) every place PAR ∈ [0, 1]
- Stopping criteria specifically for the number of improvisation (NI)

HS produces the new solutions using three principles that are concerned with harmony memory pitch adjusting and random selection. Assuming the New Harmony as
$H_{New} = \{h_{new}(1), h_{new}(2) \ldots . h_{new}(N)\}$ this can be computed as follows.

$$h_{new}(j) = h_i(j) \; i \in (1,2 \ldots HMS),$$
$$h_{new}(j) = h_i(j) \pm \text{rand}() \times WC$$
$$h_{new}(j) = h_L(j) \pm \text{rand}() \times (h_U(j) - h_L(j)).$$

Where, rand () is a number with uniform distribution with the range of [0, 1]. HMCR, PAR, HMS represent harmony memory size, respectively. $h_L(j)$ and $h_U(j)$ are lower limit and upper limit of the variable under the calculation and the WC represents the weight confidence value. The New Harmony has been generated, if its fitness value outperforms worst harmony in memory, it is replaced and harmony generation is represented until the termination condition is obtained.

**Proposed algorithm**

**Procedure call HS hybrid GA**
**Do Membership functions $F_{i_k}$ for attribute $i_k$**
**For $(k = 1; k \leq m; k++)$**
**Fuzzy set of weight confidence $WC_k$**
**Set the population size N**
**$F_{i_k} \rightarrow t_j.i_k$**
**For $(i = 1; i \leq n, i++)$**
Fuzzy weighted support ($i_k$ , $f_{i_k}$)
WminS=S . (**the weight of $f_{ave}$** )
**Return the largest itemset}**
**Perform selection, crossover and mutation**
**while** ($t <$ max*number of iterations*)
**while** ($i <=$ *number of variables*)
**If** (**rand** $<$ $r_{accept}$)
**decide a value from HM for the variable i**
**If** (**rand** $<$ $r_{grate}$)


**Fine tune the value by adding certain amount**
**end if**
**else**
**select a Random Value**
**end if**
**end**
**while recognize the New Harmony (solution)**
**if better**
**end**

**while Find present best solution**

**end**

**Go to step3**
**Generate possible all association rules**
**Find the strength association rules from fuzzy weighted confidence**
**Return that rules**

**Figure-2.** HS-Hybrid Genetic Algorithm

## 4. FWARM with enhanced HITS

The Fuzzy Weighted Association Rule Mining (FWARM) algorithm belongs to the breadth first traversal family of ARM algorithms expanded using tree data arrangements and works in a procedure similar to the Apriori algorithm. In below given algorithm $Candidate_m$ is the set of candidate item sets of cardinality, iw is the set of weights associated to items. The $Frequent_m$ of frequent item sets $R$ is the set of potential rules and $R'$ is the final set of generated fuzzy weighted association rules. Also the Enhance HITS algorithm is the process of constructing an access based graph which is based on the each single update of a user or every change of the item is taken to correspond to a perturbation to a matrix $M$ . The weight meetings chosen can perturbated in any of these cases which can be always be limited by a single element of the matrix M or row of elements in the matrix $M$ . This will have an effect on the Eigen vector of the matrix $M^T M$ and $MM^T$. The association between the changes of the ranking to principle Eigen vector of $M^T M$ and $MM^T$ which are called as $x$ and $y$ values were found , if it cause too many changes to $x$ and $y$ and a the values are checked for each updation. On validating the level of correctness and by applying the updated information can avoid running Online HITS for it. The Online HITS takes the current variations into account that happen dynamically, and the algorithm reflects a true dramatically changed, updated system knowledge of the current world. Online HITS continually checks the changes and makes operations. The fuzzy weighted association rule steps are as follows:

**Input**
D = Data set
iw = Item set weights
wsup = Weighted support
wconf = Weighted confidence
$Candidate_m$ = Candidate item set
$Frequent_m$ = Frequent item set
m = Item set
c'= Number of candidate item set in $Candidate_m$.
Fz =Fuzzy Association rule
fs = Fuzzy item set in fuzzy association rule
rs = Rules generated from $Candidate_m$.
WAR = Rules
min_wsup = minimum weighted support
min_wconf= minimum weighted confidence

**Output**
$WAR'$ = Set of Weighted Association Rules
m = 0; $Candidate_m$ = Ø; $Frequent_m$ = Ø
$Candidate_m$ = Set of 1 item sets
m → 1
**Loop**
if $Candidate_m$ = Ø **break**
∀ c' Є $Candidate_m$
c'.weighted support →weighted support count
**if** c'.weighted support > min_wsup
Fz→ Fz U c'
m→ m+1
$Candidate_m$ = generate candidates ($Fz_{m-1}$)
**End loop**
∀ fs Є $Fz_m$
generate set of candidate rules $\{rs_1,\ldots,rs_n\}$
$\{rs_1,\ldots,rs_n\}$WA R→ WAR U rs
∀ rs Є WAR
rs. weighted confidence → weighted confidence value
**if** rs. weighted confidence > min_wconf
***Output*** : WA R' = WAR' U rs

**Figure-3.** Algorithm for Fuzzy Weighted Association Rule Mining

## 5. RESULTS AND DISCUSSIONS

The experiments were performed on a 2.80 GHz Intel Pentium Processor with 2.84 GB memory. The operating system is Microsoft Windows XP. The algorithms are implemented in Java language version 1.6 in this work the food mart dataset is taken as input. In food mart, unit profits for items in utility Tables are generated

and quantities of items also generated from dataset. The proposed method of HS-hybrid GA based scheme is analyzed and explained in the form graph. Based on the generation of frequent item set, number of rule generation and execution time are analyzed by the value of support and confidence.

