

The project title goes here

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Welcome to Maneage (*Managing data lineage*) and reproducible papers/projects, for a review of the basics of this system, please see Akhlaghi et al. (2020). You are now ready to configure Maneage and implement your own research in this framework. Maneage contains almost all the elements that you will need in a research project, and adding any missing parts is very easy once you become familiar with it. For example it already has steps to downloading of raw data and necessary software (while verifying them with their checksums), building the software, and processing the data with the software in a highly-controlled environment. But Maneage is not just for the analysis of your project, you will also write your paper in it (by replacing this text in `paper.tex`): including this abstract, figures and bibliography. If you design your project with Maneage’s infra-structure, don’t forget to add a notice and clearly let the readers know that your work is reproducible, we should spread the word and show the world how useful reproducible research is for the sciences, also don’t forget to cite and acknowledge it so we can continue developing it. This PDF was made with Maneage, commit `ac8eee9`.

Keywords: Add some keywords for your research here.

Reproducible paper: All quantitative results (numbers and plots) in this paper are exactly reproducible with Maneage (<https://maneage.org>).

1. CONGRATULATIONS!

Congratulations on running the raw template project! You can now follow the “Customization checklist” in the `README-hacking.md` file, customize this template and start your exciting research project over it. You can always merge Maneage back into your project to improve its infra-structure and leaving your own project intact. If you haven’t already read Akhlaghi et al. (2020), please do so before continuing, it isn’t long (just 7 pages).

While you are writing your paper, just don’t forget to *not* use numbers or fixed strings (for example database urls like <https://fits.gsfc.nasa.gov/samples/WFPC2ASSNu5780205bx.fits>) directly within your \LaTeX source. Put them in configuration files and after using them in the analysis, pass them into the \LaTeX source through macros in the same `subMakefile` that used them. For some already published examples, please see Akhlaghi et al. (2020)¹, Infante-Sainz et al. (2020)² and Akhlaghi (2019)³. Working in this way, will let you focus clearly on your science and not have to worry about fixing this or that number/name in the text.

Once your project is ready for publication, there is also a “Publication checklist” in `README-hacking.md` that will guide you in the steps to do for making your project as FAIR as possible (Findable, Accessible, Interoperable, and Reusable).

The default \LaTeX structure within Maneage also has two \LaTeX macros for easy marking of text within your document as *new*

and *notes*. To activate them, please use the `-highlight-new` or `-highlight-notes` options with `./project make`.

For example if you run `./project make -highlight-new`, then **this text (that has been marked as new) will show up as green in the final PDF**. If you run `./project make -highlight-notes` then you will see a note following this sentence that is written in red and has square brackets around it (it is invisible without this option). **[This text is written within a tonote and is invisible without -highlight-notes.]** You can also use these two options together to both highlight the new parts and add notes within the text.

Another thing you may notice from the \LaTeX source of this default paper is there is one line per sentence (and one sentence in a line). Of course, as with everything else in Maneage, you are free to use any format that you are most comfortable with. The reason behind this choice is that this source is under Git version control and that Git also primarily works on lines. In this way, when a change in a sentence is made, git will only highlight/color that line/sentence we have found that this helps a lot in viewing the changes. Also, this format helps in reminding the author when the sentence is getting too long! Here is a tip when looking at the changes of narrative document in Git: use the `-word-diff` option (for example `git diff -word-diff`, you can also use it with `git log`).

Figure 1 shows a simple plot as a demonstration of creating plots within \LaTeX (using the PGFPlots package). The minimum value in this distribution is 1.000, and 2500.000 is the maximum. Take a look into the \LaTeX source and you’ll see these numbers are actually macros that were calculated from the same dataset (they will change if the dataset, or function that produced it,

¹ <https://gitlab.com/makhlaghi/maneage-paper>

² <https://gitlab.com/infantesainz/sdss-extended-psfs-paper>

³ <https://gitlab.com/makhlaghi/iau-symposium-355>

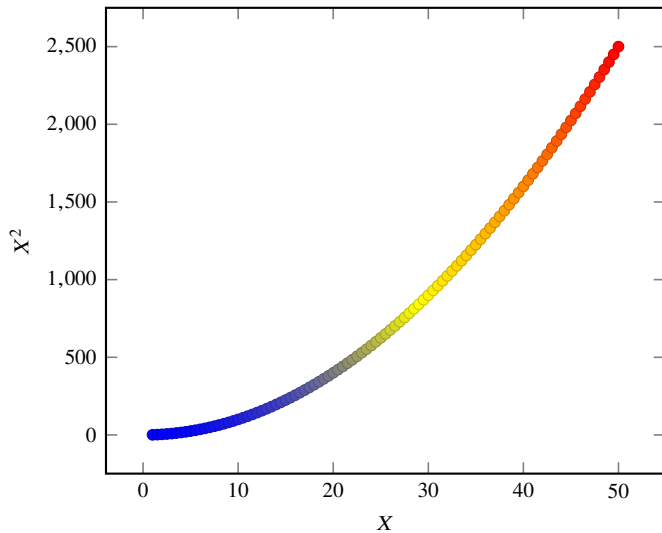


Figure 1: A very basic X^2 plot for demonstration.

changes).

