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Enhancement in the Performance of Service Broker Algorithm Using Fuzzy Rules

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Abstract

In the recent years cloud computing has become interesting field for researchers. There are various fields in it to work on. Enhanced service broker algorithm is presented in this paper. Service broker plays an important role in data centre selection and its allocation to user request. Though there are various service broker algorithms are available, in this paper, a service broker algorithm with fuzzy logic has been proposed to enhance the performance parameters. Proposed algorithm improves the performance parameters such as response time, data processing time and latency period. Proposed algorithm is simulated using Matlab and observed results are also juxtaposed with the results of existing algorithms.

Keywords - Cloud computing, Load balancing, Service broker algorithm, Fuzzy rules, Fuzzy membership function.

1. INTRODUCTION

Cloud computing has emerged as transition from an era in which underlying computing resources were both limited and expensive to an era in which the same resources were cheap and abundant. This is a method of computing in which large number of resources are centralized by the cloud providers from where users can make request for resources and pay for what they are using. There are four models available for cloud deployment i.e; public, private, community and hybrid cloud. The most familiar cloud computing architecture is public cloud used by Yahoo, Google, Facebook, Twitter and many more. Cloud is a computing resource management mode in a way in which pooling and sharing of hardware infrastructure resources is done on

a massive scale. The advantage of cloud architecture is the flexibility to use resources which can be expanded on demand as per user's requirement. It is very important to handle the entire request coming from user in such a manner so that user can get response as quickly as possible. Service broker plays an important role for the allocation of data centre and virtual machines to the user.

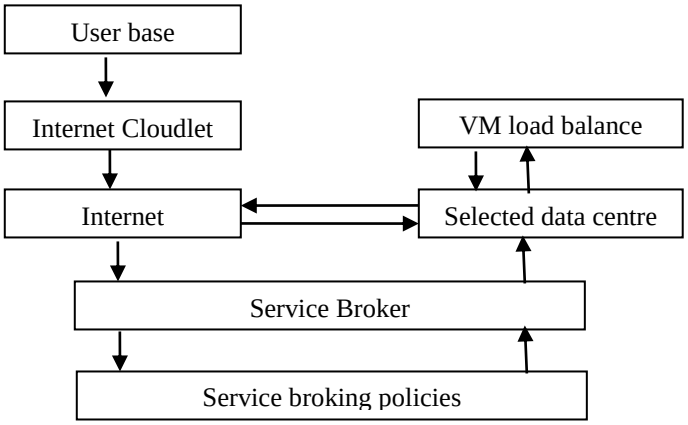


Fig. 1: Working of service broker algorithm

First user base sends the request to Internet Cloudlets via internet. Internet Cloudlet later on passes the request to the Data center controller for the selection of virtual machines using available service broker policies then it selects the appropriate Data centre and responds to the user request. The user finally gets the destination Data center for its processing. The mainly available existing service broker algorithms are:

1. **Service proximity based routing**: In this routing policy, service broker selects the shortest path from the user base to the data centre, depending on the network latency and based on that, routes the traffic to the closest data centre with the consideration of transmission latency. This routing simply follows the "closest data centre" strategy. The region proximity is ordered based on the latency (region with lowest latency first). Based on the information from the Internet Characteristics a data center is picked by the routing policy.

2. **Performance optimized routing**: This algorithm is mainly based on two parameters i.e; Cost & Network delay. These parameters are combined in such a way that it should give a lower cost with improved response. This algorithm works in two steps:
   I) one divides the load equally on the best performance data center and lowest cost one.
   II) The second considers both cost and performance parameters when choosing the data center.

3. **Dynamically reconfiguring router**: This is an extension to proximity based routing, where the routing logic is similar, but the service broker has one more responsibility of scaling the application deployment based on the load it is

facing. This policy increases and decreases the number of virtual machines allocated in the data centers.

