Computational experiments in Science

Horse wrangling in the digital age

Mathieu Lagrange and Mathias Rossignol

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Outline

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Horse taxidermy

- public horse
- hidden horses
- Potemkin Villages

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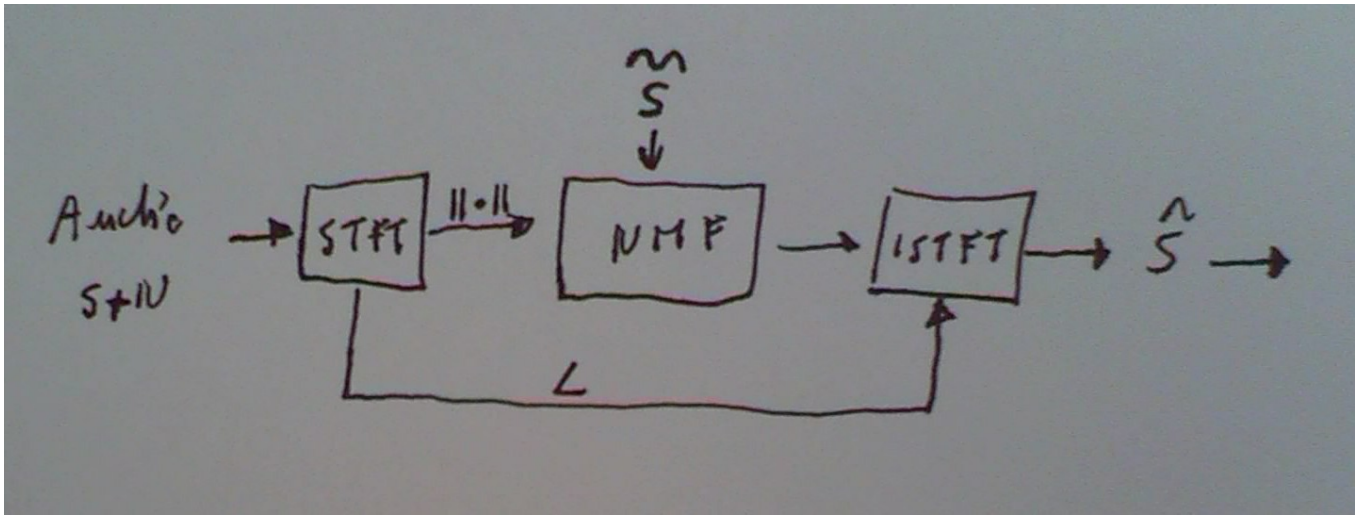
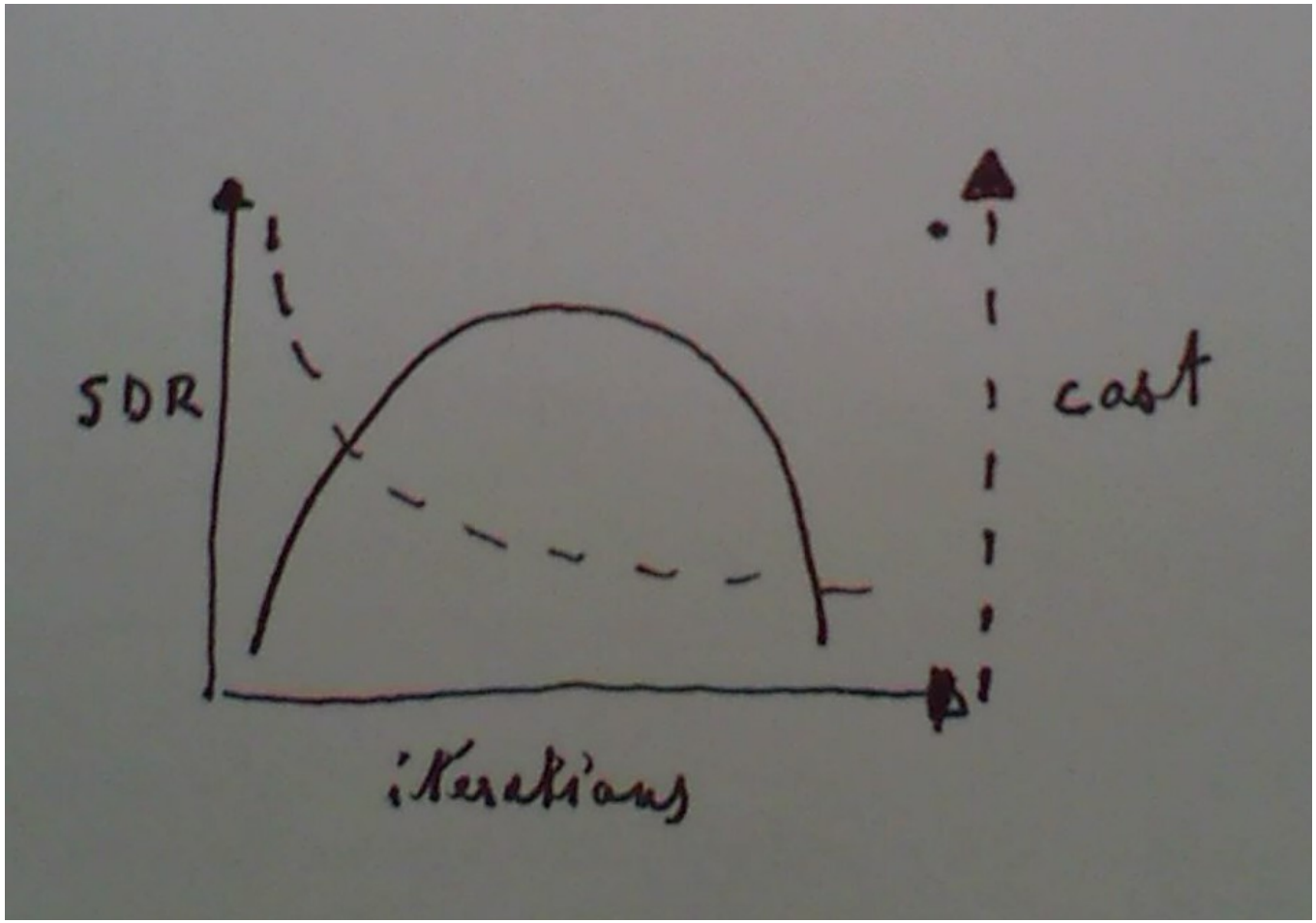
Public horses for Source separation

