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Simulating Distributed Consensus Algorithms

among Applications using CloudSim Plus Software

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Project Objectives:

The use of distributed consensus algorithm is a common strategy to offload tasks in an edge computing architecture. However, there is a lack of implementation support for such algorithms in the cloud simulators available. Hence, this project aims to extend the widely used open-source cloud simulation platform, CloudSim Plus, to include such support.

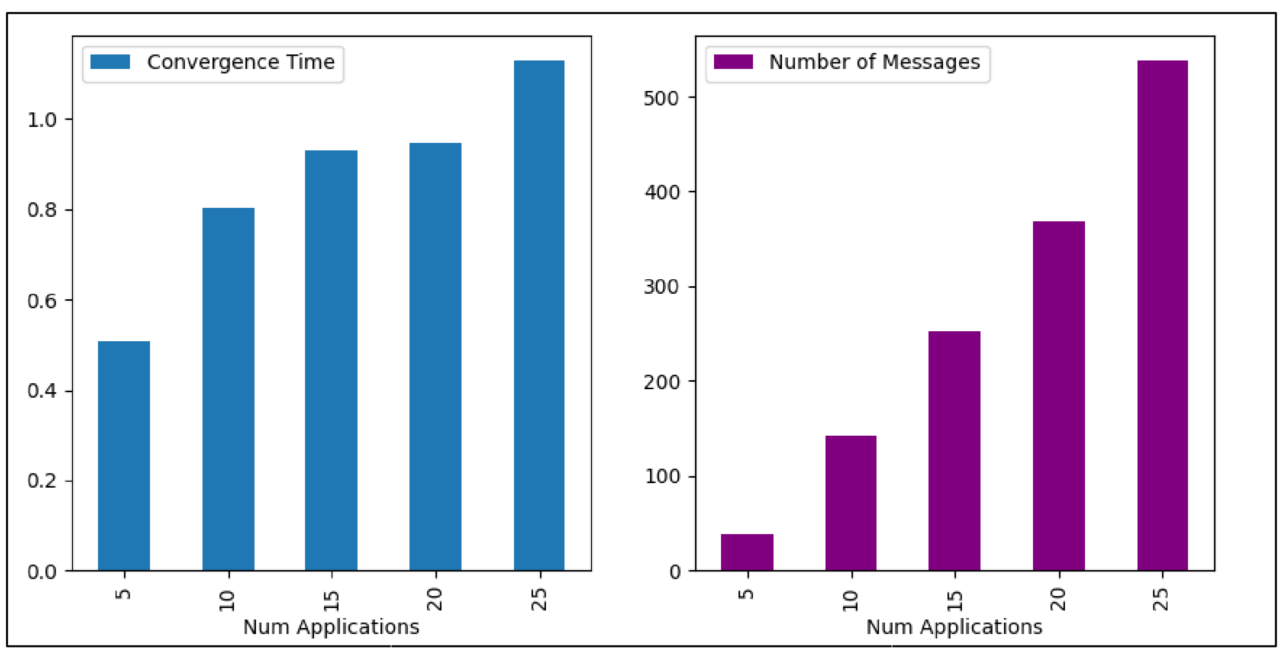
Testing with DRAGON:

Distributed Resource Assignment OrchestratioN (DRAGON) is one of the many distributed consensus algorithms. The algorithm was implemented in this project and multiple simulation runs were made.

```
time = 0.50 || Number Applications = 1 || Total Messages Exchanged = 0 || Average Convergence Time = 0.20600
time = 3.60 || Number Applications = 3 || Total Messages Exchanged = 43 || Average Convergence Time = 0.94767
time = 9.50 || Number Applications = 1 || Total Messages Exchanged = 0 || Average Convergence Time = 0.20100
time = 3.40 || Number Applications = 1 || Total Messages Exchanged = 0 || Average Convergence Time = 0.20200
time = 3.50 || Number Applications = 2 || Total Messages Exchanged = 4 || Average Convergence Time = 0.20400
```

A Single Simulation Run

Two performance metrics were collected, namely average convergence time and total number of messages exchanged. This can then be used as a benchmark when implementing your own algorithms. Paired-t confidence intervals is one statistical method for comparing the performance between two algorithms.



Results Summary

Paired-t Confidence Interval Method:

X_{ir} represents performance metric from system i for the r^{th} simulation run

SYSTEM 1: $X_{11}, X_{12}, X_{13} \dots X_{1r}$

SYSTEM 2: $X_{21}, X_{22}, X_{23} \dots X_{2r}$

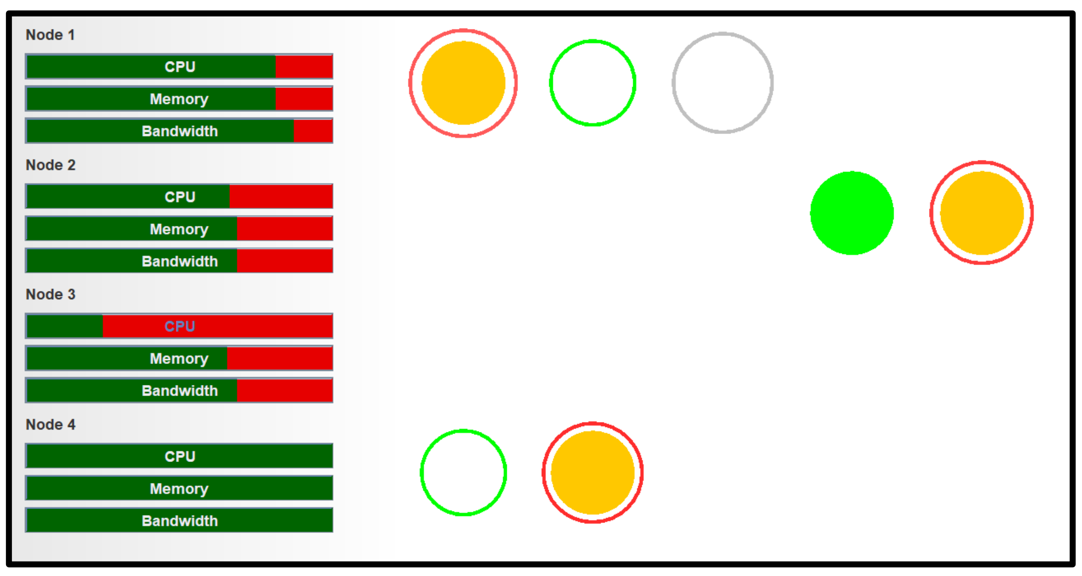
We get Z_r

where $Z_r = X_{1r} - X_{2r}$

$$\bar{Z}(n) = \frac{1}{n}\sum_{r=1}^{n} Z_r, \qquad S_Z^2(n) = \frac{1}{(n-1)}\sum_{r=1}^{n}[Z_r - \bar{Z}(n)]^2$$

Confidence Interval = $\bar{Z}(n) \pm t_{n-1,1-\alpha/2}\frac{S_Z(n)}{\sqrt{n}}$

Real-Time Visualisation of the Distributed Process:



The extension also includes a feature where users are able to view, in real-time, the arrival of different applications and its behavior within the system.