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HYBRID ALGORITHM FOR RESOURCE PROVISIONING IN HETEROGENEOUS CLOUD ENVIRONMENT

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Abstract

Cloud computing is a model for delivering information technology services in which resources are retrieved from the internet through web based tools and applications. Mostly the challenges are security, resource allocation and resource provisioning. This paper focuses on clustering Virtual Machines using Fuzzy-c-Means Algorithm(FCM) and scheduling the tasks using Particle Swarm Optimization(PSO) to optimize time. The simulation results shows that resource provisioning based on FCM-PSO algorithm is better than resource provisioning in Particle swarm optimization.

Keywords: Virtual machine, Cloudlets, Cloudsim , Task Scheduling, Clustering, PSO, Fuzzy-C-Means

Introduction

Cloud computing is an evolving concept which makes cloud users use resource that is provide by the cloud service provider. The important aim in provisioning resource is maximum performance in minimum time, to minimize the total time taken, the scheduling principle should aim to reduce the amount of data transfer with minimum cost. The basic feature of cloud computing is the ability to provide resources scale and dynamic provisioning. Particle Swarm Optimization (PSO) which inspired by the social behaviour of bird flocking and fish schooling. Fast and robust clustering algorithms play an important role to clustering the virtual machines.The Fuzzy c-means (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters. The CloudSim toolkit has been used to test the task grouping and scheduling. The toolkit, a java-based discrete-event cloud computing simulation package, supported both system and

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behavior modeling of cloud computing system components such as data center and virtual machines (VMs). Mapping of task to resource and resource management are also supported.

PSO Approach

Resource provisioning has been an important problem in the cloud computing. To solve this problem we need to improve resource utilization and provisioning in minimum time and to meet Service Level Agreement (SLA). Particle swarm optimization (PSO) is a population based stochastic optimization technique developed by Dr. Eberhart and Dr. Kennedy in 1995, inspired by social behavior of bird flocking or fish schooling. It is found to be very useful for efficient resource provisioning.Particle Swarm Optimization (PSO) have been found to be very useful.The PSO algorithm was first proposed by J. Kennedy and R. Eberhart in 1995.

PSO is a population-based algorithm. Each particle represents a solution in a n-dimensional space. Each particle also has knowledge of its previous best experience and knows the global best experience (solution) found by the entire swarm. PSO simulates the behaviors of bird flocking.Bird flocking means a group of birds are randomly searching food in an area. There is only one piece of food in the area being searched. All the birds do not know where the food is. But they know how far the food is in each iteration. So birds want to find best strategy to find the food. The effective one is to follow the bird which is nearest to the food. Christo Ananth et al. [4] discussed about Improved Particle Swarm Optimization. The fuzzy filter based on particle swarm optimization is used to remove the high density image impulse noise, which occur during the transmission, data acquisition and processing. The proposed system has a fuzzy filter which has the parallel fuzzy inference mechanism, fuzzy mean process, and a fuzzy composition process. In particular, by using no-reference Q metric, the particle swarm optimization learning is sufficient to optimize the parameter necessitated by the particle swarm optimization based fuzzy filter, therefore the proposed fuzzy filter can cope with particle situation where the assumption of existence of "ground-truth" reference does not hold. The merging of the particle swarm optimization with the fuzzy filter helps to build an auto tuning mechanism for the fuzzy filter without any prior knowledge regarding the noise and the true image. Thus the reference measures are not need for removing the noise and in restoring the image. The final output image (Restored image) confirm that the fuzzy filter based on particle swarm optimization attain the excellent quality of restored images in term of peak signal-to-noise ratio, mean absolute error and mean square error even when the noise rate is above 0.5 and without having any reference measures.

PSO learned from the above scenario and used it to solve the optimization problems. In PSO, each single solution is a "bird" in the search space. We call it "particle". All of particles have fitness values which are evaluated by the fitness function to be optimized, and have velocities which direct the flying of the particles. The particles fly through the problem space by

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following the current optimum particles. PSO is initialized with a group of random particles (solutions) and then searches for optima by updating generations. In every iteration, each particle is updated by following two "best" values. The first one is the best solution (fitness) it has achieved so far. This value is called pbest(stored fitness value). Another "best" value that is tracked by the particle swarm optimizer is the best value, obtained so far by any particle in the population. This best value is a global best and called gbest. When a particle takes part of the population as its topological neighbors, the best value is a local best and is called lbest.

