

python-ags4: A Python library to read, write, and validate AGS4 geodata files

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DOI: [10.21105/joss.04569](https://doi.org/10.21105/joss.04569)

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Submitted: 16 April 2022

Published: 04 November 2022

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Summary

Data gathered from geotechnical, geoenvironmental, and geophysical investigations can be broadly described as “geodata”. The AGS4 data format ([Association of Geotechnical and Geoenvironmental Specialists, 2011, 2017, 2021b, 2022](#)) is one of the most widely used data transmittal formats for geodata and is used across the world. It is a plain text format consisting of multiple tables of comma-separated values, tied together with a robust data schema and a comprehensive suite of validation rules. The basic structure of an AGS4 file is shown in Figure 1.

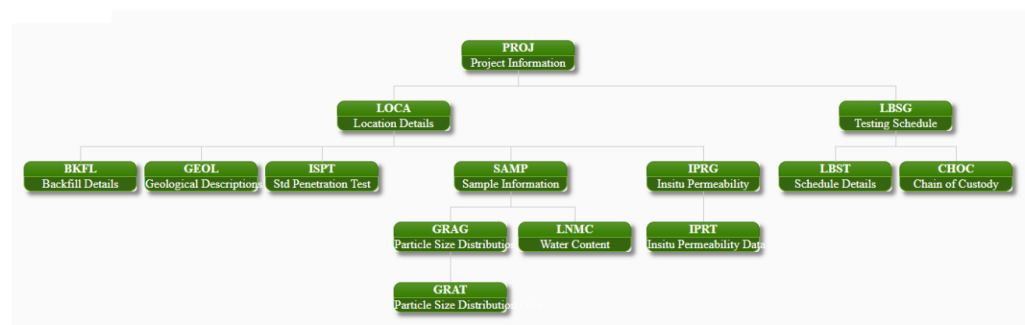


Figure 1: Simplified schematic of AGS4 data structure

Source: Association of Geotechnical and Geoenvironmental Specialists ([2022](#))

python-ags4 is a Python library that provides functionality to read, write, and validate AGS4 geodata files. It provides users with a gateway to access the full power of the Python ecosystem to explore, analyze, and visualize geodata. Pandas DataFrame ([The pandas development team, 2020](#)) is the primary data structure used within the library, therefore it can handle relatively large datasets reasonably fast. The data validation module checks the file for compliance with the validation rules and provides a detailed error report. An example error report is shown in Figure 2.

```

Running python_ags4 v0.4.0
Opening file... test_data.ags

Checking lines...
Loading tables...
Checking headings and groups...
Checking file schema...

File Name:      test_data.ags
File Size:      4 kB
Checker:        python_ags4 v0.4.0
Dictionary:     Standard_dictionary_v4_1_1.ags
Time (UTC):     2022-07-25 00:51:05

AGS_Format Rule 1:
Line 12         Has Non-ASCII character(s).

AGS_Format Rule 5:
Line 46         Contains only spaces.

AGS_Format Rule 3:
Line 63         Does not start with a valid data descriptor.

AGS_Format Rule 8:
Line 85         LLPL Value 55.1 in LLPL_LL not of data type 2SF. (Expected: 55)
Line 86         LLPL Value 155.1 in LLPL_LL not of data type 2SF. (Expected: 160)
Line 85         LLPL Value 34.8 in LLPL_PI not of data type 2SF. (Expected: 35)
Line 86         LLPL Value 134.8 in LLPL_PI not of data type 2SF. (Expected: 130)
Line 92         TEST Value 1.01 in TEST_COL not of data type 1SF. (Expected: 1)

AGS_Format Rule 10a:
Line 92         TEST Duplicate key field combination: DATA|Location_1
Line 93         TEST Duplicate key field combination: DATA|Location_1

AGS_Format Rule 10c:
Line 78         SAMP Parent entry for line not found in LOCA: BH-AA43
Line 79         SAMP Parent entry for line not found in LOCA: BH-AA43
Line 85         LLPL Parent entry for line not found in SAMP: Location_1|1.00|1a|Bag|
Line 86         LLPL Parent entry for line not found in SAMP: Location_5|2.00|2a|Bag|
Line -          TEST Parent group left blank in dictionary.

AGS_Format Rule 16:
Line -          ABBR ABBR table not found.

File check complete! 16 errors found!

```

Figure 2: Example error report

Statement of Need

This library fulfills the following needs of the engineering and scientific community that uses AGS4 geodata files:

- Provide a transparent and easily accessible tool to validate AGS4 geodata files.
- Provide access to the Python ecosystem to users of AGS4 geodata.
- Provide a cross-platform tool to work with AGS4 geodata files.

