CODECHECK: An Open Science initiative for the independent execution of computations underlying research articles during peer review to improve reproducibility

Stephen J Eglen
https://sje30.github.io
sje30@cam.ac.uk

Cambridge Computational Biology Institute
University of Cambridge
@StephenEglen

Daniel Nüst
https://nordholmen.net
daniel.nuest@uni-muenster.de

Institute for Geoinformatics
University of Münster
@nordholmen

HTML Slides: http://bit.ly/codecheck22

Declarations and acknowledgements

Declarations

Affiliate editor of *bioRxiv*; editorial board of *Gigabyte*.

These slides accompany our paper: https://f1000research.com/articles/10-253/

Acknowledgements

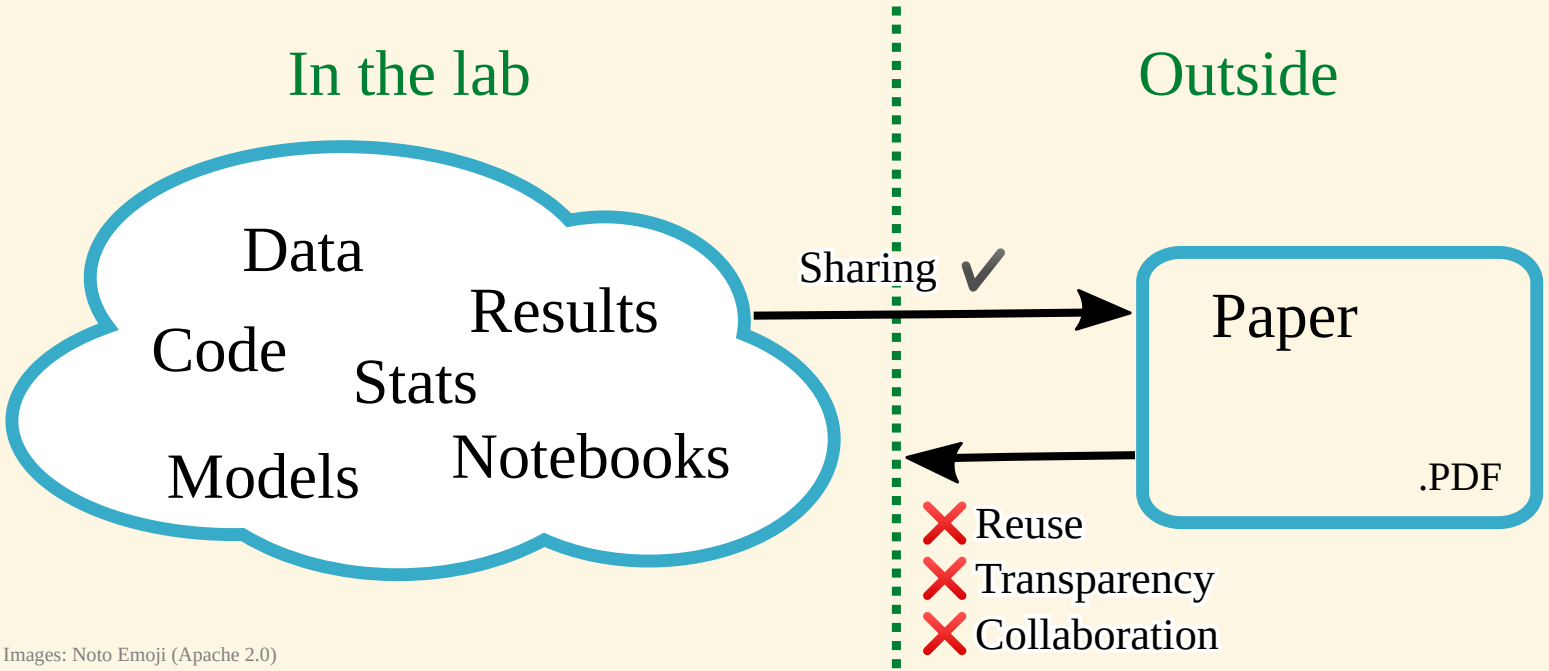
Mozilla mini science grant, UK Software Sustainability Institute.

