10 THINGS
I WISH I KNEW WHEN I STARTED MY PHD

IT'S A LONG WAY TO THE TOP
IF YOU WANNA ROCK 'N' ROLL

DISCLAIMER

It's impossible that this talk isn't very subjective.

It's colored by my experience and my personality.

It's also colored by having Pat as an Advisor.

ZERO:
ACADEMICS HAVE A DIRTY SECRET.

ZERO:
ACADEMICS HAVE A DIRTY SECRET.
ACADEMICS ARE PEOPLE.

ALL OF ACADEMIA IS RIFE WITH **PEOPLE PROBLEMS.** EVERY POINT IN THIS TALK HAS SOMETHING TO DO WITH **PEOPLE.**

ONE

WHAT IS YOUR JOB DESCRIPTION AS A PH.D STUDENT?

THIS IS NOT UNDERGRAD 2.0

NUMBER ONE

Advance the <u>scientific</u> understanding and capability of society.

Uncover fact-based problems.

Demonstrate high quality ways (<u>ideas</u>) to provably solve them

THE PHD IS:

Learn the "big tools" of current science and learn the formal scientific method.

Learn the Literature

Think Hard, Generate Ideas

Work on Projects, Work on Methods to Approach Problems

Communicate ideas, demonstrate skills: Write papers, then talk about your papers

Become part of the scientific discussion: review papers

Teach and Mentor students. Educate others.

Managing yourself and managing teams

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WRITER, SPEAKER, SALESMAN

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ADVISOR, MANAGER, COACH

HAVE A BIG PICTURE.
WORK ON SMALL STUFF

As a PhD student in Computer Science, you're attempting to be 5 to 10 years ahead of general technology.

You'll spend a lot of time working on "small" things - taking small, incremental steps, improving solutions to problems under many assumptions.

Having the big picture that drives you forward can keep the slogging through details worthwhile.

YOU ARE NO LONGER BEING TOLD WHAT TO DO. HOW DO YOU GET DIRECTION?

Bad Strategy: "How do we solve this?" "This doesn't work"

Good Strategy:

1) Come up with a solution/design/direction. Even if its silly. (It's okay to have bad ideas. Everyone does)

2) Propose it. Rapid-prototype it. People will give valuable feedback. (Corollary: know your tools super well)

3) Iterate on the solution/design/direction. Improve it, repeat.

TWO

WHERE DO RESEARCH IDEAS COME FROM?

TRAITS OF A GOOD RESEARCH IDEA FOR YOURSELF

- Something you're passionate about

- Something that fits your capabilities

- Something you can get the resources for

MORE OFTEN THAN NOT: GENERATED WHEN YOU'RE WORKING ON SOME PROJECT.

For example: Big project idea. Working on paper. You discover interesting problems along the way.

Get a bloodhound sense of those! "Wait a minute… This is a cool, exciting problem!"

The Master-Apprenticeship model can give you this!

EXAMPLE: THE DRONE CINEMATOGRAPHER

Project goal: "Drive quadrotor camera placement using the rules of cinematography".

Paper ideas generated:

- "Through-the-lens drone camera control"

- "Perceptual model for viewing people"

- "Teach photography using robotic photographers"

FROM OTHER PEOPLE!

Talking to everyone, asking them what they're working on, asking about whats difficult, whats easy, whats an open problem, etc.

IDENTIFYING TRENDS: LOOK THROUGH CONFERENCE PROCEEDINGS, ASK!

Machine Learning / Deep Learning

Virtual Reality, Augmented Reality

Cyptocurrencies, The Blockchain

Crowdsourcing

Robotics (Drones, Self-Driving Cars)

MASHING PAPERS TOGETHER

Take one paper, attempt to apply it to a different paper's problem.

NURTURING AN ACTIVE IMAGINATION

Daydream about awesome things we can do

THREE

WHAT MAKES FOR A GOOD APPROACH TO A PROBLEM?

TRAITS OF A GOOD APPROACH

1) Occam's Razor: Simpler is Better

Simpler to *explain and understand (method and abstraction)*

2) Performance: Faster is Better

3) Does it unify multiple approaches?

Can I use your approach to solve multiple problems?

FOUR

HOW TO DESIGN SOLUTIONS/METHODS

BE THOUGHTFUL

Carefully consider every design decision.

