

How to Be a Good AI Researcher

Tao LIN

October 8, 2024



1 Recitation

2 How to Do Research

- More on How to Read Papers
- How to Come up With Research Ideas?
- How to Do Experiments?
- How to Create More Impact
- 12 Resolutions for Grad Students
- Experiment Management
- How to Manage Your Time?
- How to Be Productive?
- Tips for Work-Life Balance (WLB)
- Others Career Tips

Course schedule

Week	Date	Topics
1	2024. Sep. 03	Introduction to CS & AI
2	2024. Sep. 10	How to communicate
3	2024. Sep. 14	How to do presentation
4	2024. Sep. 24	How to be a good AI researcher (I): doing research
5	2024. Oct. 08	How to be a good AI researcher (II): productivity and career
6	2024. Oct. 15	How to be a good AI researcher (III): academic paper writing and peer reviews
7	2024. Oct. 22	Sharing the experience of writing excellent academic papers and rebuttal
8	2024. Oct. 29	Practice course

Acknowledgement

- [The 7 Cs of Communication](#), World of Work Project
- [Awesome Tips](#), JiaBin Huang
- [12 resolutions for grad students](#), Matt Might
- [Tips for work-life balance](#), Matt Might
- [Productivity tips for academics](#), Matt Might
- [How I read research papers](#), Aaditya Ramdas
- [GAMES003](#)

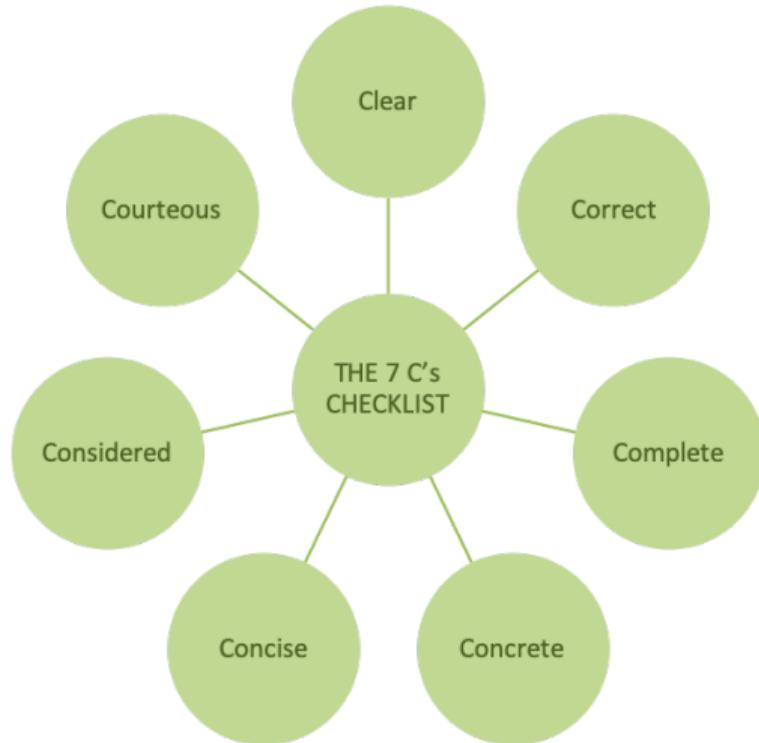
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1 Recitation

2 How to Do Research

In the previous three lectures...

We learn how to communicate: the 7 C's of communication



Please revisit our previous lecture when necessary.

We learn the principles of presentation

Great talks require effort & time!

We learn the first course on “how to do research”

- The Illustrated Guide to a Ph.D.
- 10 Easy Ways to Fail a Ph.D.
- How to Make Steady Progress?
- How to Keep Track With the Literature?
- How to Read Papers?

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- What is the problem? / How important is it?

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But why do we need to answer these questions?

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- Good reasons:
- Bad reasons:

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 - “I am citing this paper, so I should read it fully.”

How reading papers evolved for me (and might evolve for you)

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I never read a paper from start to end on my first opening (or ever)

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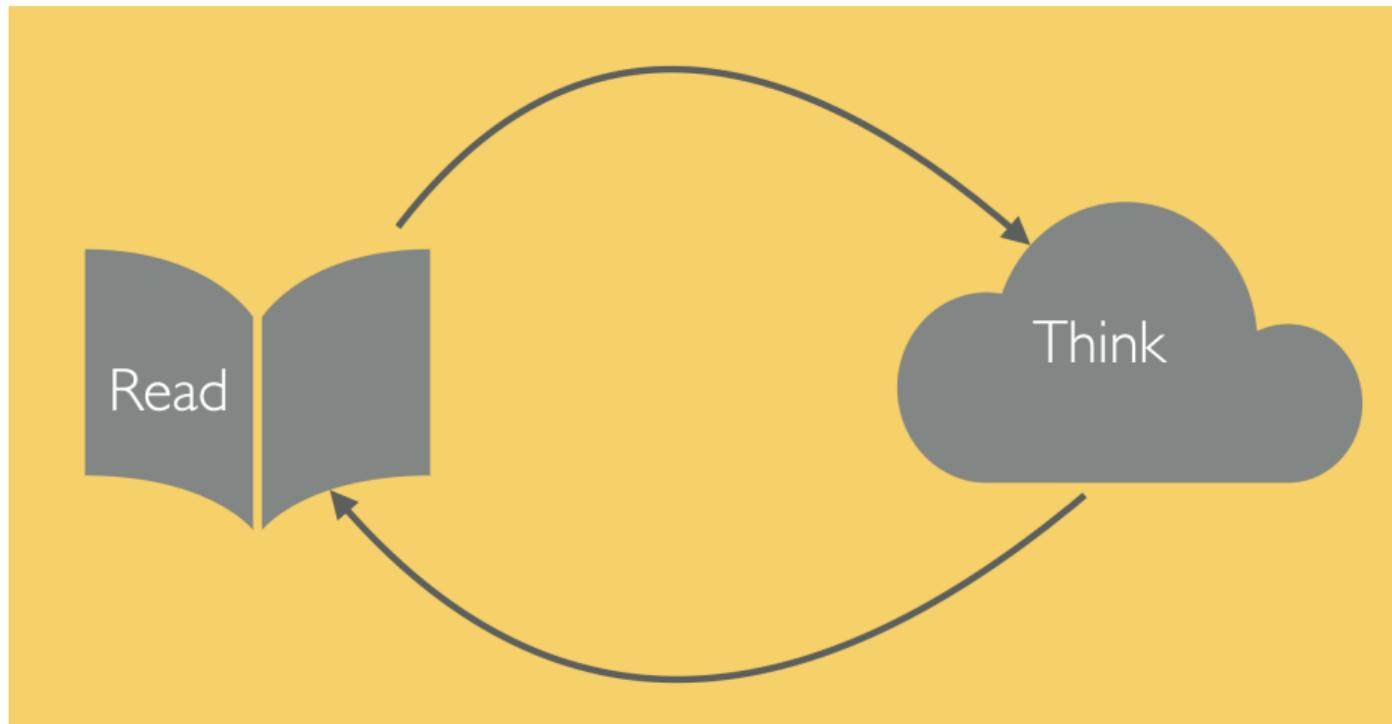
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- Sometimes the reading needs to split across days