As projected in the graph the number of frequent item sets enlarges as the minimum support reduces in all cases. In Figure-2, HS-Hybrid GA based Fuzzy Weighted ARM with enhanced HITS shows the number of frequent item sets generated using the optimization algorithm. GA based Fuzzy WARM and enhanced HITS illustrate the number of frequent item sets are the quantitative attributes with fuzzy linguistic significances. Traditional Fuzzy WARM and enhanced HITS shows the number of frequent item set generated with different weighted support thresholds. More frequent item sets and rules are generated because of the large item set collection.

According to the product category provided by the data table the experimental testing database, source was a FoodMart2000 retail transaction database rules, that experiment categorizes the products into groups Thus, products are classified into 34 categories, each with embedded in a Microsoft SQL Server 2000. It provides information about the sale of the product and how the customers are satisfied with the variety of the product. Since there are different kinds of transaction databases in food mart2000, by selecting sales fact 1997 data Table are selected for assessment. The number of product items in this data table is 1560. In order to effectively mine meaningful association rules, this experiment categorizes the products into groups according to the product category provided by the data table. Thus, products are classified into 34 categories, each with a corresponding product category id. In regard to data selection, 6000 customers are randomly selected along with their corresponding transaction data at different times. After arrangement, there are a total of 12, 100 transaction records for these 6000 customers.

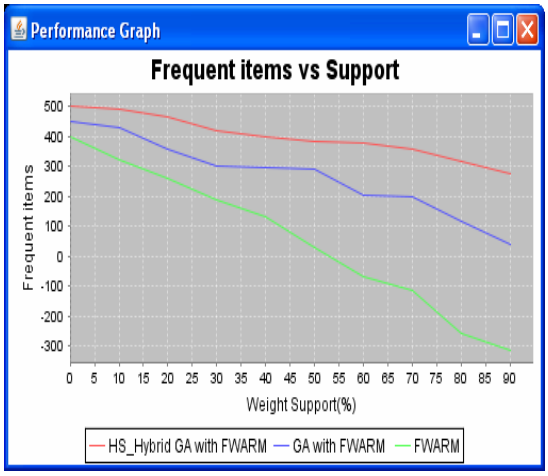


**Figure-4.** Number of frequent item sets Vs weighted support.

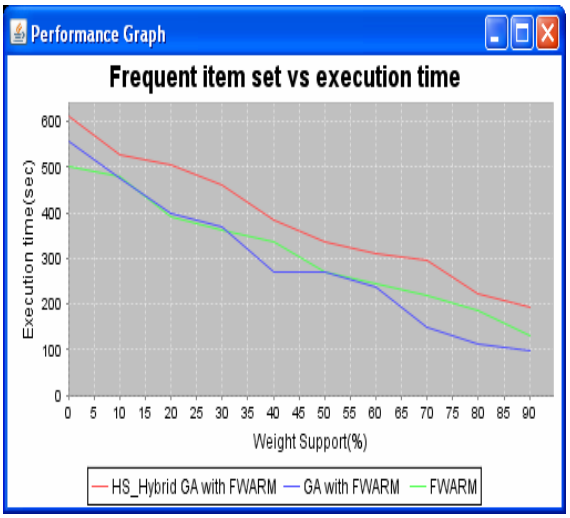


**Figure-5.** Frequent item set Vs weighted support.

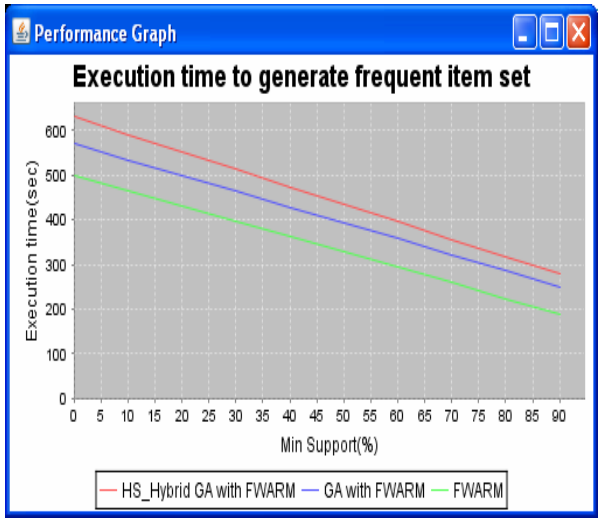


**Figure-6.** Execution time to generate frequent item sets.

Figure-4 shows the number of frequent item sets generated by HS-Hybrid GA based Fuzzy Weighted ARM, GA based Fuzzy WARM and enhanced HITS, Fuzzy WARM and enhanced HITS by means of weighted support. In all cases, the number of association rules is compared in Figure-5. This is because the interestingness measure generates fewer rules. Figure-6 shows the execution time of three algorithms.

The experiments show the proposed framework produces better results as it uses all the possible item sets and generates rules using the DCP.

## 6. CONCLUSIONS

In this, genetic based approach is proposed to resolve the difficulty of interval partitioning. The approach employs different fitness functions to find the optimal membership value. The main attainment of the anticipated approach is employing GA to regulate and optimize membership functions dynamically, which is necessary to


discover the interesting fuzzy weighted association rules from quantitative transactions, are based on support and confidence précised as linguistic terms. Through this the harmony search optimization advance is merged with this to fine-tune membership values which will generate the better result than GA. FWARM with enhanced HITS executed to support the dynamic calculation of the support and weight value of the item set. Contrasted to previous mining advances, the proposed one directly, directs linguistic parameters, which is normal and comprehensible to humans. The experimental results were measured with real-time dataset between the FWARM and HS hybrid GA with FWARM. Proposed HS hybrid GA with FWARM performs better than the existing system with real-time dataset food mart.

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