The Alan Turing Institute

The Turing Way

Reproducible, Inclusive, Collaborative Data Science

Kirstie Whitaker

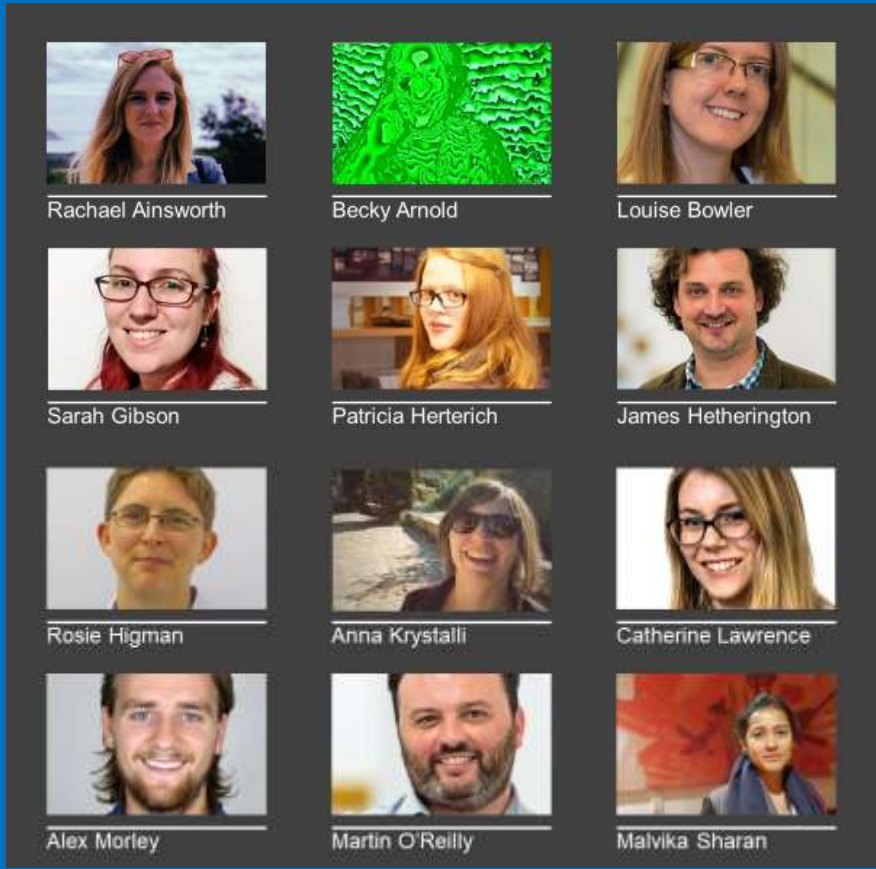
Pronouns: she/her

#PyDataCambridge #TuringWay @kirstie_j

https://doi.org/10.5281/zenodo.3543478

The Turing Way is:

- a book
- a community
- a global collaboration
- a whole tonne of work



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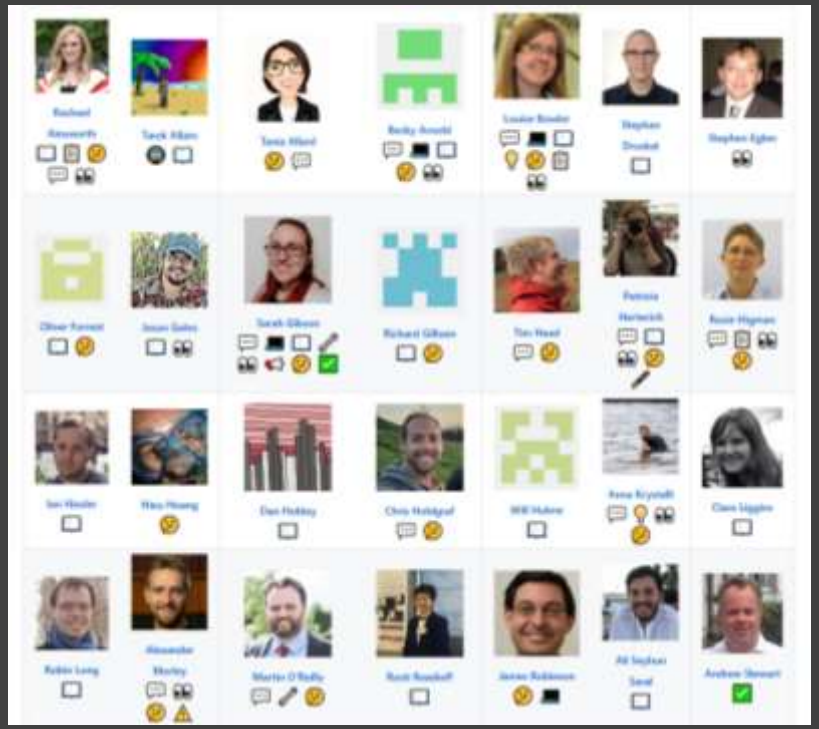
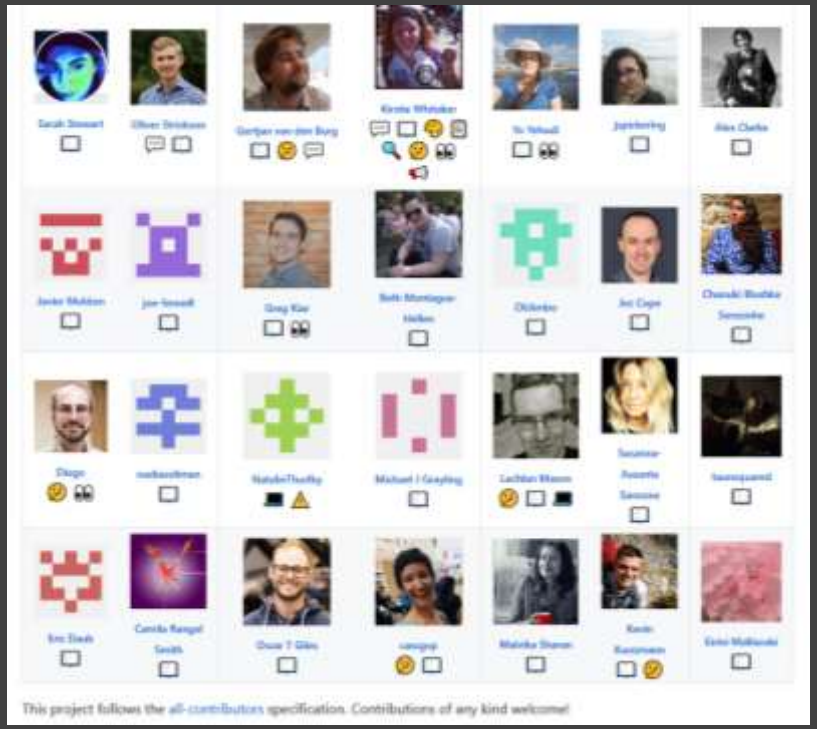
Thank you to all our contributors





https://github.com/alan-turing-institute/the-turing-way#contributors
https://allcontributors.org/docs/en/emoji-key

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An introduction to me

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Picture credit: Chris Gorgolewski
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Academic errors have real world effects

	B	C	I	J	K	L	M
2			Real GDP growth				
3			Debt/GDP				
4	Country	Coverage	30 or less	30 to 60	60 to 90	90 or above	30 or less
26			3.7	3.0	3.5	1.7	5.5
27	Minimum		1.6	0.3	1.3	-1.8	0.8
28	Maximum		5.4	4.9	10.2	3.6	13.3
29							
30	US	1946-2009	n.a.	3.4	3.3	-2.0	n.a.
31	UK	1946-2009	n.a.	2.4	2.5	2.4	n.a.
32	Sweden	1946-2009	3.6	2.9	2.7	n.a.	6.3
33	Spain	1946-2009	1.5	3.4	4.2	n.a.	9.9
34	Portugal	1952-2009	4.8	2.5	0.3	n.a.	7.9
35	New Zealand	1948-2009	2.5	2.9	3.9	-7.9	2.6
36	Netherlands	1956-2009	4.1	2.7	1.1	n.a.	6.4
37	Norway	1947-2009	3.4	5.1	n.a.	n.a.	5.4
38	Japan	1946-2009	7.0	4.0	1.0	0.7	7.0
39	Italy	1951-2009	5.4	2.1	1.8	1.0	5.6
40	Ireland	1948-2009	4.4	4.5	4.0	2.4	2.9
41	Greece	1970-2009	4.0	0.3	2.7	2.9	13.3
42	Germany	1946-2009	3.9	0.9	n.a.	n.a.	3.2
43	France	1949-2009	4.9	2.7	3.0	n.a.	5.2
44	Finland	1946-2009	3.8	2.4	5.5	n.a.	7.0
45	Denmark	1950-2009	3.5	1.7	2.4	n.a.	5.6
46	Canada	1951-2009	1.9	3.6	4.1	n.a.	2.2
47	Belgium	1947-2009	n.a.	4.2	3.1	2.6	n.a.
48	Austria	1948-2009	5.2	3.3	-3.8	n.a.	5.7
49	Australia	1951-2009	3.2	4.9	4.0	n.a.	5.9
50							
51			4.1	2.8	2.8	=AVERAGE(L30:L44)	

https://statmodeling.stat.columbia.edu/2013/04/16/memo-to-reinhart-and-rogoff-i-think-its-best-to-admit-your-errors-and-go-on-from-there
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The humans are the hardest part of reproducibility

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		Data	
		Same	Different
Analysis	Same	Reproducible	Replicable
	Different	Robust	Generalisable

https://the-turing-way.netlify.com/reproducibility/03/definitions.html

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Barriers to reproducible research

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Requires additional skills

Plead the 5th

Support additional users

Takes time

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https://www.bbc.co.uk/programmes/p0704h04
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https://bletchleypark.org.uk
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University network

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The Institute's partners and collaborators

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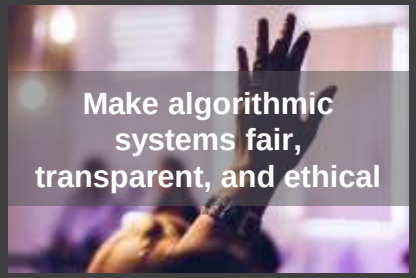
Challenges

Advance data science and artificial intelligence to…



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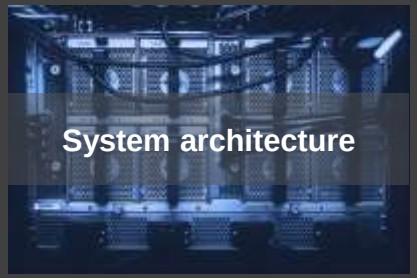
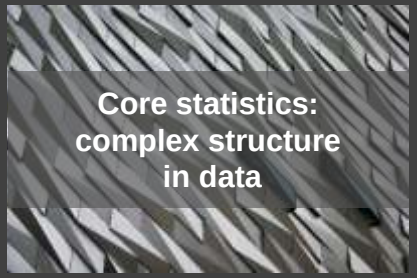
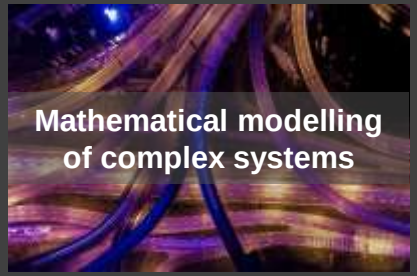
Core capabilities







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Martin O’Reilly

“Make reproducible research too easy not to do.”

