PhD - a bird’s eye view

Research: doing and writing

Vijay Kartik

15.05.2018

Table of contents

My initial dreams

Dreams

1. Learn *everything* about (new) PhD topic

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2. Brilliant brainwave

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3. Spread the idea a.k.a Publish articles (maybe 10-20)

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5. Applause from everyone

Reality is slightly different

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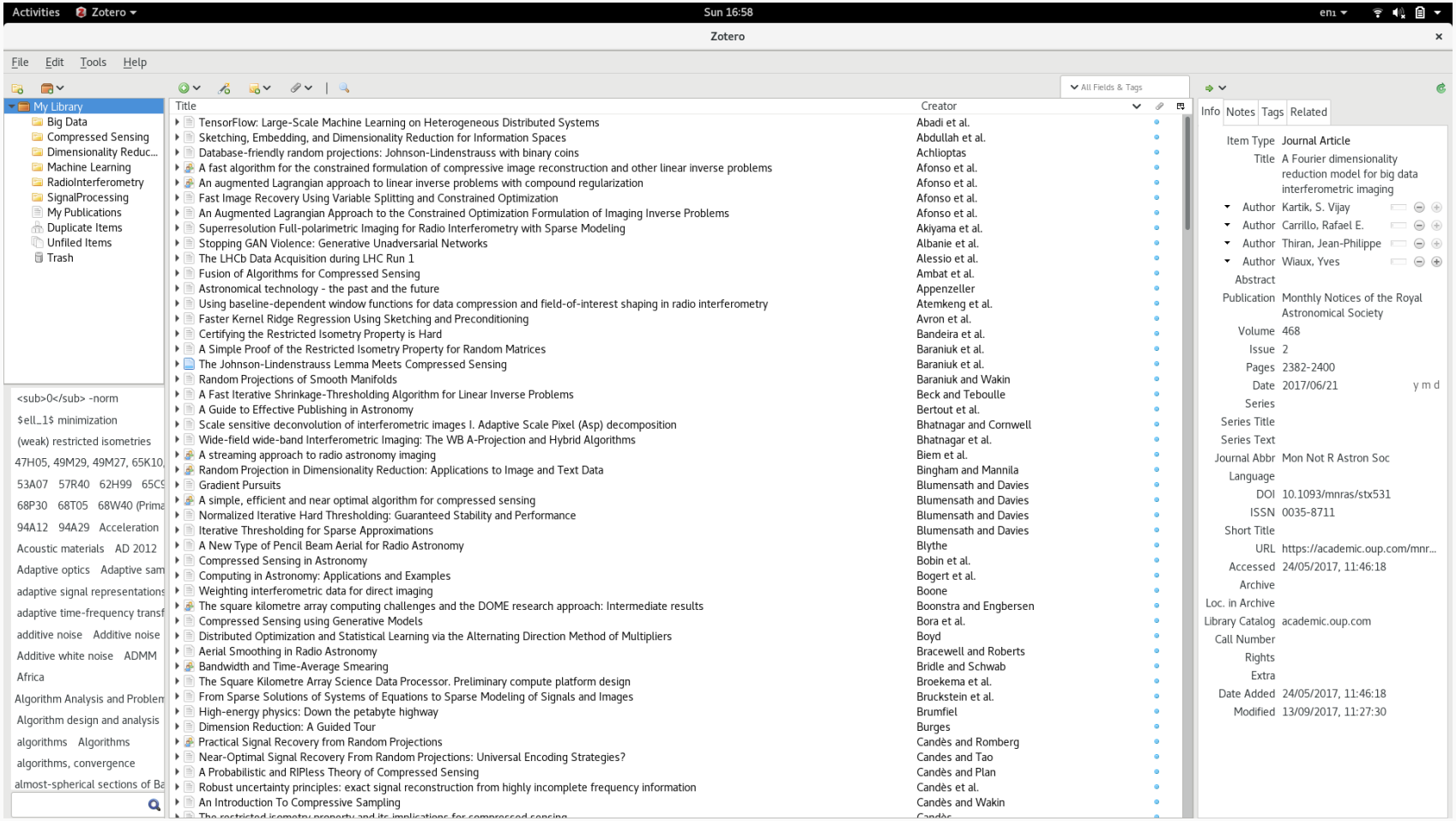
11. Submit, defend, hunt for jobs