classic NMF Source Separation scheme



NMF is an iterative scheme, do you set the number of iterations for balancing computational cost and performance ?

Public horses for Source separation



Public horses for Source separation

the use of NMF is an example of a "public" horse

- quality-of-fit optimized criterion
- target criteria (SDR, SAR, SIR)
- heavy use of "early stop" to ensure the non divergence of the target criteria

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- part of research
- and everyone is more or less happy with it

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There are many ways our community is severely harming itself

- badly designed tasks
- too small and biased datasets
- unrealistic and non reproducible results

Peter Norvig: Warning Signs in Experimental Design and Interpretation

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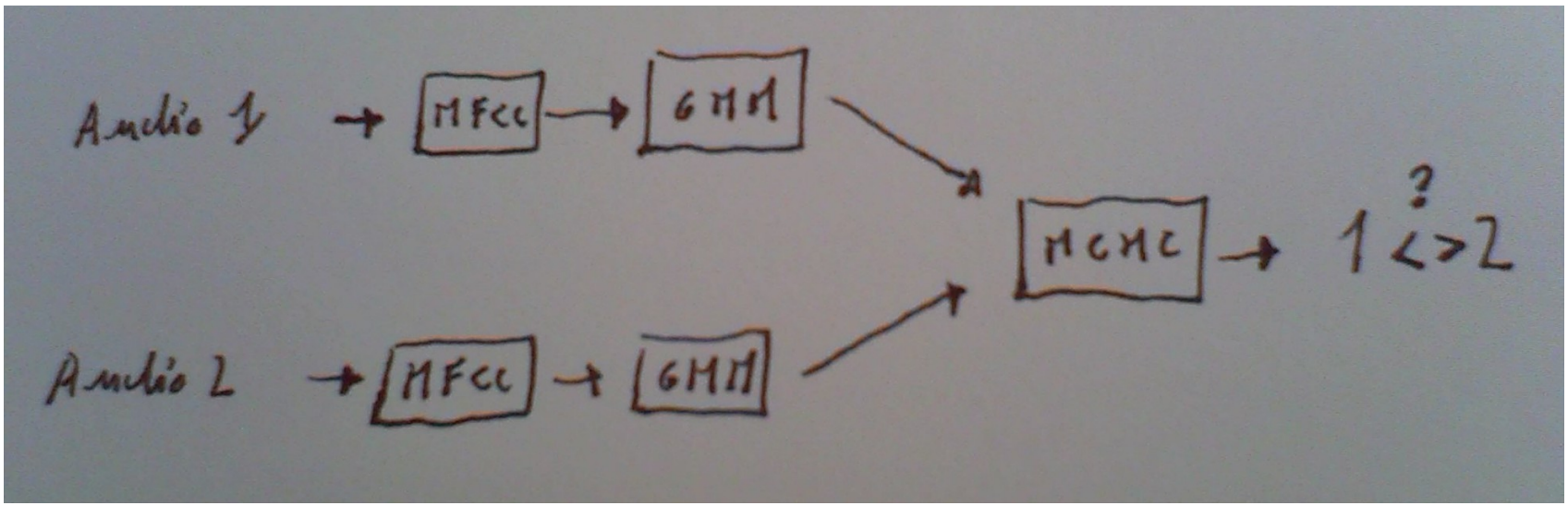
An example

Acoustic Scene Similarity Retrieval (ASSR)



An example

A Potemkin Village in ASSR

- 2007: near perfect results, solved case
- but strong issue in database design, similar to the album effect in artist / genre recognition
- 2015: new figure, GMMs useless and performance only slightly over chance

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One problem

DATA

Audio Scene Analysis

We need

- lots of data
- well annotated data
- public domain data
- controllable complexity

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Data simulation

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- simulated data is ok,
- as long as the aim is to gain knowledge and not to go to production
- simulation is not real data, but also not synthesized data
- tricky part is to choose the right level of abstraction.

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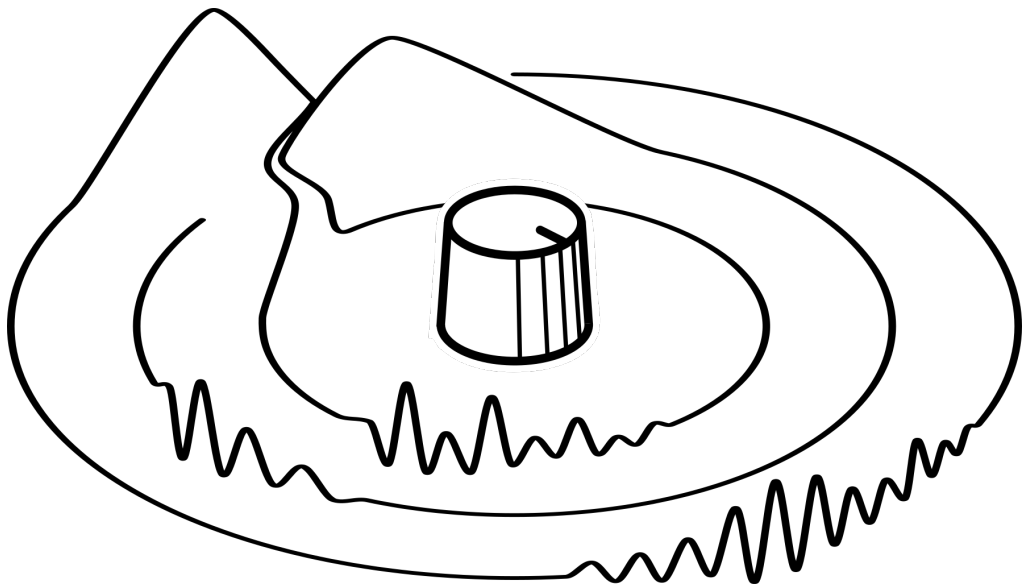
SimScene



