The Alan Turing Institute

binder

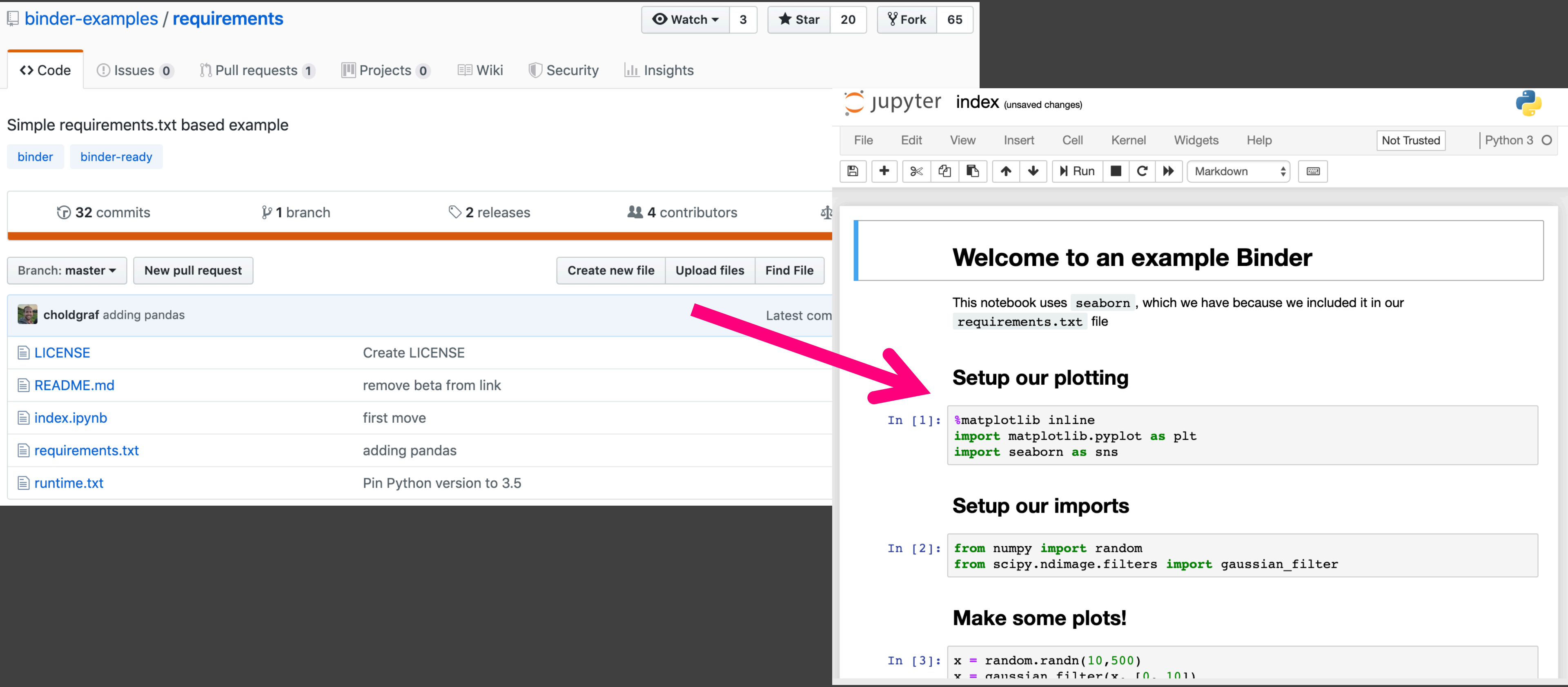
Build a BinderHub for hosting Reproducible Software in the Cloud

Sarah Gibson

https://doi.org/10.5281/zenodo.3404774

#TuringWay #ukrse19

Turn code… into an environment!



Simple requirements.txt based example

choldgraf adding pandas — Latest com

LICENSE	Create LICENSE
README.md	remove beta from link
index.ipynb	first move
requirements.txt	adding pandas
runtime.txt	Pin Python version to 3.5

Welcome to an example Binder

This notebook uses `seaborn` , which we have because we included it in our `requirements.txt` file

Setup our plotting

```
In [1]: %matplotlib inline
        import matplotlib.pyplot as plt
        import seaborn as sns
```

Setup our imports

```
In [2]: from numpy import random
        from scipy.ndimage.filters import gaussian_filter
```

Make some plots!

```
In [3]: x = random.randn(10,500)
        x = gaussian_filter(x, [0, 10])
```

https://doi.org/10.5281/zenodo.3404774

#TuringWay #ukrse19

This Workshop

- What it is:
- What it’s not:
- What we’ll do:

This Workshop

- What it is: Challenging!
- What it’s not:
- What we’ll do:

This Workshop

– What it is: Challenging!

– What it's not: A cloud/Azure workshop

– What we'll do:

https://docs.microsoft.com/en-gb/learn/azure/

This Workshop

– What it is: Challenging!

– What it’s not: A cloud/Azure workshop

– What we’ll do: Build a BinderHub!

https://docs.microsoft.com/en-gb/learn/azure/

Housekeeping

- Microsoft Azure: Please leave your email in #binderhub-workshop channel on RSE Slack
- Docker Hub: https://hub.docker.com/signup
- Code of Conduct: Be kind! https://rse.ac.uk/conf2019/code-of-conduct/
- HackMD: bit.ly/RSEConBinderHub
- post-its 🚦

Who?

Sarah
Research Data Scientist
Operator of mybinder.org

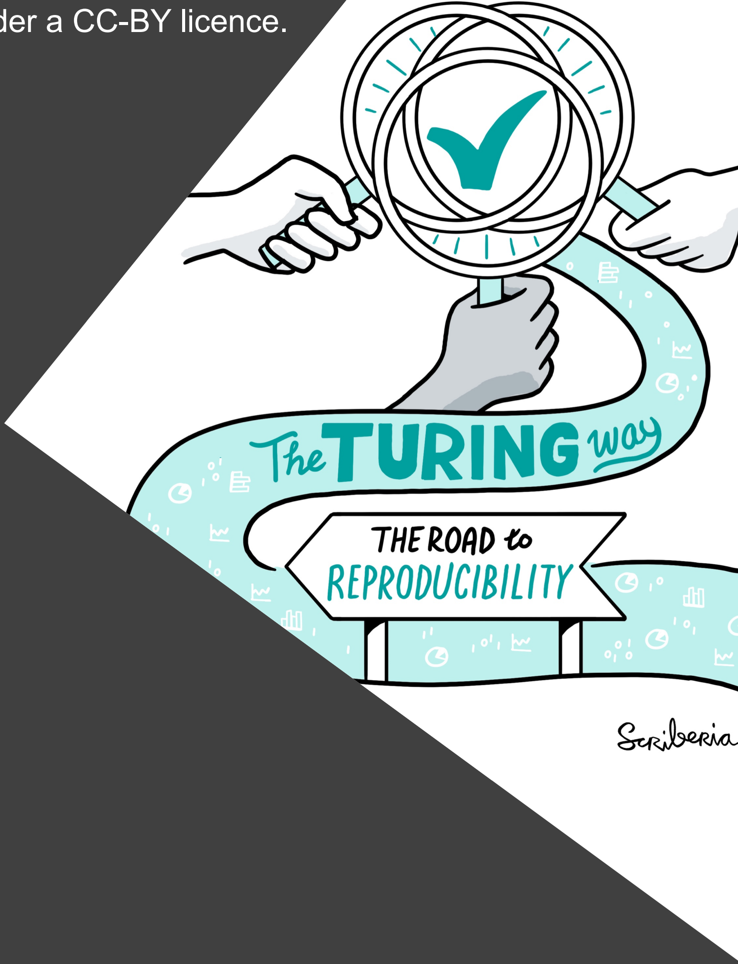
Tania
Microsoft Cloud
Developer Advocate

Anna
Research
Software Engineer

(Rough) Agenda

Time	Activity
09:00 – 09:30	👋 Introduction
09:30 – 10:30	🚀 Deploy Kubernetes cluster*
10:30 – 11:00	☕ Coffee break
11:00 – 12:30	👩‍💻 Install BinderHub

*Don’t worry if you don’t know what this is yet, I’ll explain!



The Turing Way

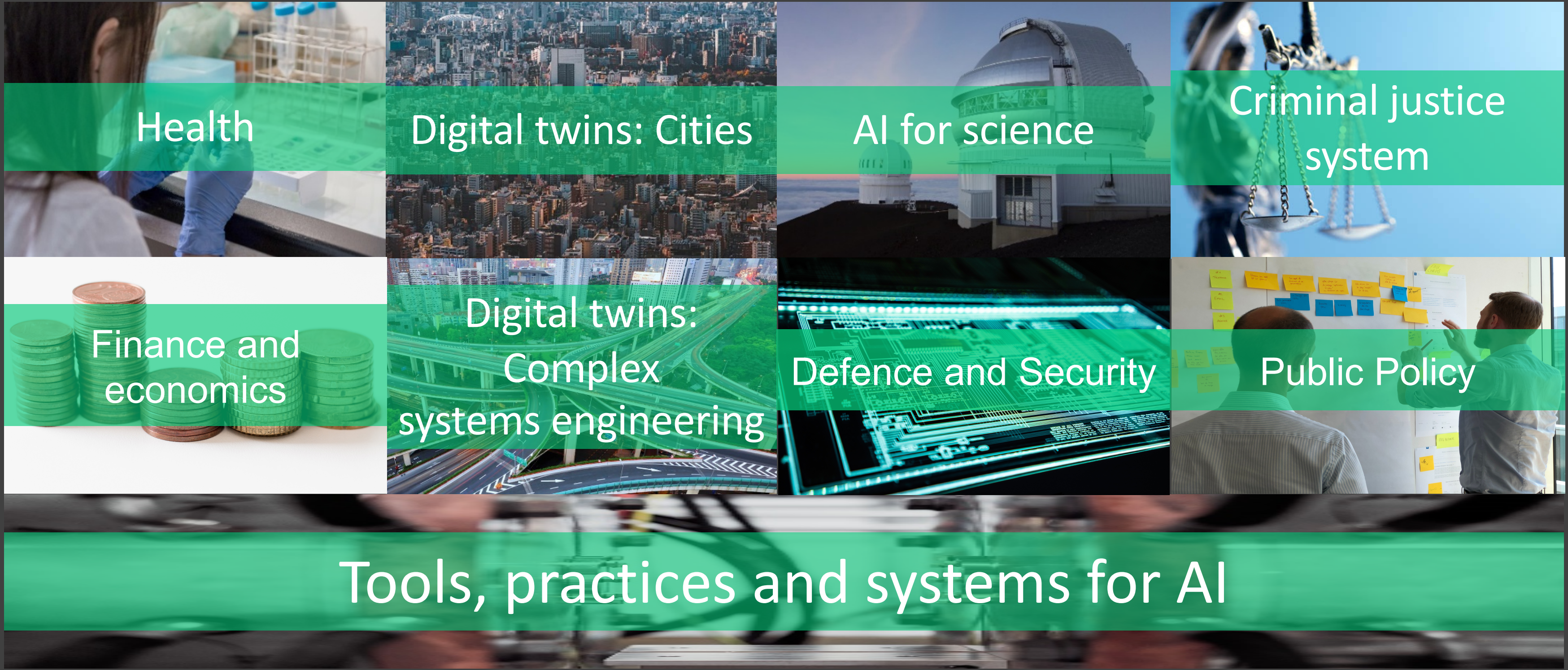
A Handbook for Reproducible Data Science

Making reproducibility too easy not to do!

https://doi.org/10.5281/zenodo.3404774

#TuringWay #ukrse19

Where does The Turing Way fit in?



