**1. Task Execution Time:**

𝑻E𝑻(𝒊,𝒋) = 𝑻L(𝒊) / 𝑷SV(𝒋)

where:

TET (i) is the execution time for task i

TL (i) is the length of task i measured in MI

PSV (j) is the processing speed of host j measured in MIPS

**2. Task Execution Cost:**

**5**

where:

TEC (i, j) is the price in dollars of running Task I in host J

Exe (i, j) The execution time of task i on Host j is measured in seconds

costCPU is the CPU processing cost in dollars/sec

R (i) The size of RAM for task i is measured in megabytes (MB).

costRAM is the cost of memory used in dollars per megabyte ($/MB)

S (i) is the size of storage for task i in megabytes (MB).

costStorage is the cost of storing data in dollars per megabyte ($/MB).

D (i) is the task i file's size measured in Kb

costB (i) is the price per megabyte for data transport.

**3.**  **Data Transfer Time**

The data transfer time for each task is computed according to the size of the task's

input and output files and the bandwidth for each Hoset, depending on the host type.

6

where:

DTT (i, j) is the data transfer time of task i in Host j

FS (i) is the size of the task i input and output files in MI

HosetB (j) is the bandwidth of Host j

**4. Data Transfer Cost**

The data transfer cost is computed according to data transfer time which is computed in Equation 6 and the cost of bandwidth of VM, as shown in Equation

7

where:

DTC (i, j) is the data transfer cost of task i in host j

DTT (i, j) is the data transfer time of task i in host j, as shown in Equation 6

CostBW (j) is the cost of bandwidth per second using host j

**5. Host Capacity**

Host capacity is computed based on the utilization of the host in terms of CPU, memory, storage size, and bandwidth, as shown in Equation 8.

**8**

HostC (j) is the capacity load of the host j

Tlength (i) is the total length for all tasks assigned to host

CMIPS(j) is the CPU speed of host j in MIPS

Ncores (j) is the number of cores in host j

The minimum ranking of the objectives is summarized in Equation 9, and the sum of ranking is presented in Equation 10. Finally, the weighted sum is computed for the two ranks to find the final rank of the solution x as shown in Equation 11.

𝐅1(𝐱) = 𝐌in (𝐫ank (𝐓EC), 𝐫ank (𝐓E𝐓), 𝐫ank (𝐃TT), 𝐫ank (𝐃TC), 𝐫ank (HostC)) 9

𝐅2(𝐱) = 𝐫ank (𝐓EC)+𝐫ank (𝐓E𝐓)+𝐫ank (𝐃TT)+𝐫ank (𝐃TC)+ 𝐫ank (hostC) 10

FinalRank(x)= 0.5\* 𝐅1(𝐱)+0.5\* 𝐅2(𝐱)

Solution=min(FinalRank(x))

This equation calculates the final rank of the solution *x* by computing a weighted sum of the two fitness functions *F*1​(*x*) and *F*2​(*x*). The weights *w*1​ and *w*2​ represent the relative importance or priority assigned to each fitness function. By adjusting these weights, the optimization algorithm can be guided to prioritize certain objectives over others, the fitness function described by these equations combines the minimum ranking and sum ranking strategies to evaluate solutions in a multi-objective optimization problem. The resulting final rank provides a quantitative measure of how well each solution performs across all objectives, taking into account both the best and worst-performing objectives.

Algorithm 5.3: Modified Ranking Strategy Algorithm.

Procedure modified ranking (p, TET, TEC, DTT, DTC, hostC)

1. For each v є p do

2. f1 (v) = Min (p, TET, TEC, DTT, DTC, hostC)

3. f2 (v) = Sum (p, TET, TEC, DTT, DTC, hostC)

4. rank (v) =f1 (v)\*0.5 + f2 (v) \*0.5 5.

End for

6. r=min (rank)

7. Return r

Save

End Procedure

P=number of hosts

تخزن النتائج في الاكسل مع خصائص الطلب وكافة خصائص ال host التي تم العتماد عليها بايجاد افضل حل