In a nutshell

SimScene is an acoustic scene simulator

- built as a sequencer
- with abstracted scheduling parameters
- where events are defined as a set of recording samples
- the outcome follows the "skeleton of events on a bed of texture paradigm"

Nelken, I., & de Cheveigné An ear for statistics Nature neuroscience, 16(4), 381-382.

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- open source:
  `https://bitbucket.org/mlagrange/simscene`
- used in DCASE 2013 and 2016 editions
- produced datasets on archive

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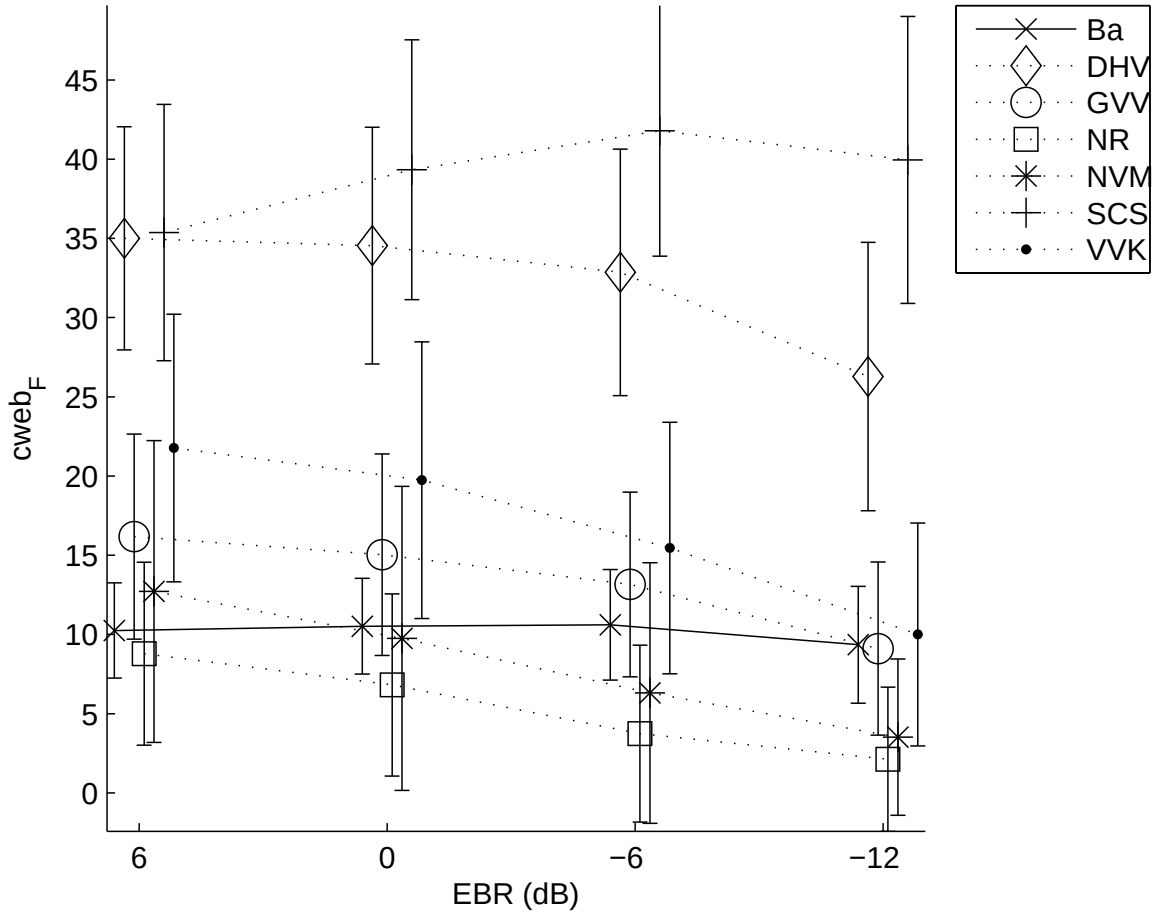
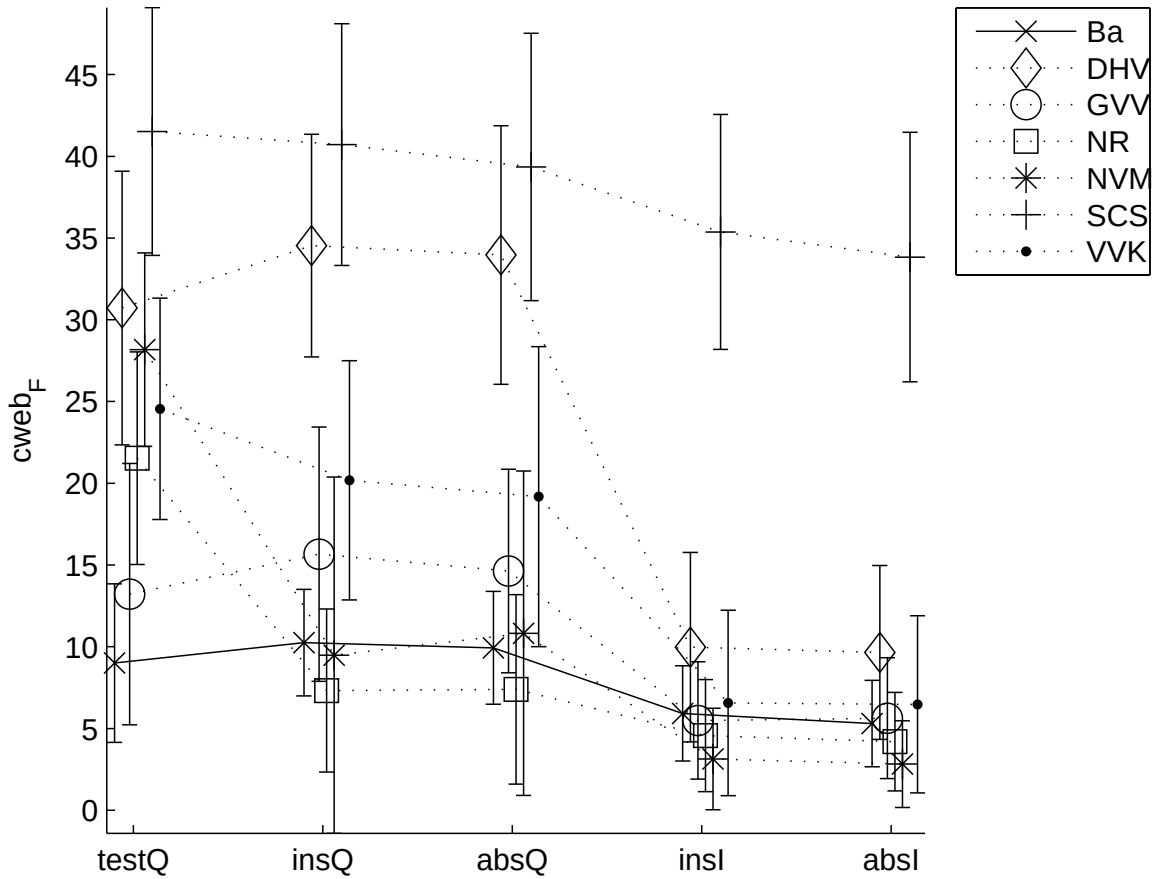
Going deeper in performance analysis