Health

Digital twins: Cities

AI for science

Criminal justice system

Finance and economics

Digital twins: Complex systems engineering

Defence and Security

Public Policy

Tools, practices and systems for AI

		Data	
		Same	Different
Analysis	Same	Reproducible	Replicable
	Different	Robust	Generalisable

Kirstie Whitaker’s talk at PyData LDN: https://youtu.be/lG3PcZ6EhiU

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

		Data	
		Same	Different
Analysis	Same	Repeatable Reproducible	Replicable
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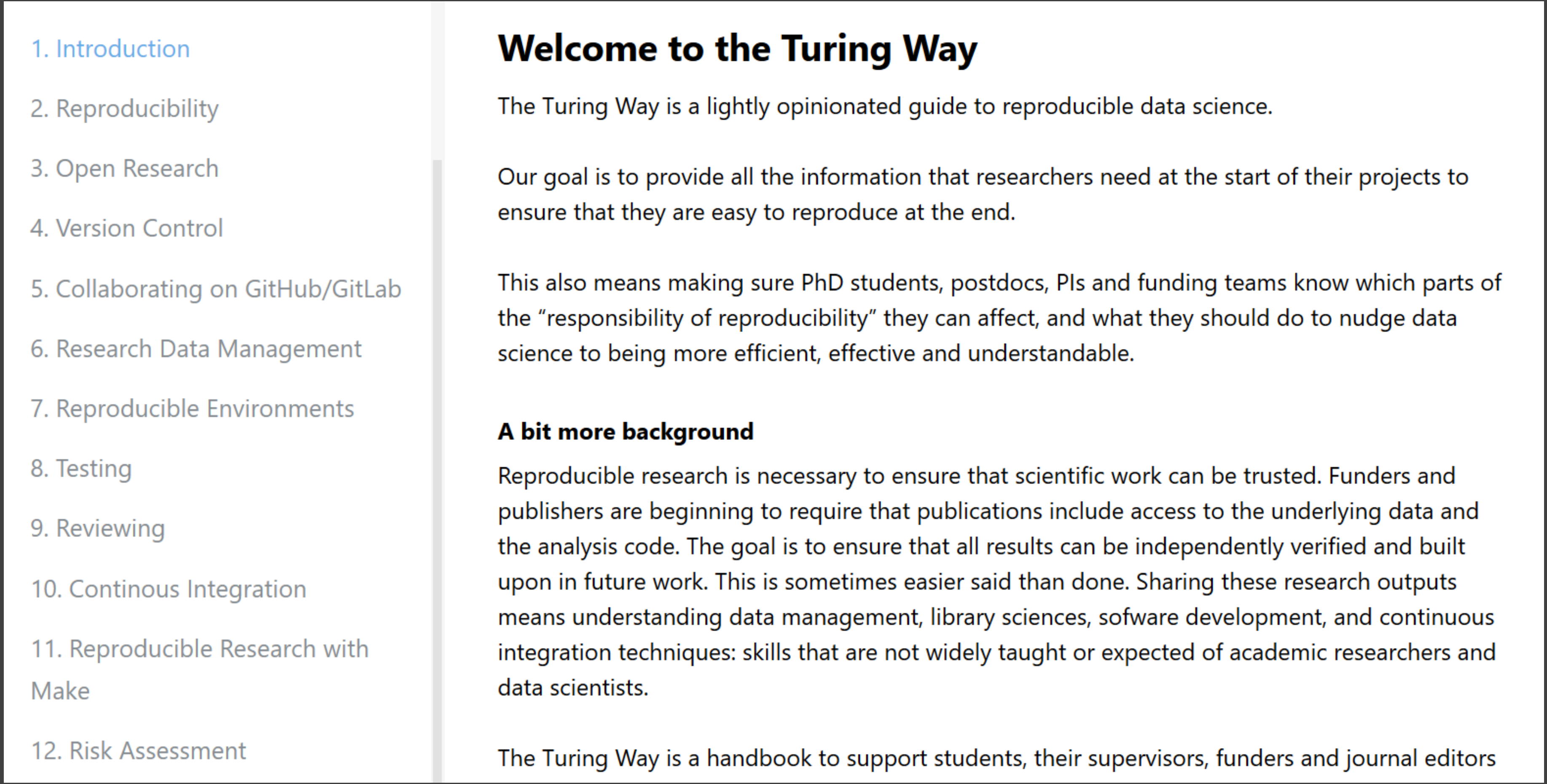

Welcome to the Turing Way

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

https://the-turing-way.netlify.com/introduction/introduction

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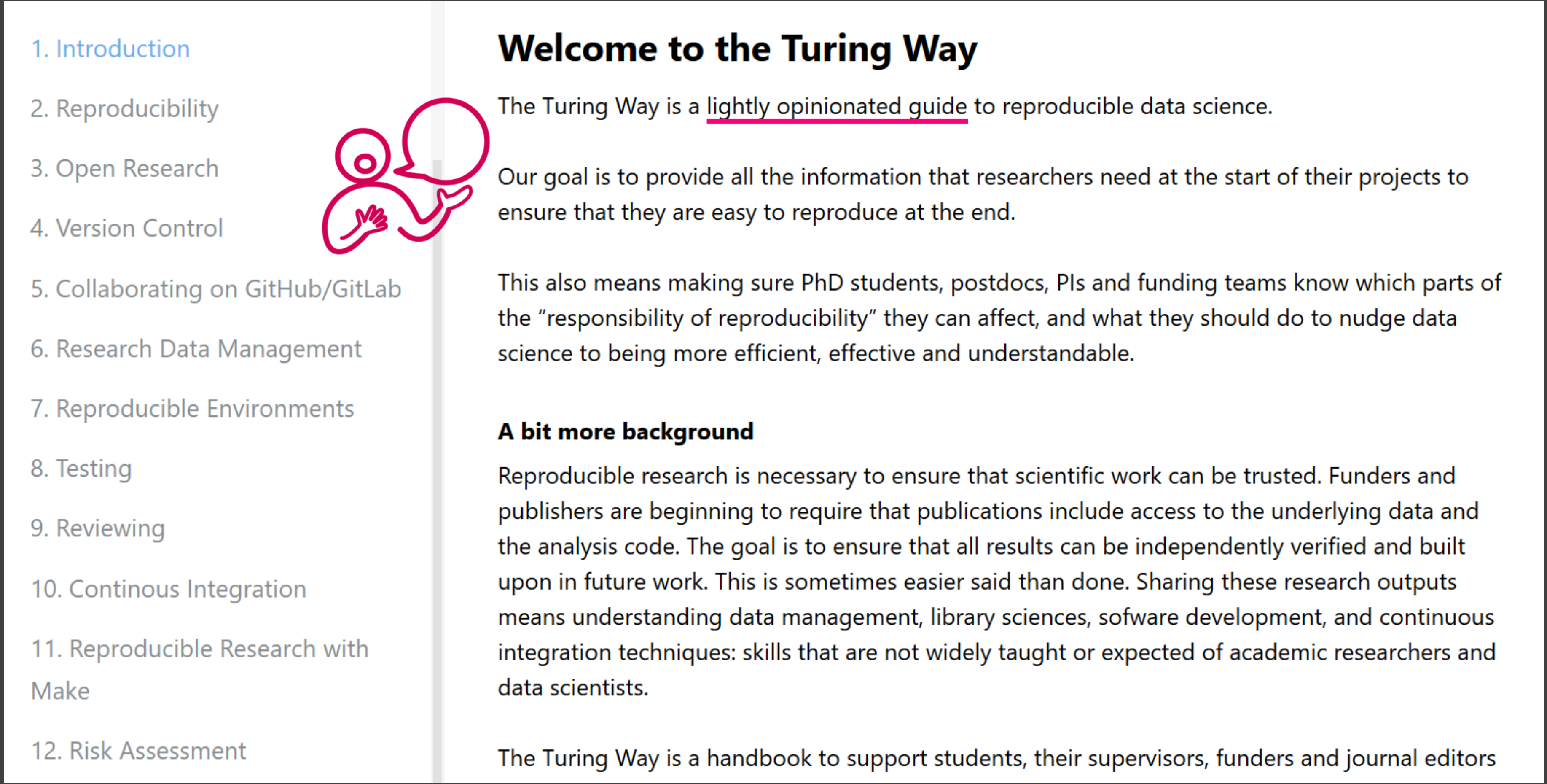

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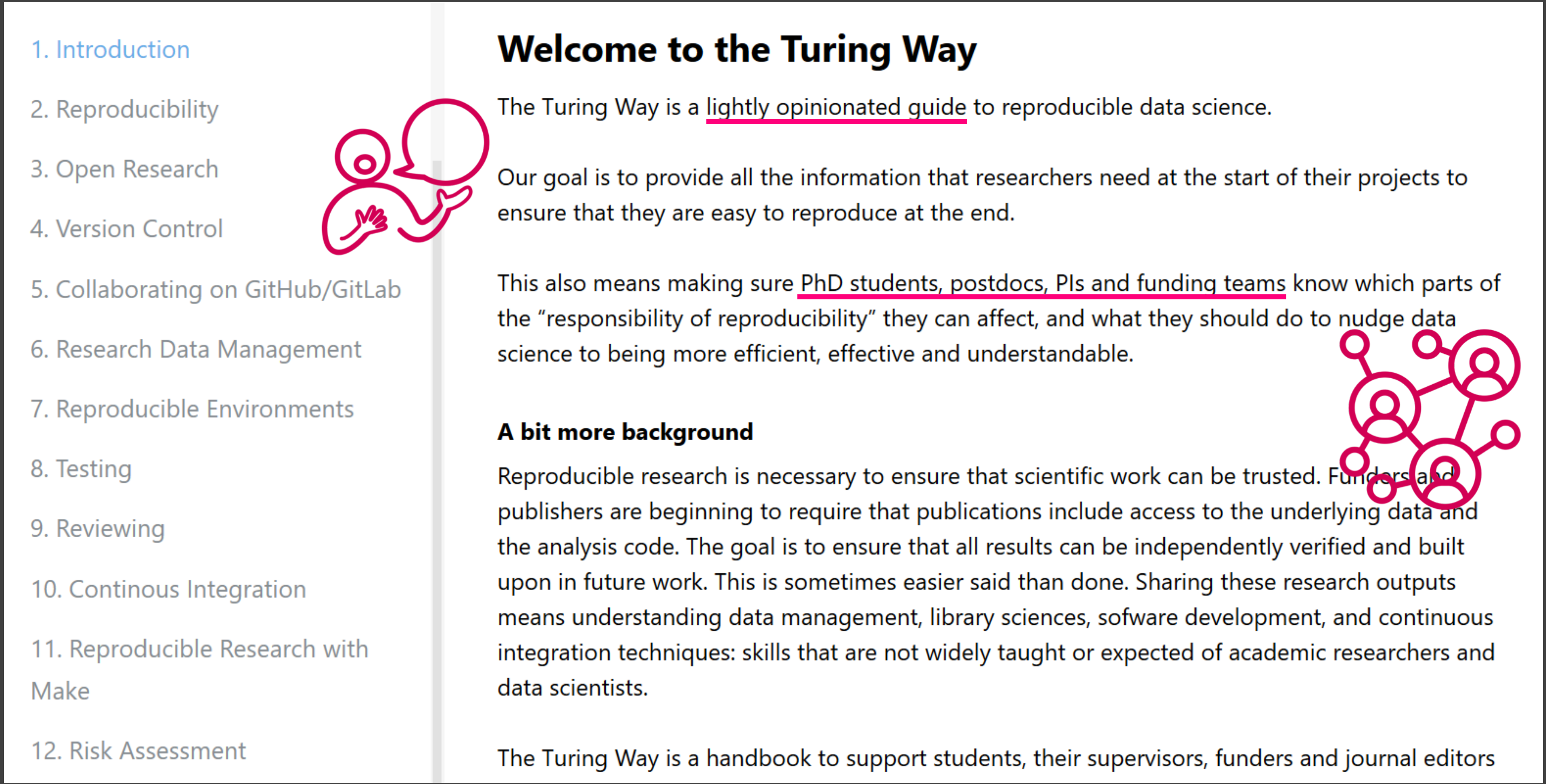

