A Critical Review to
"Brownout Approach for Adaptive Management of Resources and Applications in Cloud Computing Systems: A Taxonomy and Future Directions"
by M. Xu

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1   Introduction

In the article "Brownout Approach for Adaptive Management of Resources and Applications in Cloud Computing Systems: A Taxonomy and Future Directions" by Minxian Xu, the author introduces the Brownout approach, which is an optimization technique adoptable to cloud computing systems. Brownout approach helps the system to adapt to various situations and ensures the performance even when there is a sudden devastating change happened to the workload or the resources. By definition, brownout requires the system to turn off some optimal parts when the workload suddenly peaks, for example, in order to guarantee a stable system performance and user experience. According to the Xu's argument, deactivation of these optional services can help the resource and application of cloud computing systems to become more manageable and therefore leads to a stable performance.

In this paper, I first briefly summarize Xu's argument in his paper and then state my own opinions regarding the strengths and possible improvements I have discovered after reading Xu's paper. From my perspective, Xu indeed presents a well-structured and up-to-date article with sufficient supporting evidence that demonstrates the extensive advantages of implementing brownout approach in real cloud computing systems. Yet, besides introducing the phase structure of designing a cloud computing system, the paper lacks a deep, detailed elaboration on how to actually integrate the brownout approach with respect to each phase.

2   Article Summary

Xu claims that we need adaptive management in cloud computing systems to cope with problems such as unexpected hardware failures, energy insufficiency, saturated applications, unfriendly user experience due to unexpectedly long response time, and overloading resources. Brownout approach is presented to help the cloud computing systems to achieve adaptive management by categorizing the application components or services into mandatory and optional ones. The services that are considered optional might be turned off temporarily to ensure the stability of system performance under the disastrous circumstances described above. Brownout also provides "per request admission control", which means that some requests are processed with full admission while others are required to deactivate certain optional services. Throughout the years from 2014 to nowadays, Brownout approach has gone through a great evolution to fulfill various objectives including energy efficiency, hybrid planning, proactive self-adaptation, load balancing and many more.

After Xu introduces a holistic overview of the Brownout approach, he also gives a more detailed classified discussion of how it is applied in different phases of cloud system management. Xu discusses how we can develop the brownout approach in cloud computing systems in five phases: application design, workload scheduling, monitoring, a brownout controller/dimmer design, and metrics. All these factors affect the implementation of Brownout approach in cloud computing systems and are therefore taken into account, aiming for a more adaptive resource/application management.

In the second part of the essay, Xu reviews 18 real-world brownout-based cloud computing systems investigated by his team to demonstrate how the brownout approach helps these systems to more adaptively manage their resources and applications. The paper presents a summary of how each system possesses different properties within each category described in the previous section, aiming to show the Brownout approach is applicable to all these variations of current cloud systems. In addition, Xu also shows Brownout approach has limitations on some properties based on a summary of the advantages and limitations of the 18 investigated systems. Towards the end, the article also speculates the future challenges posed in the journey of adopting brownout approach to more computing systems.

3   My review

3.1   Strengths

The article has accomplished its objectives in a well-formed and clear structure. Xu has reached a wide range of topics regarding the different aspects of a cloud computing systems such as application design, workload scheduling, monitoring. The topics covered by this paper are broad and comprehensive, and Xu indeed addresses the benefits of Brownout approach regarding the adaptability of various real-world cloud systems.

Xu provides a detailed description for each of the five phases in designing a cloud computing system. This overview successfully demonstrates that brownout approach can be

adopted to address the performance issue within each of the category. Brownout approach can be applied to different application types such as desktop applications and web applications. The domain of these applications, general or business, are also taken into account. Different workload scheduling determines the implementation of brownout as well. The workload type could be CPU-intensive or network-intensive; the resources could be homogenous and heterogeneous. Since the operations controlling the state of services are done by "a brownout controller", Xu also introduces the design and algorithm behind a brownout controller. When we evaluate the performance of a system, different metrics are used such as response time, decision time, latency, and so on. Xu even offers clear figures to show the structure of each phase. Therefore, the audience are acknowledged that all these factors can be optimized by brownout approach to some extent.

Moreover, Xu surveys 18 different cloud computing systems in the industry that adopt the brownout approach. By analyzing the properties possessed by these systems and the specific advantages that adopting the brownout approach has brought to them, Xu indicates the practicality of Brownout in the real-world. Furthermore, Xu compares and contrasts the shortcomings and advantages of each brownout-based cloud system in order to reveal the fact that brownout approach is not all-powerful and perfect. With the support of these authentic evidence, the paper is more credible to the readers. Also, I think the article has kept up with time because the surveyed cloud systems are developed from 2014 to 2017. Therefore, this paper is particularly helpful to the computer science professionals who are interested in the brownout approach and would like to know about its current application in the industry.

3.2   Possible Improvements

After reading this article, I still have these questions unanswered about how the Brownout approach can optimize resource and application management and how it is different from ordinary resource management methods: how should brownout approach cope with different workload types? Is there a preference of better performance in terms of optional parts deactivated by brownout? How is the algorithm of a brownout controller actually implemented? What are the features of the cloud computing system that is most suitable for a brownout approach? While providing a wide range of topics within the cloud computing systems lets readers to get a sense of the flexibility of the brownout approach, I think Xu could have selected several most important topics for a further elaboration. For example, he could have elaborated on the algorithm of a brownout controller and explained the difference between a brownout and an ordinary controller. Also, Xu discusses the 18 surveyed brownout approaches with equal weight. However, I think it is better to pick one or two models to give a more detailed analysis in terms of actual implementation, benefits, and limitations.

4   References

Xu, M. Buyya, R. Brownout Approach for Adaptive Management of Resources and Applications in Cloud Computing Systems: A Taxonomy and Future Directions. ACM Comput Surv. 2019;52(1):8. doi:10.1145/3235151.