The principle of iterative refinement



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Sources: abstract/intro, problem definition, main theorem, discussion.

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Sources: examples, special cases, key lemmas/propositions, proof outlines

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Sources: appendices, proof details, corollaries, remarks, related work

How I organize my reading

Zotero library interface showing a list of publications. The list includes various academic papers from different journals and conferences. Categories visible include 'My Publications' and 'Papers'.

Title	Date	Date Modified
Report Minimization: Violating Privacy Via Inference with Large Language Models	2023-10-11	2023-10-11 10:00:37
Fast ELECTRA for Efficient Pre-training	2023-10-11	2023-10-11 10:01:39
What can knowledge graph alignment gain with Neuro-Symbolic learning approaches?	2023-10-11	2023-10-11 10:01:43
Why Does Sharpness-Aware Minimization Generates Better Than SGD?	2023-10-11	2023-10-11 10:05:13
On the Impact of Depthwise Separable Convolutional Layers	2023-10-10	2023-10-10 10:05:38
On the Left Outlier: On the In-Security of TEE-Granted DRN Partition for On-Device ML	2023-10-10	2023-10-10 10:05:59
GPT-DART: Quantized Full Parameter Tuning in LMs with Alternative Representations	2023-10-10	2023-10-10 10:47:05
Ask Assessment and Statistical Significance in the Age of Knowledge Models	2023-10-10	2023-10-10 10:48:03
FedBERT: Federated Multimodal Feature Learning with Selective Modality Communication	2023-10-10	2023-10-10 10:48:09
MARINE: Multi-Modal Responses: Variance Reduced Distributed Non-convex Optimization	2023-10-08	2023-10-08 10:47:45
How to Train a Large Language Model with Multiple Models	2023-10-08	2023-10-08 10:48:54
On the Computer: Constant Computation of Multiple Objects Without Fine-tuning	2023-10-08	2023-10-08 10:50:13
LMs Kill the Soviet Kite: New Agents Superset by Large Languages Change the Landscape etc.	2023-10-10	2023-10-10 10:51:18
Growing Brains: Co-emergence of Anatomical and Functional Modularity in Recurrent Neural Networks	2023-10-11	2023-10-11 10:50:01
Revisiting Memory and Communication Cost for Efficient Large Language Model Training	2023-10-09	2023-10-09 10:25:06
Breaking the Rules from Lucy to Max: Task Dynamics	2023-10-09	2023-10-09 10:25:01
Theorem Averaging: Backpropagation with Theorem Averaging for NLP Approaches	2023-10-09	2023-10-09 10:25:33
Low Dimensional Underlying Hyperspace is True: ODEs can be Trained in True Subspaces	2023-08-14	2023-08-14 09:09:52
theoret.LLM4: Accelerating Language Model Pre-training via Structured Pruning	2023-10-10	2023-10-10 10:50:24
Tale is a Step Back: Coding Reasoning via Abstraction in Large Language Models	2023-10-09	2023-10-09 10:49:17
Transfer Weight Averaging: A General Approach for Subspace Training	2023-08-11	2023-08-11 22:44:11
Spatial Priors for Multi-Dimensional A Distance Optimization Approach	2023-10-07	2023-10-07 22:44:30
Decomposing Context Centers in LMs via Sparse Attention with Self-Information-Based, Multi-dimensional, and Multi-scale Methods	2023-10-10	2023-10-10 10:48:29
Is There a Way to Accelerate LQD-based Extraction via Scaled Gradient Descent, Even with Degeneracy?	2023-10-09	2023-10-09 10:49:23
Moving Simplicity Bias in Deep Learning for Improved OOD Generalization and Robustness	2023-10-09	2023-10-09 10:49:49
Preferring Multi-Level Optimization over Decentralized Networks	2023-10-07	2023-10-07 10:42:90
Detecting and Learning Out-of-Distribution Data in the Open world: Algorithms and Theory	2023-10-07	2023-10-07 10:45:54
Penalties for more differentially private semi-honest data generation	2023-10-09	2023-10-09 10:46:28
On the Importance of Foundational Knowledge in the Age of ChatGPT	2023-10-03	2023-10-03 10:14:08
Break and Guard Against Language Models with Only Few In-Content Demonstrations	2023-10-03	2023-10-03 10:13:41
Multi-variance Deterministic Accelerated Gradient Descent	2023-10-10	2023-10-10 10:49:33
Understanding prompt engineering may not require rethinking generalization	2023-10-06	2023-10-06 09:02:04
The Devil of LMs: Preliminary Explanations on GPT-4's [seen]	2023-08-29	2023-08-29 09:02:37
Why Do We Need Weight Decay in Modern Deep Learning?	2023-10-08	2023-10-08 23:49:53

Zotero

Google Scholar Alerts settings page. The 'Alerts' section is highlighted with a red box. Other sections shown include 'Settings' and three examples of alerts with 'All results' and 'CANCEL' buttons.