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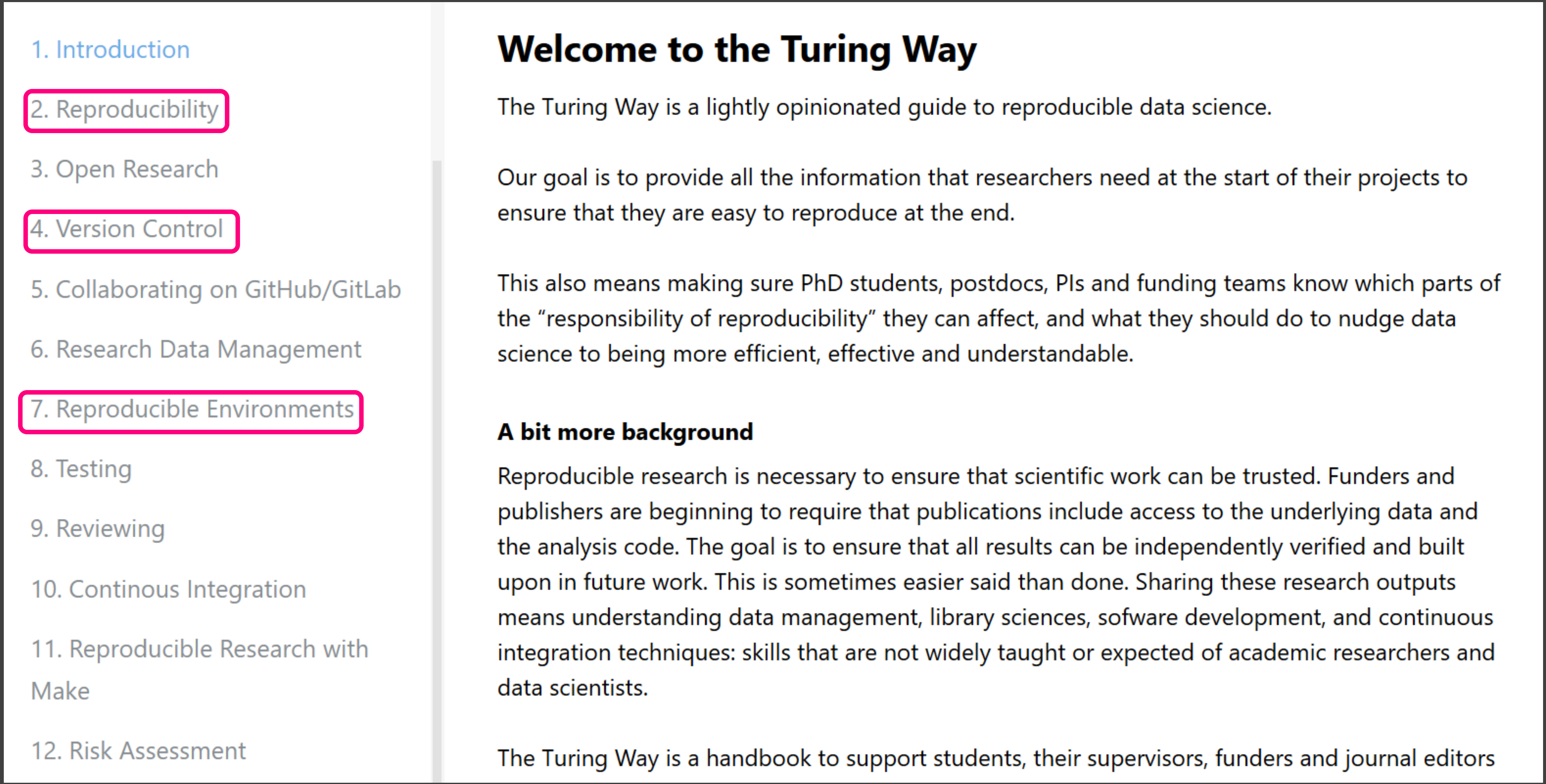

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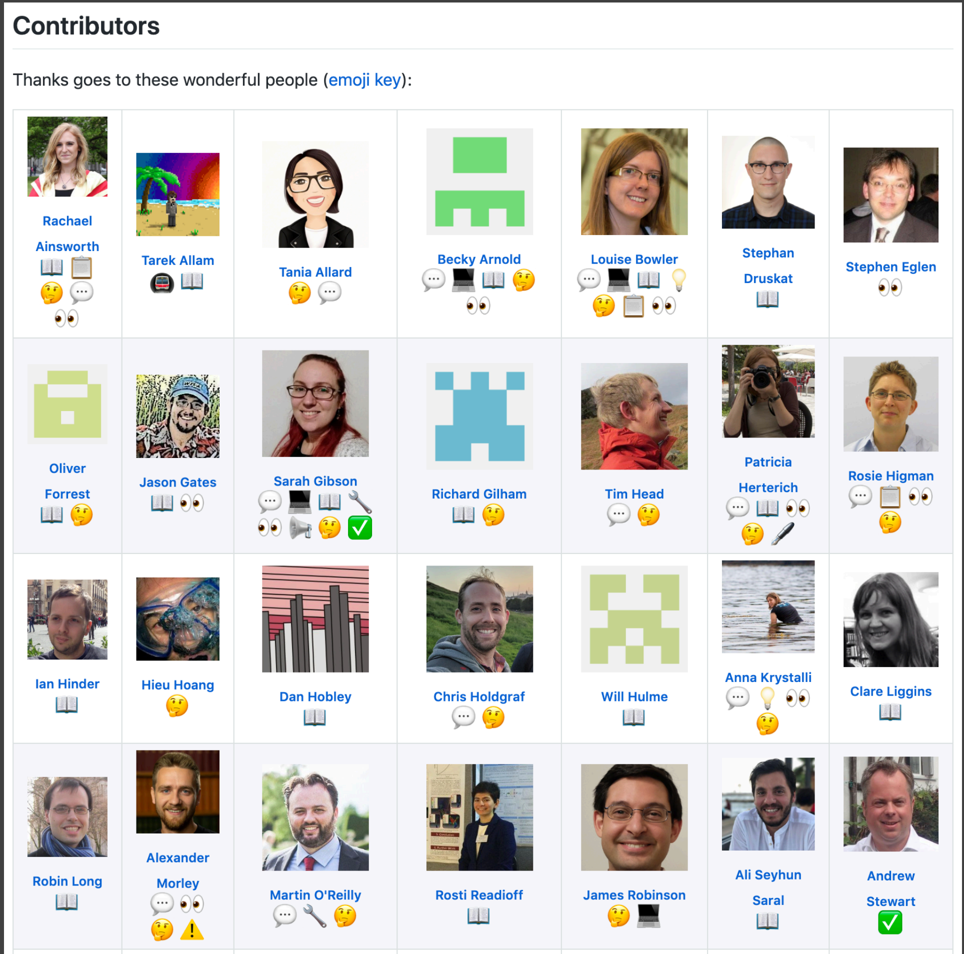
#TuringWay #ukrse19

Built by a team… AND YOU!

– Please contribute!

github.com/alan-turing-institute/the-turing-way



Contributors

Thanks goes to these wonderful people (emoji key):

Rachael Ainsworth 📖 📋 🤔 💬 👀	Tarek Allam 🚇 📖	Tania Allard 🤔 💬	Becky Arnold 💬 💻 📖 🤔 👀	Louise Bowler 💬 💻 📖 💡 🤔 📋 👀	Stephan Druskat 📖	Stephen Eglen 👀
Oliver Forrest 📖 🤔	Jason Gates 📖 👀	Sarah Gibson 💬 💻 📖 🔧 👀 📢 🤔 ✅	Richard Gilham 📖 🤔	Tim Head 💬 🤔	Patricia Herterich 💬 📖 👀 🤔 🖋	Rosie Higman 💬 📋 👀 🤔
Ian Hinder 📖	Hieu Hoang 🤔	Dan Hobley 📖	Chris Holdgraf 💬 🤔	Will Hulme 📖	Anna Krystalli 💬 💡 👀 🤔	Clare Liggins 📖
Robin Long 📖	Alexander Morley 💬 👀 🤔 ⚠️	Martin O'Reilly 💬 🔧 🤔	Rosti Readioff 📖	James Robinson 🤔 💻	Ali Seyhun Saral 📖	Andrew Stewart ✅

Barriers to reproducible research

Is not considered for promotion

Held to higher standards than others

Publication bias towards novel findings

Requires additional skills

Plead the 5th

Support additional users

Takes time

Kirstie Whitaker's talk at PyData LDN: https://youtu.be/IG3PcZ6EhiU

https://doi.org/10.5281/zenodo.3404774

#TuringWay #ukrse19

Market Research

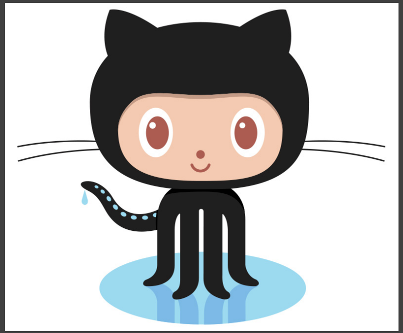
Have you ever heard…?

“Oh, it worked on my computer?”

Have you ever heard…?

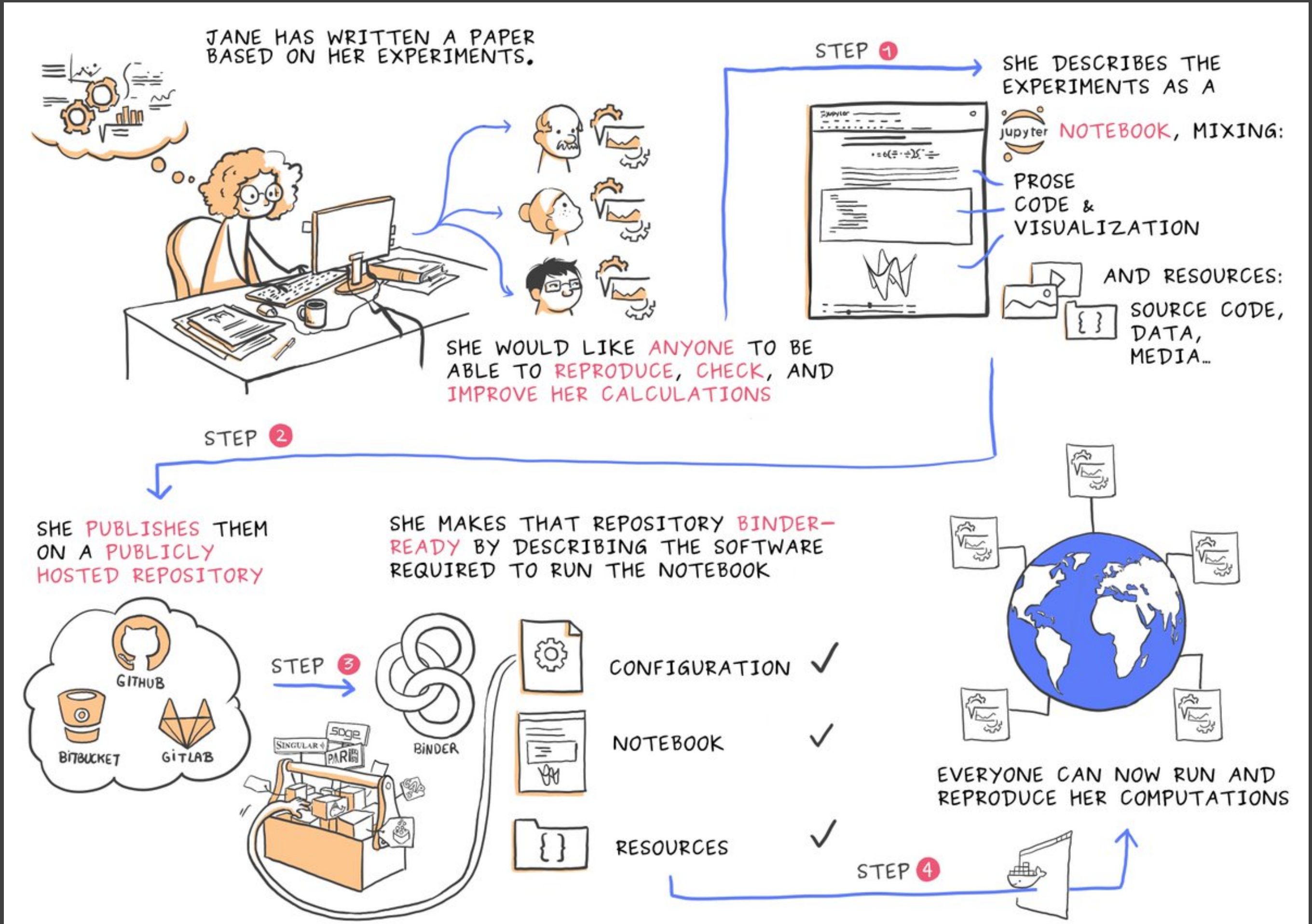
“Oh, it worked yesterday?”

“Oh, it worked on my computer?”