Editors @ *Gigascience*, *eLife*, *Scientific Data*.

CODECHECK in one slide

1. We take your paper, code and datasets.
2. We run your code on your data.
3. If our results match your results, go to step 5.
4. Else we talk to you to find out where code broke. If you fix your code or data, we return to step 2 and try again.
5. We write a report summarising that we could reproduce your finding.
6. We work with you to freely share your paper, code, data and our reproduction.

Premise



Images: Noto Emoji (Apache 2.0)

We should be sharing material on the left, not the right.

"Paper as advert for Scholarship" (Buckheit & Donoho, 1995)

Approaches to code sharing

- Barnes (2010)

Published online 13 October 2010 | *Nature* **467**, 753 (2010) | doi:10.1038/467753a

Column: World View

Publish your computer code: it is good enough

Freely provided working code — whatever its quality — improves programming and enables others to engage with your research, says Nick Barnes.

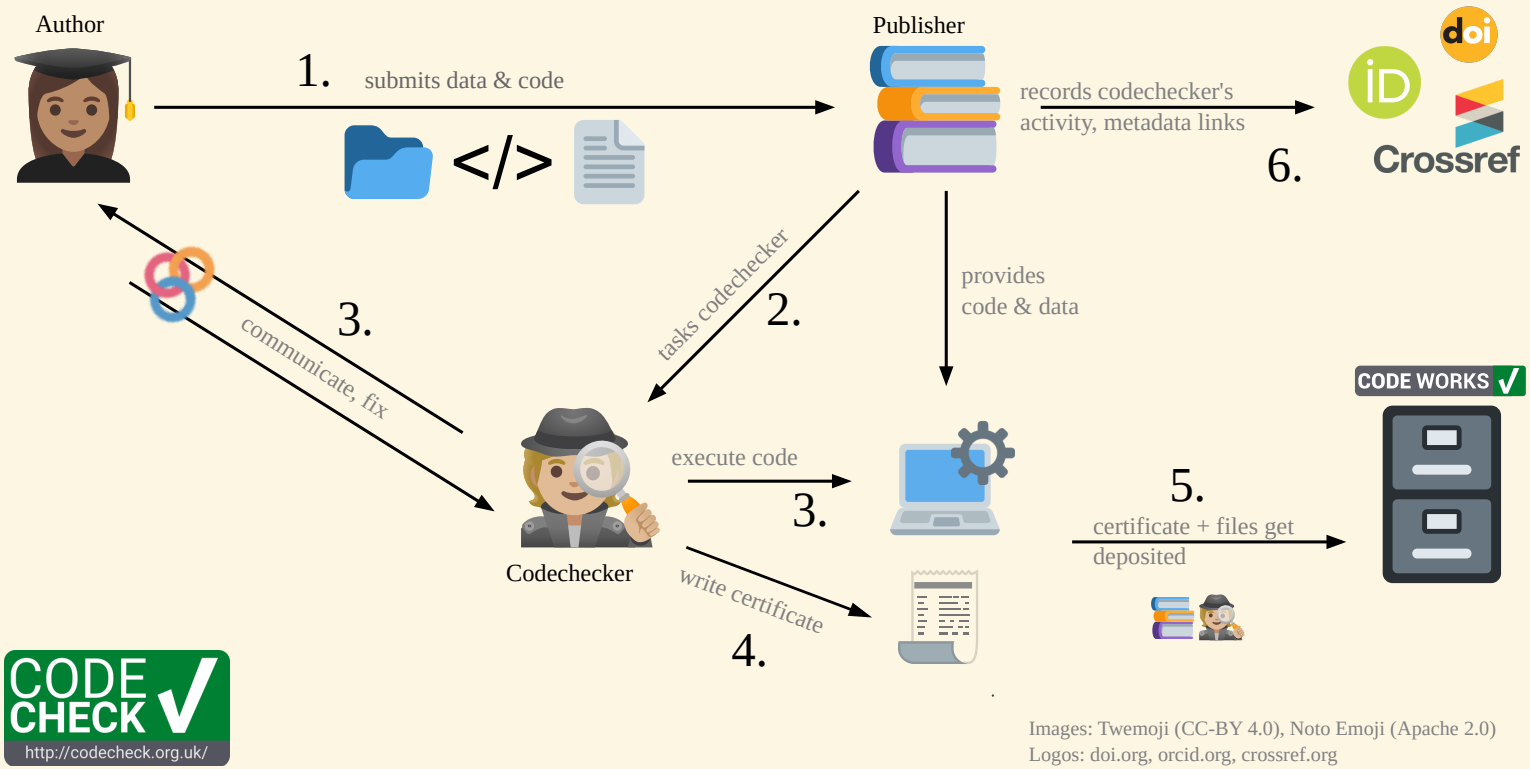
Nick Barnes

- Informal 'code buddy' system
- Community-led *research compedia*.
- Code Ocean (Nature trial)
- Certify reproducibility with confidential data (CASCAD) (Pérignon et al 2019)

The CODECHECK philosophy

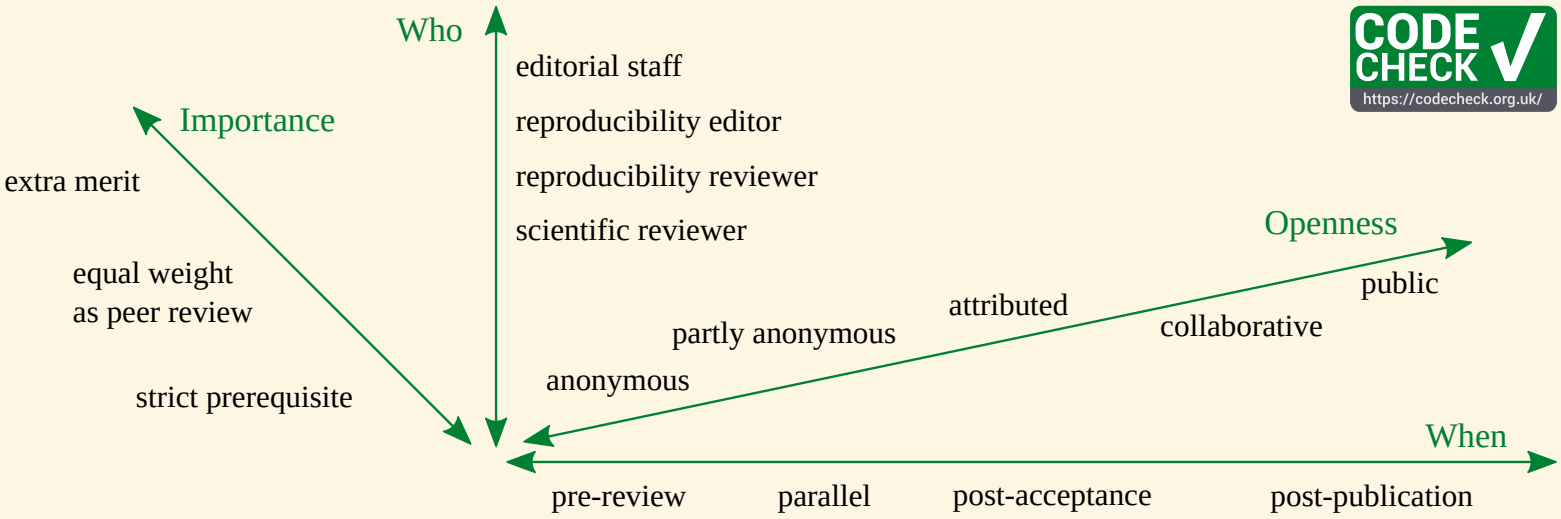
- Systems like Code Ocean set the bar high by "making code reproducible *forever* for *everyone*".
- CODECHECK simply asks "was the code reproducible *once* for *someone* else?"
- We check the code runs and generates the expected number of output files.
- The contents of those output files are not checked, but are available for others to see.
- The validity of the code is *not* checked.

