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Published in:
The Journal of Open Source Software

DOI (link to publication from Publisher):
[10.21105/joss.03438](https://doi.org/10.21105/joss.03438)

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Publication date:
2021

Document Version
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

Citation for published version (APA):
Andersen, M. M., & Højsgaard, S. (2021). caracas: Computer algebra in R. *The Journal of Open Source Software*, 6(63), [3438]. <https://doi.org/10.21105/joss.03438>

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caracas: Computer algebra in R

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Submitted: 22 June 2021

Published: 19 July 2021

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Summary

caracas is an R ([R Core Team, 2018](#)) package that enables a computer algebra system (CAS) within R via the open source Python CAS SymPy ([Meurer et al., 2017](#)), which is made possible via [reticulate](#) ([Ushey et al., 2020](#)). caracas is published at The Comprehensive R Archive Network (CRAN) ([R Core Team, 2018](#)) at <https://cran.r-project.org/package=caracas>, its source is available at <https://github.com/r-cas/caracas> and the documentation is available at <https://r-cas.github.io/caracas/>.

Much work went into integrating caracas into R such that caracas behaves much like other R libraries and objects.

caracas contains a number of vignettes demonstrating both basic functionality like solving equations as well as more advanced tasks like finding the concentration and covariance matrix in a dynamic linear model.

Compared to other CAS R packages like Ryacas ([Andersen & Højsgaard, 2019](#)) based on yacas ([A. Pinkus et al., 2016](#); [A. Z. Pinkus & Winitzki, 2002](#)), caracas is more feature complete, for example with respect to solving equations.

Statement of Need

From a statistician's perspective, R is excellent for data handling, graphics, for model fitting and statistical inference and as a programming environment. However, R largely lacks the ability to perform symbolic computations. That is, R only supports to a small extent the step from posing a problem (for example a model) in mathematical terms over symbolic manipulations of the model and further onto a stage where a model can be combined with data. The caracas provides capabilities for these steps directly in R. Topics that can be handled in caracas include:

- Sums,
- limits,
- integration,
- differentiation,
- symbolic matrices and vectors,
- simplification of mathematical expressions and
- outputting in TeX format.

Several (commercial) systems are available for such tasks (and many more), e.g. Mathematica ([Wolfram Research, Inc., 2021](#)) and Maple ([Maplesoft, a division of Waterloo Maple Inc., Waterloo, Ontario, 2021](#)). However, we will argue that there is a virtue in being able to handle such tasks directly from within R using the familiar R syntax. Moreover, it is an integrated part of the design of caracas that it is straightforward to coerce a mathematical object into an R expression which can, e.g., be evaluated numerically.

Acknowledgements

We would like to thank the R Consortium for financial support for creating the caracas package ([link to details on the funded project](#)) and to users for pinpointing points that can be improved in caracas.

References

- Andersen, M. M., & Højsgaard, S. (2019). Ryacas: A computer algebra system in R. *Journal of Open Source Software*, 4(42), 1763. <https://doi.org/10.21105/joss.01763>
- Maplesoft, a division of Waterloo Maple Inc., Waterloo, Ontario. (2021). *Maple*. <https://www.maplesoft.com>
- Meurer, A., Smith, C. P., Paprocki, M., Čertík, O., Kirpichev, S. B., Rocklin, M., Kumar, A., Ivanov, S., Moore, J. K., Singh, S., Rathnayake, T., Vig, S., Granger, B. E., Muller, R. P., Bonazzi, F., Gupta, H., Vats, S., Johansson, F., Pedregosa, F., ... Scopatz, A. (2017). SymPy: symbolic computing in Python. *PeerJ Computer Science*, 3, e103. <https://doi.org/10.7717/peerj-cs.103>
- Pinkus, A., Winnitzky, S., & Mazur, G. (2016). *Yacas - Yet another computer algebra system*. <https://yacas.readthedocs.io/en/latest/>
- Pinkus, A. Z., & Winitzki, S. (2002). YACAS: A Do-It-Yourself Symbolic Algebra Environment. *Proceedings of the Joint International Conferences on Artificial Intelligence, Automated Reasoning, and Symbolic Computation*, 332–336. https://doi.org/10.1007/3-540-45470-5_29
- R Core Team. (2018). *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. <https://www.R-project.org/>
- Ushey, K., Allaire, J., & Tang, Y. (2020). *reticulate: Interface to 'Python'*. <https://CRAN.R-project.org/package=reticulate>
- Wolfram Research, Inc. (2021). *Mathematica, Version 12.3.1*. <https://www.wolfram.com/mathematica>