SURVIVING, ENJOYING, AND EXCELLING IN YOUR PHD

NOTES FROM MY JOURNEY AND THAT OF MY FRIENDS +
ADVICE FROM MENTORS AND OTHER KIND PEOPLE +
MY LITTLE BIT OF EXPERIENCE AS A MENTOR

arjun@msu.edu thekrishnanlab.org @compbiologist

SOME EXCELLENT RESOURCES + FURTHER READING

- Ten Simple Rules for Graduate Students http://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.0030229
- Tips for PhD students and early-career researchers http://www.opiniomics.org/tips-for-phd-students-and-early-career-researchers/
- 12 resolutions for grad students http://matt.might.net/articles/grad-student-resolutions/
- You and your research (Richard Hamming) http://www.cs.virginia.edu/~robins/YouAndYourResearch.html

WHAT DOES A PHD PREPARE YOU FOR?

- I do not think that there is an over-production of PhDs! In this day & age, the default is to take up any career, be it in academia, industry, government, etc.
- "Grad school is designed to train professors" – this is *far* from true!
  - Professors are untrained in things we spend most time: supervise people, design curriculum, teach, mentor, run budgets, perform outreach, serve in committees, and recruit people.
- PhD gives you the ability to:
  - formulate questions within a solvable framework
  - define & evaluate meaningful & scientifically/practically relevant objectives
  - learn new things very fast; persist on a problem in spite of roadblocks
  - communicate complex ideas
  - embrace & be comfortable with & respectful of uncertainty

THESE ARE VALUABLE SKILLS THAT YOU & THE WORLD CAN BENEFIT FROM IMMENSELY IRRESPECTIVE OF CAREER PATH/ CHOICE

WHAT'S UP FOR TODAY

- In this workshop, I will try to do three things:
  - PART 1 | Talk to you about 10 things you can do as a student that will set you up for a great PhD experience.
  - PART 2 | Demo of a few lab practices we have in place in my group for well-rounded professional development.
  - PART 3 | Launch the "career development week" to define and measure immediate, tangible growth opportunities for you.

10 THINGS I WISH SOMEONE HAD SAT ME DOWN & TOLD ME

1. Take the lead in your research and training
2. Make a plan, evaluate the plan periodically, revise the plan
3. Read the literature
4. Work towards becoming an independent, versatile, critical thinker
5. Practice conscious ignorance and intelligent persistence
6. Keep learning new skills
7. Engage with your group, community, and the public
8. Record everything meticulously and check & double-check your work
9. Finish stuff
10. Don’t put your life on hold

PART 1

10 THINGS I WISH SOMEONE HAD SAT ME DOWN & TOLD ME

✓ 1. Take the lead in your research and training *NOT AT ALL IN THE OPTIMAL WAY!*

✗ 2. Make a plan, evaluate the plan periodically, revise the plan

✓ 3. Read the literature

✓ 4. Work towards becoming an independent, versatile, critical thinker

✓ 5. Practice conscious ignorance and intelligent persistence

✓ 6. Keep learning new skills

~✓ 7. Engage with your group, community, and the public *NOT IN THE OPTIMAL WAY!*

~✓ 8. Record everything meticulously and check & double-check your work

✓ 9. Finish stuff *NOT IN THE OPTIMAL WAY!*

NOT IN THE OPTIMAL WAY!

✗ 10. Don’t put your life on hold

In the end, what I did or did not get right during my PhD!

1. TAKE THE LEAD IN YOUR RESEARCH AND TRAINING

Meta advice!

- This is the single most important advice I have for you!
  - Take ownership of your research project & professional training, and lead the way.
  - It's 4-5 years of the prime of your life; Limited, precious time. Make it count.
- Take the initiative in discussing ideas/opportunities/challenges w/ your advisor and updating them about your progress.
- Come prepared via thorough effort with options, pros/cons, & your decisions. Then, ask for mentor's thoughts and make appropriate changes.
- Set-up the meetings, set the tone. Set deadlines and meet them.
- Persistent effort + Application ≥ Intelligence
- *Best case scenario: When you are way ahead of your advisor and they have to struggle to keep-up with you.*

