







GSAreport: Easy to Use Global Sensitivity Reporting

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Summary

GSAreport is an application to easily generate reports that describe the global sensitivities of a machine learning (ML) model, simulator or real-world process input parameters as well as possible. With the reporting application, you can inspect which features are important for a particular target function or model by simply providing an existing data set or generating a design of experiments to be evaluated. With the dockerized application, you can create a report with just one line of code and no additional dependencies. The report includes a wide variety of variance-, density- and model-based global sensitivity methods, which are visualized in an intuitive and interactive way. Global sensitivity analysis (GSA) quantifies the importance of model inputs and their interactions with respect to model output. It is crucial to better understand your machine learning models or get an understanding of complex high dimensional real-world processes.

Statement of need

GSAreport is a Dockerized and packaged Python application to easily generate GSA reports. The API for GSAreport was designed to provide a class-based and user-friendly interface to easily utilize many different and somewhat complex to implement GSA methods and sampling techniques.

GSAreport was designed to be used by both ML researchers as well as by domain experts in industry to validate and inspect different machine learning models and simulators and gain better insights into their complex industrial processes.

GSAreport unifies methods of the SHAP and SALib packages in one easy to use application with an interactive graphical report. The GSAreport application is different from using SALib directly in a number of ways:

- GSAreport does not require python knowledge (though can be used as python package as well).
- GSAreport uses a surrogate model when only 1 specific sampling scheme is present (for example for expensive industrial applications) to allow other GSA methods to work properly.
- Many GSA methods require a sampling scheme with a specific number of evaluations in terms of the dimensions (for example $x(d+1)$ or $x(d+2)$), this makes it hard to run multiple GSA methods if you are not familiar with these details, GSAreport tries to take this problem away from the user by working around these requirements.
- GSAreport selects a suitable subset of GSA methods based on empirically found rules of thumb.

GSAreport bundles the GSA methods in a readable report with interactive plots showing both first and second order sensitivities, including explanations and references to the different

methods. The application is meant for making GSA methods as easy as possible to use and to advise the end-users about which methods work well under which conditions.

Related software

The following open source software libraries are used (and extended) within GSAreport.

- SALib ([Herman & Usher, 2017](#)), a sensitivity analysis library for Python containing different SA methods and sampling schemes.
- SHAP ([Lundberg & Lee, 2017](#)), a local SA method for explainable AI.

A related toolbox (similar to SALib) originally implemented for Matlab and also available for Python and R is the SAFE toolbox ([Pianosi et al., 2015](#)).

The GSAreport application was used in the scientific research of the paper ([Stein et al., 2022](#)).

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References

- Herman, J., & Usher, W. (2017). SALib: An open-source python library for sensitivity analysis. *The Journal of Open Source Software*, 2(9). <https://doi.org/10.21105/joss.00097>
- Lundberg, S. M., & Lee, S.-I. (2017). A unified approach to interpreting model predictions. In I. Guyon, U. V. Luxburg, S. Bengio, H. Wallach, R. Fergus, S. Vishwanathan, & R. Garnett (Eds.), *Advances in neural information processing systems 30* (pp. 4765–4774). Curran Associates, Inc. <http://papers.nips.cc/paper/7062-a-unified-approach-to-interpreting-model-predictions.pdf>
- Pianosi, F., Sarrazin, F., & Wagener, T. (2015). A matlab toolbox for global sensitivity analysis. *Environmental Modelling & Software*, 70, 80–85.
- Stein, B. V., Raponi, E., Sadeghi, Z., Bouman, N., Van Ham, R. C. H. J., & Bäck, T. (2022). A comparison of global sensitivity analysis methods for explainable AI with an application in genomic prediction. *IEEE Access*, 10, 103364–103381. <https://doi.org/10.1109/ACCESS.2022.3210175>