    Technique: Track design decisions!

    Technique: Try to write the paper or video explaining the system

The greedy approach is suboptimal. Thus, you must backtrack on the components of your solution.

READ (SKIM) WIDELY

Doing literature surveys is incredibly powerful for helping design approaches!

Google Scholar: stick in a paper, look through the "cited by" list.

Make a list of professors in the field. Look through their recent publications. Make a taxonomy

FIVE

WE APPLY THE FORMAL SCIENTIFIC METHOD.

WHAT DOES IT MEAN TO BE FORMAL? HOW AND WHEN ARE WE FORMAL?

IN SCIENCE…

FORMALITY HELPS YOU NOT FOOL YOURSELF

The first principle is that you must not fool yourself – and you are the easiest person to fool.

- Feynman

AVOID FOOLING YOURSELF BY
HAVE CAREFULLY STRUCTURED THOUGHT

Actively reveal all the assumptions in your work,

Actively examine every statement and remove anything that isn't fact (isn't proven yet)

Then, build up every step of the proposed solution through logical deduction and induction: proving every step is true.

AVOID FOOLING YOURSELF BY PAYING ATTENTION TO DETAIL

"The details are not the details. They make the design" - Charles Eames

It's often easy to find a way forward, feel relieved that you're no longer stuck, and jump into it.

But you have to be careful about getting the details right

AVOID FOOLING YOUR TEAM BY BEING FORMAL IN CONVERSATION

I've found that being formal in conversation is *incredibly hard.* My hunch is, we have so many assumptions both openly shared and hidden, that its really painful to uncover them all.

Agree beforehand to have a formal conversation.

Try to understand and illuminate the assumptions, facts, opinions

Remember people are human and this can be a painful process.

WHEN TO NOT BE FORMAL

Being formal is heavyweight: tool for manipulating *facts* and avoid *fool ourselves.* tool for communication

But - being formal can be slow, frustrating, and uncreative.

Downside 1: Working with truly *no* assumptions is <u>*super slow*</u>.

Downside 2: The path to truth, more often than not, lie through regions of falsehoods.

TURN OFF FORMALITY FOR BRAINSTORMING, IDEATION

Being formal is the second part of the process.

Thinking creatively and throwing out crazy ideas

can be supported by being formal! but isn't a formal process itself.

can be done without formality: its about imagination.

IN CONVERSATION: ATTEMPT TO WORK *TOWARDS* EVERYONE'S UNDERSTANDING

Conversations have a strong informal element. Thus, things might be unclear. It's not appropriate to always uproot every argument.

Often easiest to informally work to a common understanding first, then pull out a more formal tool to ensure that everyone was on the same page informally. This can help the formal process go much faster.

SIX

WHAT IS THE SCOPE OF A PAPER?

WHAT IS A GOOD SCOPE FOR A *FIRST* PAPER?

SIMPLE AND SMALL - ESPECIALLY AS A START

My first paper here was a 2+ year systems paper. That influenced my thinking.

A paper can be many things: One simple approach to a problem, one simple analysis that demonstrates something, one new method. All makes for great papers.

PAPER VS PRODUCT VS PROJECT

We live in an area (and a school) that's product-obsessed.

100+ papers over a career.

10+ products?

SEVEN

WHAT DOES IT MEAN TO COLLABORATE?

A HEALTHY TENSION OF IDEAS

During collaboration, multiple individuals work together on the same problem.

In the best scenario - each brings individual approaches to solving a problem, develop healthy cross-breeding of ideas.

Each person owns a specific part of the overall problem, but with frequent load-balancing between people.

The same problem will give rise to multiple

THIS CAN BE IN CONFLICT WITH BEING STUDENTS

Remember you're also a student:

During collaboration, people are teaching each other. This can cause a lot of conflict when incentives aren't aligned.

Play the long game. Teach someone now, they help you on the next one.

"Pay it Forward": people invested in you the same way. It's morally good.

GIVING AND RECEIVING CRITIQUE

This is CHALLENGING: Hearing critiques can hurt. Giving high quality critiques is very challenging. Acknowledging these challenges is a good place to start.

Techniques: Stay focused on the approach.

Techniques: Highlight "i like, i wish". Use positive ways to describe flaws. Use inclusive pronouns. Metaphor: Two people looking up at the stars together.