2. RELATED WORK

A. Sarfaraz Ahmed et al. [2] premeditated proximity based routing may cause overloading of the closest data centre. So he proposed enhanced proximity based routing that redirects whole or part of the traffic to the next nearest data centre in the same region which results in reduction of overloading of the closest data centre. Gamal I. Selim et al [8] proposed two algorithms to select data centre. First algorithm chooses the best response time data centre and then finds the data centre with the lowest cost in the region. The second algorithm chooses the best data centre based on considering total cost and network delay cost. Ahmad Manasrah et al [13] demonstrated a variable service broker routing policy which is based on the heuristic techniques to achieve minimum response time considering communication channel bandwidth, latency and size of job. Mayanka Katyal1 et al. [14] discussed the min-max algorithm by which selection of resources over the network is done. Ms.Nitika et al. [17] compared three existing algorithms: Round Robin, Equally spread current execution algorithm and Throttled Load balancing .The goal of this comparison is to check better response time, maximum throughput and low latency over the distribute network. Prof. Deepak Kapgate et al. [20] expalined the existing service broker algorithms and suggested a new one with features of Service Proximity Service Broker and Weighted Round Robin Service Broker Algorithm. Ranesh kumar naha et al. [19] proposed three different algorithm cost aware brokering, load aware brokering and load aware over cost aware brokering algorithm. He suggested that considering load and cost parameter are helpful to achieve less response time and reduce latency. In this paper, a service broker algorithm with fuzzy logic has been proposed. This proposed algorithm depicts the enhancement in service proximity and also exhibit better results than the existing algorithms.

3. GAP IN LITERATURE

Various technologies has been implemented on service broker to make the data centre selection quick and efficient. Ranesh kumar naha[19] proposed three algorithms for service broker. First is based on cost, in which the selection of Data centre is made on the basis of cost issues. Second algorithm describes the selection of data centre on the bases of load, then third one select the data centre combining these two issues. All these aforementioned algorithms are based upon bivalent logic which limits its performance. In the proposed work, the fuzzy logic is being implemented on service broker algorithm to improve the efficiency.

4. FUZZY LOGICS

The implementation of fuzzy logic on cloud computing opens a new research door. Fuzzy rules are deployed on cloud service broker algorithm. Fuzzy technology has been accepted as an emerging technology since 1980's. Fuzzy logic refers to all of the theories and technologies that employ fuzzy sets, which are classes with unsharp boundaries. There are basic two reasons for using fuzzy technology:

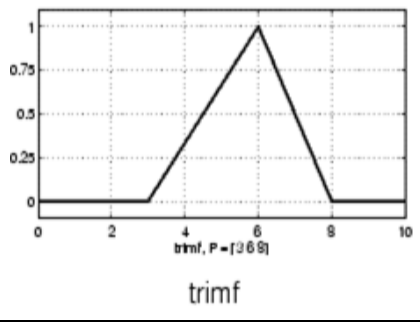
1. Fuzzy logic can be used for controlling a process that is nonlinear or ill-understood to use conventional control design.
2. Fuzzy logic enables control engineers to easily implement control strategies used by human operators.

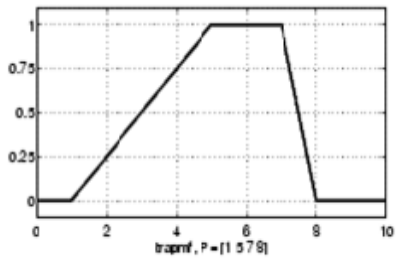
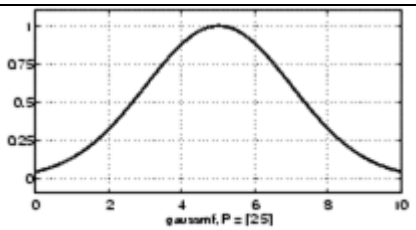
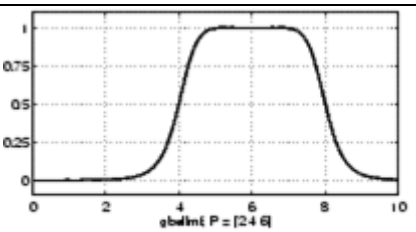
Fuzzy technique is based on four basic concepts:

1. Fuzzy sets
2. Linguistic variables
3. Possibility distribution
4. Fuzzy if-then rules

A fuzzy set is defined by a function that maps objects in a domain of concern to their membership value in the set. This function is called membership function. There exist numerous membership functions; the most commonly used in practices are triangles, trapezoidal, bell curves, Gaussian etc.