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If we can’t do it here, we can’t do it at all.”

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The Turing Way

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Welcome to the Turing Way

The Turing Way is a lightly opinionated guide to reproducible data science.

Our goal is to provide all the information that researchers need at the start of their projects to ensure that they are easy to reproduce at the end.

This also means making sure PhD students, postdocs, PIs and funding teams know which parts of the "responsibility of reproducibility" they can affect, and what they should do to nudge data science to being more efficient, effective and understandable.

A bit more background

Reproducible research is necessary to ensure that scientific work can be trusted. Funders and publishers are beginning to require that publications include access to the underlying data and the analysis code. The goal is to ensure that all results can be independently verified and built upon in future work. This is sometimes easier said than done. Sharing these research outputs means understanding data management, library sciences, sofware development, and continuous integration techniques: skills that are not widely taught or expected of academic researchers and data scientists.

The Turing Way is a handbook to support students, their supervisors, funders and journal editors

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Wilkinson et al., Sci. Data, 2016. doi: 10.1038/sdata.2016.18

https://doi.org/10.5281/zenodo.3543478

Catherine Lawrence

“We should ensure all our processes for running programmes are FAIR.

- Findable (intranet)
- Accessible (EDI)
- Interoperable across programmes and projects
- Reusable (bus factor)”

https://www.turing.ac.uk/people/business-team/catherine-lawrence

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Testing for research

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Is your code doing what you think its doing?

https://the-turing-way.netlify.com/testing/testing.html

https://www.toptal.com/qa/how-to-write-testable-code-and-why-it-matters

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```
Assert.AreEqual(
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```

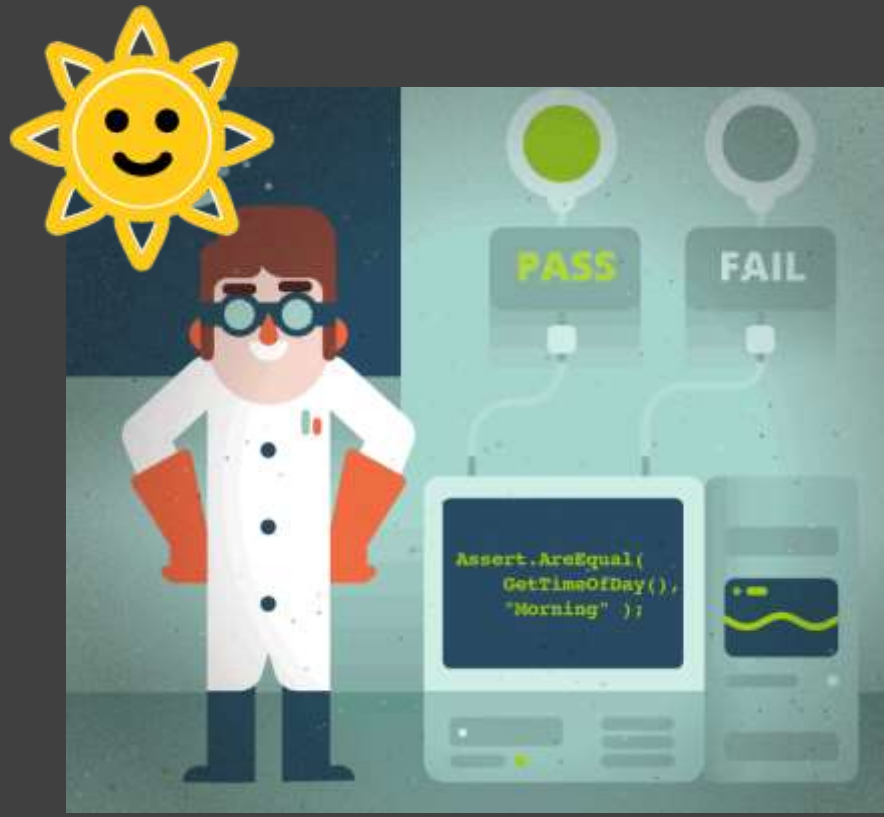

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Louise Bowler

“Add a test before you change anything.”

https://www.turing.ac.uk/people/researchers/louise-bowler
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Louise Bowler

“Add a test before you change anything.

Particularly if you’re just going to tidy up your code before sharing it.”

https://www.turing.ac.uk/people/researchers/louise-bowler
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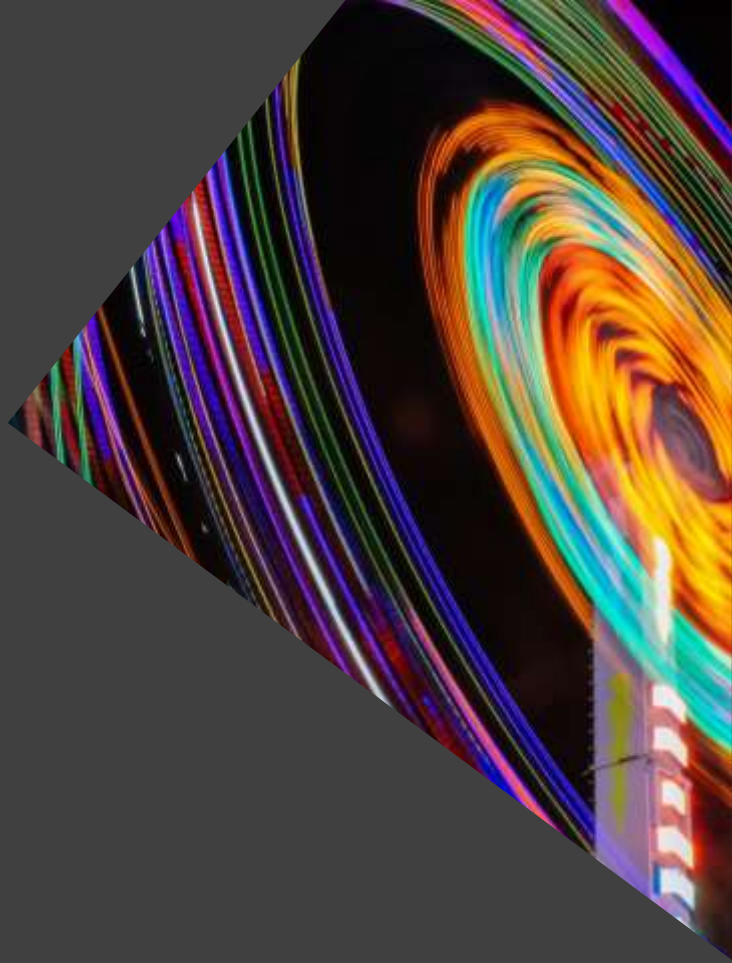
Continuous Analysis



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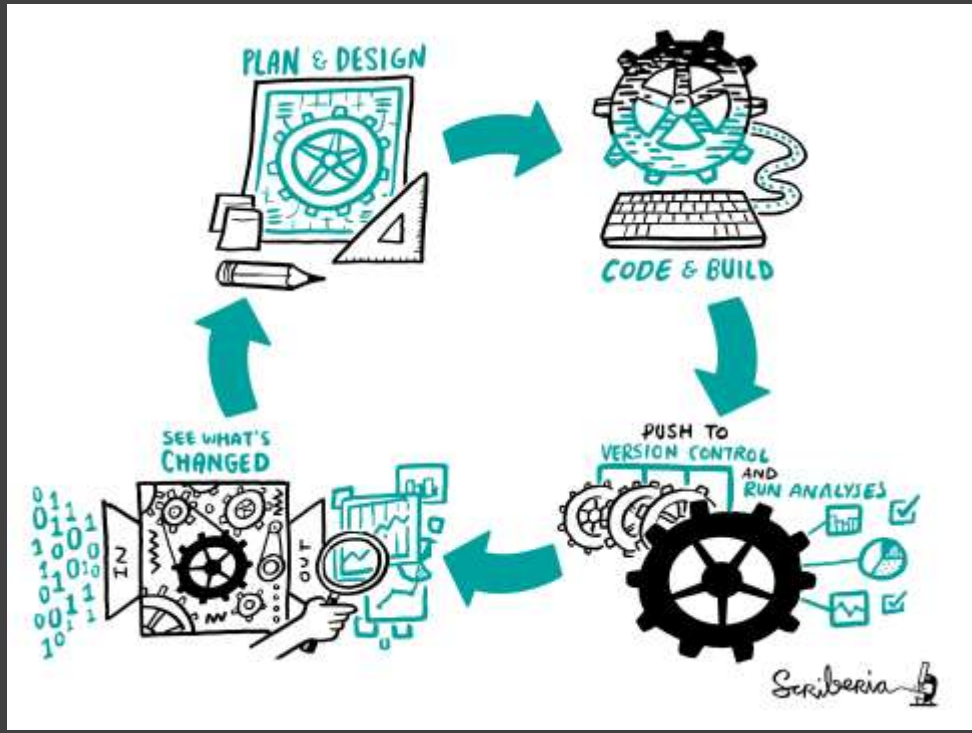
- Plan and design your experiment
- Write down those steps in code
- Push to version control and run the analyses
  - Traditionally done on the cloud, but the important part is that **all steps** are run **every time**
- Test to see what's changed