Useful things I did

Useful things I did

1. Use a reference manager

Zotero


Activities
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en1
Zotero
File
Edit
Tools
Help
All Fields & Tags
My Library
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Duplicate Items
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Certifying the Restricted Isometry Property is Hard Bandeira et al.
A Simple Proof of the Restricted Isometry Property for Random Matrices Baraniuk et al.
The Johnson-Lindenstrauss Lemma Meets Compressed Sensing Baraniuk et al.
Random Projections of Smooth Manifolds Baraniuk and Wakin
A Fast Iterative Shrinkage-Thresholding Algorithm for Linear Inverse Problems Beck and Teboulle
A Guide to Effective Publishing in Astronomy Bertout et al.
Scale sensitive deconvolution of interferometric images I. Adaptive Scale Pixel (Asp) decomposition Bhatnagar and Cornwell
Wide-field wide-band Interferometric Imaging: The WB A-Projection and Hybrid Algorithms Bhatnagar et al.
A streaming approach to radio astronomy imaging Biem et al.
Random Projection in Dimensionality Reduction: Applications to Image and Text Data Bingham and Mannila
Gradient Pursuits Blumensath and Davies
A simple, efficient and near optimal algorithm for compressed sensing Blumensath and Davies
Normalized Iterative Hard Thresholding: Guaranteed Stability and Performance Blumensath and Davies
Iterative Thresholding for Sparse Approximations Blumensath and Davies
A New Type of Pencil Beam Aerial for Radio Astronomy Blythe
Compressed Sensing in Astronomy Bobin et al.
