Cloud Computing Lab

ITPC-423

Information Technology

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Submitted to: Dr. Mohit Kumar (Department of IT)

Submitted by: Group 1

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Groupwise Lab Task

Objective:

WAP to implement the GA & DE algorithm in Cloud computing

Requirements:

1. Windows PC (Windows 7/8/10) / Mac
2. Eclipse Ide
3. JDK 15
4. CloudSim Jar files

Problem Definition

Suppose that there are m tasks $T=\{t_1,t_2,...,t_m\}$, and n virtual machines $VM=\{[vm]_1,[vm]_2,...,[vm]_n\}$.
It is a NP-complete problem which has n^m ways to allocate these tasks to VMs. When a task is bound to a virtual machine $[vm]_i$ the occupation time of $[vm]_j$ depends on the length of task and the CU of the VM. The execution time for t_{ij} on vm_j is given by t_{ij}

$$t_{ij}=L_i/C_j$$

where $i\in\{1,2,...,m\}$, $j\in\{1,2,...,n\}$, $L_{(i)}$ represents the length of task t_i, and C_j denotes the CU (Compute Unit) of virtual machine $[vm]_j$.

Genetic Algorithm:

Proposed Method:
The population is evaluated and selected to create a new generation by the fitness function. To find the correctness of the schedule the fitness function is used:

$fitness(P)=min(U_1,U_2,.....,U_n)$

where $U_1,U_2,.....,U_n$ are the chromosomes that represent the time taken to finish all the cloudlets execution for their respective assignment

Algorithm:

Step 1: Start

Step 2: Calculate the process priority as per their time

Step 3: Initialize the population as per the process priority

Step 4: Evaluate the fitness function to determine the fitness of each individual.

Step 5: Select the fittest chromosome.

Step 6: Perform crossover mapping over chromosomes.

Step 7: Perform mutation by changing the genes of individual parents.

Step 8: Add the chromosome to a new population

Step 9: Repeat steps 2 to 7 for all new arrival process Step

10: Exit

Sample Output:

```
========== OUTPUT ==========
Cloudlet ID    STATUS    Data center ID    VM ID        Time    Start Time    Finish Time
    13         SUCCESS         0             9         217.31        0.5            217.81
    11         SUCCESS         1             16         268.63        0.5             269.13
    1         SUCCESS         0             9         273.17        0.5            273.67
    12         SUCCESS         2             3         274.16        0.5             274.66
    3         SUCCESS         0             9         305.09        0.5            305.59
    14         SUCCESS         3             17         311.68        0.5             312.18
    4         SUCCESS         1             16         332.2        0.5            332.7
    2         SUCCESS         4             8         336.32        0.5            336.82
    18         SUCCESS         2             3         350.71        0.5             351.21
    6         SUCCESS         3             17         356.48        0.5             356.98
    15         SUCCESS         4             8         367.7        0.5            368.2
    9         SUCCESS         1             16         370.61        0.5             371.11
    0         SUCCESS         0             9         381.12        0.5            381.62
    22         SUCCESS         2             3         385.51        0.5             386.01
    17         SUCCESS         3             17         413.55        0.5             414.05
    21         SUCCESS         1             16         459.19        0.5             459.69
    7         SUCCESS         2             3         459.84        0.5            460.34
    24         SUCCESS         4             8         464.98        0.5             465.48
    16         SUCCESS         3             17         486.89        0.5             487.39
    20         SUCCESS         4             8         523.35        0.5            523.85
    23         SUCCESS         0             9         438.67        217.81            656.48
    8         SUCCESS         1             16         553.57        269.13             822.69
    5         SUCCESS         2             3         561.98        274.66            836.64
    10         SUCCESS         3             17         603.05        312.18             915.22
    19         SUCCESS         4             8         631.37        336.82             968.19
Total Jobs :25
CloudSimExample6: GeneticAlgorithmCloudSimulation... finished!
```

Differential Evolution:

The DE approach is mainly affected by three factors, namely:

Crossover factor (F), Crossover probability (CR), and number of iterations (I).

These factors must be carefully selected to maximize efficiency.

Algorithm:

1. Input of the number of tasks (t) versus the number of processors (p).

2. Input of the execution time matrix E = tXp (times of each task corresponding to each processor).

3. Input of the population size (s).

4. Input of the number of DE iterations (I).

5. Generation of a random population matrix P = sXt (each element Pij is a processor number allocated to task 'Tj' under population vector 'Vi').

6. Calculate the fitness value (simply the reciprocal of the sum of the execution times corresponding to processor Pij with task Tj) of each vector and pick the maximum value.

7. Pick three random vectors (a, b, c) from the population corresponding to the first vector (Pi = 1).

8. Also select a random probability rj and random crossover index R and apply crossover formula: If (rj < CR OR i = R) M = (floor [a + F * abs(b − c)] modulo p) + 1 Where M is the mutated vector and F is the mutation factor ($0 < F \leq 2$).