Google Scholar Alerts

Notion workspace interface. The left sidebar shows 'Acme Inc.' with sections for 'Search', 'Updates', 'All team spaces', and 'Settings & members'. The main area shows a 'Projects' board with cards for 'Engineering' and 'Projects'. Below it is a 'Timeline' view for February 2023, showing tasks like 'Bulk CSV Import' and 'POI Compliance' with status indicators.

Notion

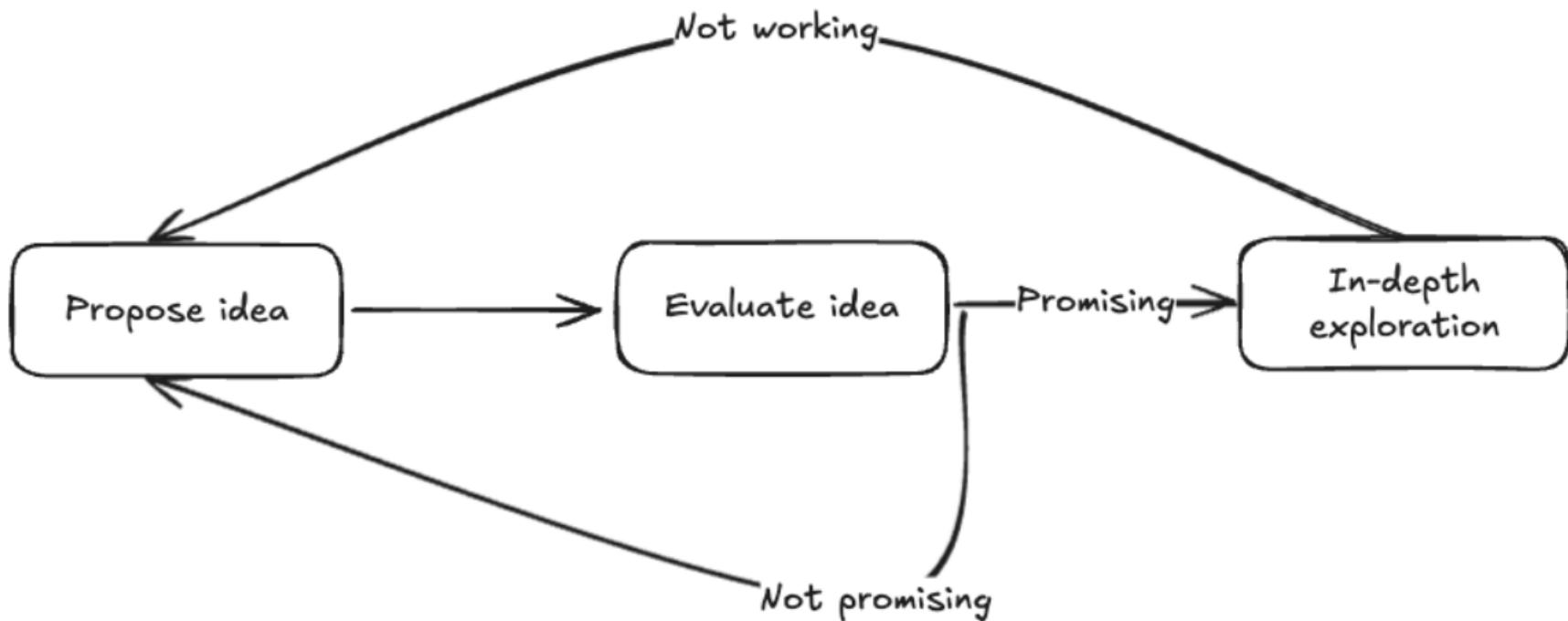
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A general loop



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- Relax assumptions

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- Make more assumptions

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 - Identify the underlying assumptions of existing work
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 - Leverage all the domain knowledge (i.e., make more assumptions) to improve the method.

Combine two ideas/problems



“To steal ideas from one person is plagiarism. To steal from many is research.” — Wilson Mizner

Add an adjective

Given an existing idea X, add an adjective to make it

- slow → fast
- batch → online
- sensitive → robust
- centralized → distributed
- single-step → progressive
- single-level → hierarchical
- fixed → adaptive, sth-aware
- data-hungry → data-efficient

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This is where your work can fill the gap.

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- 1 Write down a list of research ideas. Have a mentor you respect rate each idea 1-10. Discuss ideas where you disagree with them after reflection.

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- 5 Critically consider your research taste, and the community taste around you. Your taste is likely very influenced by your research cluster (your collaborators, advisor, etc)

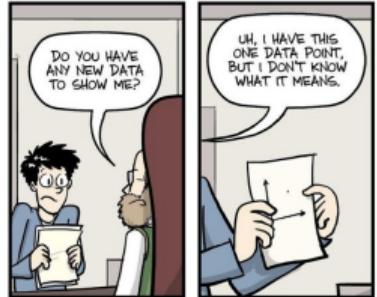
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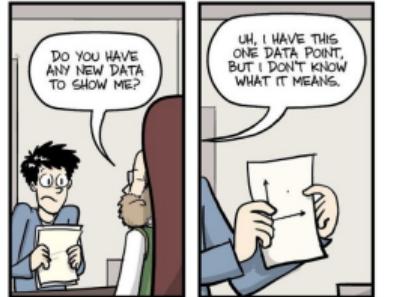
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Once we have the idea, we need to test them!



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Some tips on why, what, and how to do experiments.