After finding the two best values, the particle updates its velocity and positions with equation (1) and (2).

Equation 1 $\longrightarrow$ $v_{i,j} = w * v_{i,j} + c_1 * r_1 x*(p_{p,j} - x_{i,j}) + c_2 * r_2 *(p_{g,j} - x_{i,j})$

Equation 2 $\longrightarrow p_{i.j} = p_{i.j} + vi.j$

In equation 1, 'w' is the inertia factor influencing the local and global abilities of the algorithm , $x_{i.j}$ is the velocity of the particle 'I' , c1 and c2 are weights affecting the cognitive and social factors, respectively. r1and r2 (0,1). $p_{p.j}$stands for the best value found by particle 'i' (pbest) and $p_{g.j}$ denotes the global best found by the entire swarm (gbest).

After the velocity is updated, the new position i in its jth dimension is calculated.(eq 2). This process is repeated for every dimension and for all the particles in the swarm.

PSO ALGORITHM

1.Initializing parameters of PSO and maximum iterations

2.Calculating fitness value

3.If the fitness values is better than the best fitness values in history set ,then current values as the new pBest

4.Update Personal best and Global best

5.Update velocity and position of each particle using equation (1) and (2)

$V=W*V+C_1*R_1*(pBESTP)+C_2*R_2*(gBEST-P)$

$P=P+V$

Where V-Path direction
P-Particle's position
C1-weight of local information
C2-weight of global information
pBest-best position of the particle
gBest-best position of the swarm
rand-random number

6.Continue the step 2 to 5 until maximum iterations reached or optimized gbest

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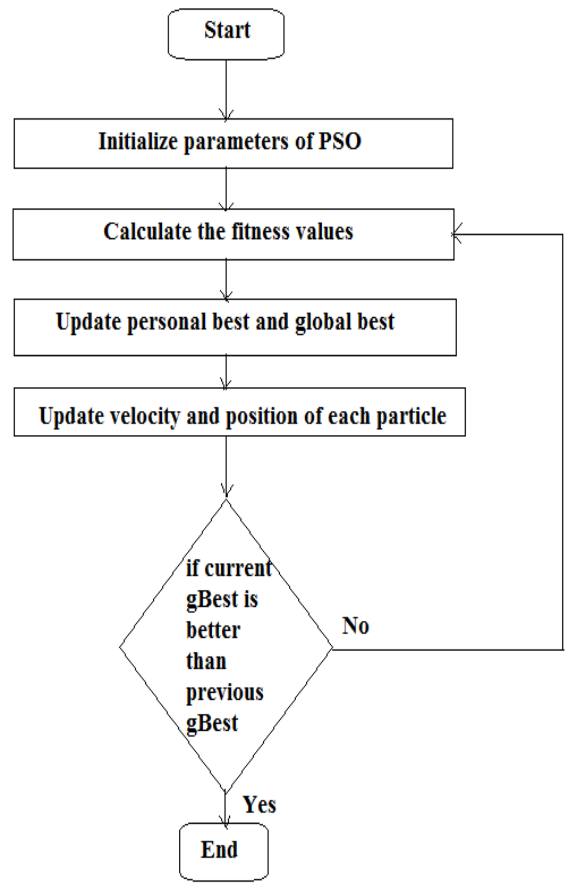
Eq 1 $\longrightarrow$ $v_{i,j} = w \times v_{i,j} + c_1 \times r_1 \times (p_{p,j} - x_{i,j}) + c_2 \times r_2 \times (p_{g,j} - x_{i,j})$

Eq 2 $\longrightarrow$ $p_{i,j} = p_{i,j} + vi.j$

In equation 1, 'w' is the inertia factor influencing the local and global abilities of the algorithm , $x_{i,j}$ is the velocity of the particle 'I' , c1 and c2 are weights affecting the cognitive and social factors, respectively. r1 and r2 (0,1). $p_{p,j}$ stands for the best value found by particle 'i' (pbest) and $p_{g,j}$ denotes the global best found by the entire swarm (gbest). After the velocity is updated, the new position i in its jth dimension is calculated.(eq 2). This process is repeated for every dimension and for all the particles in the swarm.