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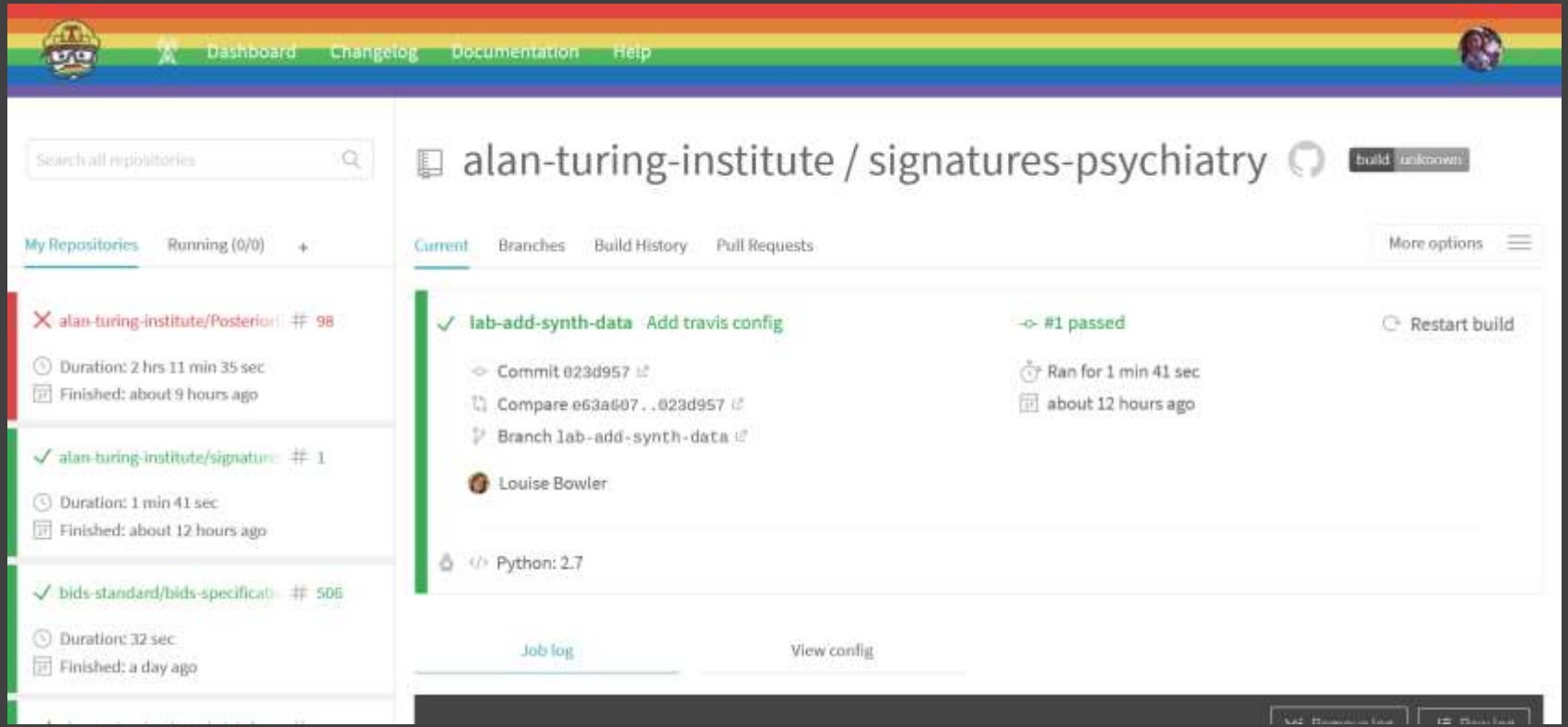

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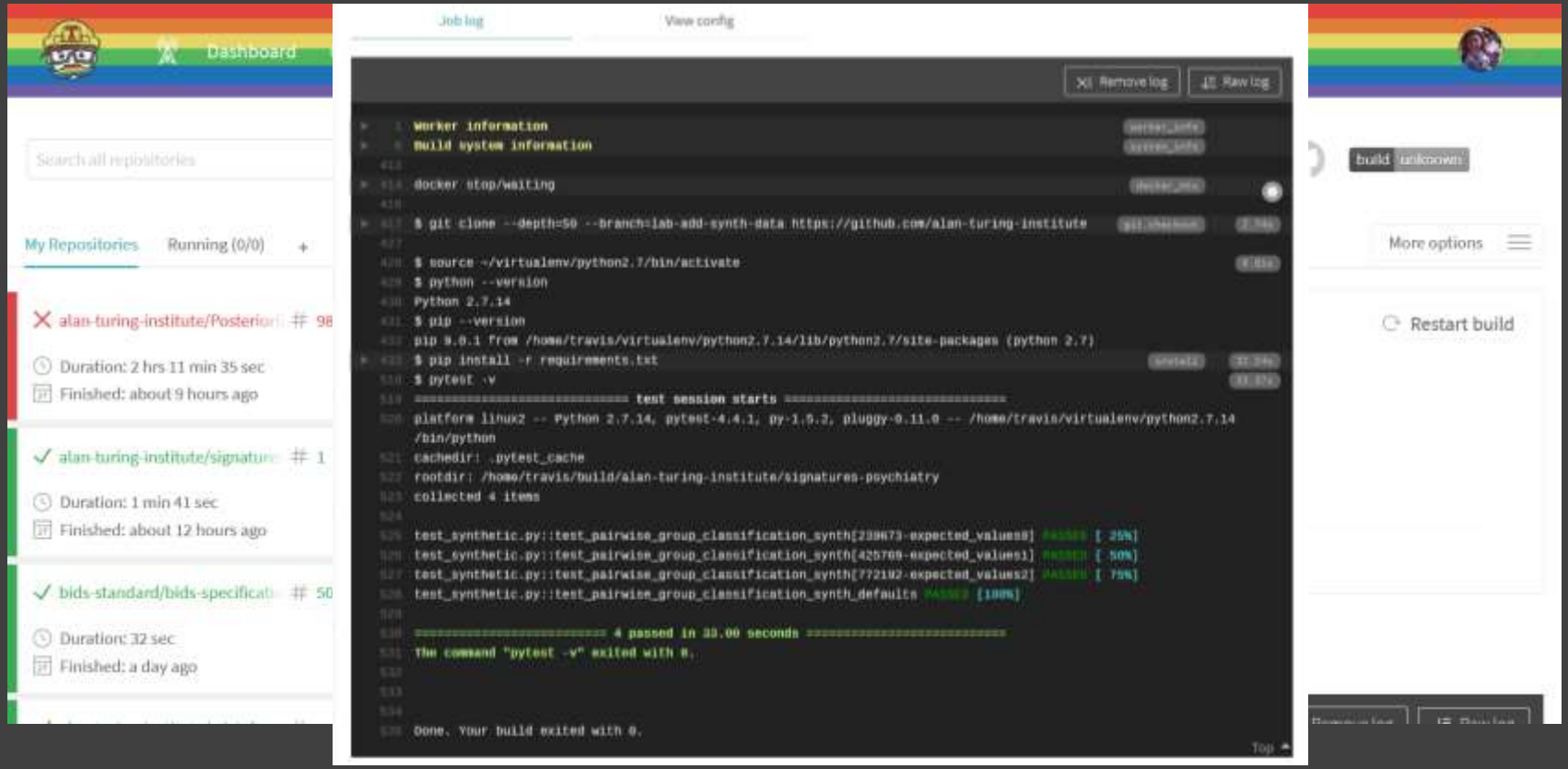

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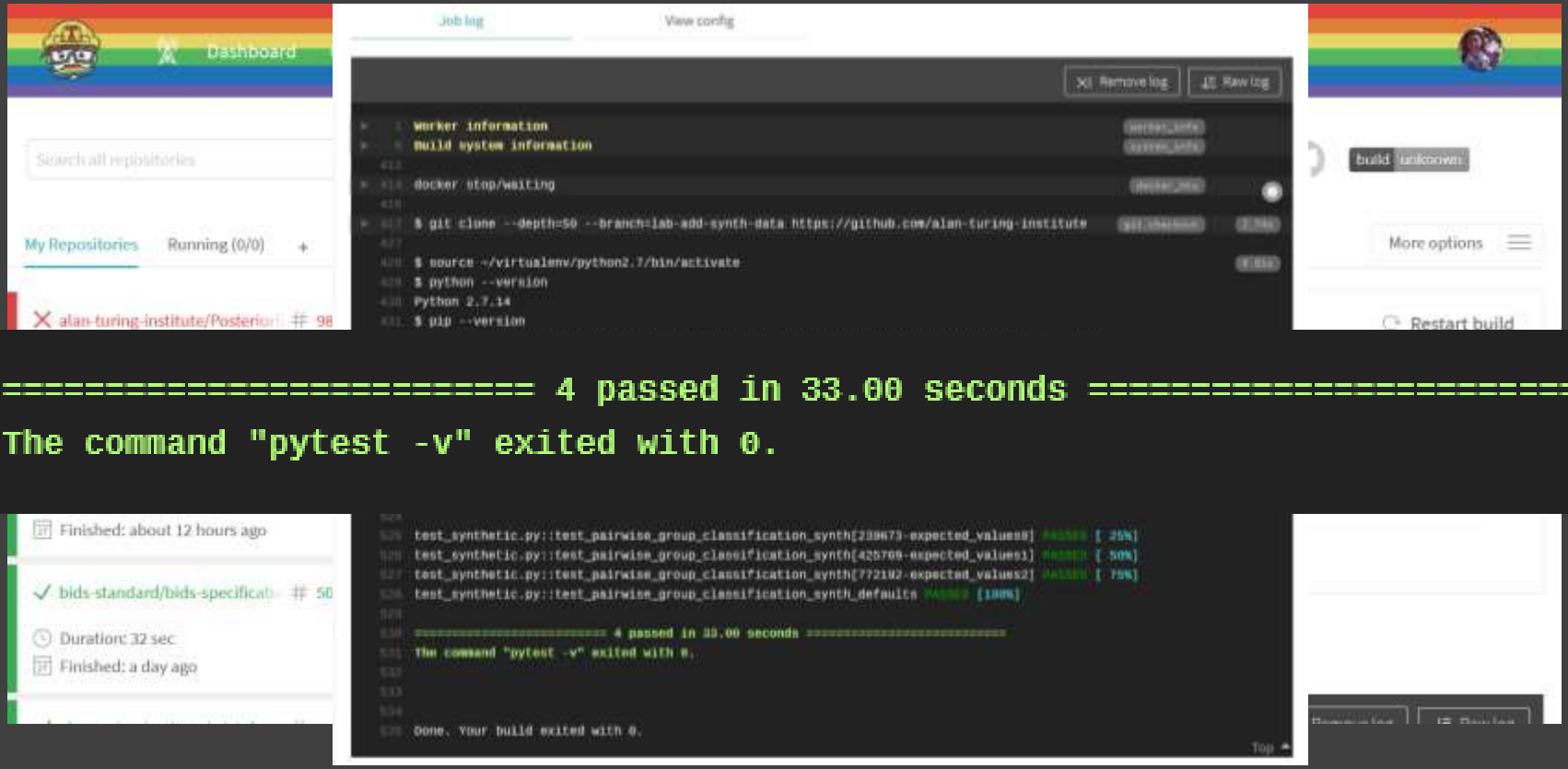


```
529
530 ========== 4 passed in 33.00 seconds ==========
531 The command "pytest -v" exited with 0.
532
```

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https://the-turing-way.netlify.com/continuous_integration/continuous_integration.html

- Run the analysis from start to finish as you work
- Many times tests will fail as expected: you're developing the analysis!
- Sometimes tests will fail unexpectedly
- CI makes you be explicit about what has changed

https://the-turing-way.netlify.com/continuous_integration/continuous_integration.html

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1. Introduction
2. Reproducibility
3. Open Research
4. Version Control
5. Collaborating on GitHub/GitLab
6. Research Data Management
7. Reproducible Environments
8. Testing
9. Reviewing
10. Continous Integration
11. Reproducible Research with Make
12. Risk Assessment

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Becky Arnold

“There are a lot of things you need to know before you can jump into continuous integration.