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- ✓ Do an experiment to test a hypothesis.

What experiments should we do?

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This involves three main steps:

- identify key research questions
- break them down into baby steps
- design experiments that best answer those questions

How?

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There are no universal answers, but here are some principles I found helpful.

Some tips

- One thing at a time

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Some tips

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- Start with a baseline

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- Document everything

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What do you expect to see if you add X / remove Y / test on Z?

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Very often, you do experiments to see a "change" (either positive or negative).

You will be in trouble later if you don't have a solid baseline first.

- Document everything

Use your brain to think, reason, and not store tedious information.

Some tips

- One thing at a time

The goal of your experiment is to test a hypothesis!

Control your variables!

- Anticipate the results!

Learn to predict the outcome **before** you do the experiments.

What do you expect to see if you add X / remove Y / test on Z?

- Start with a baseline

Very often, you do experiments to see a "change" (either positive or negative).

You will be in trouble later if you don't have a solid baseline first.

- Document everything

Use your brain to think, reason, and not store tedious information.

- Ask for feedback

Your mentors/advisors are there to help you succeed.

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- **How to Create More Impact**
- 12 Resolutions for Grad Students
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Pick a good name

(And Pick A Good Name!)

Reduced
Instruction
Set
Computers **R**edundant
 Array of
 Inexpensive
 Disks

Network
Of
Workstations

...

30



Make all your results available

3D Photography using Context-aware Layered Depth Inpainting

Meng-Li Shih^{1,2} Shih-Yang Su¹ Johannes Kopf³ Jia-Bin Huang¹

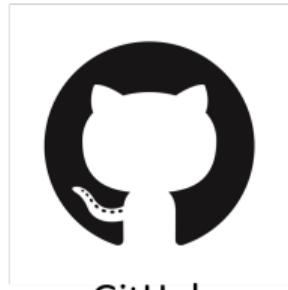
¹Virginia Tech

²National Tsing Hua University

³Facebook



Lower the barrier for others to follow



GitHub



Google colab

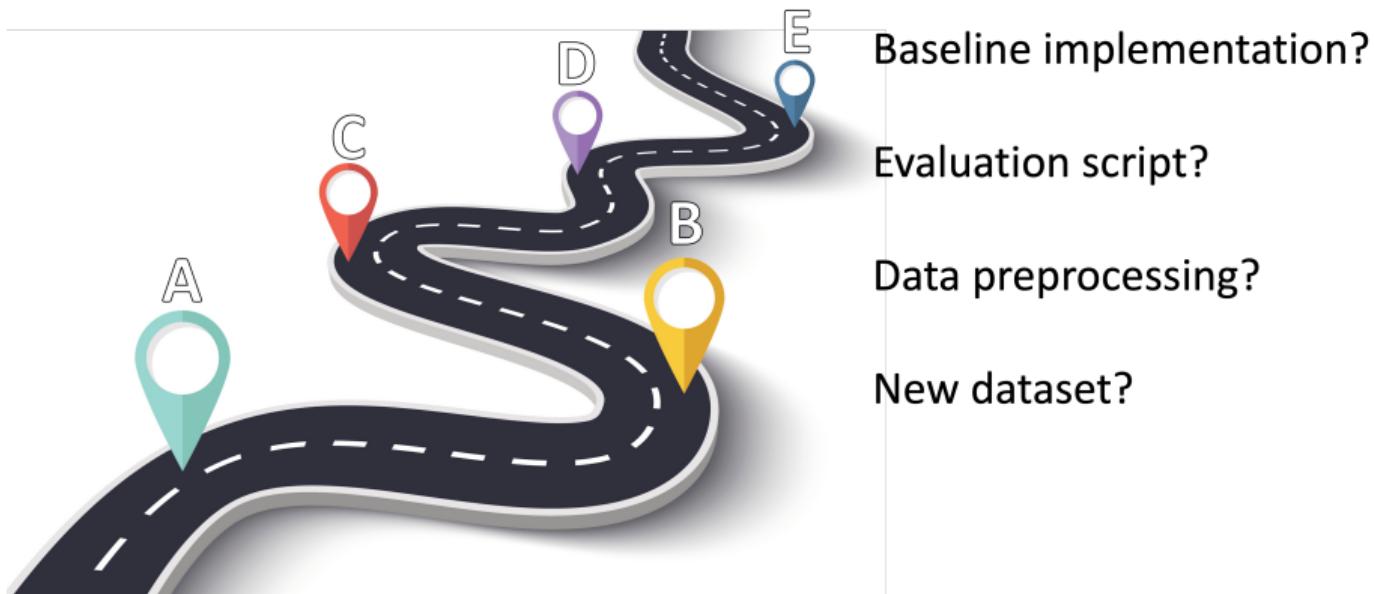


Hugging Face

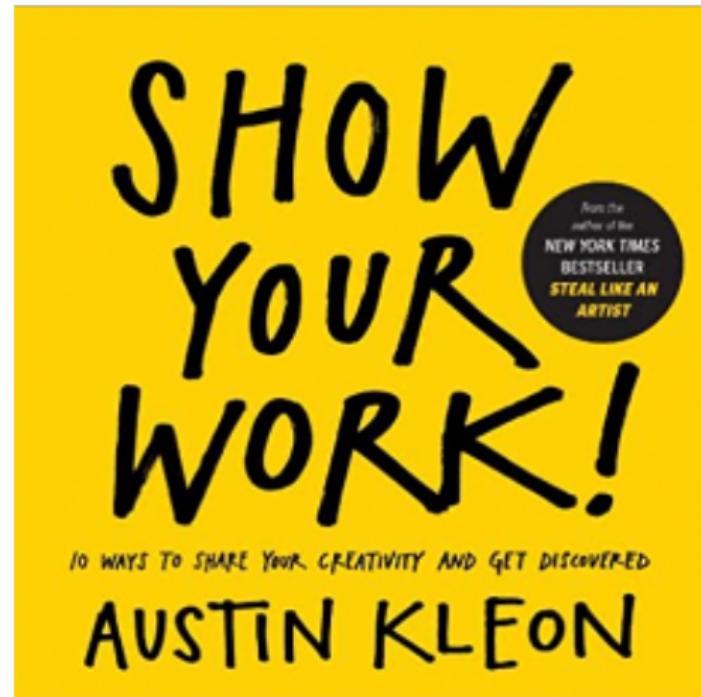


PyTorch hub

Make others' life easier



Show your work!