Computing in Astronomy: Applications and Examples Bogert et al.
Weighting interferometric data for direct imaging Boone
The square kilometre array computing challenges and the DOME research approach: Intermediate results Boonstra and Engbersen
Compressed Sensing using Generative Models Bora et al.
Distributed Optimization and Statistical Learning via the Alternating Direction Method of Multipliers Boyd
Aerial Smoothing in Radio Astronomy Bracewell and Roberts
Bandwidth and Time-Average Smearing Bridle and Schwab
The Square Kilometre Array Science Data Processor. Preliminary compute platform design Broekema et al.
From Sparse Solutions of Systems of Equations to Sparse Modeling of Signals and Images Bruckstein et al.
High-energy physics: Down the petabyte highway Brumfiel
Dimension Reduction: A Guided Tour Burges
Practical Signal Recovery from Random Projections Candès and Romberg
Near-Optimal Signal Recovery From Random Projections: Universal Encoding Strategies? Candes and Tao
A Probabilistic and RIPless Theory of Compressed Sensing Candès and Plan
Robust uncertainty principles: exact signal reconstruction from highly incomplete frequency information Candès et al.
An Introduction To Compressive Sampling Candès and Wakin
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Author Carrillo, Rafael E.
Author Thiran, Jean-Philippe
Author Wiaux, Yves
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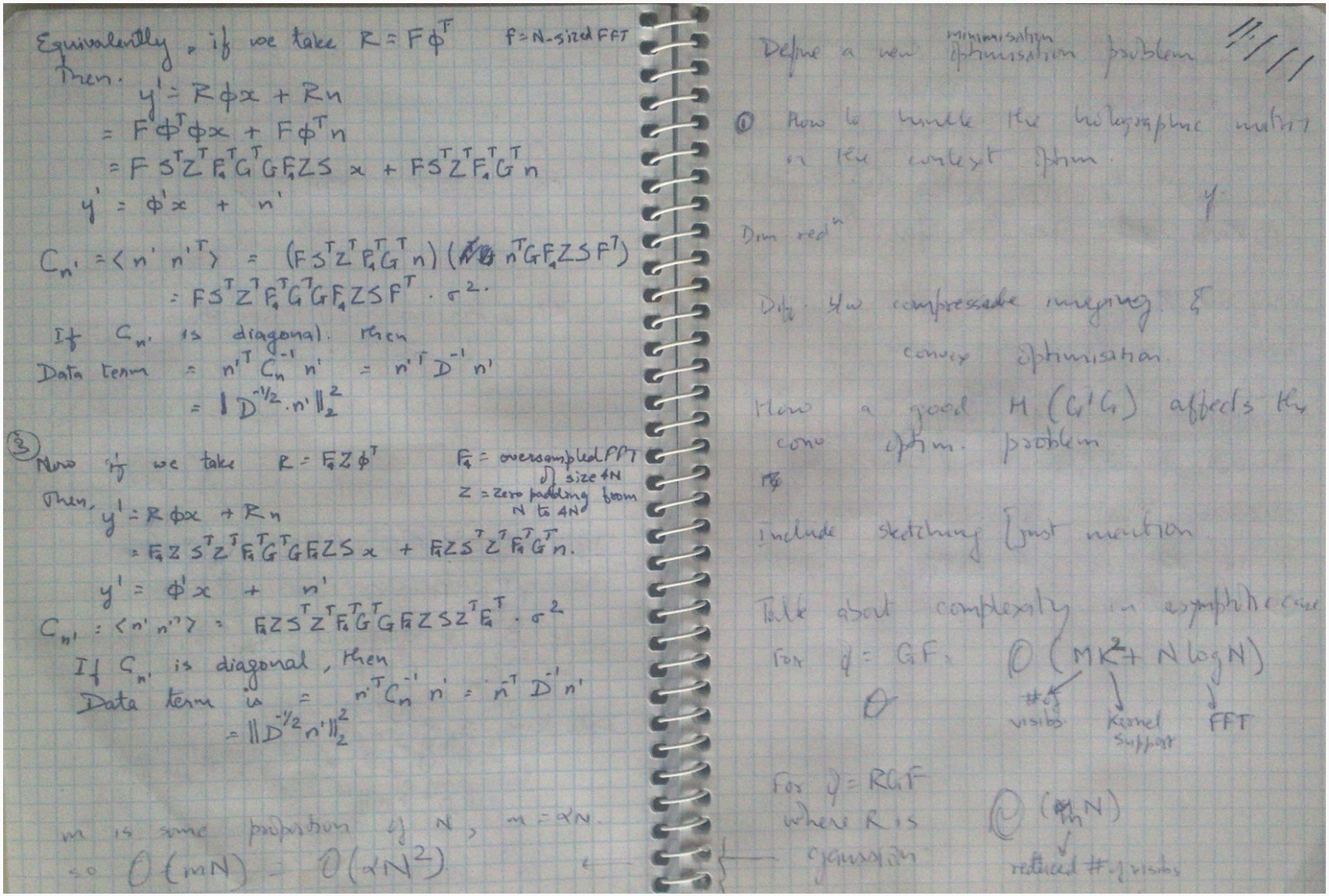
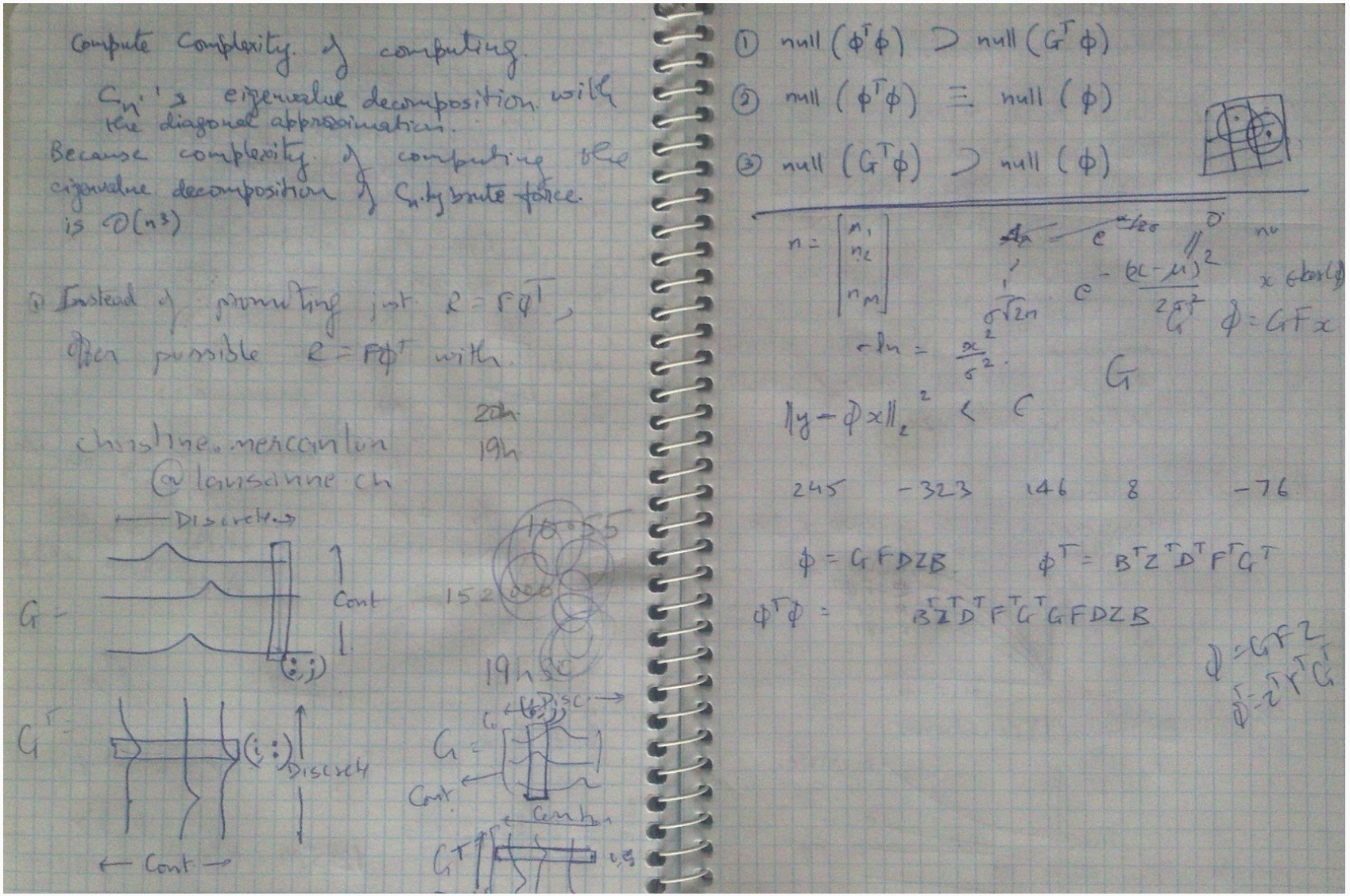
Useful things I did