Version control is a prerequisite for pretty much everything.”

https://software.ac.uk/about/fellows/becky-arnold
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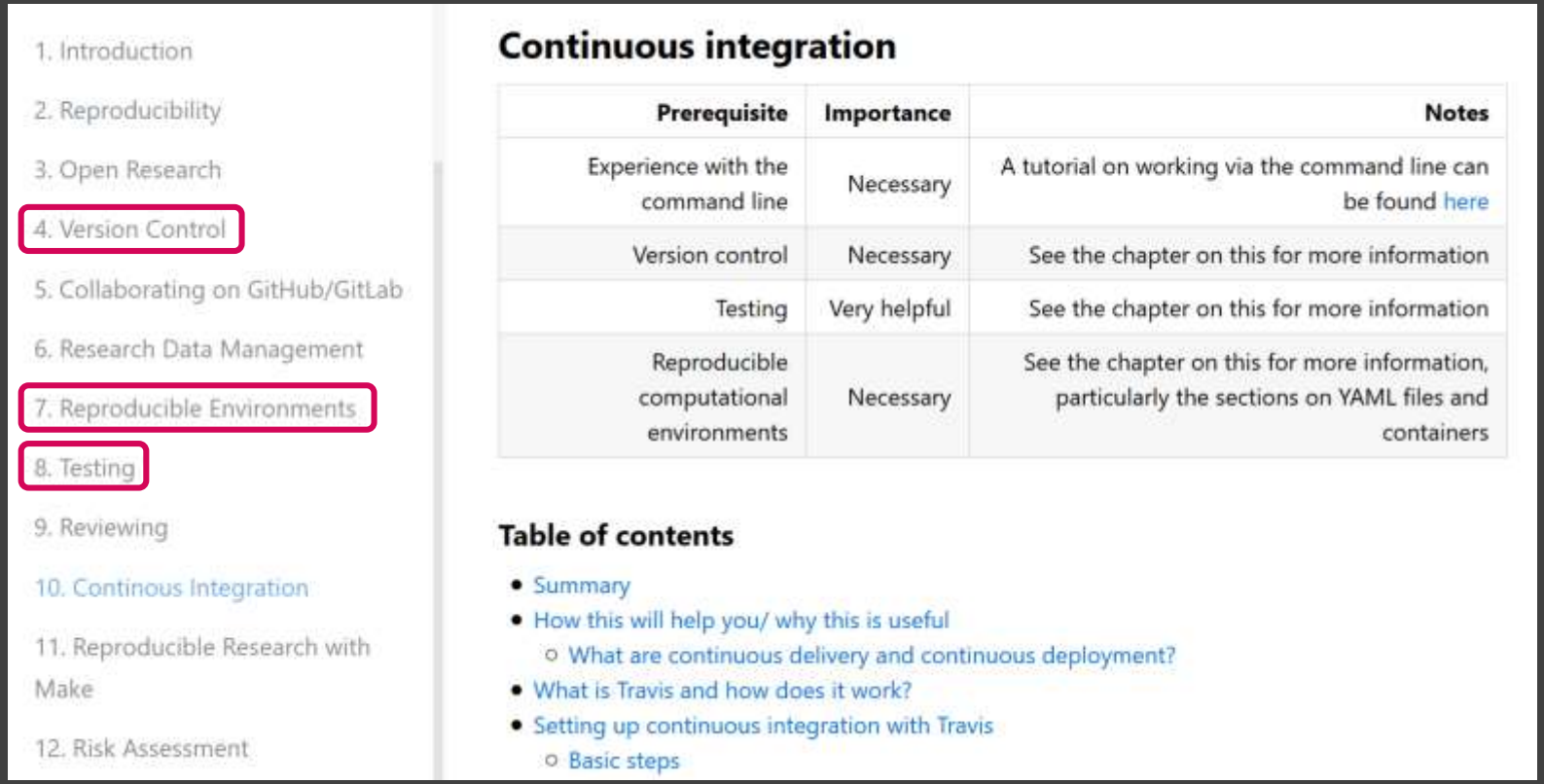

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Version control

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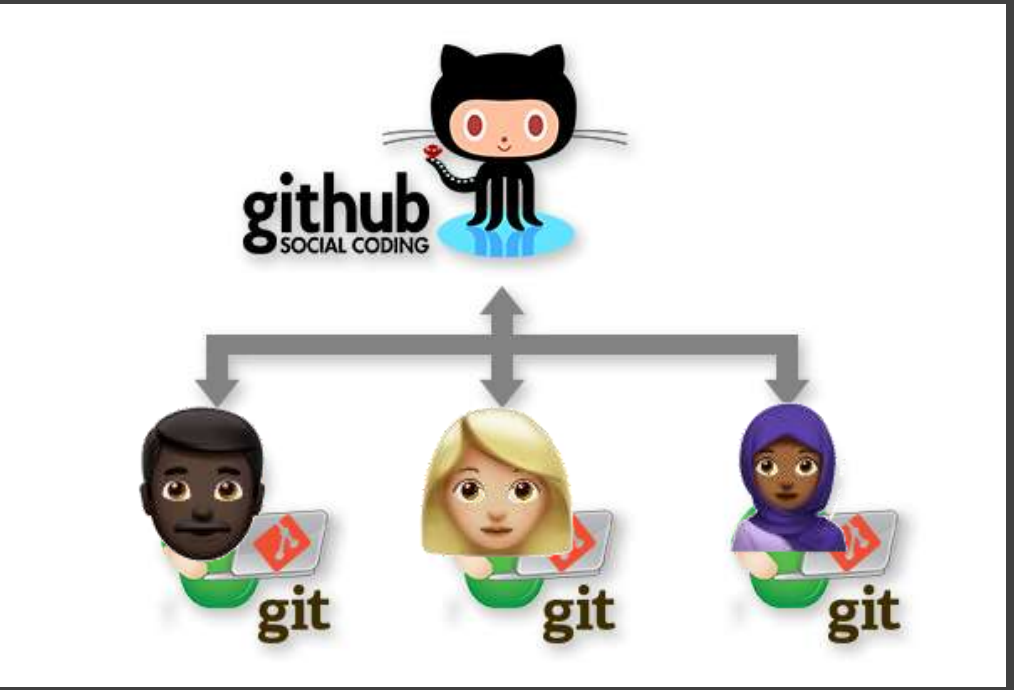

https://the-turing-way.netlify.com/collaborating_github/collaborating_github.html
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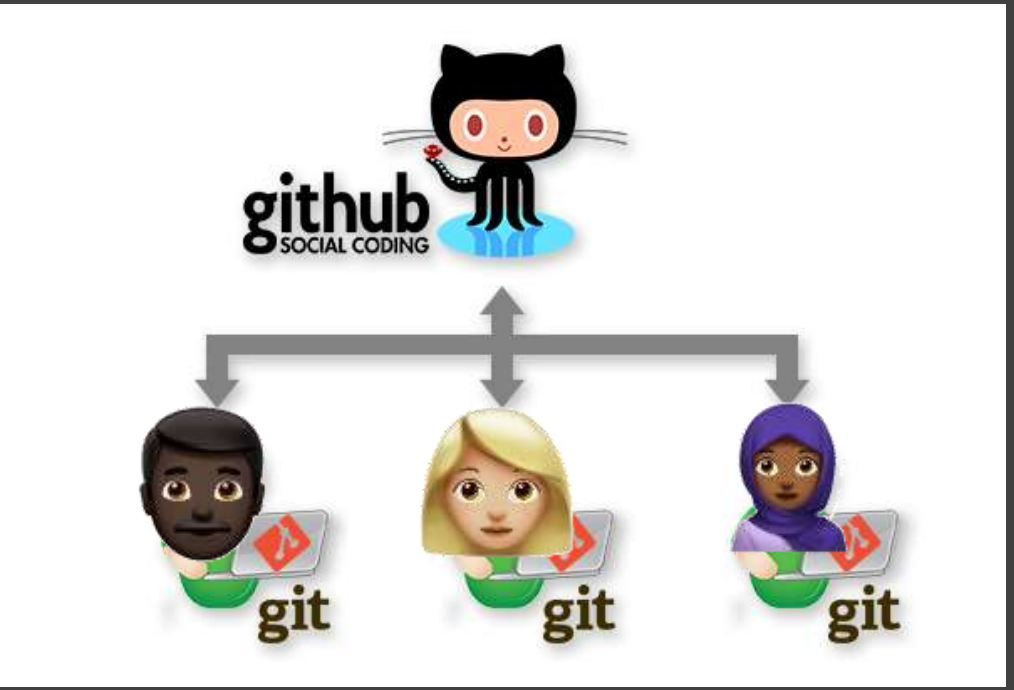
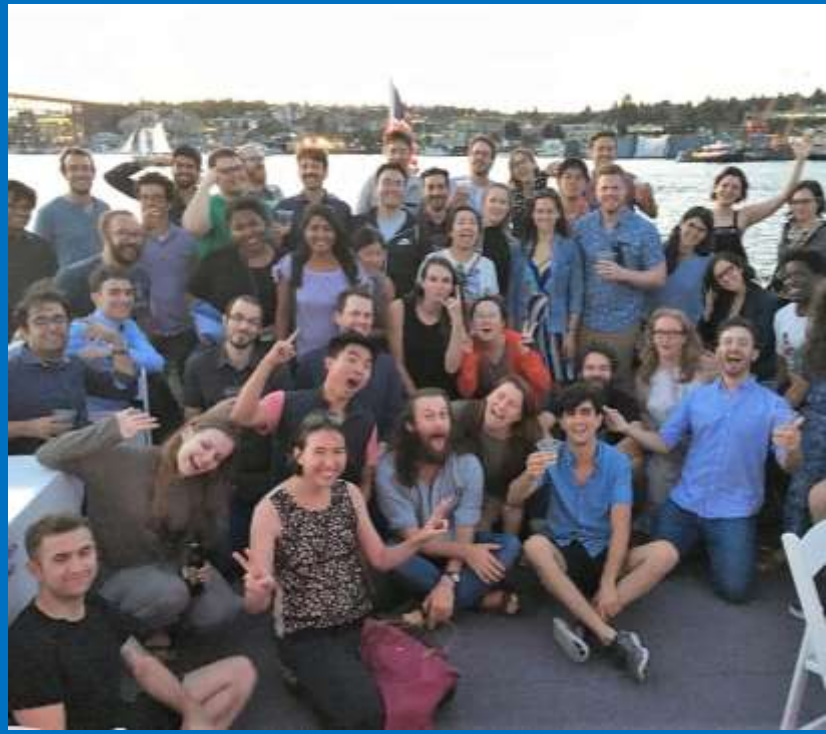