Your website, Zhihu, Weibo, bilibili, YouTube, Twitter, etc

This week we will talk more on ***productivity and career.***

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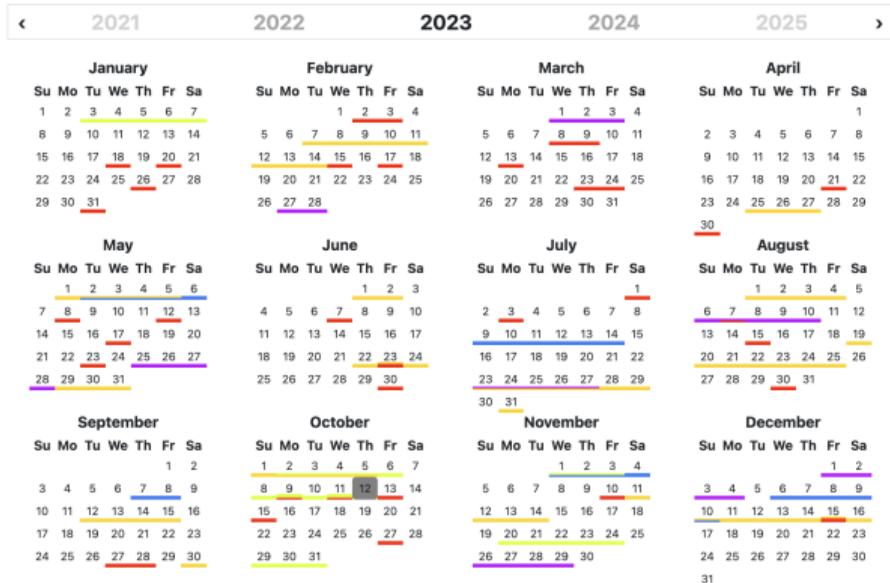
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Map out the year

Map out what the next twelve months will look like.

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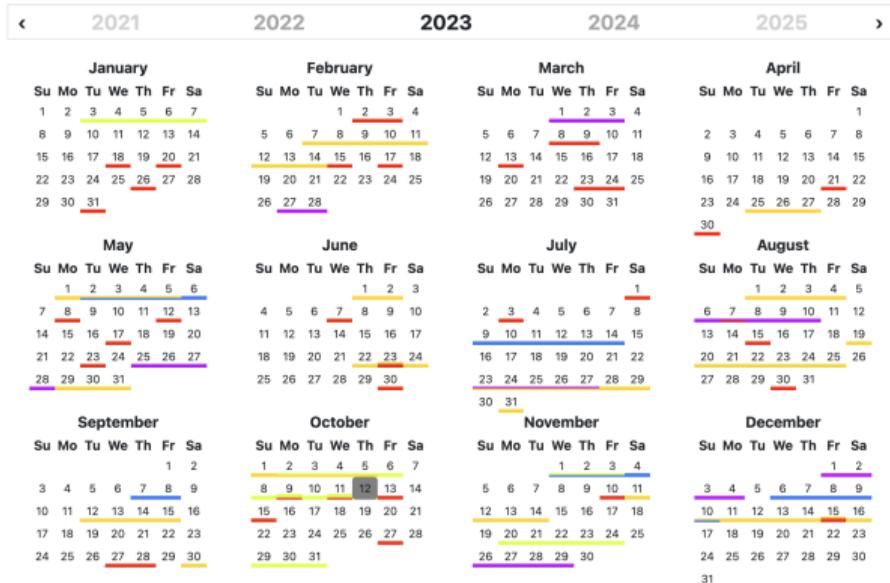
- Deadlines
- Computer Vision
- Robotics
- Automated Planning

- Today
- Computer Graphics
- Natural Language Proc
- Data Mining
- Knowledge Representation

- Machine Learning
- Human-Computer Interaction

Map out the year

Map out what the next twelve months will look like.



- Put major deadlines on your calendar.

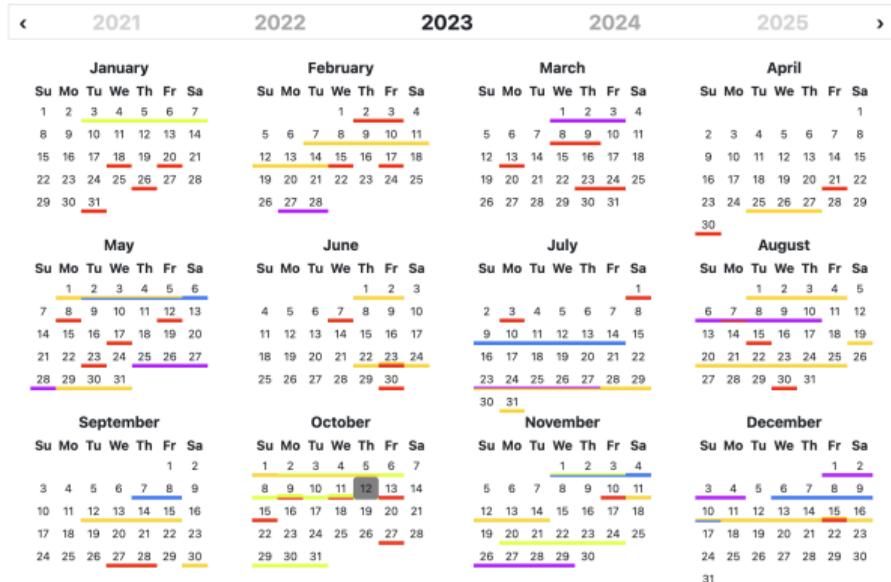
Deadlines
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Map out the year

Map out what the next twelve months will look like.