1. Use a reference manager
2. Take fairly regular notes of experiments

Notes


Equivalently, if we take R = Fφ^T F = N-sized FFT
Then.
y' = Rφx + Rn
= Fφ^Tφx + Fφ^Tn
= FS^TZ^TF_4^TG^TGF_4ZS x + FS^TZ^TF_4^TG^Tn
y' = φ'x + n'
C_n' = ⟨n' n'^T⟩ = (FS^TZ^TF_4^TG^Tn)(n^TGF_4ZSF^T)
= FS^TZ^TF_4^TG^TGF_4ZSF^T · σ^2.
If C_n' is diagonal. then
Data term = n'^T C_n^-1 n' = n'^T D^-1 n'
= ‖D^-1/2 · n'‖_2^2
(3) Now if we take R = F_4Zφ^T
F_4 = oversampled FFT ⌋ size 4N
Z = zero padding from N to 4N
Then, y' = Rφx + Rn
= F_4ZS^TZ^TF_4^TG^TGF_4ZS x + F_4ZS^TZ^TF_4^TG^Tn.
y' = φ'x + n'
C_n' = ⟨n' n'^T⟩ = F_4ZS^TZ^TF_4^TG^TGF_4ZSZ^TF_4^T · σ^2
If C_n' is diagonal, then
Data term is = n'^T C_n^-1 n' = n'^T D^-1 n'
= ‖D^-1/2 n'‖_2^2
m is some proportion of N, m = αN.
∴ O(mN) = O(αN^2)
Define a new minimisation optimisation problem
① How to handle the holographic matrix in the context of optim.
y
Dim red^n
Diff. for compressed imaging & convex optimisation.
How a good H (G'G) affects the conv optim. problem
Include sketching (just mention
Talk about complexity in asymptotic case
For G = GF_4 O(MK^2 + N log N)
# of visibs Kernel support FFT
For G = RGF where R is sparsifying O(M_R N)
reduced # of visibs

Notes


Compute Complexity of computing.
$C_{n'}$'s eigenvalue decomposition with the diagonal approximation.
Because complexity of computing the eigenvalue decomposition of C_n by brute force is $\mathcal{O}(n^3)$
Instead of computing just $\Sigma = F\Phi^T$, after possible $\Sigma = F\Phi^T$ with.
christine.mercanton@lausanne.ch
20h
19h
Discrete
Cont
$G =$
G^T
Discrete
Cont
10:55
152
19h50
Discrete
$G =$
Cont
Cont
G^T
① null $(\Phi^T\Phi)$ ⊃ null $(G^T\Phi)$
② null $(\Phi^T\Phi)$ ≡ null (Φ)
③ null $(G^T\Phi)$ ⊃ null (Φ)
$n = \begin{bmatrix} n_1 \\ n_2 \\ \vdots \\ n_M \end{bmatrix}$
$-\ln = \frac{x^2}{\sigma^2}$
G
$\|y - \Phi x\|_2^2 < \epsilon$
245 −323 146 8 −76
$\Phi = GFDZB$
$\Phi^T = B^TZ^TD^TF^TG^T$
$\Phi^T\Phi = B^TZ^TD^TF^TG^TGFDZB$
$\Phi = GFZ$
$\Phi^T = Z^TF^TG^T$

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3. Try different collaborative writing tools

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5. Automate versioning of all research output

Automate versioning

```
[@castor:~/admm/choleskyapprox] griddinggaussian(+11/-10)+* ± git branch
  diagreduction256images
* griddinggaussian
  master
  nothresholding
  nufftdiagreduction
  randomisedhadamard
  spreadspectrum
  systematicdiscardcols
  testhistogrampeakiness
```

Automate versioning

```
vkartik@deneb2:choleskyapprox$git branch
  discardeigenvectors
  fouriergrid2imgsize
  grid2imgsize
  master
  multispectralthresholding
  newcovmatfunc
  randomcoverage
* sigmaftrial
  zoomskacoverage
```