2. MAKE A PLAN, EVALUATE THE PLAN PERIODICALLY, REVISE THE PLAN

- Plan your dissertation: chapters and likely papers.
  - Use the first semester to lay the groundwork, read relevant literature, and brainstorm projects.
- Plan your training and professional goals every 6months - 1 year.
- Pan your next 4-6 weeks. *Essentially, have short, medium, & long-term plans.*
- Plans are going to change. But, you're better off consciously deviating from a set plan than meandering along until you have enough work to populate a paper/thesis.
- Constantly communicate with your advisor to make sure you are aware of the goals and benchmarks of the project or even your entire tenure in the lab.
- Yearly planning meeting: invaluable for taking stock of your progress, managing expectations, and charting a path forward.

3. READ THE LITERATURE

- In fast paced fields, papers will be out of date within 2-3 years.
  - To be on top of your game, you will have to read a lot of papers.
- Reading papers is a also great way to learn how to:
  - i) frame a question, ii) come-up with a series of logically-linked analyses, iii) establish groundwork & produce new results towards answering the Q.
- Make reading a habit! Take a coffee, go somewhere quiet, & read daily.
- Be critical: Don't be swayed by high-profile papers, media, or current dogma.
- Contextualize what you read: Analyze info in terms of you & your project.
- Soon, you should become the student sending your advisor emails saying "*hey, have you seen this cool new paper?*" rather than the other way around.

4. WORK TOWARDS BECOMING AN INDEPENDENT, VERSATILE, CRITICAL THINKER

- Two things to do regularly (and brain-storm with your advisor & colleagues):
  - Think through your work: Turn off autopilot & take control. Constantly critique & appraise your work.
  - Remember (& reassess) the big picture: Don’t get so engrossed in the details that you forget to check what is the goal and impact of your whole project/endeavor.
- Develop your own idea filter.
  - Question everything that you read or hear.
  - Challenge your advisor (& colleagues) and be prepared to defend your ideas.
- Science the s*** out of it.
  - Experiment as much and as often as you want. Try as many things as you can.
  - Explore and prototype early to fail fast and learn.
  - Don’t speculate or make assumptions. Implement your idea & check.

5. PRACTICE CONSCIOUS IGNORANCE, AND INTELLIGENT PERSISTENCE

- Conscious ignorance:
  - Take pleasure in actively seeking gaps in *your* knowledge & filling them. You'll soon find gaps in our *collective* knowledge → a breakthrough is necessary.
  - If something doesn't make sense, you are on the threshold of learning something valuable. ["Problems worthy of attack prove their worth by fighting back" – Piet Hein]
- Intelligent persistence:
  - Don't allow yourself to remain stuck on the same point. Figure out exactly where you get stuck. "I don't understand this" → "What I don't understand about this is…"
- Ask "stupid" questions! [There are no stupid Qs]
  - Talk to several people. Such Qs often lead to a new perspective. What seems trivial might not be quite so simple, and might point to critical gaps/issues.
- Develop a thick skin against feeling stupid, having setbacks, and receiving criticism.

6. KEEP LEARNING NEW SKILLS

- In addition to doing great science, it is also good to be:
  - employable, in-demand, and irreplaceable
- Look for trends – latest techniques, software, algorithms, and application areas – and see how you can integrate these into your project.
- What's trending?
  - Literature & vibrant online communities/blogs | Latest conference talks, seminars, podcasts | Twitter!
- Learn to critique, write, & communicate: Review papers w/ your advisor | Apply for a fellowship/grant | Write a review article | Blog + Twitter
- You can learn anything, if you are ready to put in the effort.
  - During your PhD, you're also training to be a fast and versatile learner

7. ENGAGE WITH YOUR GROUP, COMMUNITY, AND THE PUBLIC

- Engage with your group & make it your own.
  - Talk to your advisor often | Brainstorm with peers and senior members | Train junior members | Be the champion of good values
- Engage with your committee & collaborators for well-informed external perspective
- Go to meetings/conferences/workshops, and be active in them:
  - Help in inviting and hosting speakers | Participate in group lunches/dinners, etc. | Give talks (not just posters) at seminars/meetings/conferences/workshops.
- Talk to many about your personal development & about your research project – *You need multiple mentors*
- Look for opportunities to engage with folks outside your academic institution: school teachers/students via SkypeAScientist, general public.