Varying Event to Background Ratio (EBR)

Going deeper in performance analysis



Changing recording location for events and background

Another problem

PROCESSING

The scientific method

- Analysis: Describe problem
- Hypothesis: Specify solution
- Synthesis: Implement solution
- Validation: Compute performance

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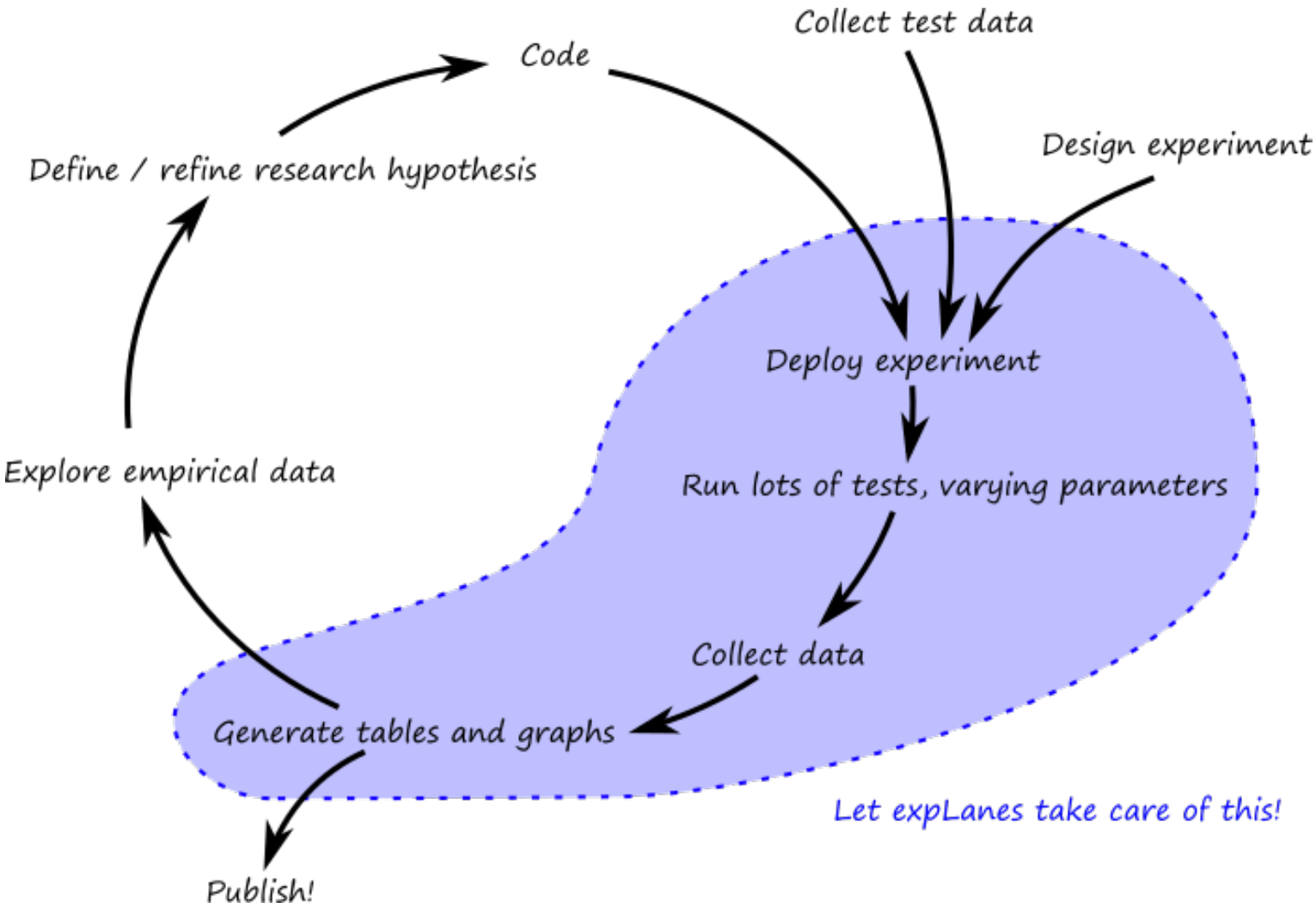
Why using expLanes ?