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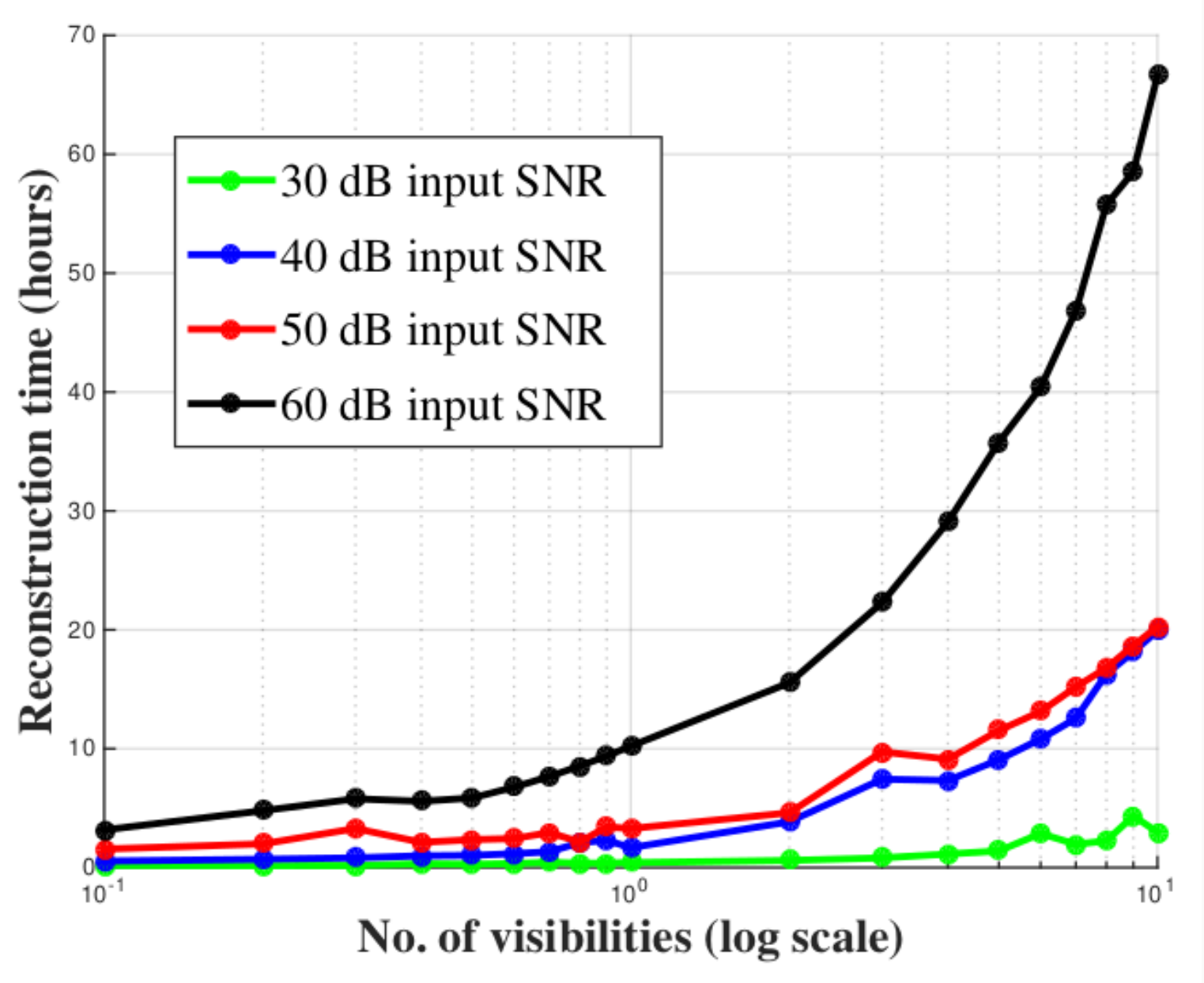
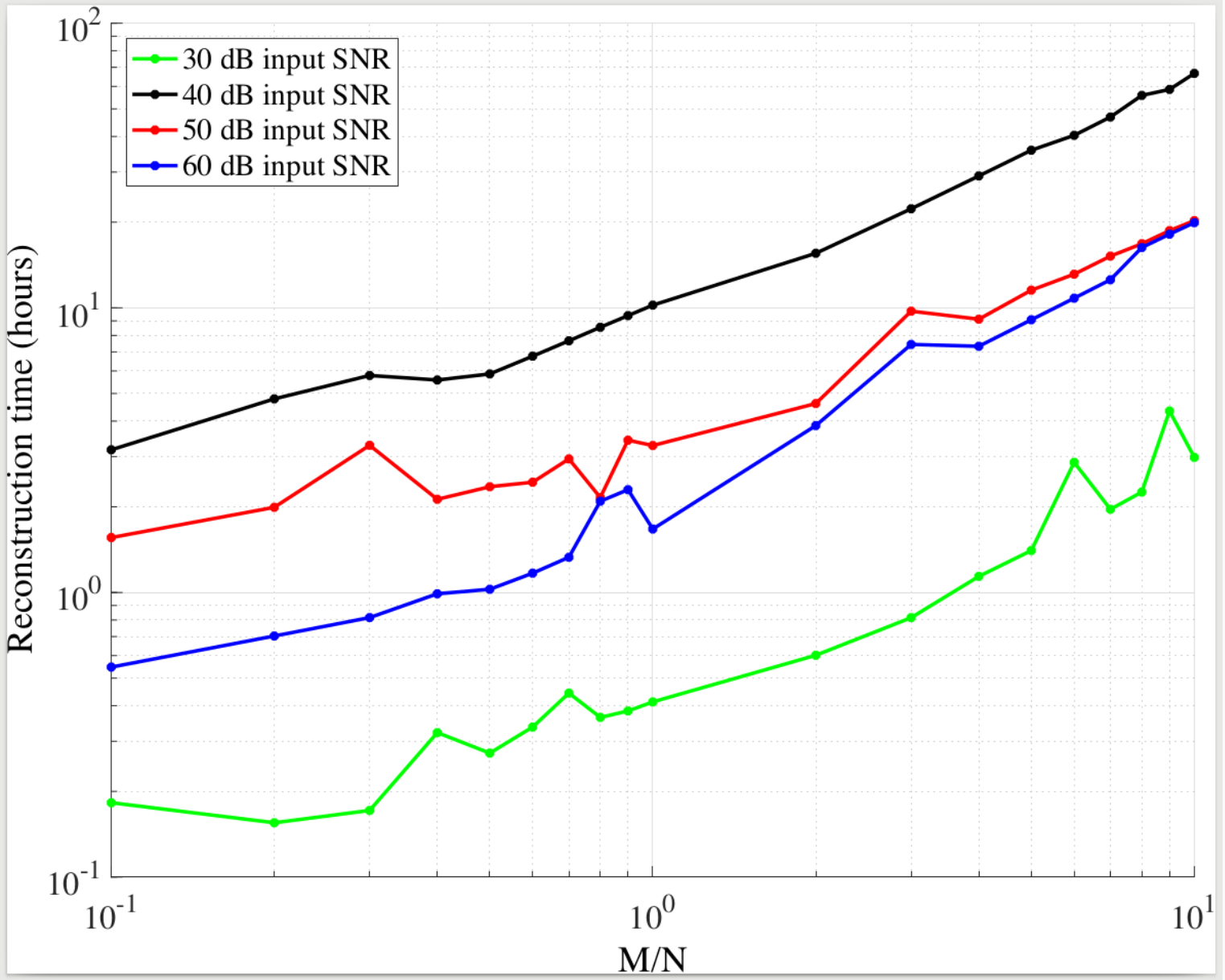
Automate plotting