The individual PDF file of Figure 1 is available under the `tex/tikz/` directory of your build directory. You can use this PDF file in other contexts (for example in slides showing your progress or after publishing the work). If you want to directly use the PDF file in the figure without having to let TiKZ decide if it should be remade or not, you can also comment the `makepdf` macro at the top of this \LaTeX source file.

Figure 2 is another demonstration of showing images (datasets) using PGFPlots. It shows a small crop of an image from the Wide-Field Planetary Camera 2 (that was installed on the Hubble Space Telescope from 1993 to 2009). As another more realistic demonstration of reporting results with Maneage, here we report that the mean pixel value in that image is 5.12 and the median is 0.86. The skewness in the histogram of Figure 2(b) explains this difference between the mean and median. The dataset is visualized here as a black and white image using the `Convert-Type` program of GNU Astronomy Utilities (Gnuastro). The histogram and basic statistics were generated with Gnuastro’s Statistics program.

PGFPlots⁴ is a great tool to build the plots within \LaTeX and removes the necessity to add further dependencies, just to create the plots. There are high-level libraries like Matplotlib which also generate plots. However, the problem is that they require *many* dependencies, for example see Figure 1 of Alliez et al. (2020). Installing these dependencies from source, is not easy and will harm the reproducibility of your paper in the future.

Furthermore, since PGFPlots builds the plots within \LaTeX , it respects all the properties of your text (for example line width and fonts and etc). Therefore the final plot blends in your paper much more nicely. It also has a wonderful manual⁵.

2. NOTICE AND CITATIONS

To encourage other scientists to publish similarly reproducible papers, please add a notice close to the start of your paper or in the end of the abstract clearly mentioning that your work is fully

⁴ <https://ctan.org/pkg/pgfplots>

⁵ <http://mirrors.ctan.org/graphics/pgf/contrib/pgfplots/doc/pgfplots.pdf>

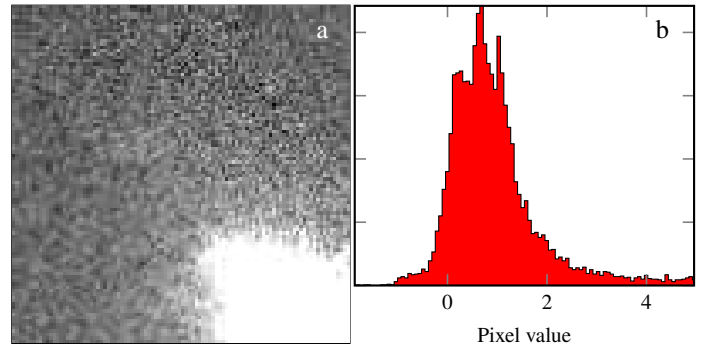


Figure 2: (a) An example image of the Wide-Field Planetary Camera 2, on board the Hubble Space Telescope from 1993 to 2009. This is one of the sample images from the FITS standard webpage, kept as examples for this file format. (b) Histogram of pixel values in (a).

reproducible. One convention we have adopted until now is to put the Git checksum of the project as the last word of the abstract, for example see Akhlaghi (2019), Infante-Sainz et al. (2020) and Akhlaghi et al. (2020)

Finally, don’t forget to cite Akhlaghi et al. (2020) and acknowledge the funders mentioned below. Otherwise we won’t be able to continue working on Maneage. Also, just as another reminder, before publication, don’t forget to follow the “Publication checklist” of `README-hacking.md`.

3. ACKNOWLEDGMENTS

Please include the following paragraph in the Acknowledgement section of your paper. In order to get more funding to continue working on Maneage, we need to to cite it and its funding institutions in your papers. Also note that at the start, it includes version and date information for the most recent Maneage commit you merged with (which can be very helpful for others) as well as very basic information about your CPU architecture (which was extracted during configuration). This CPU information is very important for reproducibility because some software may not be buildable on other CPU architectures, so it is necessary to publish CPU information with the results and software versions.