- Put major deadlines on your calendar.
- Decide program milestones

Improve productivity

We will discuss it later!

Embrace the uncomfortable

What topics in your field are outside your comfort zone?

Embrace the uncomfortable

What topics in your field are outside your comfort zone?

Try those!

Embrace the uncomfortable

What topics in your field are outside your comfort zone?

Try those!

Tips:

Embrace the uncomfortable

What topics in your field are outside your comfort zone?

Try those!

Tips:

- The “rule of 3”:

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When a third person recommends you try something, you must try it.

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- The “15 minute rule”:

Embrace the uncomfortable

What topics in your field are outside your comfort zone?

Try those!

Tips:

- The “rule of 3”:

When a third person recommends you try something, you must try it.

- The “15 minute rule”:

Give something the benefit of the doubt for 15 minutes.

If you don’t want to continue after 15 minutes, drop it.

Upgrade your tools

Make sure you have the right tools.

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Make sure you have the right tools.

For example,

Upgrade your tools

Make sure you have the right tools.

For example,

- Do you have an automatic research workflow?

Upgrade your tools

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- Do you have an automatic research workflow?
- Is there software or hardware that could accelerate your workflow?

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- Have you optimized your configuration files?

Upgrade your tools

Make sure you have the right tools.

For example,

- Do you have an automatic research workflow?
- Is there software or hardware that could accelerate your workflow?
- Have you optimized your configuration files?
- Is it time to set up your LaTeX macros?

Stay healthy

Mind and body are connected: a healthy body supports a creative mind.

¹It's OK to get depressed. It's not OK to do nothing about it.

Stay healthy

Mind and body are connected: a healthy body supports a creative mind.

- Evaluate your diet and exercise habits.

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Stay healthy

Mind and body are connected: a healthy body supports a creative mind.

- Evaluate your diet and exercise habits.
- Learn to do something with your body.

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Stay healthy

Mind and body are connected: a healthy body supports a creative mind.

- Evaluate your diet and exercise habits.
- Learn to do something with your body.
- Watch out for mental health¹.

¹It's OK to get depressed. It's not OK to do nothing about it.

Update your CV and web site

Doing a Ph.D. \approx building your life product.

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- For a CSer, if you can't be googled, you don't exist.

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Update your CV and web site

Doing a Ph.D. \approx building your life product.

- For a CSer, if you can't be googled, you don't exist.
- Maintain a well-designed, professional-looking academic web site.
- Try your best to improve your profile / product.

Keep your eye on the job market

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- Ask around at conferences about the state of the job market.

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- Get internships at top companies for return offer.

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Keep your eye on the job market

- Ask around at conferences about the state of the job market.
- Get internships at top companies for return offer.
- Look at the hiring areas and check whether your work fits.
- If your school is interviewing, attend hiring talks.

Network

Your future success will depend in part on networking.

Network

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For example,

Network

Your future success will depend in part on networking.

For example,

- You will need letter-writers.

Network

Your future success will depend in part on networking.

For example,

- You will need letter-writers.
- You will need them to pull you from the crowd when applying for jobs/interns.

Say thanks

Thank the giants upon whose shoulders you stand.

Volunteer for a talk

Effective public communication is critical to success.

Practice writing

Effective writing is equally critical to success.

Check with your committee

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- If you don't have a committee

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→ form one earlier rather than later.

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→ you may even uncover opportunities for collaboration.

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→ form one earlier rather than later.
- If you have a committee
→ check in with your committee at least once a year to update them on your plan.
- Check with your committee is also a way for networking
→ you may even uncover opportunities for collaboration.
- Keeping your committee informed eliminates surprises at your defense.

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See an external link.

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Why do we need a good time management?

Be on top of things. Avoid drama and stress.

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Philosophy: Calendars convert time to space.

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It makes the finiteness of time apparent.

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Be on top of things. Avoid drama and stress.

Assumption: □ Your bottleneck is time management, and not motivation □

Philosophy: Calendars convert time to space.



It makes the finiteness of time apparent.



Make EVERYTHING you plan to do as a calendar entry
(including planning the calendar) and do it at that time.

Calendar, not to-do lists: viewing time as space².

- Principle 1: Everything takes time. So everything needs to be on your calendar.
- Principle 2: It is easier to *measure how wrong your time estimates are than it is to fix them.*
- Principle 3: More generally, incorporate your patterns.
- Principle 4: Re-plan.
- Principle 5: Break it down.
- Principle 6: Backtrack. Foresee.
- Principle 7: Visualize your time.

²See details in <https://deviparikh.medium.com/calendar-in stead-of-to-do-lists-9ada86a512dd>

Principle 1: Everything takes time → everything on your calendar.

Time is always ticking and there is finite time in the day.

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Everything takes time

(something, anything, and nothing)

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Everything takes time

(something, anything, and nothing)



Everything needs to be an entry on your calendar.

Principle 2 & 3: Wrong time estimation → incorporate your patterns.

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 - no tasks there.

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- If you are not a morning person
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 - no tasks there.
- If you are not a morning person
 - mark your mornings as “not a morning person” and don’t put tasks there.
- If you see repeatedly that you are too tired on Saturdays to do anything
 - Mark your entire Saturdays as “goof off”

Principle 4: Re-plan.

Re-planning is not failure

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Re-planning is not failure \implies Re-planning is part of the plan

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- The plan is feasible. But it is not guaranteed to work.
- Move things you could not get done to other open slots.
- The future you will appreciate the extra buffer!

Principle 5: Break it down.