Automate plotting



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7. Multiple backups of ongoing work

More useful things

Useful things I wish I did

1. *Maintain* an organized log (weblog, notebook, tattoos, *anything*)

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2. Actively follow up conference discussions

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2. Actively follow up conference discussions
3. Organize/label data and results better
4. Write up different research methods tried (and possibly failed)

Reusing content in the thesis

What content?

Step 1: Write a paper

Step 2: Done. I now have (unpublished) content.

Ideally, I would already start thinking about how much ‘freedom’ I have with *my own* content.

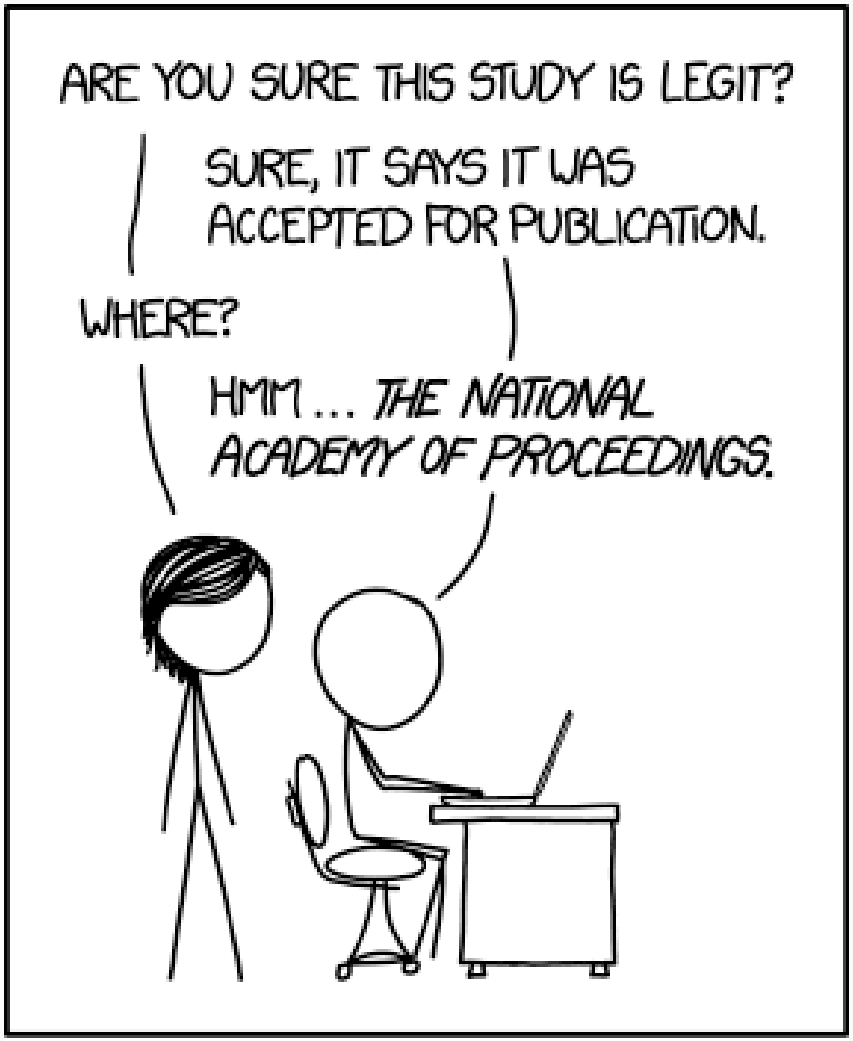
(Copy) rights

Questions to ask:

1. Can I retain copyright? (Answer: not always)
2. Can I provide public access to my paper?
3. Can I use text/images from my paper in my thesis?
    - Not to self-plagiarize in another paper!
4. Where do I submit?