https://the-turing-way.netlify.com/collaborating_github/collaborating_github.html
https://the-turing-way.netlify.com/version_control/version_control.html #PyDataCambridge #TuringWay @kirstie_j
https://neurohackademy.org https://doi.org/10.5281/zenodo.3543478

Neurohackademy

“Every hackathon should have a gong that you can ring when you complete your first pull request.”



https://neurohackademy.org
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https://doi.org/10.5281/zenodo.3543478

Beyond reproducibility

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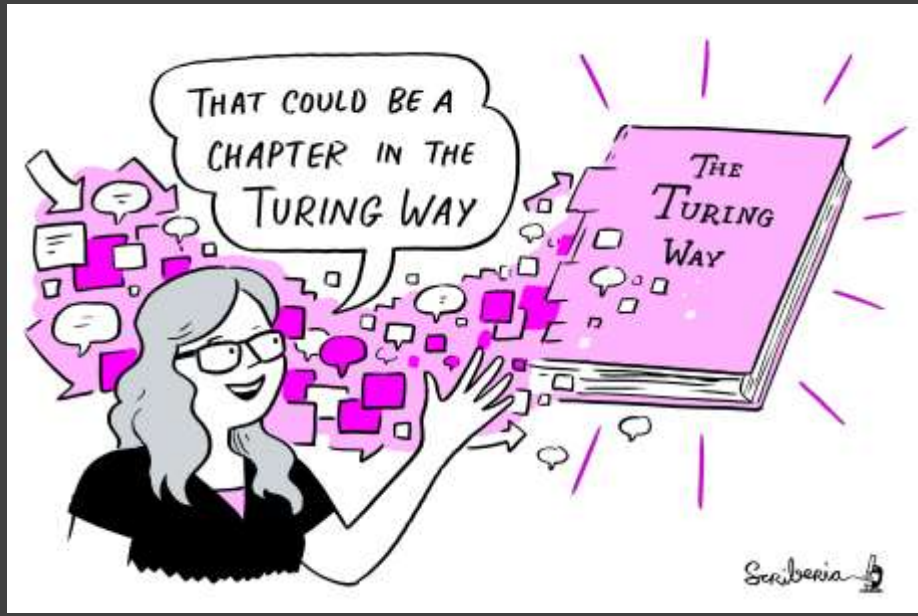
https://doi.org/10.5281/zenodo.3543478

The expansion

- Create a handbook for all data science practices
  - Reproducibility
  - Scoping and designing a data science project
  - Communication and visualisation
  - Ethics
  - Collaborative working



https://github.com/alan-turing-institute/the-turing-way/blob/master/project_management/tps-funding-application-20190429.md

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https://doi.org/10.5281/zenodo.3543478

Scoping & designing a data science project

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An algorithm is a set of instructions

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An algorithm is a set of instructions

AI is not magic

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“AI is whatever hasn't been done yet.”

- No agreed upon definition
- There is a lot of hype
- Setting appropriate expectations in collaborations is really important and hard to do!

https://xkcd.com/1838
https://en.wikipedia.org/wiki/AI_effect

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Communicating your work

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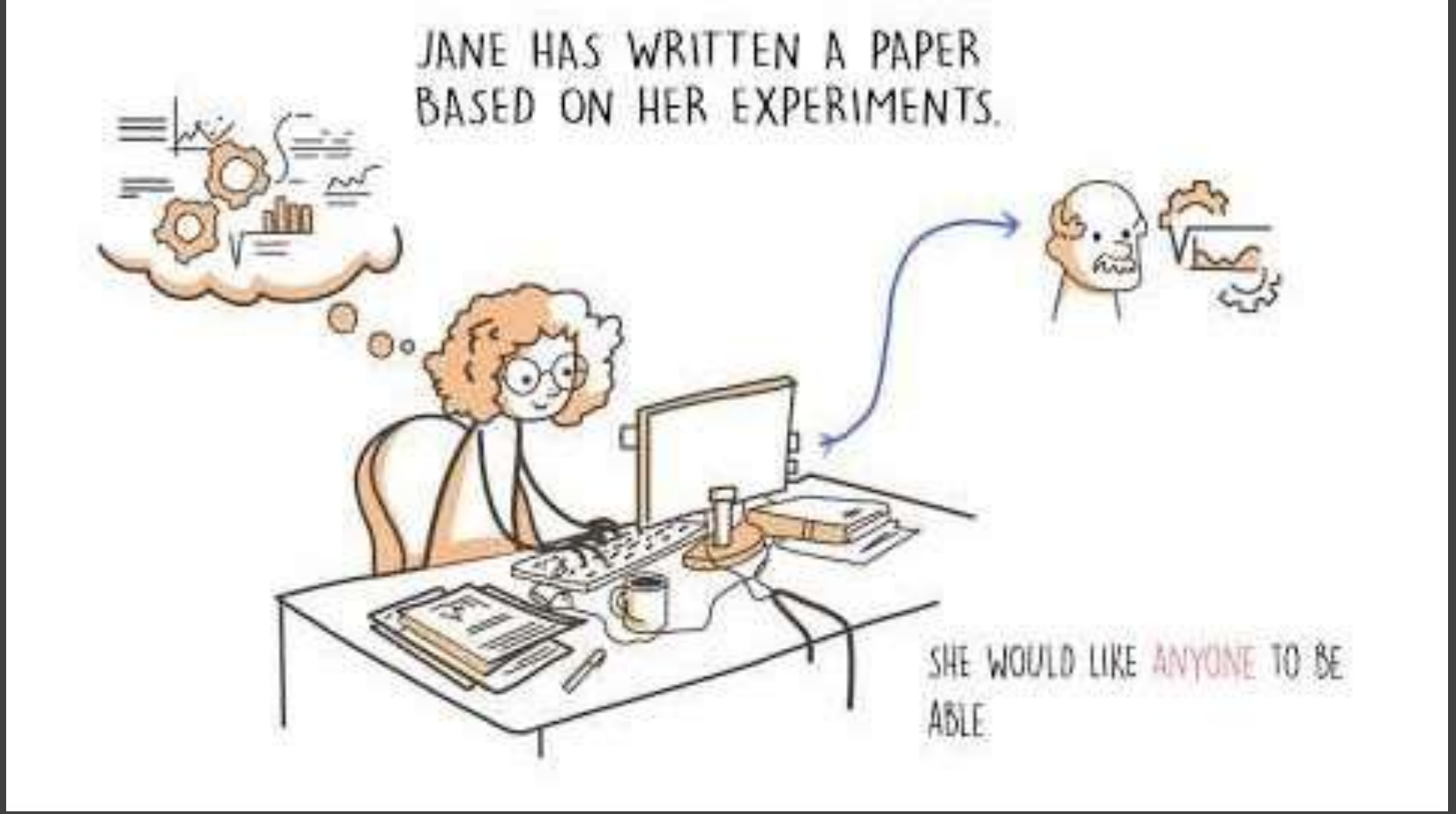

Drawing by Juliette Taka: https://twitter.com/mybinderteam/status/1082556317842264064
Animation by Pix Video, via Open Dream Kit project: https://youtu.be/a5i42lSj-L4

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https://doi.org/10.5281/zenodo.3543478

- Leave PDFs behind
- Share the responsibility of reproducibility with busy PIs
- Requires version control, capturing environment and new build for each change

https://doi.org/10.5281/zenodo.3543478

Sarah Gibson

“It took me a while to feel like I knew enough to contribute to Binder. But the team are always so excited to have my input. Its really motivating to be part of such a welcoming community.”

https://www.turing.ac.uk/people/researchers/sarah-gibson
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https://doi.org/10.5281/zenodo.3543478

https://chanzuckerberg.com/rfa/essential-open-source-software-for-science
https://medium.com/@cziscience/the-invisible-foundations-of-biomedicine-4ab7f8d4f5dd

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https://doi.org/10.5281/zenodo.3543478