This project was developed in the reproducible framework of Maneage (*Managing data lineage*, Akhlaghi et al. 2020, latest Maneage commit `ac8eee9`, from 1 Dec 2020). The project was built on an `x86_64` machine with Little Endian byte-order, see Appendix A for the used software and their versions. Maneage has been funded partially by the following grants: Japanese Ministry of Education, Culture, Sports, Science, and Technology (MEXT) PhD scholarship to M. Akhlaghi and its Grant-in-Aid for Scientific Research (21244012, 24253003). The European Research Council (ERC) advanced grant 339659-MUSICOS. The European Union (EU) Horizon 2020 (H2020) research and innovation programmes No 777388 under RDA EU 4.0 project, and Marie Skłodowska-Curie grant agreement No 721463 to the SUNDIAL ITN. The State Research Agency (AEI) of the Spanish Ministry of Science, Innovation and Universities (MCIU) and the European Regional Development Fund (ERDF) under the grant AYA2016-76219-P. The IAC project P/300724, financed by the MCIU, through the Canary Islands Department of Economy,

Knowledge and Employment.

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A. SOFTWARE ACKNOWLEDGEMENT

This research was done with the following free software programs and libraries: Bzip2 1.0.6, Cairo 1.16.0, CFITSIO 3.48, CMake 3.18.1, cURL 7.71.1, Dash 0.5.10.2, Discoteq flock 0.2.3, Expat 2.2.9, File 5.39, Fontconfig 2.13.1, FreeType 2.10.2, Git 2.28.0, GNU Astronomy Utilities 0.12 (Akhlaghi and Ichikawa 2015), GNU Autoconf 2.69.200-babc, GNU Automake 1.16.2, GNU AWK 5.1.0, GNU Bash 5.0.18, GNU Binutils 2.35, GNU Compiler Collection (GCC) 10.2.0, GNU Coreutils 8.32, GNU Diffutils 3.7, GNU Findutils 4.7.0, GNU gettext 0.21, GNU gperf 3.1, GNU Grep 3.4, GNU Gzip 1.10, GNU Integer Set Library 0.18, GNU libiconv 1.16, GNU Libtool 2.4.6, GNU libunistring 0.9.10, GNU M4 1.4.18-patched, GNU Make 4.3, GNU Multiple Precision Arithmetic Library 6.2.0, GNU Multiple Precision Complex library, GNU Multiple Precision Floating-Point Reliably 4.0.2, GNU Nano 5.2, GNU NCURSES 6.2, GNU Readline 8.0, GNU Scientific Library 2.6, GNU Sed 4.8, GNU Tar 1.32, GNU Texinfo 6.7, GNU Wget 1.20.3, GNU Which 2.21, GPL Ghostscript 9.52, Libbsd 0.10.0, Libffi 3.2.1, Libgit2 1.0.1, libICE 1.0.10, Libidn 1.36, Libjpeg v9b, Libpaper 1.1.28, Libpng 1.6.37, libpthread-stubs (Xorg) 0.4, libSM 1.2.3, Libtiff 4.0.10, libXau (Xorg) 1.0.9, libxcb (Xorg) 1.14, libXdmpc (Xorg) 1.1.3, libXext 1.3.4, Libxml2 2.9.9, libXt 1.2.0, Lzip 1.22-rc2, Metastore (forked) 1.1.2-23-fa9170b, OpenSSL 1.1.1a, PatchELF 0.10, Perl 5.32.0, Perl Compatible Regular Expressions 8.44, Pixman 0.38.0, pkg-config 0.29.2, Python 3.8.5, R 4.0.2, Unzip 6.0, util-Linux 2.35, util-macros (Xorg) 1.19.2, WCSLIB 7.3, X11 library 1.6.9, XCB-proto (Xorg) 1.14, xorgproto 2020.1, xtrans (Xorg) 1.4.0, XZ Utils 5.2.5, Zip 3.0 and Zlib 1.2.11. The \LaTeX source of the paper was compiled to make the PDF using the following packages: biber 2.15, biblatex 3.15a, bitset 1.3, caption 56374 (revision), courier 35058 (revision), csquotes 5.2j, date-time 2.60, ec 1.0, etoolbox 2.5j, fancyhdr 3.10, fmtcount 3.07, fontaxes 1.0e, footmisc 5.5b, fp 2.1d, kastrup 15878 (revision), letltxmacro 1.6, logreq 1.0, newtx 1.630, pdfescape 1.15, pdftexcmds 0.33, pgf 3.1.6, pgfplots 1.17, preprint 2011, setspace 6.7a, tex 3.14159265, texgyre 2.501, times 35058 (revision), titlesec 2.13, trimspaces 1.1, txfonts 15878 (revision), ulem 53365 (revision), xcolor 2.12, xkeyval 2.7a and xstring 1.83. We are very grateful to all their creators for freely providing this necessary infrastructure. This research (and many other projects) would not be possible without them.