P.S.: Sometimes you do not have a say in which journal to publish in (e.g., supervisor decides for you)

Where do I submit?



Source: https://xkcd.com/1847

Reusing published content in a presentation

Check first!

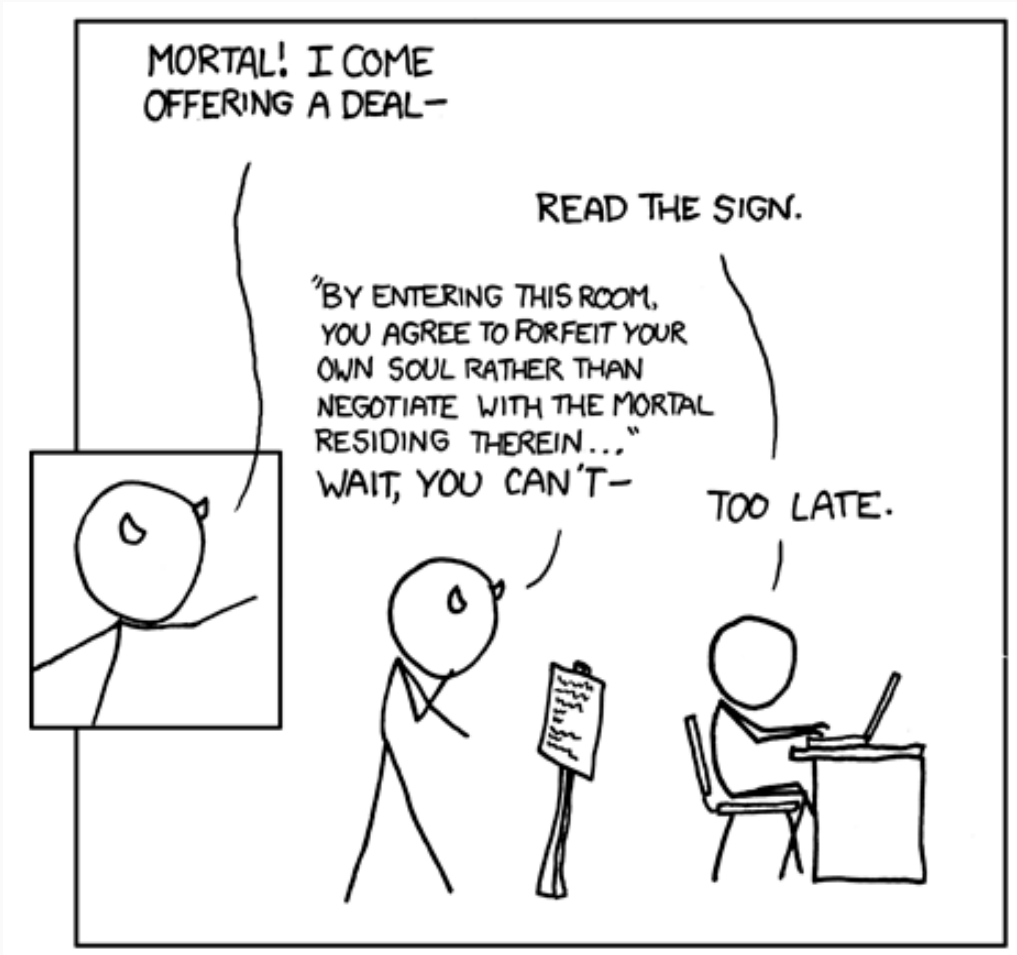
xkcd.com

Randall Munroe
Contact:
orders@xkcd.com -- All store-related email.
press@xkcd.com -- Press questions, etc (may take a long time to get to me).

