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# Federated Clouds: A New Metric for Measuring the Quality of Data Anonymization

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## Abstract

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Federated cloud has emerged as solution for cloud service providers to get scalability in serving the growing demand for cloud resources. In a federated cloud, a cloud member can provide service or request it from other cloud provider members in the federation. The federation enables its cloud provider members to be able to satisfy a service beyond the resources they owned by using the resources market in the federation. Data privacy is a major concern in federated clouds. As the privacy regulations and laws of the countries in the federation may vary, it is difficult to assess and confirm that they are in compliance. This makes protecting privacy even more challenging. Privacy management strategies primarily involve anonymization, cryptography, and data splitting. Anonymization is the traditional approach to preserving privacy, which aims at masking the link between the quasi-identifier and sensitive data. The most widely used anonymization techniques are  $k$ -anonymity,  $l$ -diversity and  $t$ -closeness. However, there is a lack of a formal metric to measure the quality of the anonymization process in terms of its ability to prevent re-identification. This paper examines the issue of assessing anonymization quality and introduces a new metric, *Mmaq*, for this purpose. It can be used to evaluate the anonymization of one or multiple attributes. The metric is a combination of the Shannon index, which measures diversity, and a stabilizer factor, which corrects the Shannon index for pathological cases. The initial results suggest that *Mmaq* can be used to classify attributes as identifier, quasi-identifier, and anonymous. Furthermore, it can be employed as a Cloud Privacy Policy anonymization compliance checker.

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## References

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1. Abbasi, A., Mohammadi, B.: A clustering-based anonymization approach for privacy-preserving in the healthcare cloud. *Concurrency Comput. Pract. Exper.* **34**(1), e6487 (2022)

### [Article Google Scholar](#)

2. Adetiba, E., et al.: FEDGEN Testbed: a federated genomics private cloud infrastructure for precision medicine and artificial intelligence research. In: Misra, S., Oluranti, J., Damaševičius, R., Maskeliunas, R. (eds.) ICIIA 2021. CCIS, vol. 1547, pp. 78–91. Springer, Cham (2022). [https://doi.org/10.1007/978-3-030-95630-1\\_6](https://doi.org/10.1007/978-3-030-95630-1_6)

### [Chapter Google Scholar](#)

3. Andrew, J., Karthikeyan, J., Jebastin, J.: Privacy preserving big data publication on cloud using Mondrian anonymization techniques and deep neural networks. In: 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS), pp. 722–727. IEEE (2019)

### [Google Scholar](#)

4. Bernsmed, K., et al.: Thunder in the clouds: security challenges and solutions for federated clouds. In: 4th IEEE International Conference on Cloud Computing Technology and Science Proceedings, pp. 113–120. IEEE (2012)

### [Google Scholar](#)

5. Blanquer, I., et al.: Federated and secure cloud services for building medical image classifiers on an intercontinental infrastructure. *Futur. Gener. Comput. Syst.* **110**, 119–134 (2020)

### [Article Google Scholar](#)

6. Brasileiro, F., Brito, A., Blanquer, I.: Atmosphere: Adaptive, trustworthy, manageable, orchestrated, secure, privacy-assuring, hybrid ecosystem for resilient cloud computing. In: 2018 48th Annual IEEE/IFIP International Conference on Dependable Systems and Networks Workshops (DSNW), pp. 51–52. IEEE (2018)

### [Google Scholar](#)

7. Domingo-Ferrer, J., et al.: Privacy-preserving cloud computing on sensitive data: a survey of methods, products and challenges. *Comput. Commun.* **140**, 38–60 (2019)

### [Article Google Scholar](#)

8. Dwork, C., Roth, A., et al.: The algorithmic foundations of differential privacy. *Found. Trends® Theor. Comput. Sci.* **9**(3–4), 211–407 (2014)

### [MathSciNet Google Scholar](#)

9. Ferrer, A.J., et al.: OPTIMIS: a holistic approach to cloud service provisioning. *Future Gener. Comput. Syst.* **28**(1), 66–77 (2012)

### [Article Google Scholar](#)

10. George, R.S., Sabitha, S.: Data anonymization and integrity checking in cloud computing. In: 2013 Fourth International Conference on Computing, Communications and Networking Technologies (ICCCNT), pp. 1–5. IEEE (2013)

### [Google Scholar](#)

11. Li, N., Li, T., Venkatasubramanian, S.: t-closeness: privacy beyond kanonymity and l-diversity. In: 2007 IEEE 23rd International Conference on Data Engineering, pp. 106–115. IEEE (2006)

### [Google Scholar](#)

12. Machanavajjhala, A., et al.: l-diversity: Privacy beyond k-anonymity. ACM Trans. Knowl. Disc. Data (TKDD) **1**(1), 3-es (2007)

### [Google Scholar](#)

13. Rochwerger, B., et al.: The reservoir model and architecture for open federated cloud computing. IBM J. Res. Dev. **53**(4), 4 (2009)

### [Article Google Scholar](#)

14. Rosa, M., et al.: Bionimbuz: a federated cloud platform for bioinformatics applications. In: 2016 IEEE International Conference on Bioinformatics and Biomedicine (BIBM), pp. 548–555. IEEE (2016)

### [Google Scholar](#)

15. Samarati, P., Sweeney, L.: Protecting privacy when disclosing information: k-anonymity and its enforcement through generalization and suppression (1998)

### [Google Scholar](#)

16. Silva, H., et al.: A re-identification risk-based anonymization framework for data analytics platforms. In: 2018 14th European Dependable Computing Conference (EDCC), pp. 101–106. IEEE (2018)

### [Google Scholar](#)

17. Taneja, H., Singh, A.K., et al.: Preserving privacy of patients based on re-identification risk. *Procedia Comput. Sci.* **70**, 448–454 (2015)

[Article Google Scholar](#)

18. Yang, M., et al.: Differentially private data sharing in a cloud federation with blockchain. *IEEE Cloud Comput.* **5**(6), 69–79 (2018)

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