Tasks don't always present themselves in calendar-sized chunks.

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- ① A 300-hour project due in 3 months cannot be a calendar entry.

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Tasks don't always present themselves in calendar-sized chunks.

- ① A 300-hour project due in 3 months cannot be a calendar entry.
- ② Break it down.
- ③ Mark them on your calendar in available slots

Principle 6: Backtrack and Foresee.

Backtrack on the timeline.

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Backtrack on the timeline. For example: What if a conference deadline is in 3 months?

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- It means that *you need to start writing the paper at least a month before the deadline.*
- It means that *you have a month to get your main basic result.*

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Backtrack on the timeline. For example: What if a conference deadline is in 3 months?

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- It means that *you have a month to get your main basic result.*
- It means that *A week before the conference deadline tends to be crazy.*

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→ Mark that entire week as busy.

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 - This will make sure the week before the deadline is not any more stressful than it needs to be.

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Backtracking tells you when is the latest you need to get something done.

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Backtracking tells you when is the latest you need to get something done.

- ✗ Don't mistake it to be the time when you should do something.
- Re-planning needs empty slots, needs buffer.

Principle 7: Visualize your time.

Wed	Thu	Fri	Sat	Sun
7:30 AM Get ready and go to work	7:30 AM Get ready and go to work	7:30 AM Get ready and go to work	7:30 AM Sleep in	
Add LaidSiv paper to CV SFA replied? Plan expenses	PerceptiveConv meeting LaidSiv Pytorch meeting	AI Guest interview		Call Mom 9:30 AM Look into Atlanta apartments
Prepare for hiring meeting	Hold because talks often...	10 AM Alex Parrish's talk	10 AM Get ready, brunch, loiter	Call Shankar and Gulpreet
Write YFA grant report	Ramesh's meeting DAI biweekly	Meet RE candidate		12 PM Write time management blog post
Lunch	Lunch	Lunch		
Plan PRCV18 practice ses... David going to IACL? Look into Kelly's gifts data...	1 PM Plan for planning class in Fall	1 PM Group meeting or reading group		
2:30 PM Think about service role for next year -- let Brian know	3 PM Algorithmic art coding	Manager 1:1 When is Angela starting? Maria's Q&A	3 PM Meeting Julie and Andy	
4 PM Figure out concrete intern projects. Otherwise hard to make good progress! Set up meetings with Boris to brainstorm.		5 PM Calvin, Sam transferring courses? Dawn, Mohit taking quals next semester?		
Dinner	Dinner	Dinner		Dinner
Leave \$120 for Lydia Swati's job search status?	Read article Dori sent			8 PM Black Mirror
Order fans				
answer question in journal	answer question in journal	answer question in journal	answer question in journal	answer question in journal
Sleep	Sleep	Sleep		Sleep

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When transiting from *structured learning environments* (e.g. courses) to *unstructured ones* (e.g. research)

When transiting from *structured learning environments* (e.g. courses) to *unstructured ones* (e.g. research)



We need • a productive routine and • a good time management.

Exercise, exercise, exercise

Doing regular exercise (e.g., in the early morning) gives you the

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Doing regular exercise (e.g., in the early morning) gives you the

- mental acuity

Exercise, exercise, exercise

Doing regular exercise (e.g., in the early morning) gives you the

- mental acuity
- physical energy

Exercise, exercise, exercise

Doing regular exercise (e.g., in the early morning) gives you the

- mental acuity
- physical energy
- emotional stability

Exercise, exercise, exercise

Doing regular exercise (e.g., in the early morning) gives you the

- mental acuity
- physical energy
- emotional stability
- social health

Eat that frog

Start your day by working on the most important task of the day (aka the frog)

Stick to your plan and do what you are doing

Stick to your plan and do what you are doing

Multitasking /ˌmʌlti'tæskɪŋ/

(v.) Screwing up multiple things
at the same time.

Multi-tasking gives you the illusion of productivity.

Stick to your plan and do what you are doing

Multitasking /ˌmʌlt̬.ti'tæs.kɪŋ/

(v.) Screwing up multiple things
at the same time.

Multi-tasking gives you the illusion of productivity.

Follow your calendar and focus on one thing at a time instead.

Practice self-care

Take care of yourself!

Practice self-care

Take care of yourself!

- Get enough sleep,

Practice self-care

Take care of yourself!

- Get enough sleep,
- Eat well,

Practice self-care

Take care of yourself!

- Get enough sleep,
- Eat well,
- Do exercise.

Use interrupt coalescing

Group and defer interruptions

Use interrupt coalescing

Group and defer interruptions
(e.g., emails, slack messages, twitter feeds)
according to their urgency.

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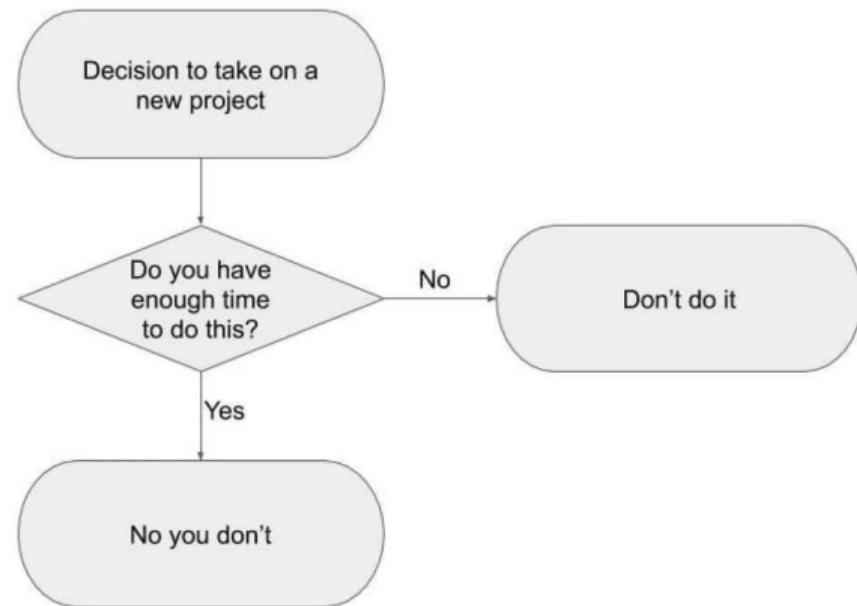
Allocate a specific time slot in a day to address these interruptions.