9. Calculate the fitness values for P1 and M.

10. If fitness value of M exceeds that of P1, replace P1 by M in the population matrix P

11. Apply steps 5–7 for every vector of the population matrix.

12. Calculate the maximum fitness value among all vectors of the latest population matrix obtained at the end of step 8.

13. Take the final population as the initial population for the next iteration and repeat steps 6–12, I-1 times more.

Sample Output:

```
========== OUTPUT ==========
Cloudlet ID    STATUS    Data center ID    VM ID        Time    Start Time    Finish Time
    4        SUCCESS        2             15          216.76       0.5           217.26
    6        SUCCESS        4             12          217.3        0.5           217.8
    19        SUCCESS        3             10          247.64       0.5           248.14
    3        SUCCESS        6             8           247.99       0.5           248.49
    18        SUCCESS        4             12          255.71       0.5           256.21
    21        SUCCESS        2             15          259.41       0.5           259.91
    5        SUCCESS        3             10          289.12       0.5           289.62
    16        SUCCESS        5             11          291.04       0.5           291.54
    2        SUCCESS        6             8           291.06       0.5           291.56
    14        SUCCESS        5             11          333.33       0.5           333.83
    15        SUCCESS        2             15          335.32       0.5           335.82
    23        SUCCESS        4             12          349.28       0.5           349.78
    7        SUCCESS        3             10          381.9        0.5           382.4
    8        SUCCESS        6             8           382.72       0.5           383.22
    9        SUCCESS        2             15          386.36       0.5           386.86
    20        SUCCESS        4             12          395.56       0.5           396.06
    10        SUCCESS        6             8           429.75       0.5           430.25
    11        SUCCESS        3             10          459.25       0.5           459.75
    1        SUCCESS        5             11          459.27       0.5           459.77
    12        SUCCESS        5             11          515.22       0.5           515.72
    17        SUCCESS        2             15          441.37       217.26           658.64
    0        SUCCESS        4             12          474.69       217.8           692.49
    22        SUCCESS        6             8           513.58       248.49           762.07
    13        SUCCESS        3             10          547.76       248.14           795.91
    24        SUCCESS        5             11          631.79       291.54           923.34
Total Jobs :25
CloudSimExample6: DECloudSimulation... finished!
```

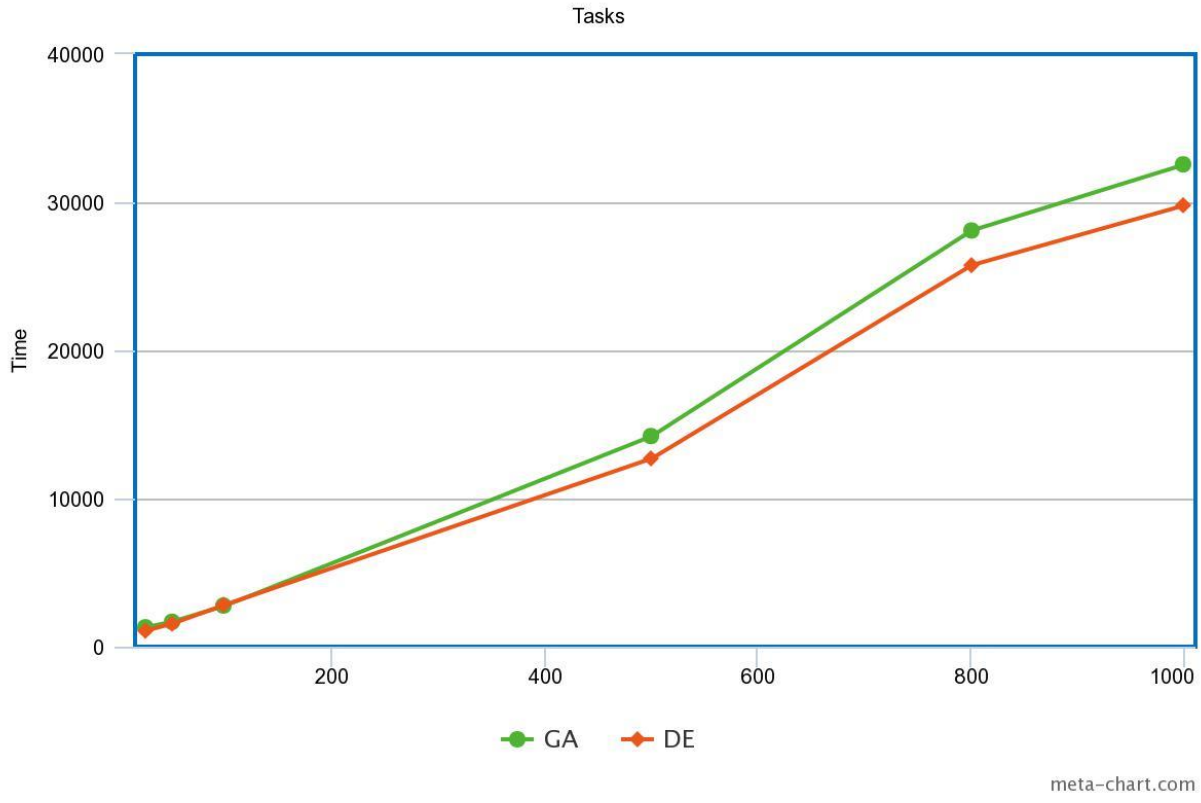
Performance Evaluation:

Configuration:

No of Datacenters	5
No of VMs	25
No of Iterations (both GA and DE)	25

No of Tasks vs Time:

Number of Tasks	Time taken by Genetic Algorithm (micro sec)	Time taken by Differential Evolution Algorithm (micro sec)
25	1311	1073
50	1683	1551
100	2774	2839
500	14218	12709
800	28095	25754
1000	32561	29799



Comparison between GA and DE