+ CI

“Oh, it worked yesterday?”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VISUALIZATION
AND RESOURCES:
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Sage
PARI
BINDER
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NOTEBOOK ✓
RESOURCES ✓
STEP 4
EVERYONE CAN NOW RUN AND REPRODUCE HER COMPUTATIONS

binder

mybinder.org

Courtesy of Juliette Taka: https://twitter.com/mybinderteam/status/1082556317842264064

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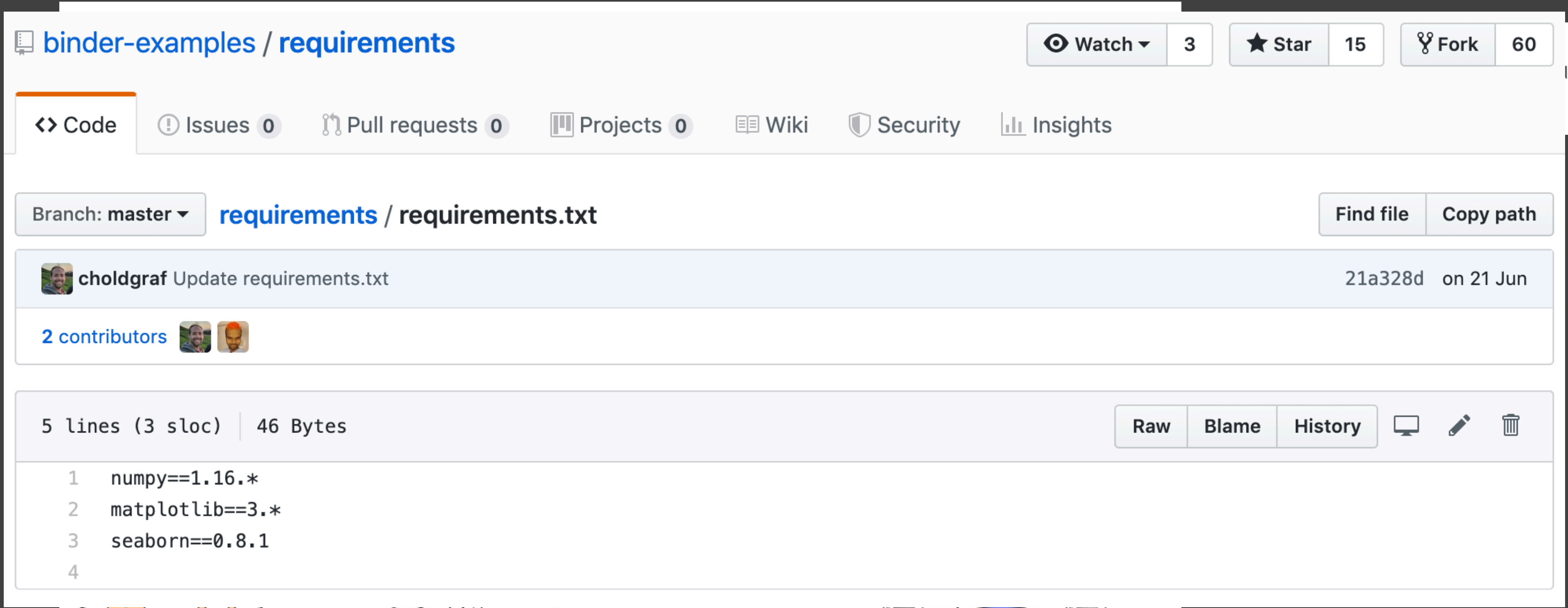


requirements / requirements.txt

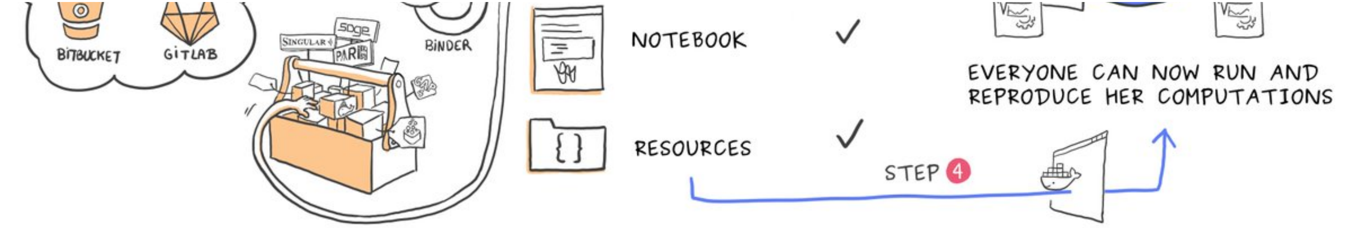
choldgraf Update requirements.txt 21a328d on 21 Jun

2 contributors

5 lines (3 sloc) 46 Bytes

```
numpy==1.16.*
matplotlib==3.*
seaborn==0.8.1

```



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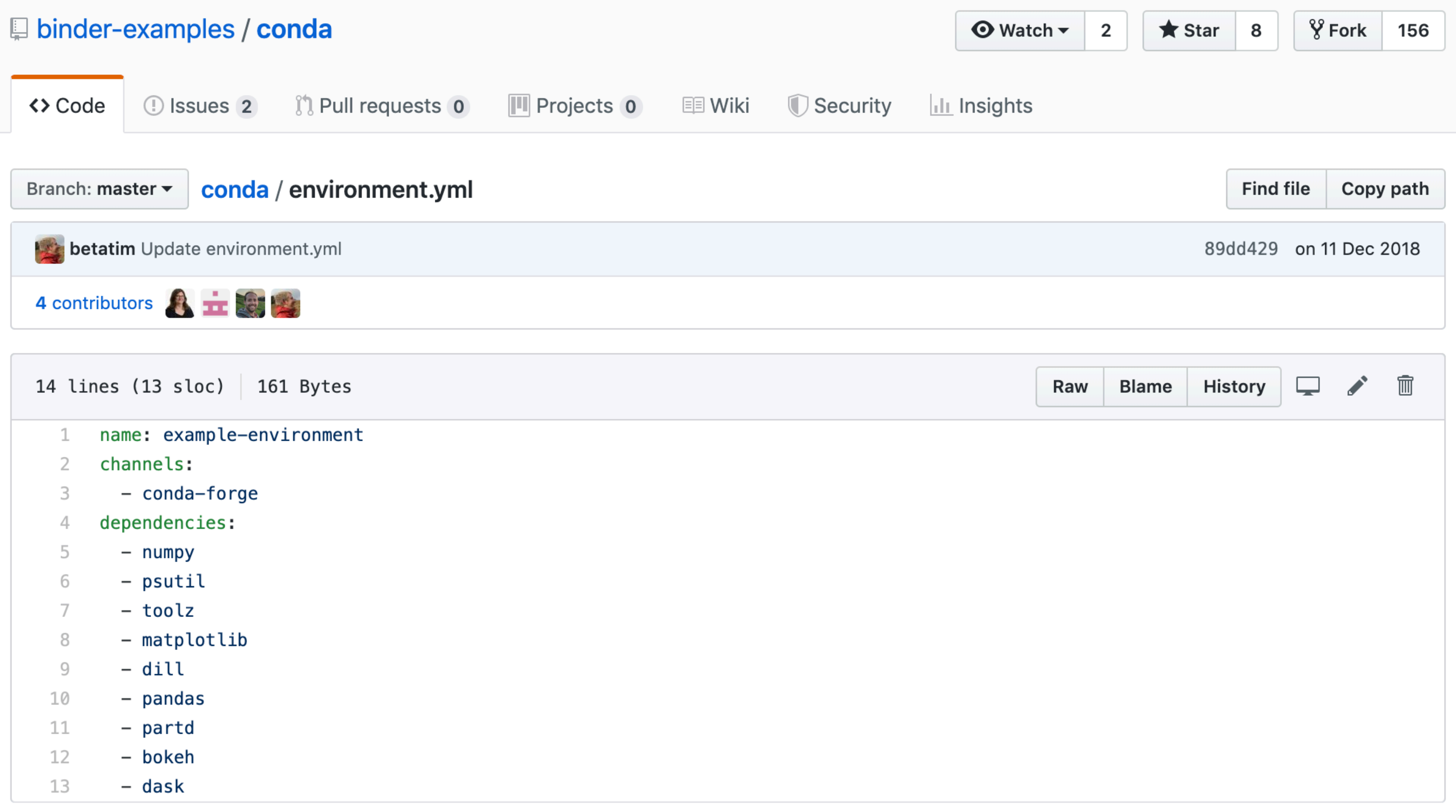


binder-examples / conda

conda / environment.yml

betatim Update environment.yml 89dd429 on 11 Dec 2018

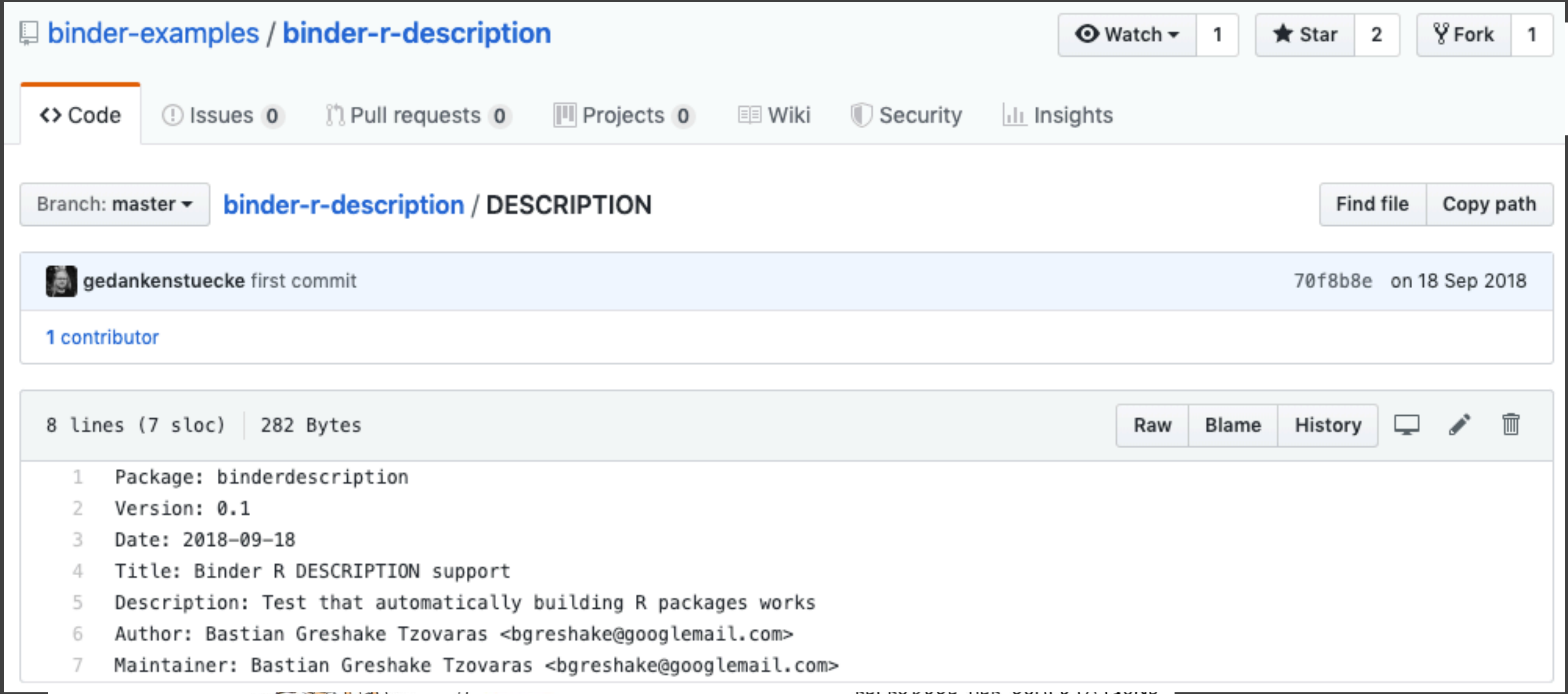
4 contributors

14 lines (13 sloc) 161 Bytes

```
name: example-environment
channels:
  - conda-forge
dependencies:
  - numpy
  - psutil
  - toolz
  - matplotlib
  - dill
  - pandas
  - partd
  - bokeh
  - dask
```