Ethical research

https://doi.org/10.5281/zenodo.3543478

Image credit: Robin Champieux & Danielle Robinson

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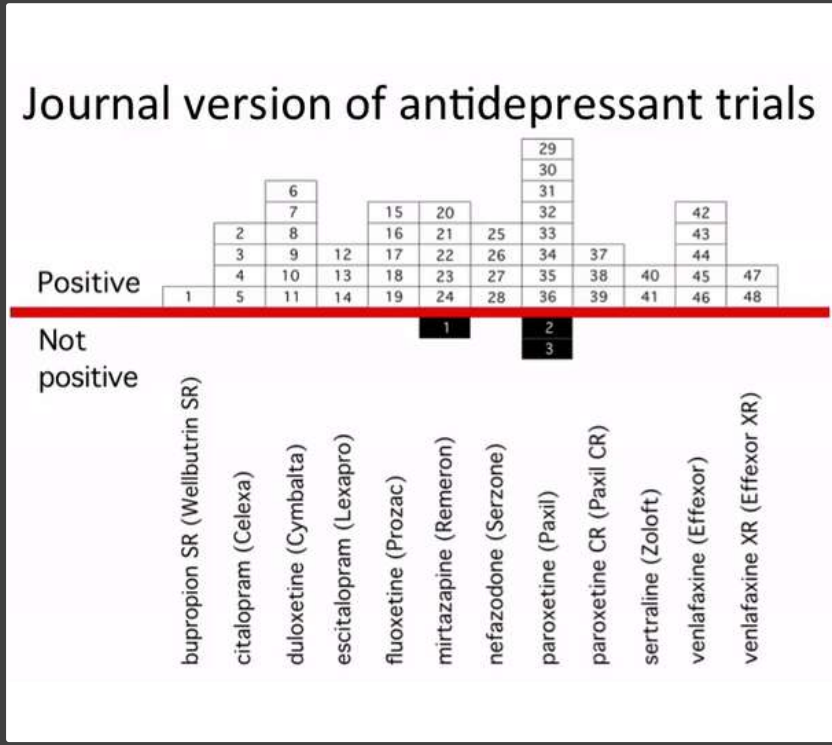
Ethical data science

– Transparent publishing



https://twitter.com/eturnermd1/status/737436322344927232
https://doi.org/10.6084/m9.figshare.3381379

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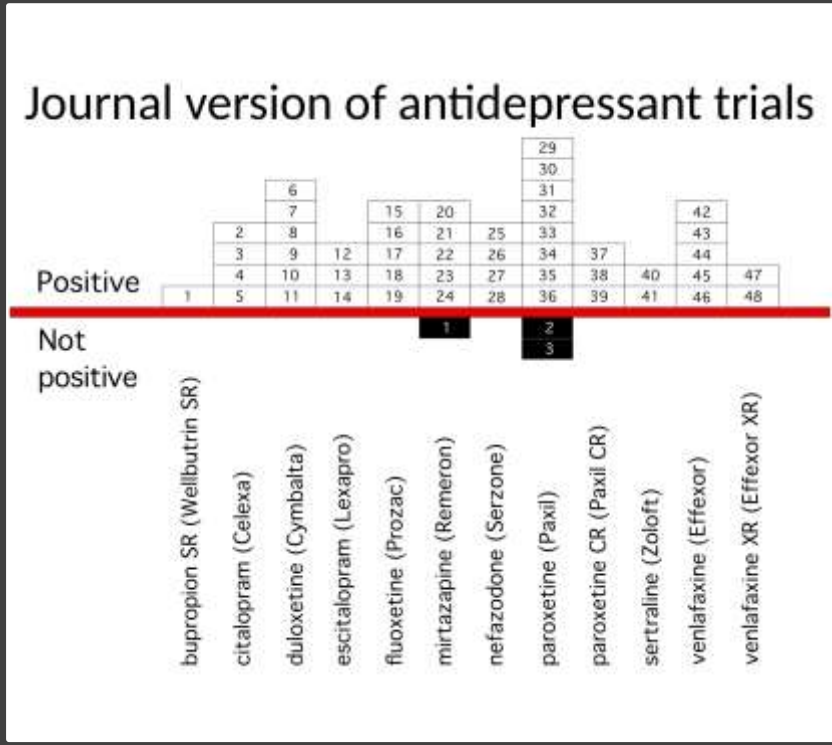
https://doi.org/10.5281/zenodo.3543478

Ethical data science

– Transparent publishing



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https://doi.org/10.6084/m9.figshare.3381379

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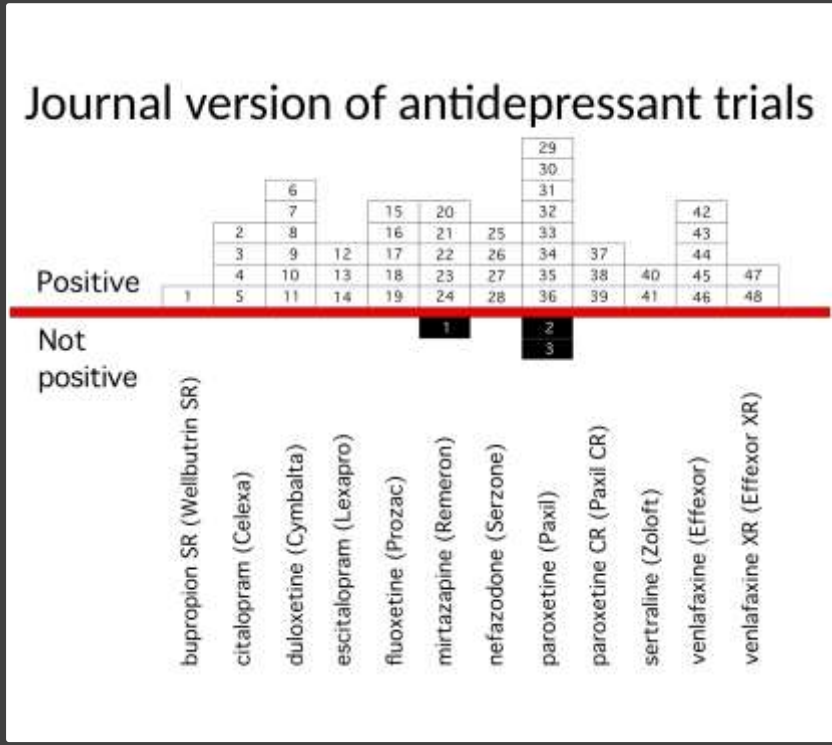
https://doi.org/10.5281/zenodo.3543478

Ethical data science

– Transparent publishing
– Consent (GDPR)
– Privacy (safe haven)
– Societal harm



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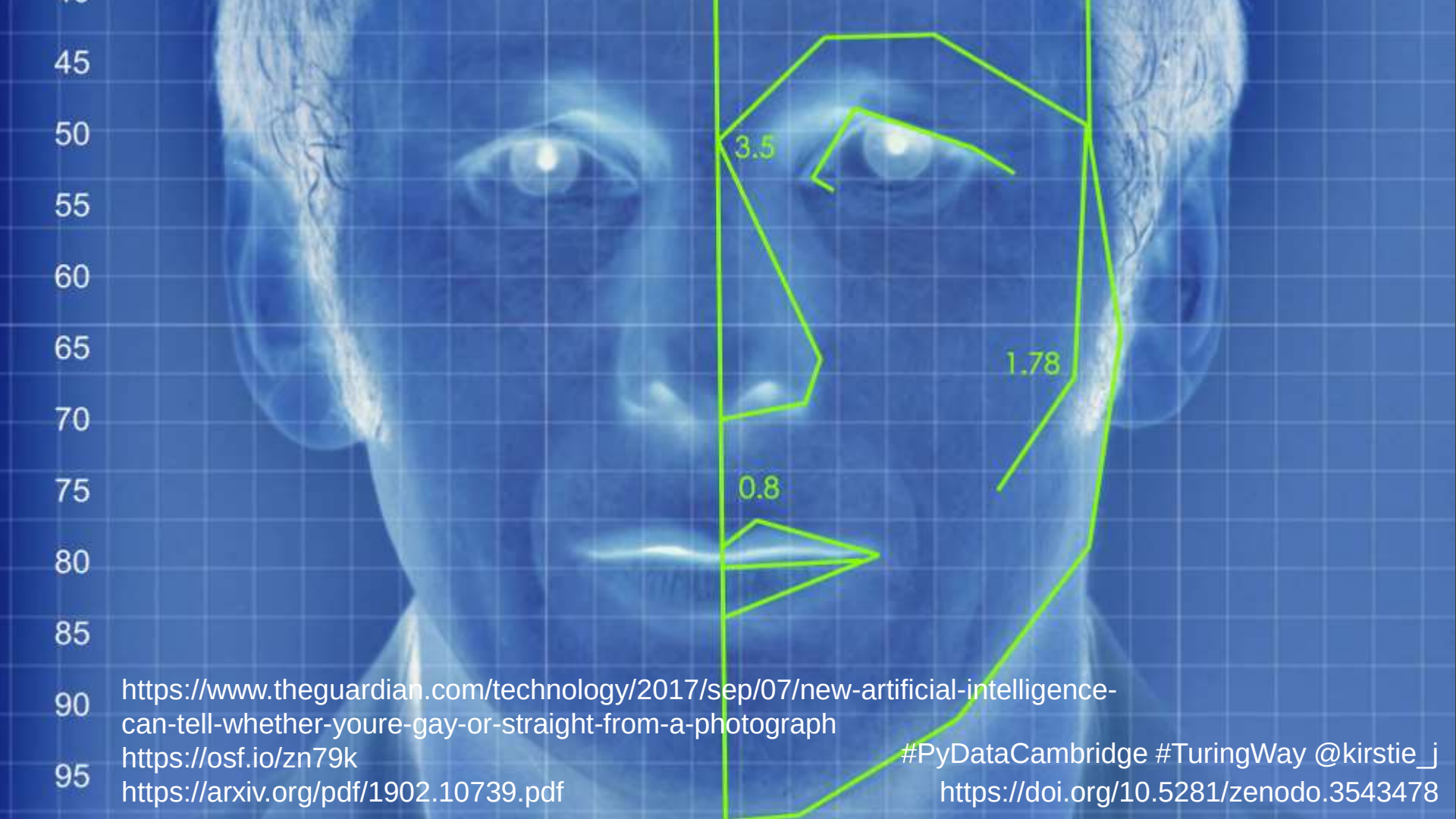

https://www.theguardian.com/technology/2017/sep/07/new-artificial-intelligence-can-tell-whether-youre-gay-or-straight-from-a-photograph
https://osf.io/zn79k
https://arxiv.org/pdf/1902.10739.pdf