Table 1: List of membership function

S. No.	Membership function	Number of variables	Name	Graph
1.	Triangular	3	Trimf	 trimf

2.	Trapezoidal	4	Trapmf	 trapmf
3.	Gaussian	2	Gaussmf	 gaussmf
4.	bell-shaped	3	Gbellmf	 gbellmf

Fuzzy classification is a method in which value of one object belongs to multiple classes and its value ranges from sample sum to 1.There are certain set of rules to get these values,and these rules are known as Fuzzy rules.

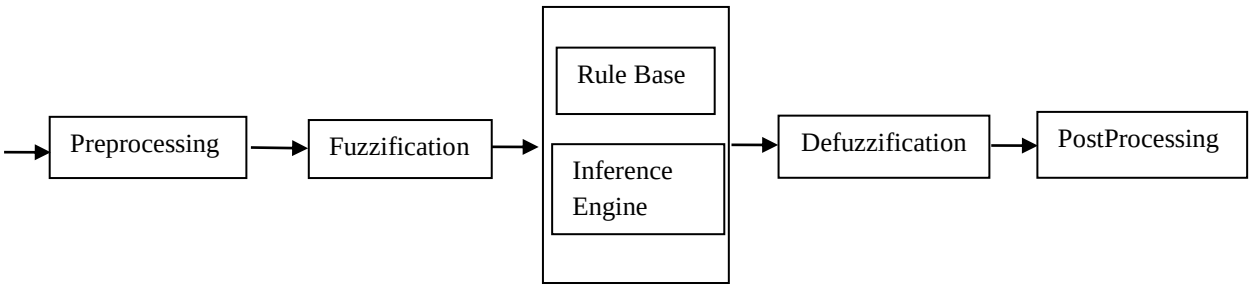


Fig. 2: Fuzzy Controller

To implement fuzzy logic technique to a real application requires the following three steps:

1. Fuzzifications – convert classical data or crisp data into fuzzy data or Membership Functions (MFs).
2. Fuzzy Inference Process – combine membership functions with the control rules to derive the fuzzy output.
3. Defuzzification - use different techniques to calculate each associated output and put them in to a table: the lookup table. Grab the output from the lookup table on the basis of the current input during an application.

3. EXPERIMENTATION AND RESULTS

3.1 Methodology

1. User initiates the request.
2. User sends the job request to cloud server. Server identifies the job and sends to server broker for further allocation of data center.
3. Selection of datacenter will be done by proposed algorithm in which we are applying some fuzzy rules.
4. In fuzzy rules we are applying below parameters
   a. Availability of services
   b. Number of jobs
   c. Priority of user
   d. Number of jobs sent by current user
   e. Waiting time
5. After calculating these parameters we check the availability options and will response to user with the assigned data centre. It will response to user request and will check further jobs requested or not.
6. If there are no further jobs then this request will come to end by return.
7. If there are further requested jobs then it will again check the component availability and proceed.

The Fuzzy membership functions are as:

1. Trapezoidal: A trapezoidal membership function is specified by four parameters Trapezoid(x:a,b,c,d). Due to its simple formulae and computational efficiency it is used extensively in control.
2. Gbell shape: a bell shape membership function is specified by three parameters Bell(x:a,b,c)