CODECHECK process



Images: Twemoji (CC-BY 4.0), Noto Emoji (Apache 2.0)
Logos: doi.org, orcid.org, crossref.org

Variations in a codecheck



Core principles

1. Codecheckers record but don't investigate or fix.
2. Communication between humans is key.
3. Credit is given to codecheckers.
4. Workflows must be auditable.
5. Open by default and transitional by disposition.

Who does the work?

1. **AUTHOR** provides code/data and instructions on how to run.
2. **CODECHECKER** runs code and writes certificate.
3. **PUBLISHER** oversees process, helps depositing artifacts, and persistently publishes certificate.

Who benefits?

1. **AUTHOR** gets early check that "code works"; gets snapshot of code archived and increased trust in stability of results.
2. **CODECHECKER** gets insight in latest research and methods, credit from community, and citable object.
3. **PUBLISHER** Gets citable certificate with code/data bundle to share and increases reputation of published articles.
4. **PEER REVIEWERS** can see certificate rather than check code themselves.
5. **READER** Can check certificate and build upon work immediately.

Our register of certificates

https://codecheck.org.uk/register/

CODECHECK Register

Certificate	Repository	Type	Issue	Report	Check date
2020-001	Piccolo-2020	journal (GigaScience)	NA	http://doi.org/10.5281/zenodo.3674056	2019-02-14
2020-002	Reproduction-Hancock	community	2	http://doi.org/10.5281/zenodo.3750741	2020-04-13
2020-003	Hopfield-1982	community	1	https://doi.org/10.5281/zenodo.3741797	2020-04-06
2020-004	Barto-Sutton-Anderson-1983	community	4	https://doi.org/10.5281/zenodo.3827371	2020-05-14
2020-005	Larisch-reproduction	community	5	https://doi.org/10.5281/zenodo.3959175	2020-07-23
2020-006	Detorakis-reproduction	community	6	https://doi.org/10.5281/zenodo.3948353	2020-07-16
2020-007	Hathway-Goodman-2018	community	7	NA	NA
2020-008	covid-uk	community (preprint)	8	http://doi.org/10.5281/zenodo.3746024	2020-04-09
2020-009	2020-cov-tracing	community (preprint)	9	http://doi.org/10.5281/zenodo.3767060	2020-04-26
2020-010	covid-report9	community (preprint)	14	https://doi.org/10.5281/zenodo.3865491	2020-05-29
2020-011	covid19model-nature	community (in press)	18	https://doi.org/10.5281/zenodo.3893138	2020-06-13
2020-012	covid19model-report23	community (preprint)	19	https://doi.org/10.5281/zenodo.3893617	2020-06-14
2020-013	Spitschan2020_bioRxiv	community (preprint)	20	https://doi.org/10.5281/zenodo.3947959	2020-07-14
2020-014	Sadeh-and-Clopath	community	21	https://doi.org/10.5281/zenodo.3967326	2020-07-28
2020-015	Liou-and-Bateman	community	22	https://doi.org/10.5281/zenodo.3978402	2020-08-04
2020-016	OpeningPractice	community	15	https://doi.org/10.5281/zenodo.3981253	2020-06-02

CSV source | searchable CSV | JSON | Markdown

Example certificate: https://zenodo.org/record/3865491/files/codecheck.pdf

"It ain't pretty, but it works" (Hilda Bastian)

Sabine L.van Elsland
@SabineLvE

Independent review @StephenEglen confirmed that @MRC_Outbreak team's #COVID19 simulation is reproducible: thumbs up from code-checking efforts @nature #COVID19 #covid19science

nature.com
Critiqued coronavirus simulation gets thumbs up from code-checking ef…
Nature - Influential model judged reproducible — although software engineers called its code ‘horrible’ and ‘a buggy mess’.

Limitations

1. CODECHECKER time is valuable, so needs credit.
2. Very easy to cheat the system, but who cares?
3. Author's code/data must be freely available.
4. Deliberately low threshold for gaining a certificate.
5. High-performance compute is a resource drain.
6. Cannot (yet) support all thinkable/existing workflows and languages.

Next steps

1. Embedding into journal workflows.
2. Training a community of codecheckers.
3. Funding for a codecheck editor.
4. Come and get involved

For more information please see: http://codecheck.org.uk and #CODECHECK