Courtesy of Juliette Taka: https://twitter.com/mybinderteam/status/1082556317842264064

https://doi.org/10.5281/zenodo.3404774 #TuringWay #ukrse19



binder-r-description / DESCRIPTION

gedankenstuecke first commit 70f8b8e on 18 Sep 2018

1 contributor

8 lines (7 sloc) | 282 Bytes

```
Package: binderdescription
Version: 0.1
Date: 2018-09-18
Title: Binder R DESCRIPTION support
Description: Test that automatically building R packages works
Author: Bastian Greshake Tzovaras <bgreshake@googlemail.com>
Maintainer: Bastian Greshake Tzovaras <bgreshake@googlemail.com>
```

Courtesy of Juliette Taka: https://twitter.com/mybinderteam/status/1082556317842264064

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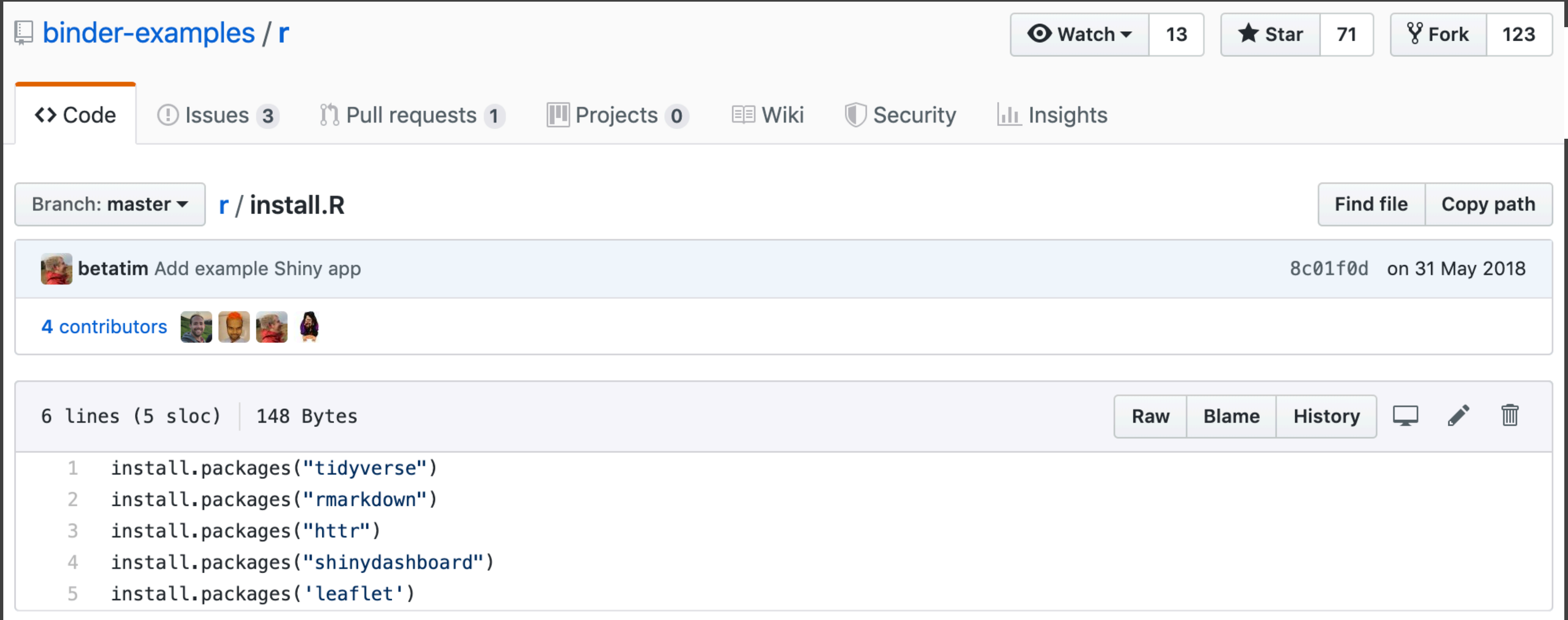


binder-examples / r

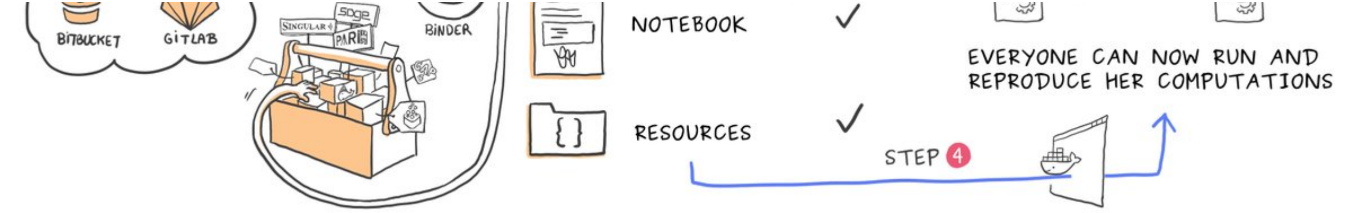
r / install.R

betatim Add example Shiny app 8c01f0d on 31 May 2018

4 contributors

6 lines (5 sloc) | 148 Bytes

```
install.packages("tidyverse")
install.packages("rmarkdown")
install.packages("httr")
install.packages("shinydashboard")
install.packages('leaflet')
```



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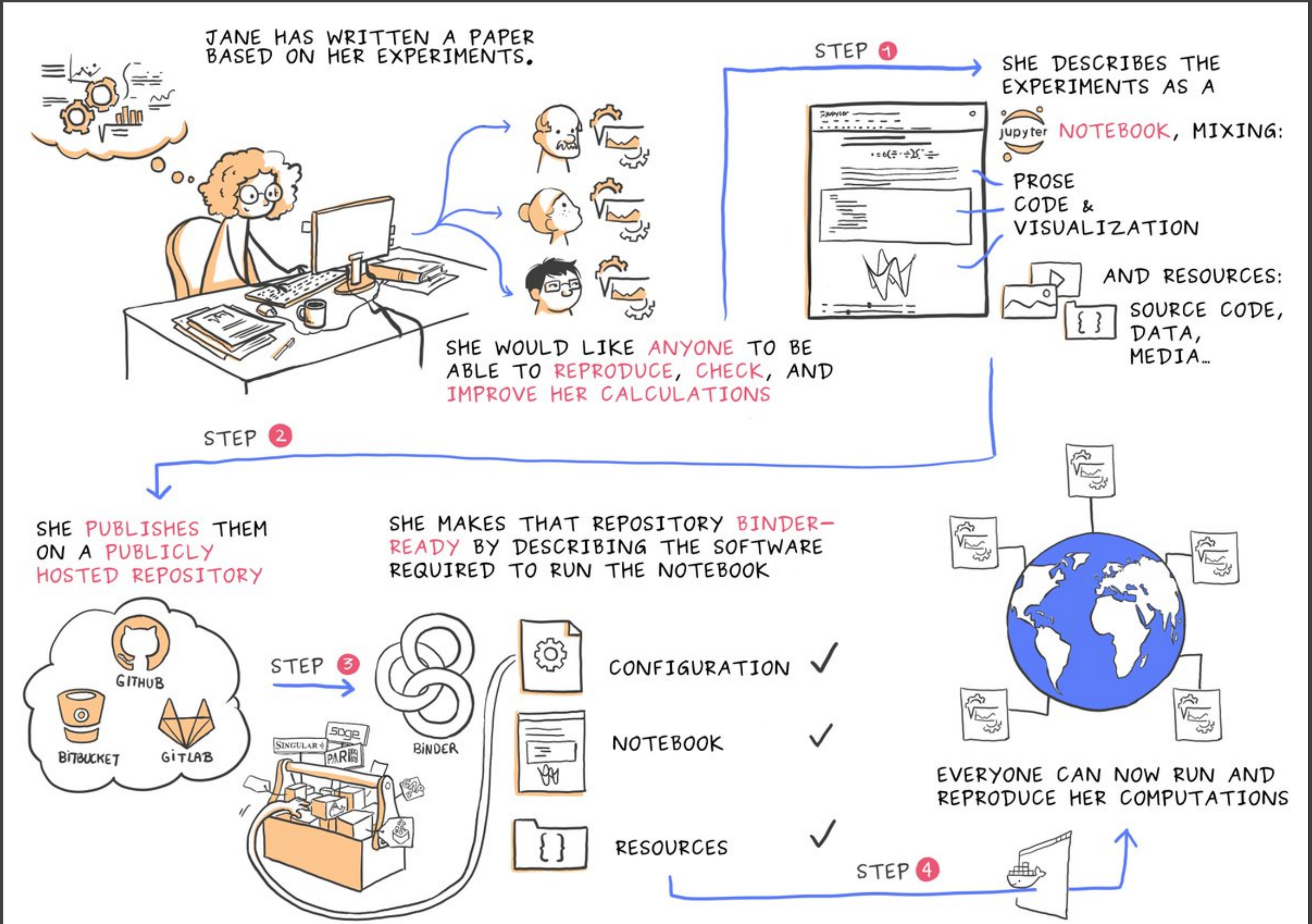
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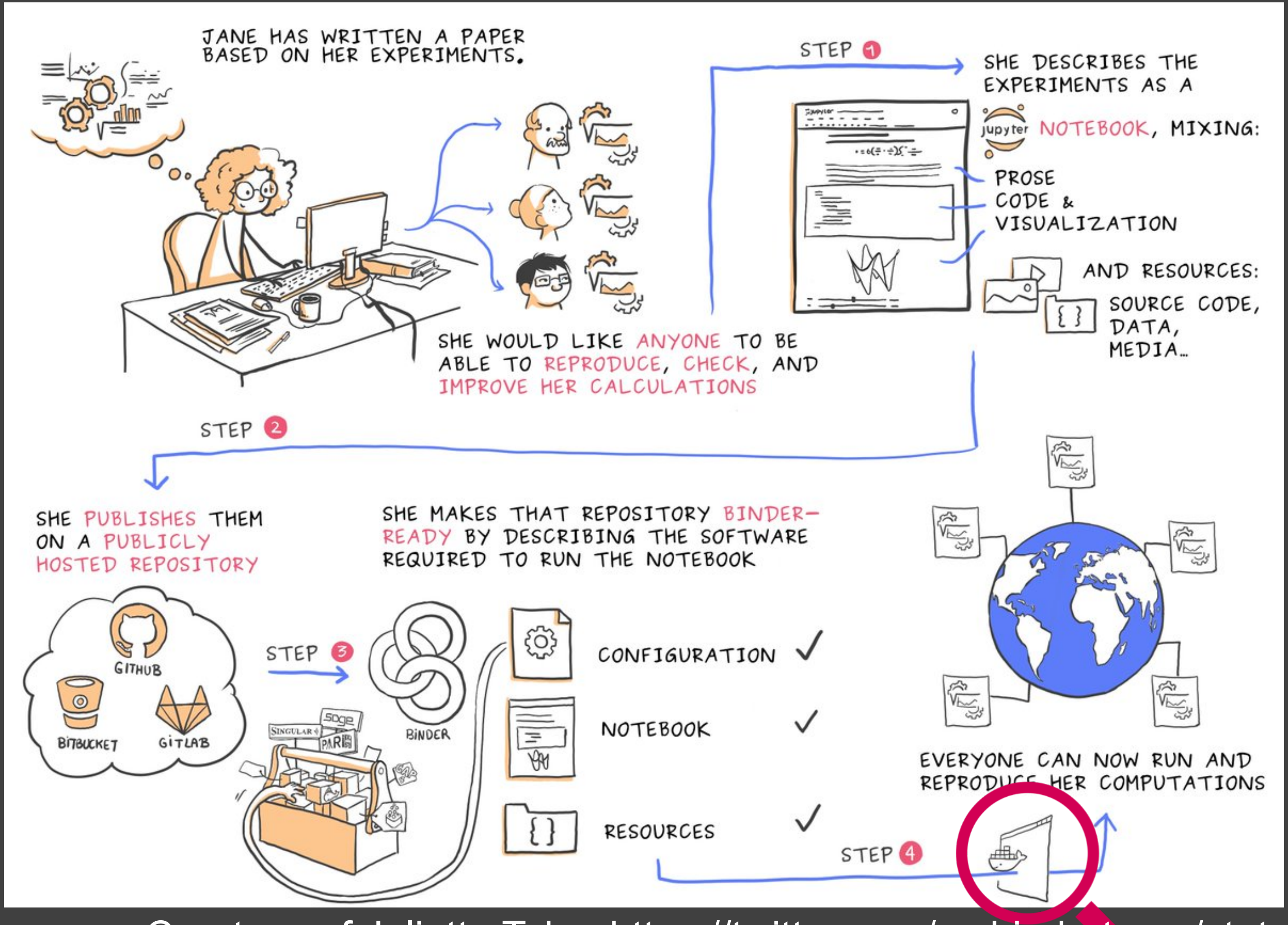
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What’s the difference?

