Research Project
(IT4010)

Group Assessment File

Project ID: 2020-021

Supervisor: Dr. Dharshana Kasthurirathna

Project Title:

A NETWORK SCIENCE BASED APPROACH FOR OPTIMAL MICROSERVICE GOVERNANCE

Group Details:

Student ID	Student Name
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IT17012966	L.S. Jayasinghe
IT17410250	M.V. Lakshitha

Research Project (IT4010)

Student Assessment File

Project ID: 2020-021

Student ID: IT17016230

Student Name: Saranga S.A.G

Research Domain: Distributed and Parallel Computing

Project Title

A Network Science Based Approach for Optimal Microservice Governance

Project Sub Title

A network science based approach for the generation of dependency map and a service mesh based on the network traffic and user behaviour on a Kubernetes cluster

Individual Component Abstract

Even though micro-service architecture has its many advantages, being complex makes it challenging to manage and scale. With the arrival of concepts such as containerization and Kubernetes orchestration, the difficulty of maintaining a complex application deployed with micro-service architecture decreased. But with the growth of the existing application, developers tend to introduce more and more nodes and end-points to make their work more comfortable, which makes the system complex again.

With the vast number of nodes and end-points, getting an overall idea about the whole system and use that idea to design an optimal deployment strategy to reduce the latency of the network is essential.

The dependency map and the service mesh described in the topic will be implemented by reading the logs and metrics for all the nodes and the pods in a Kubernetes cluster. An open-source independent service mesh called "Istio" will be configured and deployed to the Kubernetes cluster. Istio will create a proxy on top of every node, and it will be able to capture the network requests and responses of a particular node. By configuring Istio, we will be able to create a monitoring solution to provide detailed dashboards like Grafana, Kibana, and Prometheus. With the help of collected logs and metrics, we can identify and quantify the connection strength between each node and, in turn, enable developers and system administrators to identify key microservices on which to focus on thus enabling them to focus on key microservices which greatly affect the overall performance of the deployment.

Research Project (IT4010)

Student Assessment File

Project ID: 2020-021

Student ID: IT17006880

Student Name: De Silva N.

Research Domain: Data Science

Project Title

A Network Science Based Approach for Optimal Microservice Governance

Project Sub Title

A data science based approach for an improved auto-scaling policy in Kubernetes based on load prediction

Individual Component Abstract

One of the many advantages of using Kubernetes for microservice deployments is the ability to scale cluster resources based on traffic. This ability of Kubernetes to automatically scale cluster resources thereby enables developers and system administrators to reduce costs and make use of their deployed microservices in a more effective and efficient manner.

However, even though the autoscaling tools such as the Horizontal Pod Autoscaler (HPA) provided by Kubernetes help developers and system administrators to effectively utilize their microservice deployments as previously stated, they also possess some inherent drawbacks as well. The main drawbacks among them being the lack of service quality caused due to the delay in response time due to pod initialization and ineffective scaling caused due to the under allocation of resources in the configuration process.

This research thereby aims to address this issue prevalent through aiming to provide a data science-based approach with the help of time series analysis and machine learning methodologies to proactively scale resources while also investigating the need for this proposed improved auto-scaling policy in the development of an optimized deployment strategy for Kubernetes deployments, as proposed in the main research project.

Research Project (IT4010)

Student Assessment File

Project ID: 2020-021

Student ID: IT17012966

Student Name: L.S. Jayasinghe

Research Domain: Distributed and Parallel Computing

Project Title

A Network Science Based Approach for Optimal Microservice Governance

Project Sub Title

A network science based approach for generating optimal deployment strategy based on Dependency, load predictions and resiliency measures among microservices in Kubernetes.

Individual Component Abstract

In the Cloud network, nodes are located on a certain distance, so there is some delay between nodes. Those delays are not the same over the cloud network. Those things directly affect the whole system, and if the most communicated couple microservice is deployed in too far, the system becomes slow.

Furthermore, in the typical microservice deployments, microservices with high dependencies are deployed closer such that optimal performance. However, at times through Application Performace Monitoring tools used, it is difficult to identify these key microservices due to the huge amount of metrics that need to be analysed and thereby also obtain a holistic view of their deployment with respect to its performance.

The proposed solution will aid in providing a solution to this problem by incorporating the use of an optimization algorithm which makes use of load prediction, resiliency and dependency measures to provide a holistic view of the current deployment with respect to its performance as well as determine the optimal deployment strategy and provide developers and system administrators to make more effective decisions with respect to the performance of their deployed cluster.

Research Project (IT4010)

Student Assessment File

Project ID: 2020-021

Student ID: IT17410250

Student Name: M.V. Lakshitha

Research Domain: Distributed and Parallel Computing

Project Title

A Network Science Based Approach for Optimal Microservice Governance

Project Sub Title

A network science based approach for evaluation of resiliency among microservices through the use of Chaos Engineering

Individual Component Abstract

In the process of achieving optimal performance of microservice deployments, the resiliency of the microservice cluster plays an important role.

Dealing with unexpected failures is one of the hardest problems to solve, especially in a distributed system. Much of the code that developers write involves handling exceptions, and this is also where the most time is spent in testing. The problem is more involved than writing code to handle failures. What happens when the machine where the microservice is running fails? Not only do you need to detect this microservice failure, but you also need something to restart your microservice. Furthermore, with the use variety of Application Performance Monitoring Tools (APM) tools used to evaluate performance in the cluster, it has become quite difficult for system administrators to focus on the resiliency of the microservices deployed.

"Chaos Engineering" approach is one of the popular methods of evaluating resilience. With the help of tools such as Chaos Monkey, by performing targeted attacks on the identified microservices with the help of developed dependency map as proposed in the main research, the level of resiliency of microservices can be identified. After identifying the level of resiliency, have to come up with measures that will help to increase the level of resiliency of the microservices. Finally, a UI dashboard with final findings of the optimization process has to be implemented showing the optimal deployment strategy to the user.