# Jupyter notebooks for Research

JAMES SLACK & NÚRIA RUIZ

# What are Jupyter notebooks?

Computational notebook

Multi-language support

Open Source

https://jupyter.org/

	•	💆 jupy	ter La	orenz D	lifferential	Equatior	1S (autosav	ed)		-
		File Edit	View	Insert	Cell Kerr	nel Help				Python 3 O
		B + ×	00	* *	▶ ■ C	Code	0	Cell Toolbar: None	0	
Jupyter Welcome to P			Explo	ring	the Lor	enz S	yster	n		
File Edit View Insert Cell			In this Notebook we explore the Lorenz system of differential equations:							
		$\dot{x} = \sigma(y - x)$								
5			$\dot{y} = \rho x - y - xz$							
						ż =	$-\beta z + x$	<sup>v</sup>		
	🔁 Jupyter		This is one of the classic systems in non-linear differential equations. It exhibits a range of complex behaviors as the parameters ( $\sigma$ , $\beta$ , $\rho$ ) are varied, including what are known as <i>chaotic</i> solutions. The system was originally developed as a simplified mathematical model for atmospheric convection in 1963.							
	Welcome to the	In [7]:	interact	(Lorenz	Nefixed	10)	10=(0	360 1		
			Incerace		0,50.0),β=					
	This Notebook Server was	×	angle					308		
	WARNING								-6	
	Don't rely on this serv		max_time					12		
	bon croy on the burn		a					10		
	Your server is hosted than		P					2.6		
			0					28		
	Due come Dathers									
Run some Python ( To run the code below:										
	1. Click on the cell to se									
	2. Press SHIFT+ENTER			11	-				-	
A full tutorial for using the				11	1		~			
				11		-				
	In [ ]: Mmatplotlib inline						111			/
	import pandas as pd			//			1100		//	
	import numpy as np import matplotlib			11					//	
	amport matpiotith			1		-			/	
					1	_		(/)		

### Working with Jupyter





### Local Install

- Ideal for exploratory use
- Individual research
- More experimental

### Jupyterhub

- Multiuser environment
- Cloud hosted solution
- Ideal for group research, within or across institutions

# Sharing Jupyter



Static Published notebook

Good for sharing concepts

Shareable Interactive version

- Ideal for sharing output to other researchers
- Public engagement

### Why use Jupyter?

- Reliably document computational workflows
- Create visualizations alongside explanations within document
- Create reproducible analyses that can easily be shared
- Combine software code, computational output, explanatory text and multimedia resources in a single document
- Analyse large remote data sets

#### omic analysis of elongated skulls **Rensive** female-biased immigration arly Medieval Bavaria

Krishna R. Veeramah<sup>a</sup>, Andreas Rott<sup>b, 1</sup>, Melanie Groß<sup>c, 1</sup>, Lucy van Dorp<sup>d</sup>, Saioa López<sup>e</sup>, Karola Kirsanow<sup>c</sup>, Christian Sell<sup>c</sup>, Jens Blöcher<sup>c</sup>, Daniel Wegmann<sup>f, g</sup>, Vivian Link<sup>f, g</sup>, Zuzana Hofmanová<sup>f, g</sup>, Joris Peters<sup>b, h</sup>, Bernd Trautmann<sup>b</sup>, Anja Gairhos<sup>i</sup>, Jochen Haberstroh<sup>j</sup>, Bernd Päffgen<sup>k</sup>, Garrett Hellenthal<sup>d</sup>, Brigitte Haas-Gebhard<sup>i</sup>, Michaela Harbeck<sup>b,2,3</sup>, and Joachim Burger<sup>c,2,3</sup>

\*Department of Ecology and Evolution, Stony Brook University, Stony Brook, NY 11794-5245; <sup>b</sup>State Collection for Anthropology and Palaeoanatomy, Bavarian Natural History Collections, 80333 Munich, Germany; <sup>c</sup>Palaeogenetics Group, Institute of Organismic and Molecular Evolution, Johannes Gutenberg University Mainz, 55099 Mainz, Germany; <sup>d</sup>UCL Genetics Institute, Department of Genetics, Evolution and Environment, University College London, WC1E 6BT London, United Kingdom; \*Cancer Institute, University College London, WC1E 6DD London, United Kingdom; \*Department of Biology, University of Fribourg, 1700 Fribourg, Switzerland; 9Swiss Institute of Bloinformatics, 1700 Fribourg, Switzerland; hArchaeoBioCenter and Institute for Palaeoanatomy, Domestication Research and the History of Veterinary Medicine, Ludwig Maximilian University, 80539 Munich, Germany, Bavarian State Archaeological Collection, 80538 Munich, Germany; Bavarian State Department of Monuments and Sites, 80539 Munich, Germany; and Einstitute of Prehistoric and Protohistoric Archaeology, Ludwig Maximilian University, 80799 Munich, Germany

#### ne Scientifie Paper Is Obsolete 2018 (received for review November 21, 2017)

Here's what's next phy, while genetic analysis of prehistoric bination of the romanized local population of the border province humans has indicated at least two major waves of immigration of the former Roman Empire and immigrants from north of the

ropean genetic structure demonstrates strong corre- to form in the 5th century AD, and that it emanated from a com-

#### **O'REILLY**°

#### The Intertwingularity is near: When hum<u>ans transcend</u> print media

Both reproducible science and open source are necessary for collaboration at scale-the nexus for that intermingling is Jupyter.

By Paco Nathan. April 24, 2018





#### **KEVIN ZIELNICKI**

July 26, 2017 - San Francisco, CA

Y Tweet this post! In Post on LinkedIn

Analysis should be reproducible.

#### Why Jupyter is data scientists' computational notebook of choice



An improved architecture and enthusiastic user base are driving uptake of the open-source web tool.

effrey M. Perkel