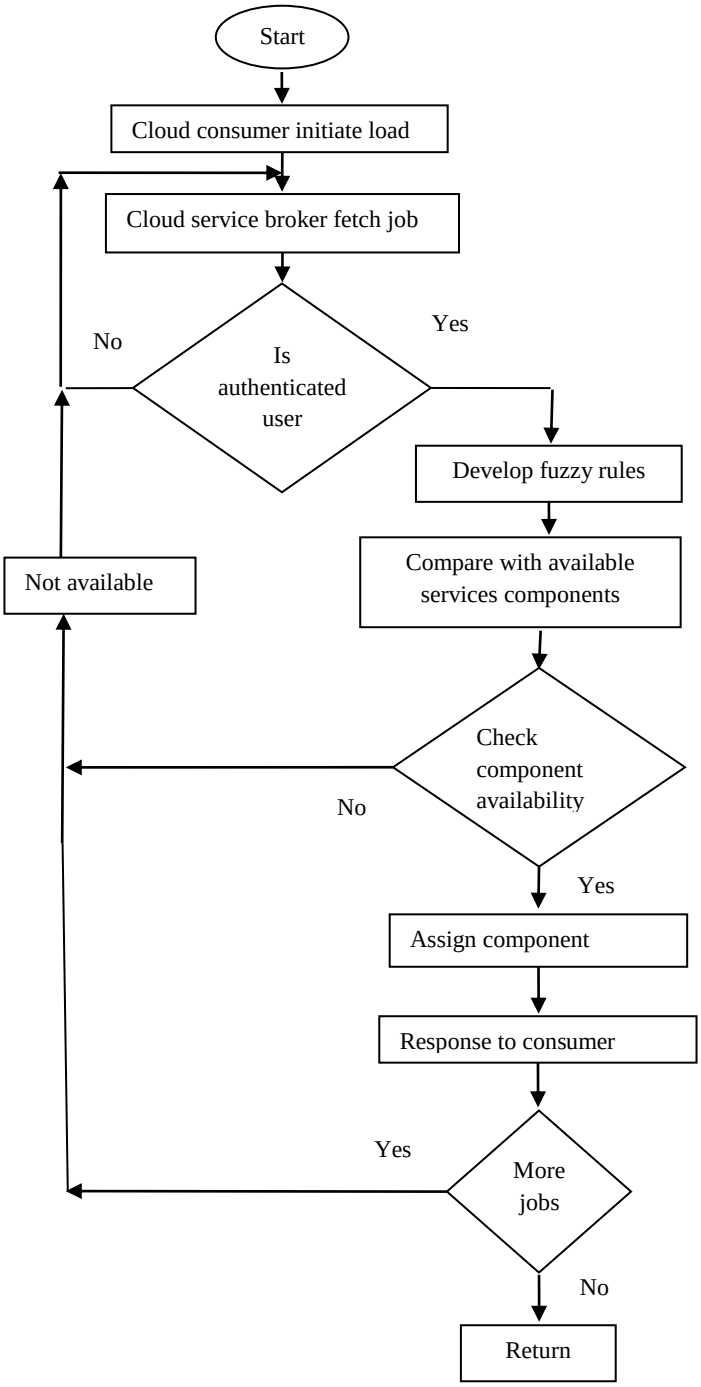


Fig. 3: Flow chart for user request processing

3.2 Performance analysis

The proposed technique is designed and implemented in Matlab tool .So the evaluation of the proposed technique is done on the basis of following parameters Data processing time, Average Response time, Latency period with ten number of

iterations. A comparison is drawn between all the parameters and delineated in the figures 4, 5 and 6.

3.2.1 Response time

Response time refers to the amount of time Enterprise Server takes to return the results of a request to the user. In this section, response time refers to the mean, or average, response time. Fig.4 shows comparison of response time between existing and proposed service broker algorithm where x- axis represents the number of iteration and y – axis represents the time is seconds. Here the green line shows the proposed technique and blue line shows the existing technique. It can be contemplated from fig.4 that proposed response time is less in comparison to [19].