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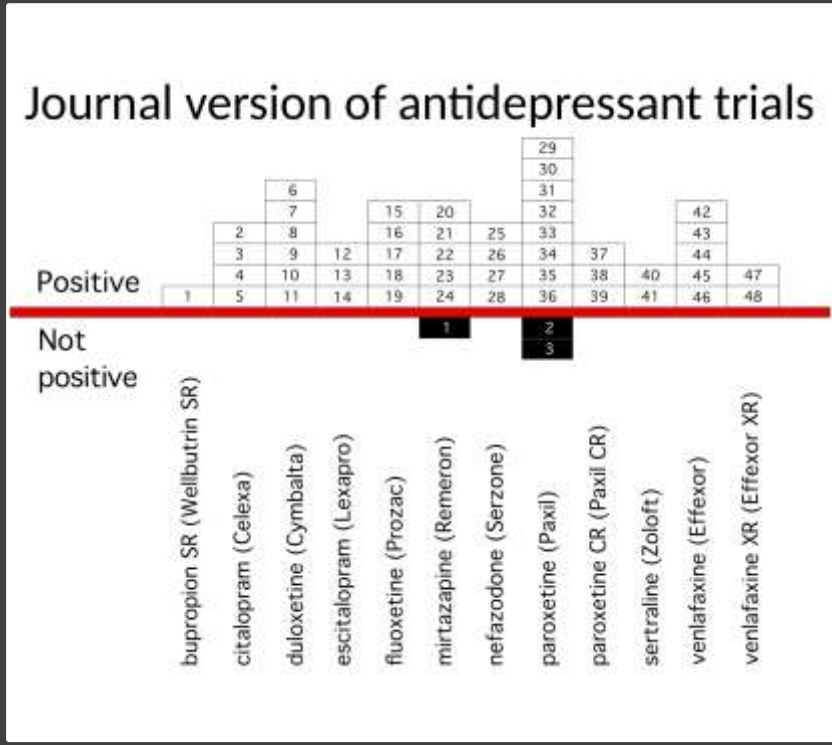
https://doi.org/10.5281/zenodo.3543478

Ethical data science

– Transparent publishing
– Consent (GDPR)
– Privacy (safe haven)
– Societal harm
– Wellbeing of the research team



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https://www.theverge.com/2019/2/25/18229714/cognizant-facebook-content-moderator-interviews-trauma-working-conditions-arizona

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Collaboration

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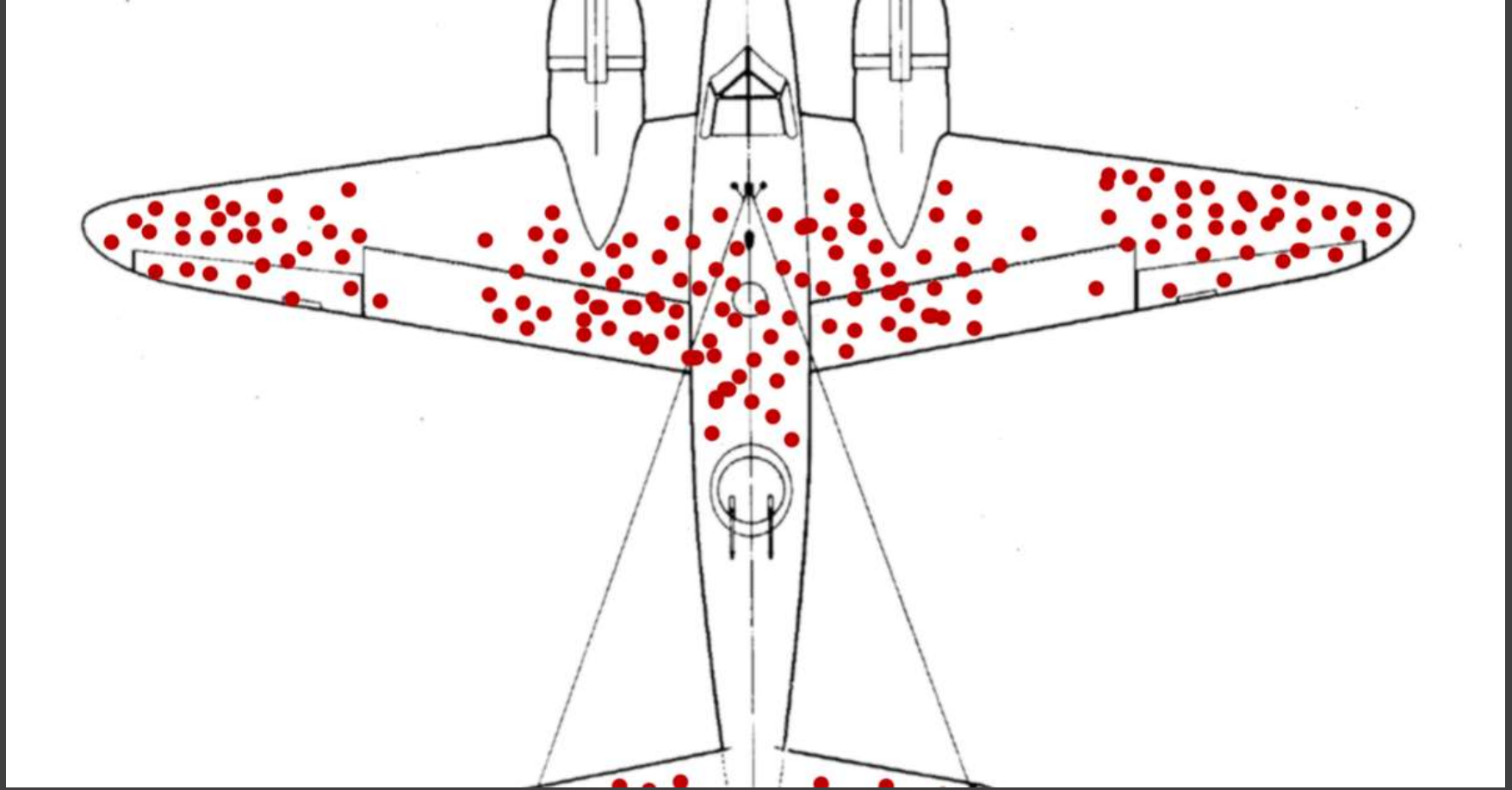

https://medium.com/@penguinpress/an-excerpt-from-how-not-to-be-wrong-by-jordan-ellenberg-664e708cfc3d

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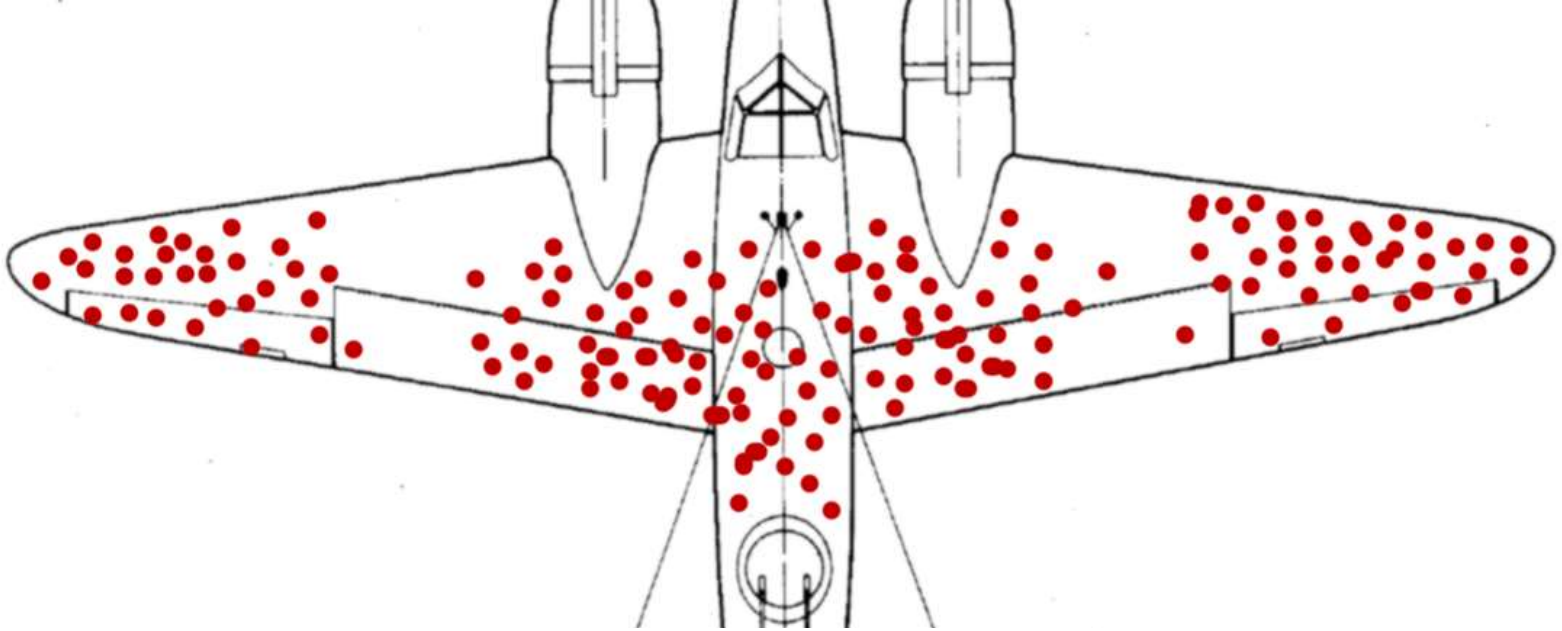

The armor, said Wald, doesn't go where the bullet holes are. It goes where the bullet holes aren't: on the engines.

https://medium.com/@penguinpress/an-excerpt-from-how-not-to-be-wrong-by-jordan-ellenberg-664e708cfc3d

https://doi.org/10.5281/zenodo.3543478

Whose voices are missing?

- In this room
- In your friend group
- At work and in your open source communities

https://doi.org/10.5281/zenodo.3543478

https://www.nhm.ac.uk/visit/wpy/gallery/2010/images/eric-hosking-portfolio-award/4372/a-marvel-of-ants.html

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https://doi.org/10.5281/zenodo.3543478

A global collaboration

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https://doi.org/10.5281/zenodo.3543478

Patricia Herterich

“What really sets The Turing Way apart is HOW we’re writing the book. The focus on community, the commitment to transparency and working open right from the beginning is an exciting (and terrifying) new way of working.”

https://rd-alliance.org/users/patricia-herterich
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https://doi.org/10.5281/zenodo.3543478

Open Leadership Principles

Understanding
You make the work accessible and clear

Sharing
You make the work easy to adapt, reproduce, and spread

Participation & Inclusion
You build shared ownership and agency to make the work inviting and sustainable for all.