Flow chart for PSO:



FUZZY C MEANS ALGORITHM

Clustering algorithms play an important role in extracting useful information in large databases. The aim of cluster analysis is to partition a set of N object into C clusters such that objects within cluster should be similar to each other and objects in different clusters are should be dissimilar with each other. Clustering means organize items into groups based on similarity criteria. Fuzzy c-means (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters. This method

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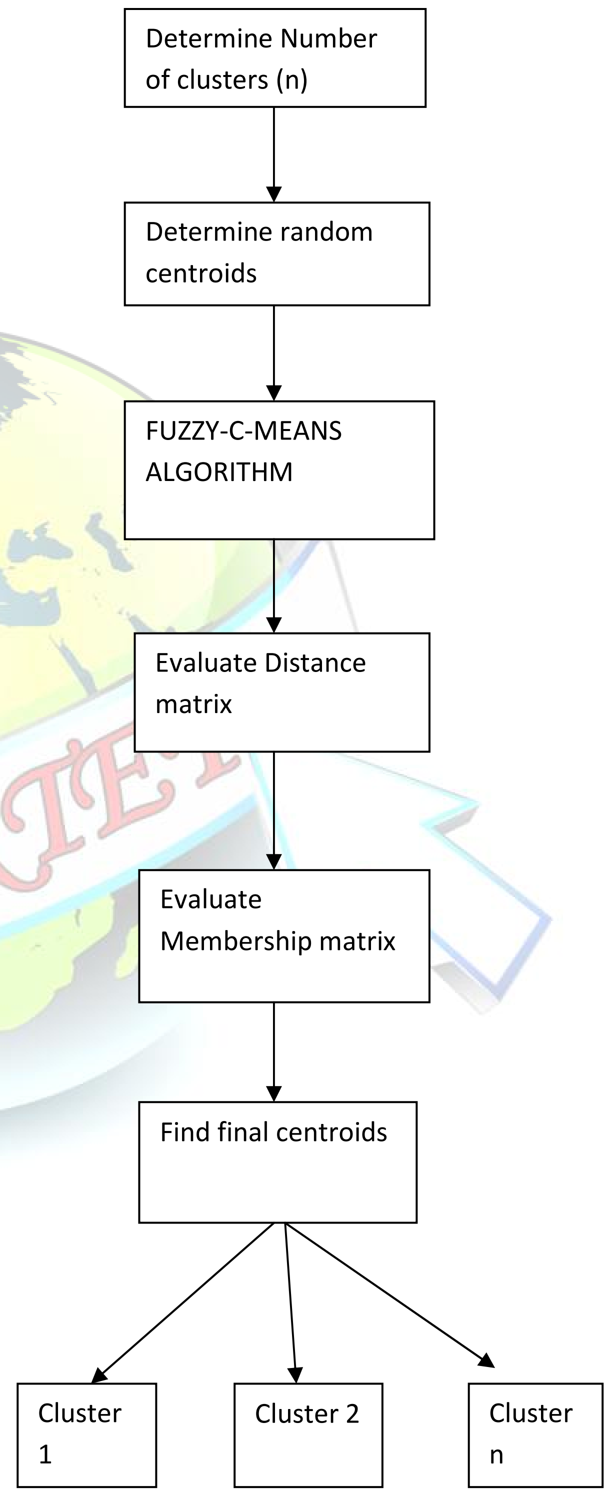
(developed by Dunn in 1973 and improved by Bezdek in 1981) is frequently used in pattern recognition. In FCM where each item belong to more than one group(hence the word fuzzy) where degree of membership for each item is given by a probability distribution over the clusters. It is useful when required number of clusters are pre-determined. It doesnot calculate absolute membership of datapoints instead it calculate degree of membership that a data point will belong to that cluster. It is fact because it doesnot calculate absolute membership. The central idea in fuzzy clustering is the non-unique partitioning of the data into a collection of clusters. The data points are assigned membership values for each of the clusters and fuzzy clustering algorithm allow the clusters to grow into their natural shapes. Fuzzy-C-Means is probably
Better clustering than K-Means clustering. Fuzzy clustering is a powerful method for the analysis of data and construction of models.Fuzzy clustering is more natural than hard clustering.Its advantages are unsupervised and Converges .