8. RECORD EVERYTHING AND CHECK & DOUBLE-CHECK YOUR WORK

- Keep a record of everything you do.
- Use GitHub/GitLab or any online notebook to write and maintain well-documented procedures, code, results, etc.
- Your future self will be immensely thankful to you for this.
- Allow others to reproduce your work.
- May very well serve as a record for protecting intellectual property.
- Use all these as your organized framework to check and double-check your code, results, and conclusions. A little obsession with correctness and perfection is a good thing.

9. FINISH STUFF

- "The first 90% of a project is a lot easier than the second 90%." [Tim Sweeney].
- *Wrapping-up the project* will take an unexpectedly long time.
- Don’t underestimate how much work it is, or how long it will take to:
  - tie-up all loose ends
  - organize all the results as a coherent narrative
  - write a cogent, well-referenced paper.
- Be the person who can do the 90% and the 10%. Focus on taking ideas and turning them into a finished paper.
- Meticulous documentation and note-keeping will be a boon.

10. DON'T PUT YOUR LIFE ON HOLD

- Cultivate a life outside of the lab.
- Find a hobby/activity that you can regularly fully immerse yourself in that has absolutely nothing to do with your research.
- Take care of your body and mind.
- Take personal-time when you need it.
- Start being a 'grown-up' in simple ways:
  - Learn to (be a better) cook | Pick a doctor and go | Learn to service your car
- Your general happiness and well-being should not hinge on how your PhD is going!

10 THINGS I WISH SOMEONE HAD SAT ME DOWN & TOLD ME

✓ 1. Take the lead in your research and training *NOT AT ALL IN THE OPTIMAL WAY!*

✗ 2. Make a plan, evaluate the plan periodically, revise the plan

✓ 3. Read the literature

✓ 4. Work towards becoming an independent, versatile, critical thinker

✓ 5. Practice conscious ignorance and intelligent persistence

✓ 6. Keep learning new skills

~✓ 7. Engage with your group, community, and the public *NOT IN THE OPTIMAL WAY!*

~✓ 8. Record everything meticulously and check & double-check your work

✓ 9. Finish stuff *NOT IN THE OPTIMAL WAY!*

NOT IN THE OPTIMAL WAY!

✗ 10. Don’t put your life on hold

In the end, what I did or did not get right during my PhD!

SOME GOOD PRACTICES FOR WELL-ROUNDED PROFESSIONAL DEVELOPMENT

- Onboarding
- Code of conduct
- Communication
- Expectations
- Planning professional & personal development

PART 2

PLANNING EACH YEAR OF YOUR PHD

- Schedule a Yearly Planning Meeting with your mentor to discuss where you were and to plan where you are going next.
- Goals
  - Celebrate accomplishments.
  - Set short-term and long-term research and career goals.
  - Help make rapid progress by prioritizing projects and identifying barriers.
  - Clarify and solidify relationships by giving honest constructive criticism.
  - Clarify expectations in both directions and address any disagreements.
- Birds-eye-view of your accomplishments and goals gives your mentor a chance to tailor their advice to be most helpful in your particular circumstances.