mybinder.org

- Free to use service for everyone
- Must be public code
- Limited computational resources
- No GPU access

Private BinderHub

- Service can be limited to teams or institutions
- Can be public or private code
- Set your own computational limits
- Deploy onto any type of machine you need

The Vocab

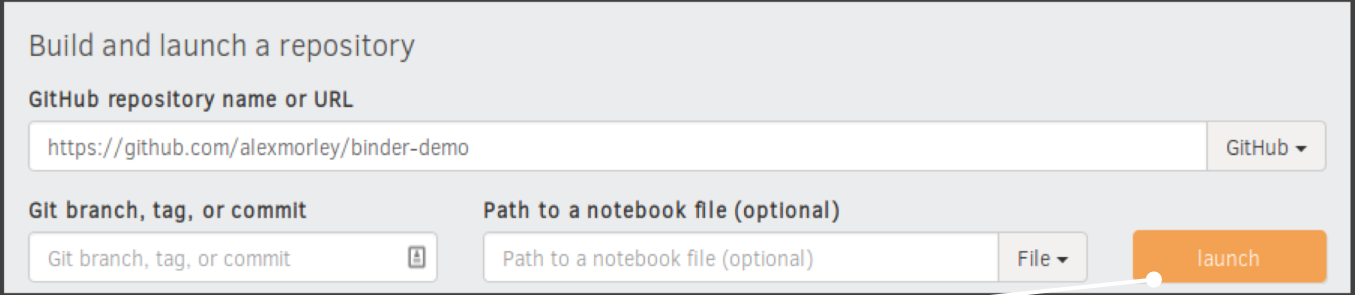
– Binder → user interface/experience

– BinderHub → computational infrastructure

– mybinder.org → public BinderHub for everyone

~~Magic!~~ Technology

BinderHub



Build and launch a repository

GitHub repository name or URL

https://github.com/alexmorley/binder-demo

Git branch, tag, or commit

Git branch, tag, or commit

Path to a notebook file (optional)

Path to a notebook file (optional)
File ▾
launch

Clone GitHub Repo

1

https://doi.org/10.5281/zenodo.3404774

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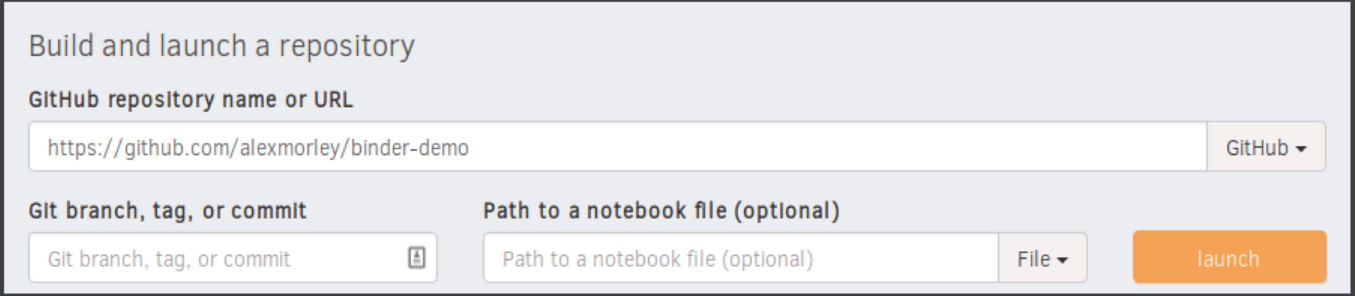
BinderHub



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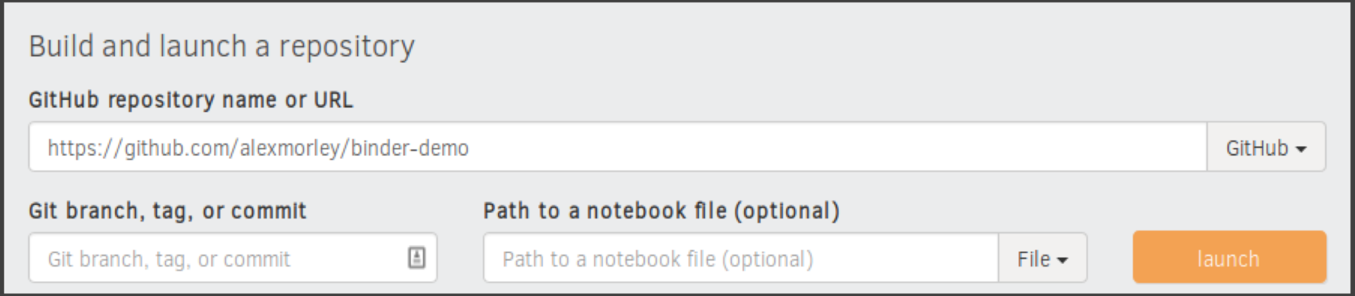
repo2docker

1 Clone GitHub Repo

2 Build image according to instructions contained within the repo

BinderHub



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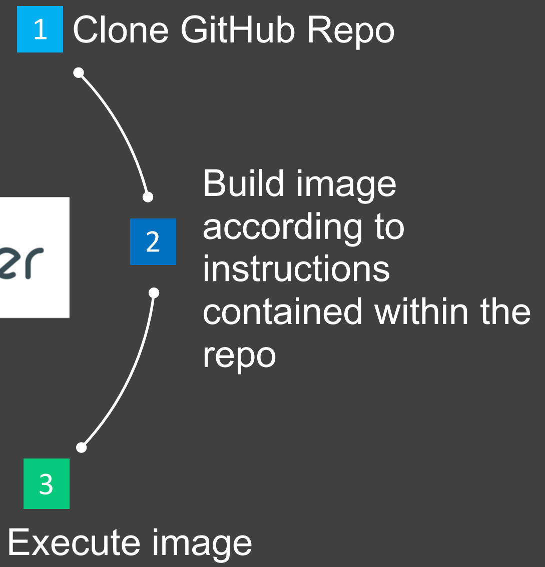

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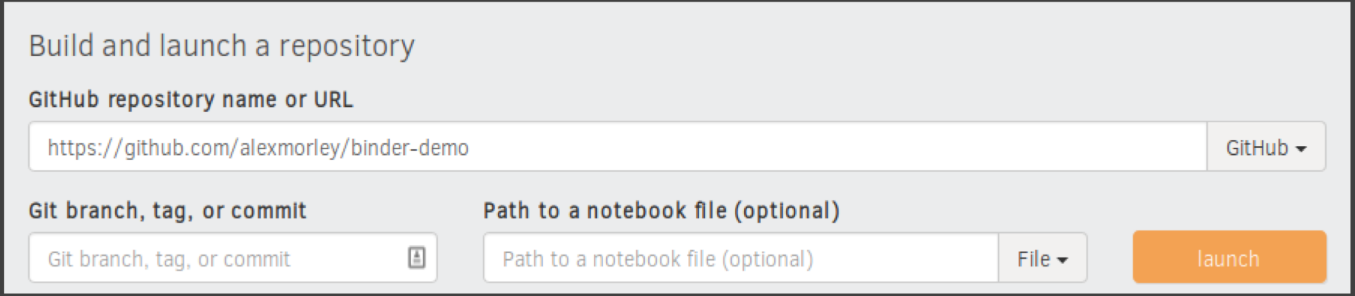
3 Execute image

BinderHub



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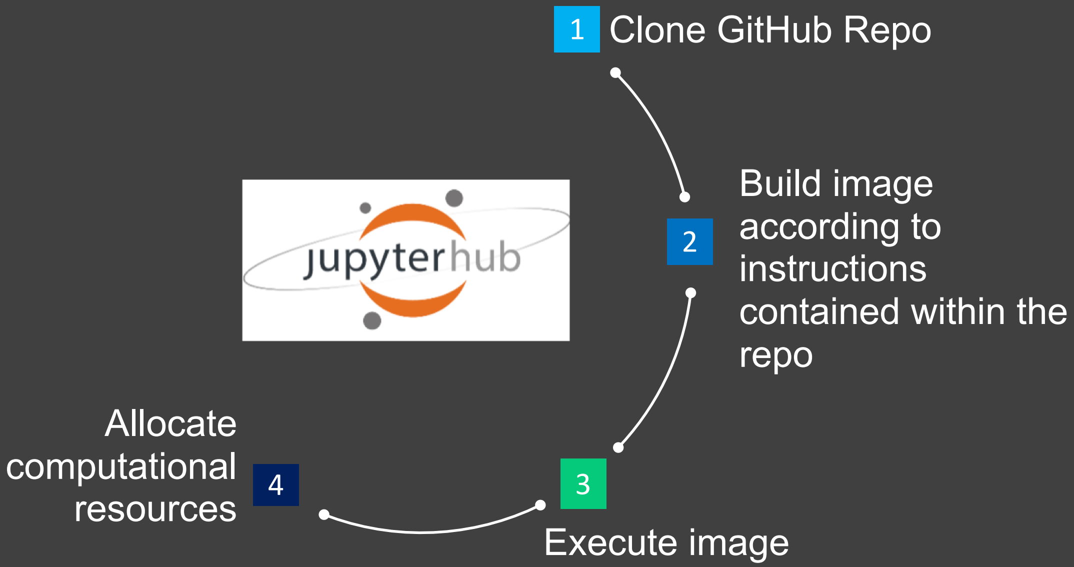


1 Clone GitHub Repo

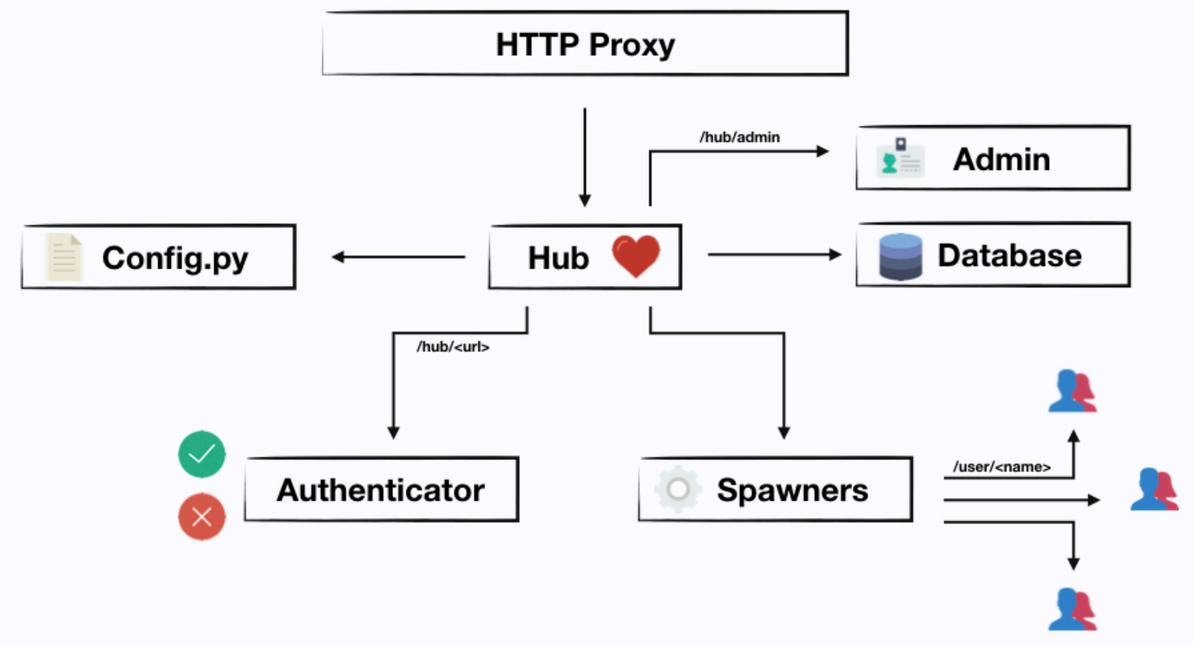
2 Build image according to instructions contained within the repo

3 Execute image

4 Allocate computational resources

What is a JupyterHub?