In a nutshell

- Design: follow strictly the Design of Experiments paradigm (DoE)
- Code: feed forward pipeline
- Process: multi user, multi core, multi host
- Reduce: fast and convenient thanks to factor masking
- Visualize: Matlab, LaTeX, html

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- demonstrations: clustering, source separation, ...
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- The horse phenomenon is a reality
- Potemkin villages are very common also in emerging fields
- Scientists as individuals are smart humans
- Yet, the social impact is very strong
- As a community, the scientific method must be enforced
- Strict reproducible research is the way to go
- Need tools for that, not only languages

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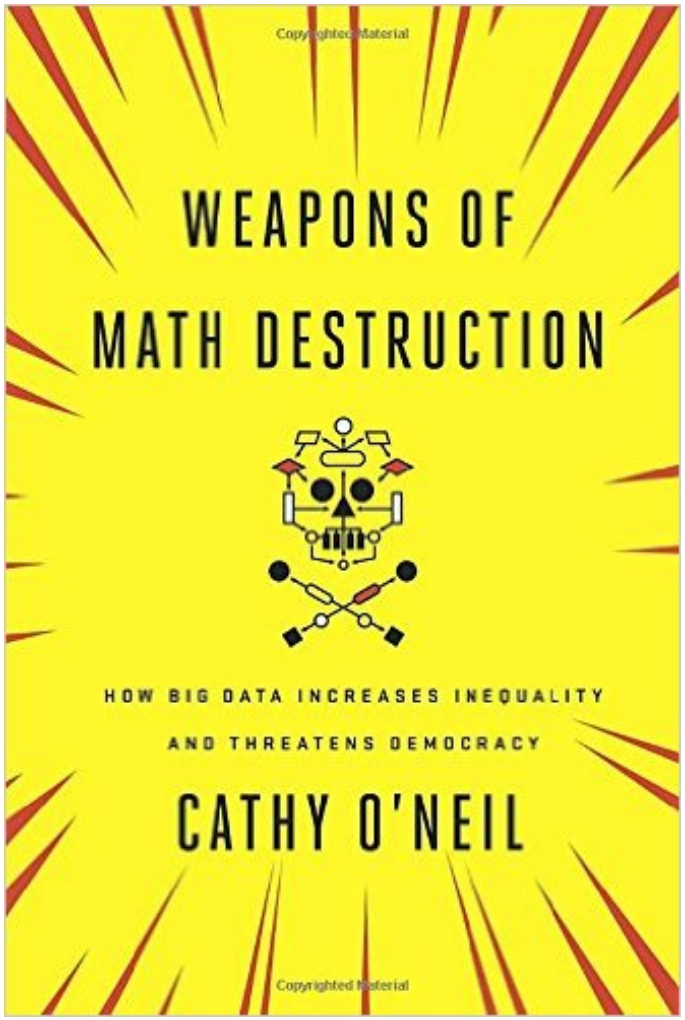
Cathy O'Neil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Victoria Stodden

one of three "reproducibility editors" appointed to look over code and data sets submitted by authors to the Journal of the American Statistical Association (JASA)