https://www.ncbi.nlm.nih.gov/pubmed/26046646

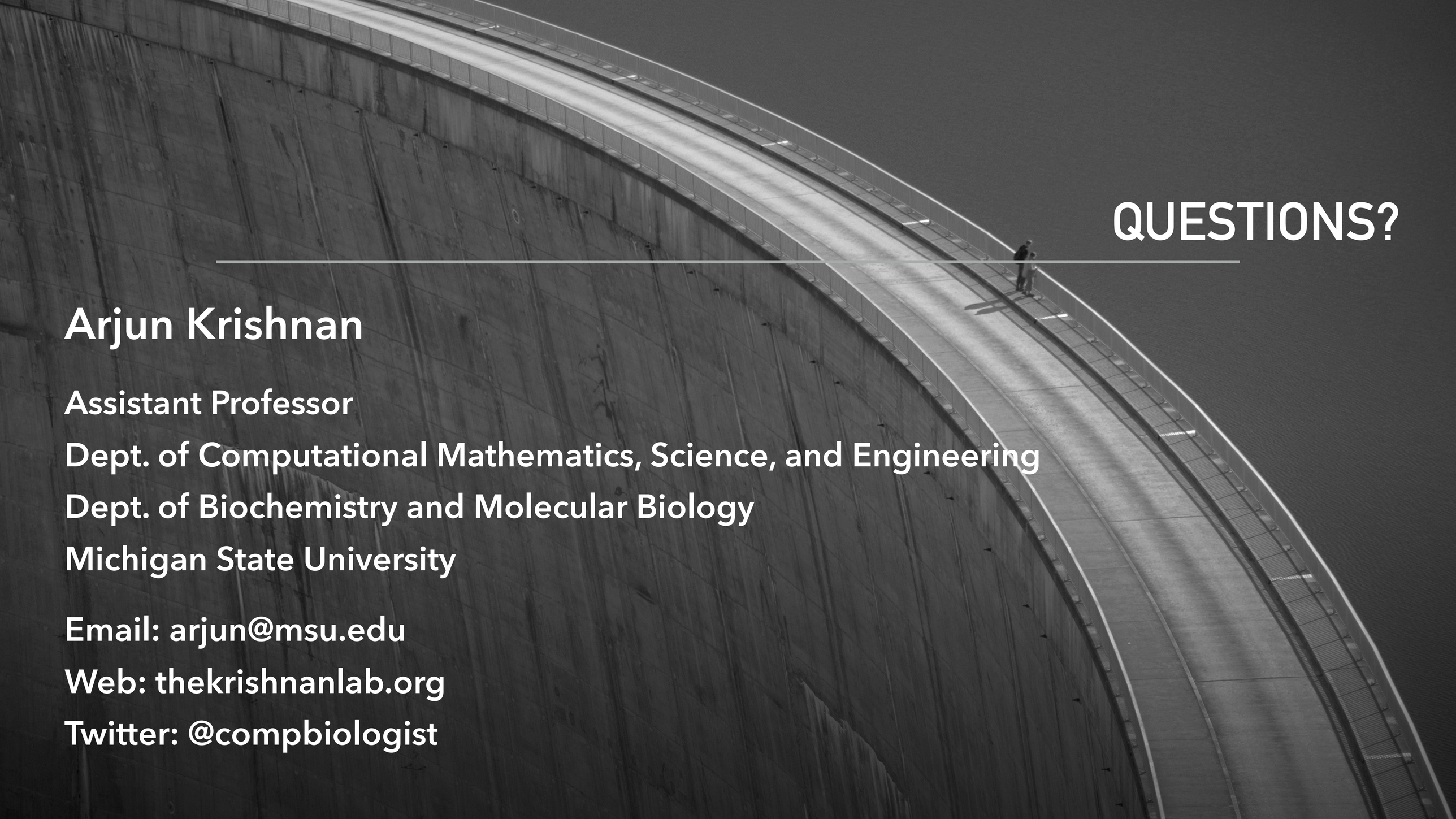
CAREER DEVELOPMENT WEEK

PART 3

DEFINE AND MEASURE IMMEDIATE, TANGIBLE GROWTH OPPORTUNITIES

- Update CV and submit it for feedback
- Join Twitter and post a tweet
- Join a professional society
- Sign-up for mentoring and outreach
- Prepare an elevator pitch
- Make a simple website (or LinkedIn profile) promoting yourself and your science
- Create a blog or submit a blog post about your project or lab experience to be posted on the lab's blog
- Perform and submit a self-evaluation: strengths, weaknesses, and career goals (w/ timeline)?
- Volunteer to give a talk (campus event, seminar, or elsewhere for outreach)
- Initiate contact with a scientist/ professional outside the lab/institution (whom you don't know before) – get career advice, scientific advice, or a letter
- Read and review an article and post your comments on PubPeer or bioRxiv

www.avasthilab.org/2016/07/19/career-development-week/



QUESTIONS?

Arjun Krishnan

Assistant Professor

Dept. of Computational Mathematics, Science, and Engineering

Dept. of Biochemistry and Molecular Biology

Michigan State University

Email: arjun@msu.edu

Web: thekrishnanlab.org

Twitter: @compbiologist