Learn to say no

Before accepting any new tasks, ask yourself

Learn to say no

Before accepting any new tasks, ask yourself



Give up precise task prioritization

Sometimes you may be *spending more time ranking the tasks than actually doing it.*

Touch each email/message exactly once

Open an email, skim through it, and make a quick decision
(reply/archive/allocate a time slot).

Don't work from home (?)

Don't work from home (?)

Home is full of distractions

Don't work from home (?)

Home is full of distractions

Academics have flexible schedules

Don't work from home (?)

Home is full of distractions \longleftrightarrow Academics have flexible schedules

Don't work from home (?)

Home is full of distractions \longleftrightarrow Academics have flexible schedules

Invest in making your work-space a comfortable, productive, enjoyable place to be, e.g.,

Don't work from home (?)

Home is full of distractions \longleftrightarrow Academics have flexible schedules

Invest in making your work-space a comfortable, productive, enjoyable place to be, e.g.,

- Move your books into your work-space.

Don't work from home (?)

Home is full of distractions \longleftrightarrow Academics have flexible schedules

Invest in making your work-space a comfortable, productive, enjoyable place to be, e.g.,

- Move your books into your work-space.
- Get an ergonomic office chair.

Don't work from home (?)

Home is full of distractions \longleftrightarrow Academics have flexible schedules

Invest in making your work-space a comfortable, productive, enjoyable place to be, e.g.,

- Move your books into your work-space.
- Get an ergonomic office chair.
- Get a high-quality ergonomic keyboard.

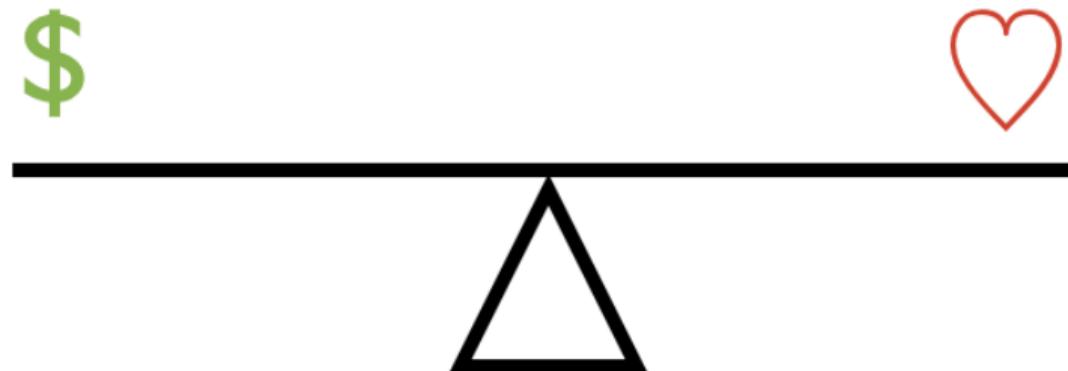
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Tips for work-life balance



Some high-level tips³:

- Explicitly acknowledge priorities
- Avoid workaholism
- Avoid perfectionism
- Set and enforce boundaries
- Avoid over-commitment
- Use a work-flow system
- Communicate
- Keep hobbies
- Exploit opportunity cost
- Continuously adapt

³See details in <https://matt.might.net/articles/work-life-balance/>

Explicitly acknowledge priorities

Start by listing your priorities in life.

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- ✗ If those inverted priorities persist

Explicitly acknowledge priorities

Start by listing your priorities in life.

- ✗ If factors like “health”, “happiness”, or “family” rank below professional goals
⇒ your long-term priorities are not stable.
- ✗ If those inverted priorities persist
⇒ a crisis—*injury/sickness, depression or divorce*—is inevitable.

Avoid workaholism

- ✗ The “work more; sleep less” mentality is misguided.

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The equation for work:

$$\text{output} = \frac{\text{unit of work}}{\text{hour}} \times \text{hours worked} \quad (1)$$

:=productivity

Avoid perfectionism

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Iterate toward perfection!

Set and enforce boundaries

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For example,

- I always schedule recurring “life” time into my calendar

Avoid over-commitment

Learn when and how to say “no.”

Keep hobbies

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Hobbies are a way of letting stress go before it explodes.

Table of Contents

1 Recitation

2 How to Do Research

- More on How to Read Papers
- How to Come up With Research Ideas?
- How to Do Experiments?
- How to Create More Impact
- 12 Resolutions for Grad Students
- Experiment Management
- How to Manage Your Time?
- How to Be Productive?
- Tips for Work-Life Balance (WLB)
- Others Career Tips

Check out links below:

- How to Get a Great Letter of Recommendation
- Academic job search advice
- Fantastic Faculty Jobs and How to Get Them?
- See more at <https://github.com/jbhuang0604/awesome-tips#career>

Course schedule

Week	Date	Topics
1	2023. Sep. 01	Introduction to CS & AI
2	2023. Sep. 08	How to communicate
3	2023. Sep. 15	How to present
4	2023. Sep. 22	How to be a good AI researcher (I): doing research
5	2023. Oct. 13	How to be a good AI researcher (II): productivity and career
6 (next week)	2023. Oct. 20 ← proposal submission	How to be a good AI researcher (III): academic paper writing and peer reviews
7	2023. Nov. 03	Sharing the experience of writing excellent academic papers and rebuttal
8	2023. Nov. 10	Practice course