Concept Of FCM:



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ALGORITHM FOR FCM :

Step 1: Determine no of clusters

Step 2: Randomly initializing the cluster center

Step 3: Creating distance matrix from a point xi to each of the cluster centers to with taking the Euclidean distance between the point and the cluster center

$$D_{ii} = \sqrt{\sum_{i=1}^{n}(x_i - c_i)}$$

Step 4: Creating membership matrix

$$\mu_i(x_i) = ((1/d_{ij})^{1/m-1}) / (\sum_{i=1}^{n} (1/d_{ik})^{1/m-1})$$

Step 5: Total membership for a point in sample or decision space must add to 1

Step 6: Generating new centroid for each cluster

$$C_i = (\sum_{i=1}^{n}(\mu_i(x_i))^m . x_i) / (\sum_{i=1}^{n}(\mu_i(x_i))^m)$$

Step7: Generating new centroid until it matches for two iterations

Step8: Then finalize the centroid and membership matrix.

Here m is real number equal to 1.25, $\mu_{ij}$is the degree of membership of X_i in the cluster ,
x_i is the i^{th} of d-dimensional measured data, $c_i$is the d-dimension center of the cluster,

PROPOSED WORK :

The proposed work is clustering the virtual machines using FCM and then PSO is implemented. Firstly,In FCM determine no of clusters and virtual machines parameters such as mips,ram, size. Generate the random cluster center values based on parameter values.
Then FCM is used to find the final centroid values and cluster the VMs as small, medium and large categories. Finally Vms are clustered using FCM. Next PSO is implemented where machines and tasks are taken as row and columns respectively in execution, population matrices. Generate execution time for each machines to do a particular tasks.Allocate the task to the corresponding VMs based on minimum execution time. In population matrix generate machine numbers uniquely. Then calculate pbest and gbest values based on minimum execution time in each row and update the velocity and position values using the equation mentioned in the PSO algorithm. When optimized gbest is get then take particular Vms row. That Vms are clustered using FCM. Tasks are allocated to each clusters efficiently.Thus makespan is better by combining FCM and PSO.

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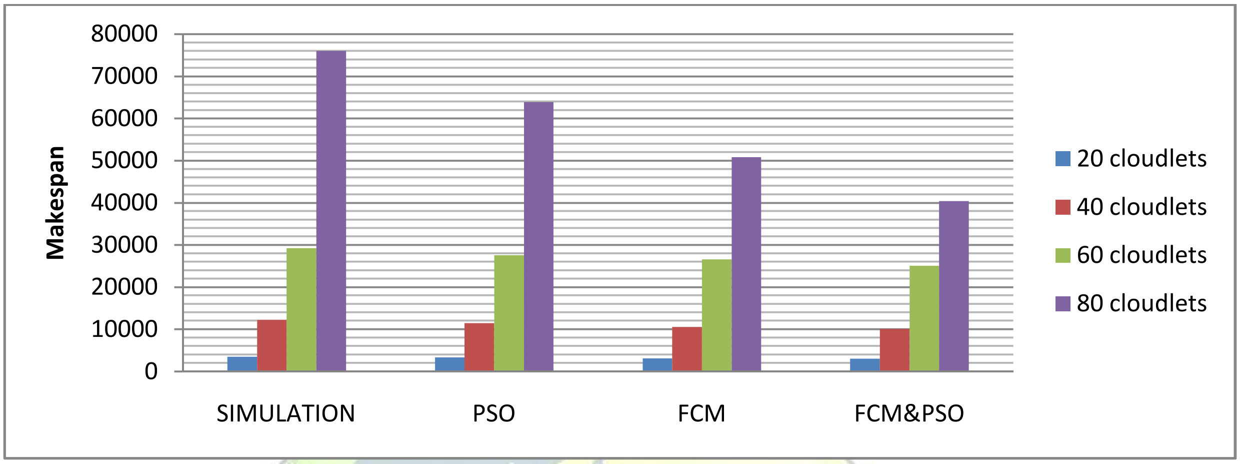
Implementation and Result:



Conclusion

This paper presented Hybrid algorithm based on PSO optimization algorithm and FCM algorithm which can solve the task scheduling problem under the computing environment and makespan is reduced. But, in changing environment, cloud computing resources needs to be operated in optimally. Therefore, Hybrid algorithm based FCM-PSO was suitable for cloud computing environment because the algorithm effectively utilize the system resources to reduce makespan.

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