GitHub



All icons were obtained from Flaticon (https://www.flaticon.com/packs/essential-collection)

JupyterHub is a way to help your humans use your computers. With notebooks!

hin the

resources

Execute image

https://doi.org/10.5281/zenodo.3404774

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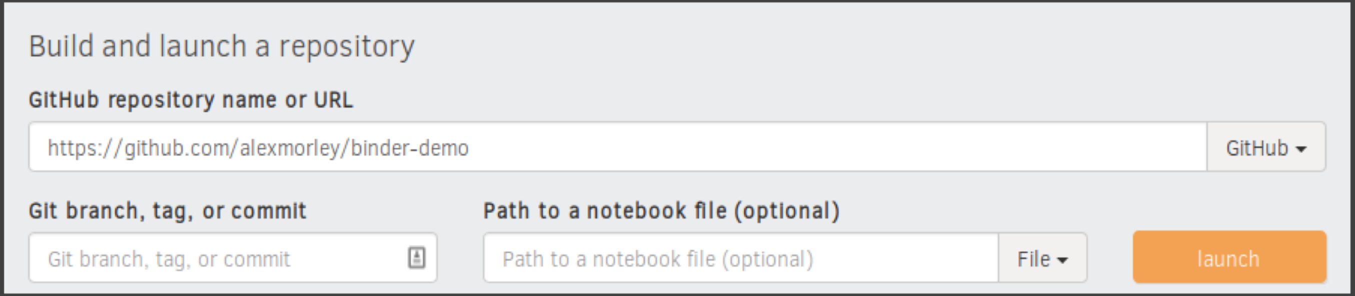
BinderHub



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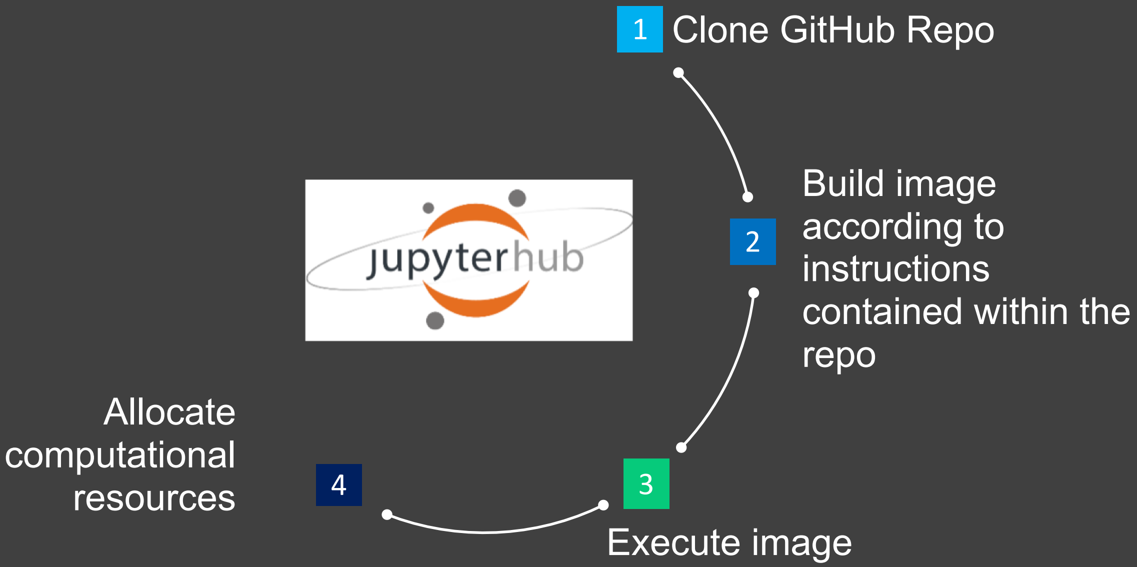

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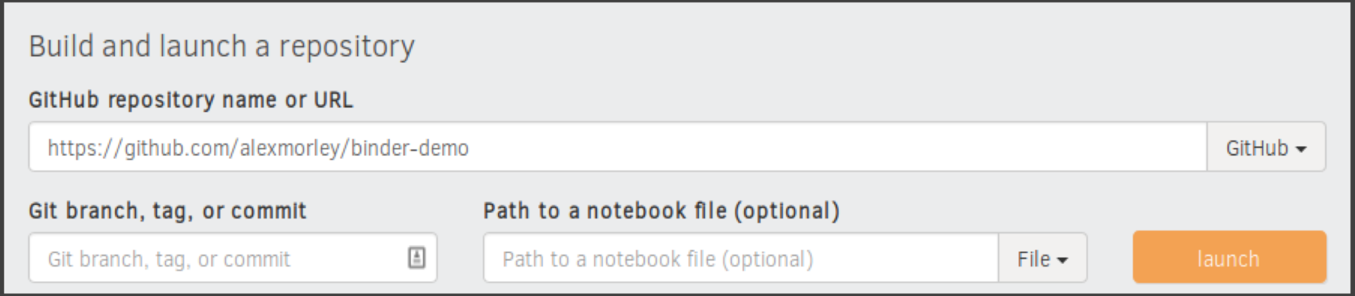

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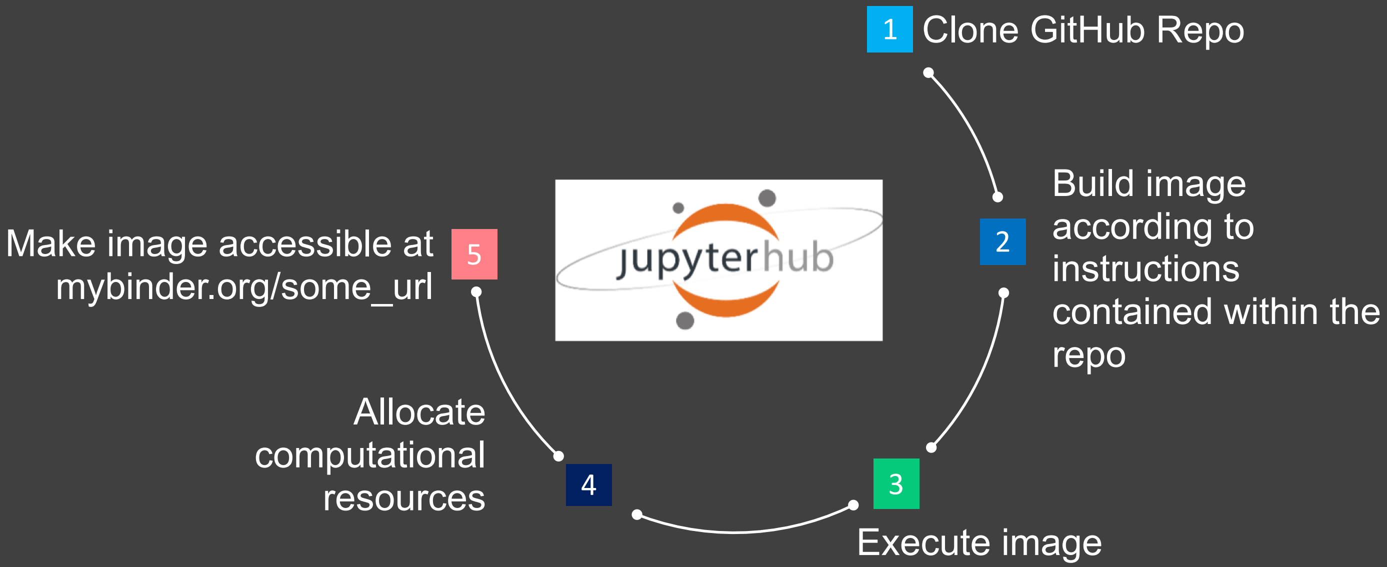
Git branch, tag, or commit

Git branch, tag, or commit

Path to a notebook file (optional)

Path to a notebook file (optional)



1 Clone GitHub Repo

2 Build image according to instructions contained within the repo

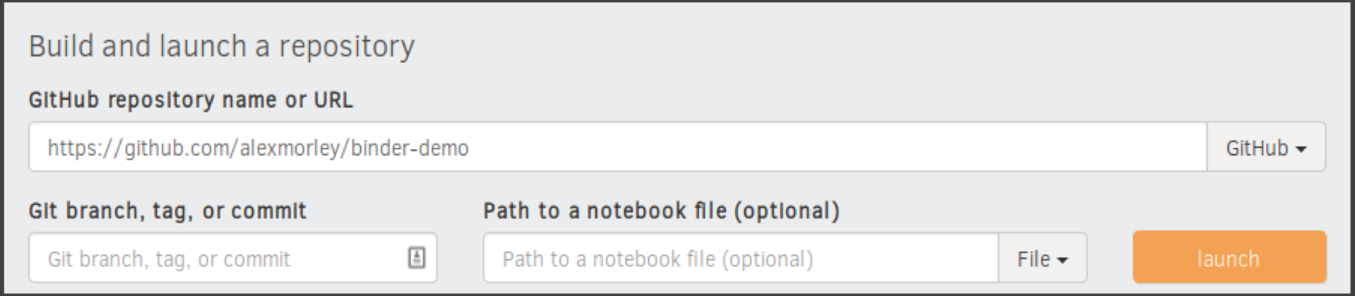
3 Execute image

4 Allocate computational resources

5 Make image accessible at mybinder.org/some_url

https://doi.org/10.5281/zenodo.3404774

BinderHub



Build and launch a repository

GitHub repository name or URL

https://github.com/alexmorley/binder-demo

Git branch, tag, or commit

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Path to a notebook file (optional)

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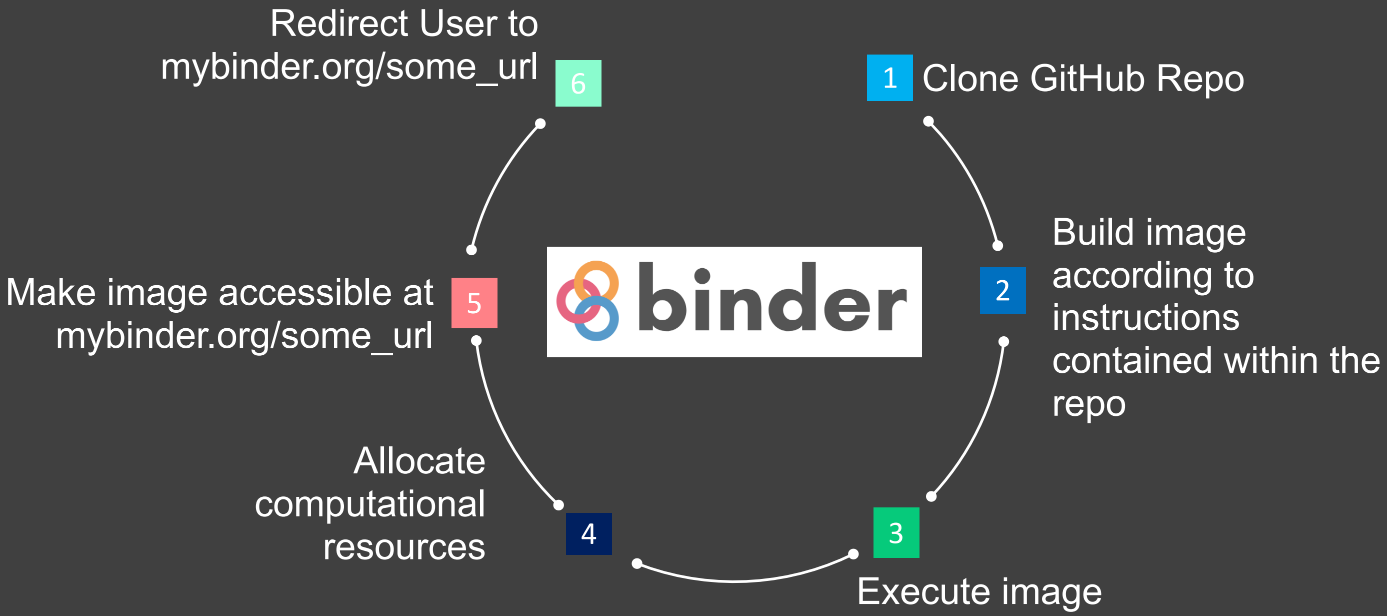