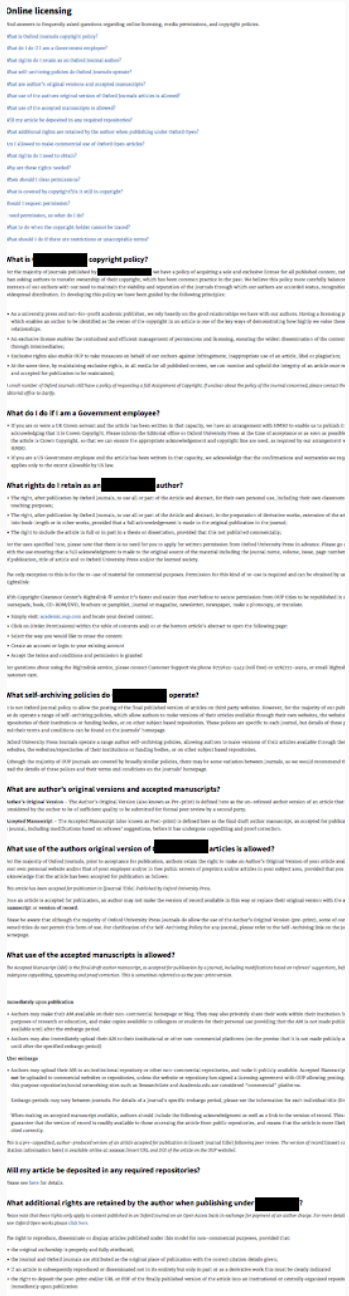
Note: You are welcome to reprint occasional comics pretty much anywhere (presentations, papers, blogs with ads, etc). If you're not outright merchandizing, you're probably fine. Just be sure to attribute the comic to xkcd.com.

Source: https://xkcd.com/about

Advice: Read *before* signing a licence



Source: https://xkcd.com/501



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What is Oxford Journals copyright policy?
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What rights do I retain as an Oxford Journal author?
What self-archiving policies do Oxford Journals operate?
What are author's original versions and accepted manuscripts?
What use of the authors original version of Oxford Journals articles is allowed?
What use of the accepted manuscripts is allowed?
Will my article be deposited in any required repositories?
What additional rights are retained by the author when publishing under Oxford Open?
Am I allowed to make commercial use of Oxford Open articles?
What right do I need to obtain?
Why are these rights needed?
When should I clear permissions?
What is covered by copyright? Is it still in copyright?
Should I request permission?
I need permission, so what do I do?
What to do when the copyright holder cannot be traced?
What should I do if there are restrictions or unacceptable terms?

What is [redacted] copyright policy?

What do I do if I am a Government employee?

What rights do I retain as an [redacted] author?

What self-archiving policies do [redacted] operate?

What are author's original versions and accepted manuscripts?

What use of the authors original version of [redacted] articles is allowed?

What use of the accepted manuscripts is allowed?

Will my article be deposited in any required repositories?

What additional rights are retained by the author when publishing under [redacted]?

Pre/post-prints & pre/post-embargo

What use of the accepted manuscripts is allowed?

The Accepted Manuscript (AM) is the final draft author manuscript, as accepted for publication by a journal, including modifications based on referees' suggestions, before it has undergone copyediting, typesetting and proof correction. This is sometimes referred to as the post-print version.

Immediately upon publication

- Authors may make their AM available on their non-commercial homepage or blog. They may also privately share their work within their institution for the purposes of research or education, and make copies available to colleagues or students for their personal use providing that the AM is not made publicly available until after the embargo period.
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- Authors may upload their AM to an institutional repository or other non-commercial repositories, and make it publicly available. Accepted Manuscripts **may not** be uploaded to commercial websites or repositories, unless the website or repository has signed a licensing agreement with [redacted] allowing posting. For this purpose repositories/social networking sites such as ResearchGate and Academia.edu are considered "commercial" platforms.

Advice: Look for precise statements

What is [redacted] copyright policy?

For the majority of journals published by [redacted], we have a policy of acquiring a sole and exclusive license for all published content, rather than asking authors to transfer ownership of their copyright, which has been common practice in the past. We believe this policy more carefully

Advice: Check Dos & Don’ts

Once an article is accepted for publication, an author may not make the version of record available in this way or replace their original version with the **accepted manuscript** or **version of record**.

Please be aware that although the majority of [redacted] Journals do allow the use of the Author’s Original Version (pre-print), some of our [redacted] owned titles do not permit this form of use. For clarification of the Self-Archiving Policy for any

Advice: Ask for *written* clarifications

Vijay Kartik

to [redacted]

Dear [redacted],

Thank you for your message. I would just like to ask for clarification about uploading accepted papers to the astro-ph website. Could I please know which website [redacted] encourages authors to upload accepted papers to? A web URL would be helpful to clear any confusion I may have.

Additionally, could you please confirm that uploading the accepted manuscript to the astro-ph website is coherent with the default licence that the [redacted] proposes to authors for [redacted]?

Regards,
Vijay Kartik

[redacted]

to me

Dear Vijay,

Yes it is fine to upload your paper to the astro-ph website https://arxiv.org/

Kind regards,

[redacted]

Advice: Seek explicit confirmation

What rights do I retain as an [redacted] author?

- The right, after publication by [redacted], to use all or part of the Article and abstract, for their own personal use, including their own classroom teaching purposes;
- The right, after publication by [redacted], to use all or part of the Article and abstract, in the preparation of derivative works, extension of the article into book-length or in other works, provided that a full acknowledgement is made to the original publication in the journal;
- The right to include the article in full or in part in a thesis or dissertation, provided that this not published commercially;

General research writing tips

General writing tips

1. Track progress

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2. Have measurable goals

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9. Get enough sleep

Questions?

Attributions

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https://github.com/vijaykartik/talk_researchandwriting

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