Table 2: Response Time

No. Of iterations	CA	LA	LAOC	SPBR	Proposed
1	6.2622	6.4470	3.0905	6.5160	2.3876
2	6.1466	6.1986	2.4544	6.2351	2.3762
3	6.2452	6.1202	2.3448	6.2954	2.1814
4	6.0990	6.1940	2.3496	6.3349	2.3763
5	6.1169	6.5019	2.1546	6.3490	2.1720
6	6.1103	6.5965	2.4559	6.2354	2.3747
7	6.1142	6.5929	2.3006	6.2545	2.1749
8	6.1154	6.1871	2.2997	6.4551	2.2090
9	6.1366	6.2026	2.3058	6.2798	2.1769
10	5.9829	6.2387	2.1669	6.4570	2.3080

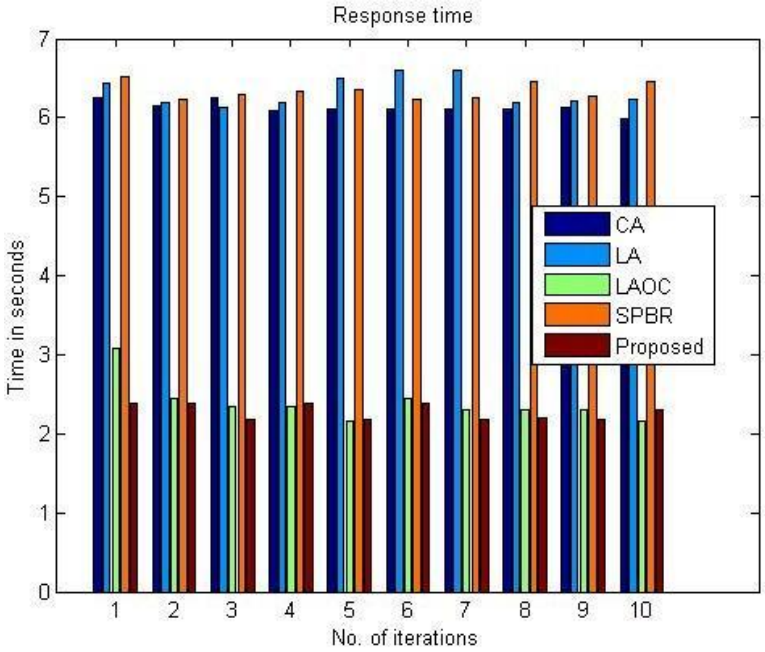


Fig. 4: Response Time

3.2.2 Latency

Latency is a time interval between the stimulation and response, or a time delay between the cause and the effect of some physical change in the system being observed. Fig.5 shows the comparison of latency between existing and proposed service broker algorithm where x- axis represents the number of iterations and y – axis represents the time is seconds. Here, the green line shows the proposed technique and blue line shows the existing technique. As depicted in Fig. 5, the latency period in the proposed algorithm is decreased in comparison to the [19].

Table 3: Latency Period

No. Of iteration	CA	LA	LAOC	SPBR	Proposed
1	129.0032	152.1499	51.5660	136.8366	44.3784
2	127.8494	123.9714	41.9141	134.6775	39.7326
3	134.8954	139.5404	39.8299	120.8716	43.1690
4	137.8382	139.9856	39.9717	111.4943	36.0552
5	137.0194	163.8479	34.0260	134.5986	41.2048
6	123.4293	151.7186	38.5571	117.2256	51.1177
7	149.1859	126.5832	47.6944	122.5876	38.3404
8	125.9784	143.5409	38.4835	125.2298	38.1154
9	154.6431	132.7361	37.3078	124.3399	32.5513
10	135.2133	143.4895	37.9877	125.2651	30.2102