1 Clone GitHub Repo

2 Build image according to instructions contained within the repo

3 Execute image

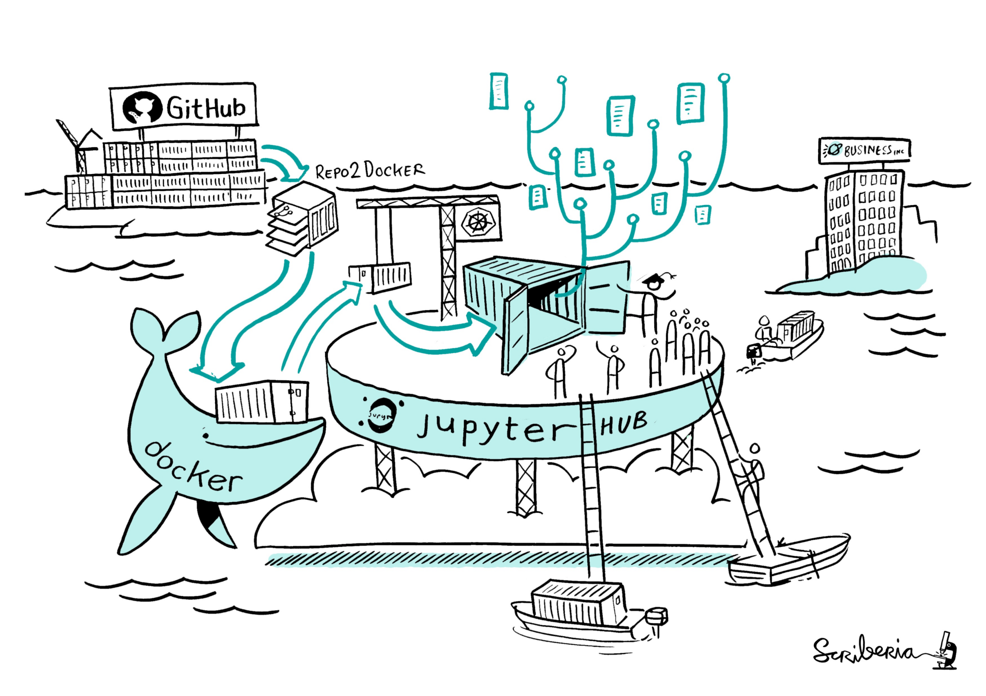
4 Allocate computational resources

5 Make image accessible at mybinder.org/some_url

6 Redirect User to mybinder.org/some_url

BinderHub

- Collection of tools working in harmony which BinderHub orchestrates



https://doi.org/10.5281/zenodo.3404774

#TuringWay #ukrse19

Scaling a BinderHub for multiple users

Problems if you run this on one computer:

– Resource intensive

– Resource control

– Security

Solution: Kubernetes!

– Resource intensive → Cluster management

– Resource control → Container management

– Security → Container isolation

Solution: Kubernetes!

– Resource intensive → Cluster management
– Resource control → Container management
– Security → Container isolation

Problem: Also Kubernetes… 😢

This Workshop

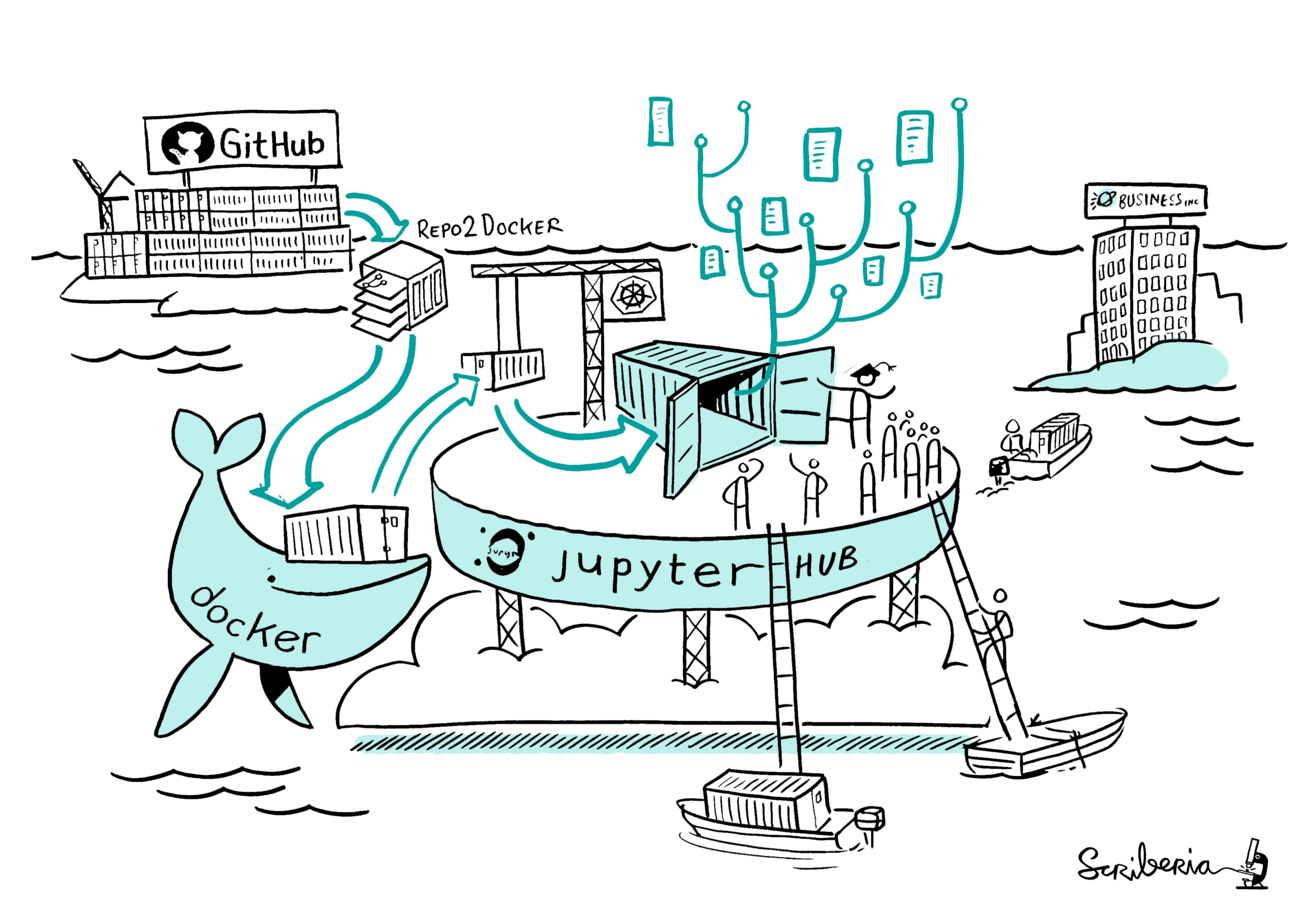
- What it is: Challenging!
- What it's not: A cloud/Azure workshop
- What we'll do: Build a BinderHub!

https://docs.microsoft.com/en-gb/learn/azure/

This Workshop

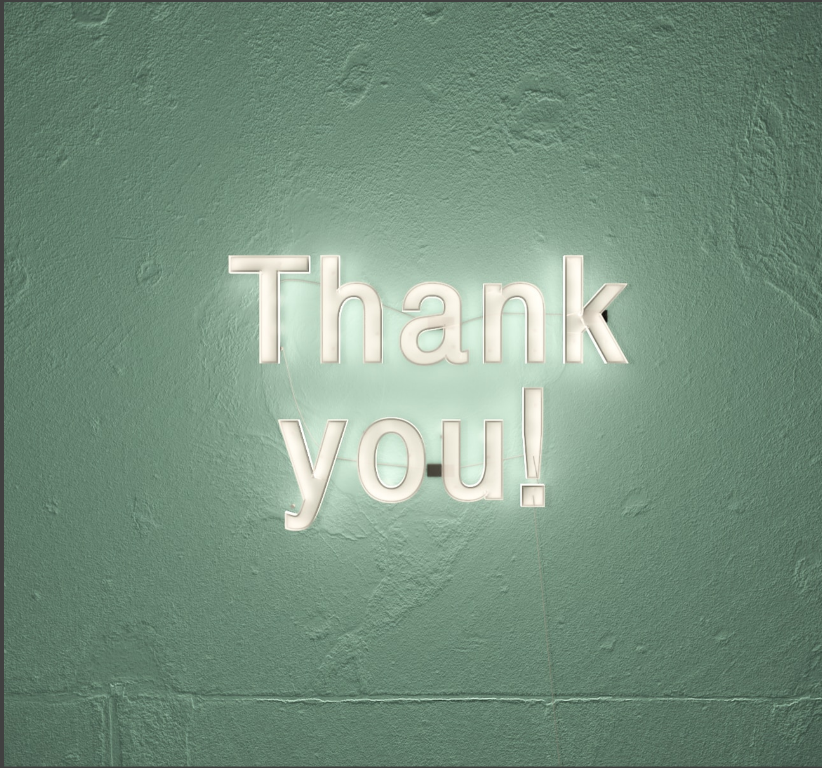
bit.ly/zero-to-binderhub-workshop

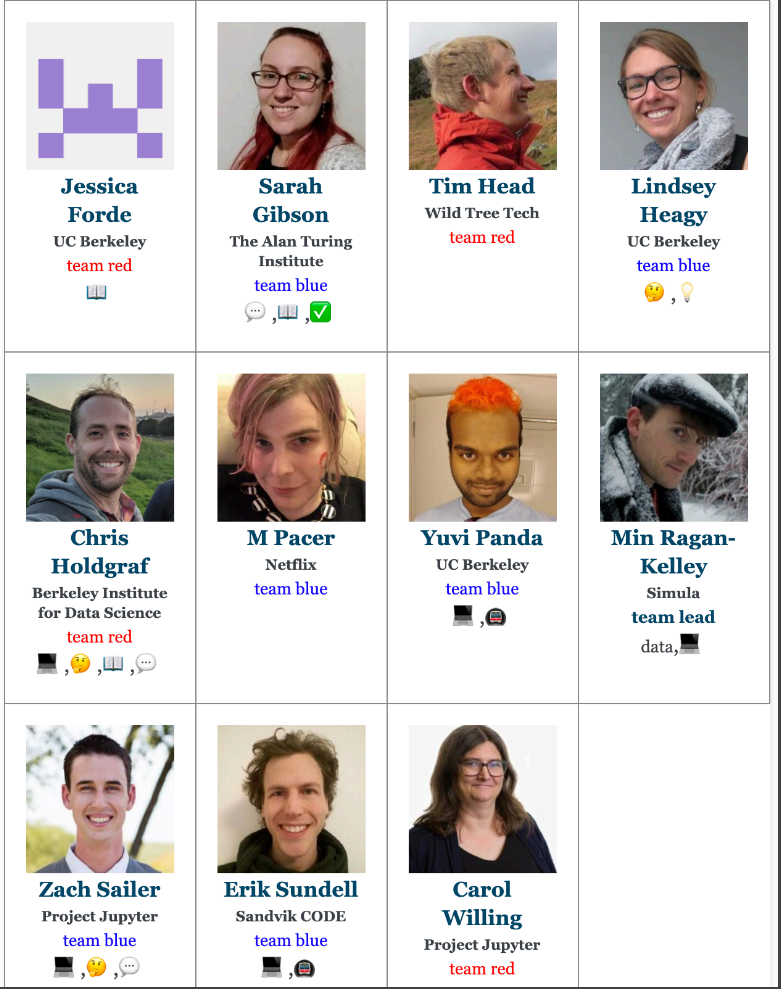
HackMD: bit.ly/RSEConBinderHub



https://doi.org/10.5281/zenodo.3404774 #TuringWay #ukrse19

- You have successfully built a BinderHub! 🤞
- Now check out this repo: github.com/alan-turing-institute/binderhub-deploy
- Please leave feedback in the HackMD: bit.ly/RSEConBinderHub





Jessica Forde UC Berkeley team red 📖	**Sarah Gibson** The Alan Turing Institute team blue 💬 ,📖 ,✅	**Tim Head** Wild Tree Tech team red	**Lindsey Heagy** UC Berkeley team blue 🤔 , 💡
Chris Holdgraf Berkeley Institute for Data Science team red 💻 ,🤔 ,📖 ,💬	**M Pacer** Netflix team blue	**Yuvi Panda** UC Berkeley team blue 💻 ,🚇	**Min Ragan-Kelley** Simula team lead data,💻
Zach Sailer Project Jupyter team blue 💻 ,🤔 ,💬	**Erik Sundell** Sandvik CODE team blue 💻 ,🚇	**Carol Willing** Project Jupyter team red	

Thank You!

https://doi.org/10.5281/zenodo.3404774

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