EIGHT

HOW TO WORK WITH (AND MANAGE) PEOPLE

MANAGING PEOPLE

Have a predictive model for people. Act accordingly. Don't get upset either way.

Give people opportunity to impress you. Keep looping back to them. Check in to help. (careful that you don't throw out your own work)

Set expectations, communicate clearly *why* you're doing what you're doing (including the meta-stuff, like why you're asking the questions you're asking)

Be ready to be emotionally vulnerable, and learn to handle emotional situations well - kindness, compassion, empathy, setting boundaries, confidence, self-care, selflessness.

NINE

MENTORING STUDENTS IS IMPORTANT AND FUN

MENTOR-MENTEE RELATIONSHIP

Having a great mentor-mentee relationship is a rewarding experience.

Anh Truong, Harrison Wray, Kat Phan, Stephanie Tang, Eli Wu, Noa Glaser, Victoria Flores

SELF-IMPROVEMENT ARGUMENT: LEARN THROUGH TEACHING

The singe most important thing I did for my own education is mentoring students

- You have to explain things very clearly. If you're wrong, and they mess up, you feel bad. Uncovers holes in your own thinking.

MORAL ARGUMENT: PAY IT FORWARD

Others invested in you - often without seeing any "return".

As a community, we invest in students coming in, this keeps science moving forward.

THE "BUILDING AN ARMY" ARGUMENT

Your students can become your closest allies in getting your research done

Anh Truong: co-author on our Horus paper

Eli Wu: did majority of accuracy quantification in Drone Cinematographer paper

Noa Glaser: she now co-runs SUAVE while I'm MIA

Pat is our mentor.

Mentoring students means you can step into his shoes better.

That helps you be a better student yourself.

TEN - AND MOST IMPORTANT

MANAGING MENTAL HEALTH
YOUR OWN
YOUR COLLEAGUES'

MENTAL HEALTH OF GRAD STUDENTS

47% of graduate students are depressed at some point in their graduate career.*

20% of graduate students abuse substances (74% for stress relief).**

10% contemplate suicide.*

100% of graduate students experience stress.

*Graduate student happiness and well-being report, UC Berkeley, 2015

**Arora et al, 2016

I'VE PERSONALLY WITNESSED

Serious drug and alcohol abuse, late night emergency room trips.

Eating disorders, clinical depression, and anxiety, a reliance on antidepressants, dropping out

Complete sabotage of excellent opportunities, where people were unable to communicate

Huge amount of imposter syndrome, coming out in damaging ways.

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THIS IS NOT A GOOD STATUS QUO

A STEP FORWARD: USE LANGUAGE THAT IS COMPASSIONATE AND EMPOWERING

As a community, being open about how challenging it is. (We're pretty good at complaining about it already)

Traits are not fixed. Courage, Determination, Discipline, Motivation, all these can be learned and must be actively applied to a scenario.

Create an environment where ideas can be challenged while people are supported.

A STEP FORWARD: ADDRESSING IMPOSTER SYNDROME

Learn to be Mindful: Being present in the moment.

Learn to Practice Self-Compassion

Learn to apply Courage and Determination as skills

Stop telling people "it takes courage". Tell them "when that happens, notice it, accept it, and apply courage!"

A STEP FORWARD: SUPPORTING FELLOW STUDENTS

Recognize the effect of people's mental state on their ability to do different types of work.

Be flexible and supportive in working with your fellow students.

Set clear goals, communicate expectations, and become good at saying "no".

Commit to investing in your fellow students, its long term optimal.

A STEP FORWARD
BE PLAYFUL

Stanford is a surprisingly serious place.

Fostering and accepting playfulness!

WHAT HAS HELPED ME

HEADSPACE®
TREAT YOUR HEAD RIGHT

Meditation, Therapy, Active Introspection, Writing

Becoming good at setting my own mind:

Empower myself.

Practice self-compassion

Disconnect my identity from my work

YOU ARE NOT A NORMAL PERSON.
YOU'RE ONE OF THE CHOSEN FEW.

IMPOSTER SYNDROME IS A THING
SELF-DOUBT IS A THING.
INSECURITY IS A THING.

FIND MOTIVATION.
ASK FOR HELP.
PRACTICE GRATITUDE.
APPLY COURAGE.
BE DETERMINED.
UP YOUR DISCIPLINE.

Thank you!