Having a free and open-source tool that can validate AGS4 files will help producers and receivers of data check that the geodata file is of the required standard. It also lowers the barrier to entry for those who are not familiar with this data format and fosters data sharing and collaboration. python-ags4 has already been adopted by the British Geological Survey to work with its large repository of publicly available AGS4 geodata files.

Python has a rich ecosystem of packages that can be utilized to analyze and visualize data. The ability to easily import geodata from AGS4 files will greatly enhance the ability of engineers and scientists to interpret data and improve knowledge of ground conditions. A Jupyter Notebook with examples of how to import data to Pandas and GeoPandas (Jordahl et al., 2020) for statistical and spatial analyses and visualize using Matplotlib (Hunter, 2007) is provided in the git repo of this library. We provide an example for users in the git repo.

The command-line interface included with the library is a convenient and easy to use tool to work with AGS4 geodata files. It is cross-platform and has been tested in Linux, Windows, and Mac environments.

The current state of practice for validation of AGS4 files is to use one of two proprietary software, namely KeyAGS Checker, which is freeware, and gINT AGS Checker, which is part of

the widely used gINT geotechnical data management suite. They are only available for the Windows operating system and can provide slightly different results in some cases. Therefore, validators based on python-ags4 are expected to become the standard in the future and provide a single source of truth for the validity of AGS4 files (Association of Geotechnical and Geoenvironmental Specialists, 2021a; Chandler, 2021).

The open-source geotechnical software package [groundhog](#) also provides functionality to import AGS4 data to Pandas DataFrames, therefore it can be used as an alternative to python-ags4 in this regard. However, the main focus of that package is general purpose geotechnical engineering calculations so it does not provide functionality to validate and export AGS4 files.

Ongoing Projects

python-ags4 has been implemented in two free and open-source software projects, making the library more accessible to non technical users.

- [Windows application](#) offering the functionality of the library
- [API](#) and [GUI](#) developed by the British Geological Survey, offering the functionality of the library on the web.

It has also been used in commercial projects. (e.g. <https://digitalgeotechnical.com/apps-home/>)

Acknowledgements

The authors acknowledge the work done by the AGS Data Format Working Group to develop the AGS4 data format and the support it has extended to develop this library. This work was supported by the British Geological Survey via NERC national capability.

References

- Association of Geotechnical and Geoenvironmental Specialists. (2011). *Electronic Transfer of Geotechnical and Geoenvironmental Data Edition 4 Addendum 3*. <https://www.ags.org.uk/data-format/ags4-data-format>
- Association of Geotechnical and Geoenvironmental Specialists. (2017). *Electronic Transfer of Geotechnical and Geoenvironmental Data Edition 4 Addendum 4*. <https://www.ags.org.uk/data-format/ags4-data-format>
- Association of Geotechnical and Geoenvironmental Specialists. (2021a). *AGS validator (beta)*. <https://www.ags.org.uk/data-format/ags-validator>
- Association of Geotechnical and Geoenvironmental Specialists. (2021b). *Electronic Transfer of Geotechnical and Geoenvironmental Data Edition 4.1*. <https://www.ags.org.uk/data-format/ags4-data-format>
- Association of Geotechnical and Geoenvironmental Specialists. (2022). *Electronic Transfer of Geotechnical and Geoenvironmental Data Edition 4.1.1*. <https://www.ags.org.uk/data-format/ags4-data-format>
- Chandler, R. (2021). *AGS checkers, DIGGS and the future world of data transfer*. <https://communities.bentley.com/products/geotechnical1/b/geoblog/posts/ags-checkers-diggs-and-the-future-world-of-data-transfer>
- Hunter, J. D. (2007). Matplotlib: A 2D graphics environment. *Computing in Science & Engineering*, 9(3), 90–95. <https://doi.org/10.1109/MCSE.2007.55>

Jordahl, K., Bossche, J. V. den, Fleischmann, M., Wasserman, J., McBride, J., Gerard, J., Tratner, J., Perry, M., Badaracco, A. G., Farmer, C., Hjelle, G. A., Snow, A. D., Cochran, M., Gillies, S., Culbertson, L., Bartos, M., Eubank, N., maxalbert, Bilogur, A., ... Leblanc, F. (2020). *Geopandas/geopandas: v0.8.1* (Version v0.8.1) [Computer software]. Zenodo. <https://doi.org/10.5281/zenodo.3946761>

The pandas development team. (2020). *Pandas-dev/pandas: pandas* (latest) [Computer software]. Zenodo. <https://doi.org/10.5281/zenodo.3509134>