Read more
https://mozilla.github.io/olm-whitepaper

moz://a

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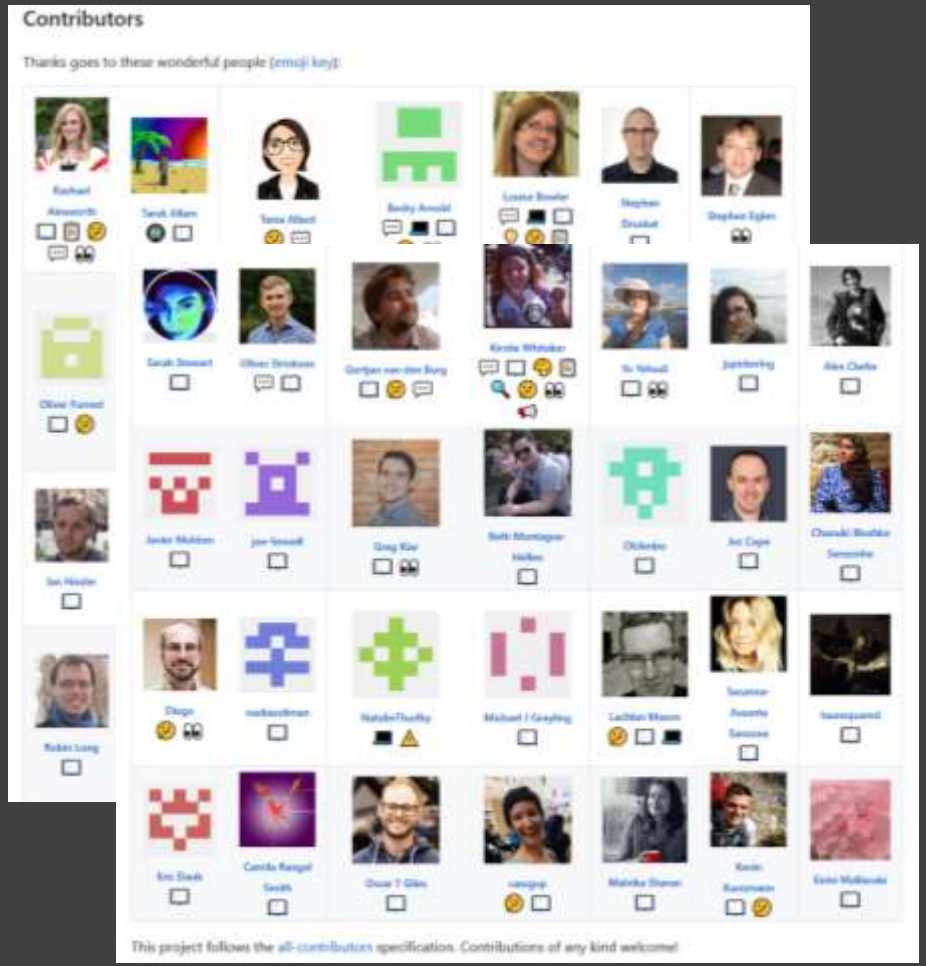

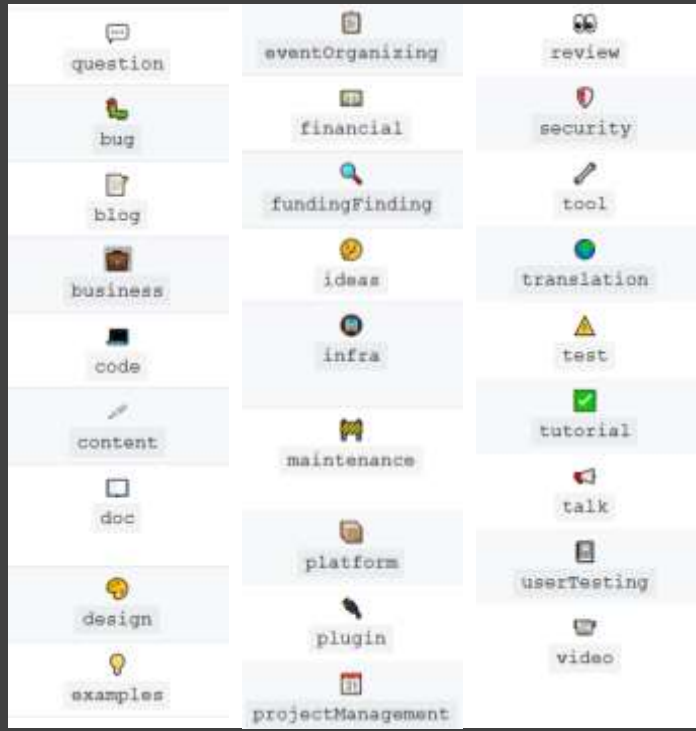

https://github.com/alan-turing-institute/the-turing-way#contributors
https://allcontributors.org/docs/en/emoji-key

https://github.com/alan-turing-institute/the-turing-way
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https://doi.org/10.5281/zenodo.3543478

Rosie Higman

“There’s no point in running events when you’re only preaching to the choir. We need to show researchers the selfish reasons to follow our recommendations.”

https://rosiehigman.wordpress.com
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https://doi.org/10.5281/zenodo.3543478

Book Dashes

– Manchester and London
– 13 selected people to contribute to the book
– 1:3 support ratio: mentored support to contribute expertise

https://github.com/alan-turing-institute/the-turing-way/blob/master/workshops/book-dash/book-dash-[mcr|ldn]-report.md

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https://doi.org/10.5281/zenodo.3543478

Collaboration cafes

- 1st and 3rd Wednesdays of each month
- All remote participation
  - Zoom call
  - Pomodoro technique
  - Breakout rooms for mentored contributions
- Everyone welcome

https://github.com/alan-turing-institute/the-turing-way/blob/master/project_management/online-collaboration-cafe.md

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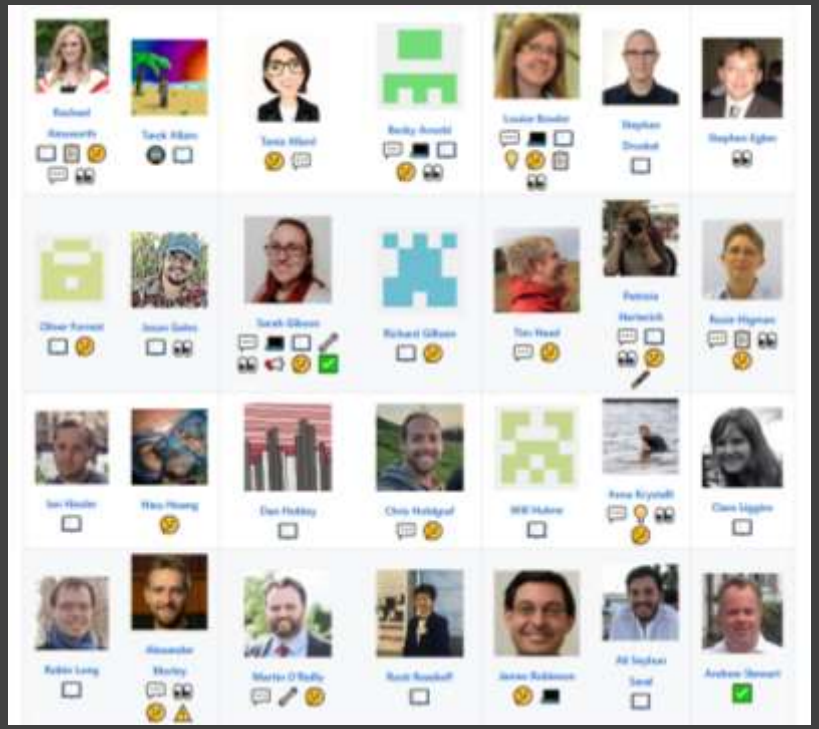
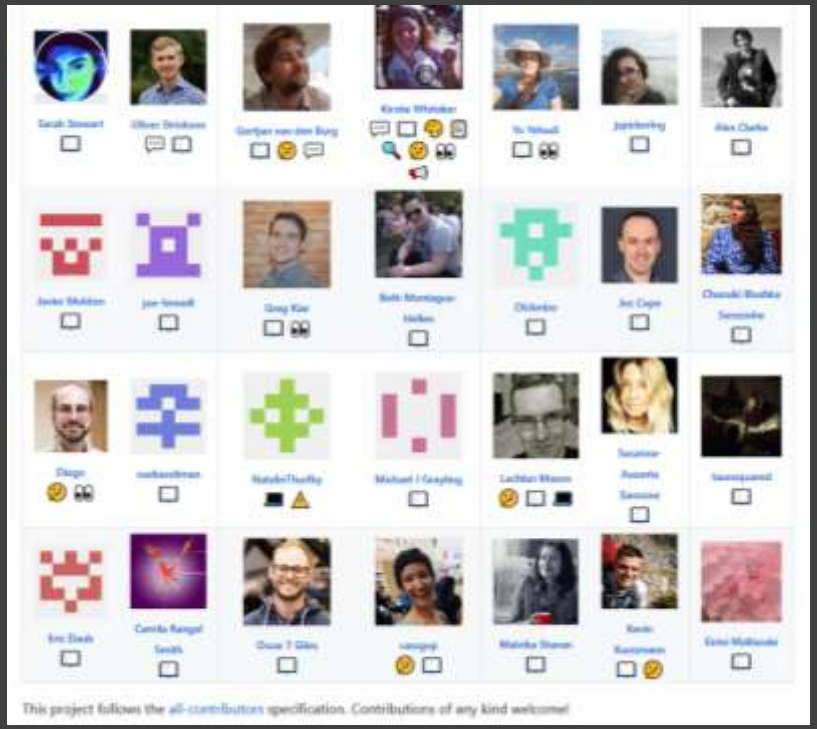
https://doi.org/10.5281/zenodo.3543478

Thank you to current (& future) contributors





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https://allcontributors.org/docs/en/emoji-key

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https://doi.org/10.5281/zenodo.3543478

Thank you

- Book: https://the-turing-way.netlify.com
- Newsletter: https://tinyletter.com/TuringWay
- GitHub: https://github.com/alan-turing-institute/the-turing-way
- Chat: https://gitter.im/alan-turing-institute/the-turing-way
- Next Collaboration Café: 20 November at 7pm UK time

- This work was supported by The UKRI Strategic Priorities Fund under the EPSRC Grant EP/T001569/1, particularly the "Tools, Practices and Systems" theme within that grant, and by The Alan Turing Institute under the EPSRC grant EP/N510129/1.

- Unsplash photos by Adolfo Felix, Austin Distel, Chris Ried, Dan Gold, Freddy Castro, James Pond, Kinson Leung, Mateo Vrbnjak, Med Badr, Michael Aleo, Mimi thian, Perry Grone, Rebecca Grant, Wei Ding. Noun Project icons by Luis Prado, Becris, Rose Alice Design, Hyemm.work.
- Original artwork by Scriberia: https://doi.org/10.5281/zenodo.3332807

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