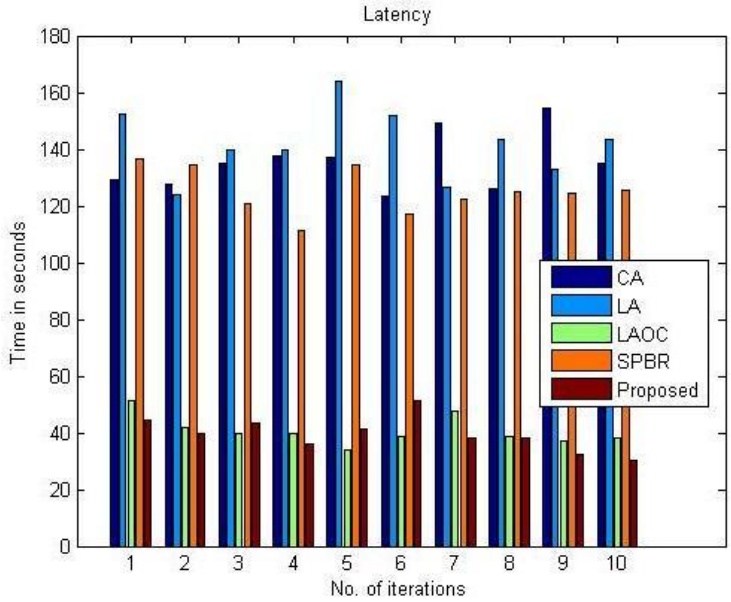


Fig.5: Latency

3.2.2 Data processing time

It is the manipulation of the input user request with an application program to obtain desired output as a result. Fig.6 shows the comparison of data processing time between existing and proposed service broker algorithms. Here x- axis represents the number of iterations and y – axis represents the time is seconds. The green line shows the proposed technique and blue line shows the existing technique. If proposed algorithm is compared with [19], it indicates that data processing time is decreased.

Table 4 : Data Processing Time

No. Of iterations	CA	LA	LAOC	SPBR	Proposed
1	4.1200	4.7200	3.3370	4.2000	3.7174
2	4.1600	4.0000	3.4154	4.3200	3.3442
3	4.3200	4.5600	3.3974	3.8400	3.9579
4	4.5200	4.5200	3.4024	3.5200	3.0346
5	4.4800	5.0400	3.1585	4.2400	3.7941
6	4.0400	4.6000	3.1399	3.7600	4.3051
7	4.8800	3.8400	4.1463	3.9200	3.5257
8	4.1200	4.6400	3.3468	3.8800	3.4509
9	5.0400	4.2800	3.2359	3.9600	2.9906
10	4.5200	4.6000	3.5062	3.8800	2.6179

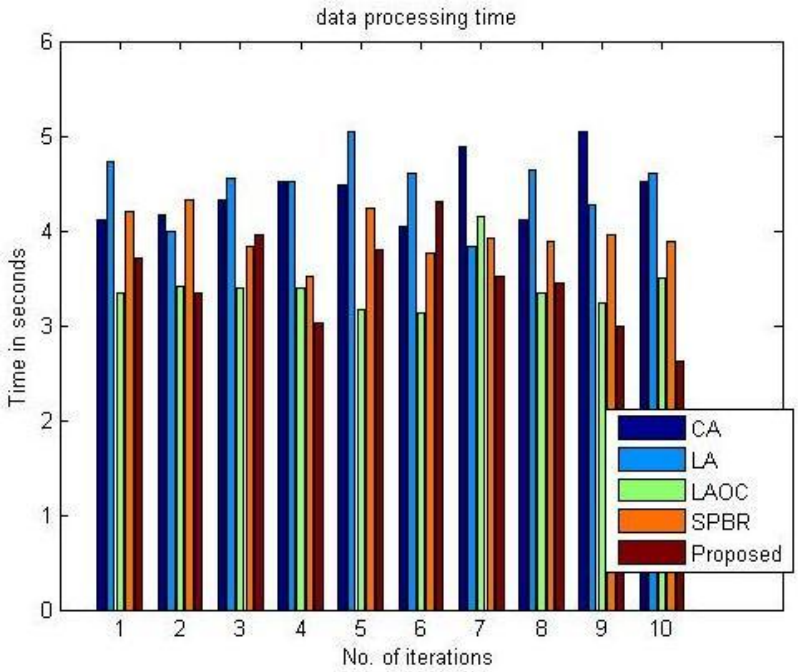


Fig.6: Data Processing Time

4. CONCLUSION

The proposed service broker algorithm based on fuzzy concept gives better results in terms of response time, latency period and data processing time. The observed average values of response time, latency period and data processing time are 2.2 sec, 39.4 sec, 3.4 sec respectively. The proposed algorithm is also juxtaposed with the existing algorithms based on the aforesaid performance parameters and adorned as better algorithm. Even on the basis of performance parameters, proposed algorithm can be claimed as optimal algorithm.

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