#### Pseudo Code of the modified ant colony Algorithm

The algorithm steps of our proposed algorithm are as below:

|  |
| --- |
| **begin**  **Initialize the number of ants, datacenter , server,**  **while (has\_task) do**  **Position each ant in a starting VM**  **Time= estimate\_execution\_time(task)**  **Distance\_matrix = calculate\_distance(task)**  **Server = find\_best\_server\_using\_ant\_colony(time,distance,task)**  **Assign\_task(task,server)**  **If(no\_more\_task) :**  **Wait\_for\_task()**  **Endif**  **If(machine\_is\_idel ):**  **Machine\_is\_Auto\_off();**  **Endif**  **end while**  **Update the task**  **Calculate total cost and makespan**  **Calculate Host and Server**  **end** |

#### Mathematical Representation

###### Initialize pheromone of VMj At the beginning, ants are distributed on VMs randomly, and then it will initialize the VMj pheromone value based on:

###### (0) = pe\_ × pe\_+ vm\_ ………………..(1)

###### Where pe\_numj is the number of VMj processor, pe\_mipsj is the MIPS (Million Instructions Per Second) of each processor of VMj and the parameter VM\_bwj that is related to the communication bandwidth ability of the VMj.

###### **B**. The rule of choosing VM for next task The k-ant chooses VMj for next task with a probability that is defined as:

###### 

##### Where

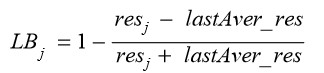
##### • τj(t) is the VMj pheromone value at time t.

##### • EV j is the computing capacity of VMj, it is defined as follows:

##### EVj = pe\_numj × pe\_mipsj + vm\_bwj (2)

Where pe\_numj is the number of VMj processor, pe\_mipsj is the MIPS of each processor of VMj and the parameter VM\_bwj that is related to the communication bandwidth ability of the VMj.

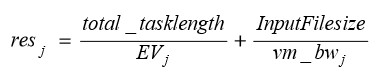
• LBj is the load balancing factor of VMj, to minimize the degree of imbalance, which is defined as follows:



Where lastAver\_res is the average execution time of the virtual machines in the last iteration of the optimal path, and resj is the expected execution time of the task in the VMj,

which is defined as follows:

Processing time of VM:



Where total\_tasklength is the total length of the tasks that have been submitted to VMj, and InputFilesize is the length of the task before execution. • α, β and γ are three parameters that control the relative weight of the pheromone trail, the computing capacity of VMs and the load balancing factor of VMs.

Once some VMs are loading heavy, it becomes a bottleneck in the cloud and it influences the makespan of a given tasks set. Therefore we define the load balancing factor LBj in the ant algorithm to improve the load balancing capability, and the bigger LBj of VMj should be chosen with high probability, that means the comprehensive ability of VMj is power now, and then it is high desirable

**C Phenomenon Updating**

Let τj(t) be the intensity of VMj pheromone at time t. The pheromone update is given by (7):



Where ρ ∈(0, 1] is the pheromone trail decay coefficient. The greater the value of ρ is, the less the impact of past solution is. The value of ∆τj is defined as follows: When an ant completes its tour, the local pheromone updating is applied on the visited VMs, and the value of ∆τj is given by



Where Tik is the shortest path length that searched by kant at i-th iteration. When an ant completes its tour, if it finds the current optimal solution, it can lay a larger intensity of the pheromone on its tour[20, 21], and the global pheromone updating is applied on the visited VMs, and the value of ∆τj is given by



Where Top is the current optimal solution, and D is the encouragement coefficient.

#### Expected Outcome from the Work

Better utilization of resources and task take minimum completion time so that the performance of system will be improved. Our algorithm finding optimal least underloaded virtual machine for increasing the system performance. Our system will detect the execution time of a task automatically. If a new task comes and all the machines are busy, then load balancer will create another machine if the cost of machines fulfils the budget function .The core scheduling factors are- cost of a machine, execution time of a task, distance from the task initiator (client) to machine (datacenter).

### **Discussion**

This chapter showed a clear description about the methodology we used for the various analysis of our thesis. Here also showed an overview of Analytical approach, and the Flow Diagram and pseudo code and details.