Becoming a Researcher: Practical Strategies for Taming the Angst and Changing the World

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- Today I am going to share with you the best concrete advice that I can in <1 hour for becoming a researcher
  - How to pick a research topic
  - How to find venues to follow
  - How to master the related work
  - How to recognize good work, how to criticize work, how to build on other's work
  - How to find papers to model your work after
  - How to find concrete activities to do when you are stuck
  - How to tame the angst that is part of research

Bookends

- Becoming a researcher is hard!

- Not only do have to solve the problem, first you have to find the problem
- You also have to convince yourself and others that you have solved the problem sufficiently
- It is not enough to just solve the problem and leave the bookend pieces to others

Lesson 1: Find venues to follow

- Being a researcher means joining a community and teaching that community something they don't already know!
  - Example of good targeted question to ask a mentor!
  - But you can also find good venues yourself
- Early in your career, much easier to find out what an existing community is already interested in and make a contribution there than to pick a topic and then go searching for a community

Some specific examples

- Some suggestions for computer security
  - USENIX Security: https://www.usenix.org/conferences/byname/108
  - IEEE SP: http://www.ieee-security.org/TC/SP-Index.html
  - Associated workshops like LEET, Woot, …
  - There are many others!
- Look on www.wikicfp.com
- Who sponsors the conference? USENIX? ACM? IEEE? Who is on the program committee?

Benefits of "venue selection"

- Choosing venues to follow is a fair amount of work
  - But its worth it
  - Read titles of papers, sessions, look at program committee
- Allow yourself to be instructed by successful publishing authors in your choice of topic
  - What are people currently publishing!
  - What has already been done
- Much better than looking for a topic without such guidance!

Lesson 2: Read, read, read

- Now that you've chosen some venues, lets choose some papers
- Read every paper in those venues for the last 5 years
  - Every one? Yes!
  - Every word in every one? No!!
- Being a researcher means being familiar with the literature in your subject
  - No substitute for reading lots of papers
  - Never stops! (Back of envelope calculation on time to keep up every year)

Reading

- You are going to be doing a lot of reading of research papers
  - This is a huge part of what it means to be a researcher!
  - Its how you know whether something is new and that is what it means to be research
  - Its how you know where to publish your ideas
- How do you become a good writer? Just writing? No! reading great writing!
- How do you become a good researcher? Just doing research? No! reading great research!

Form a reading group

- Others to help cover space – which papers worth reading more deeply
- Vet your ideas with others
- Everyone needs a non-judgmental place to ask "silly" questions
- Choose similar research topics
- Support each other
- Excellence grows up together
- Don't fall into "mine all mine"

Other Slices

- Follow some particular researchers
- Look for a topic across venues
- Classics vs current work

Keys to reading papers well

- Learn how to read papers
  - Increasing levels of depth – just the abstract vs. all the related work
  - Find some paper worth reading very very deeply (criteria?)
  - One more level of reading deeply – repeated research
  - See pamphlet – "Efficient Reading of Papers in Science and Technology"
- Read with a purpose
  - Take focused notes – a topic I might consider, future work I could do, methods I can learn from
  - Write down questions, criticisms, ideas

Finding a paper worth reading deeply

- Could I have done this work if I had the idea?
  - Sometimes the answer is no
- Do I have ideas for going further?
- Are the datasets or source code available?
- Are there methods here I could learn?
- Recent papers especially good!

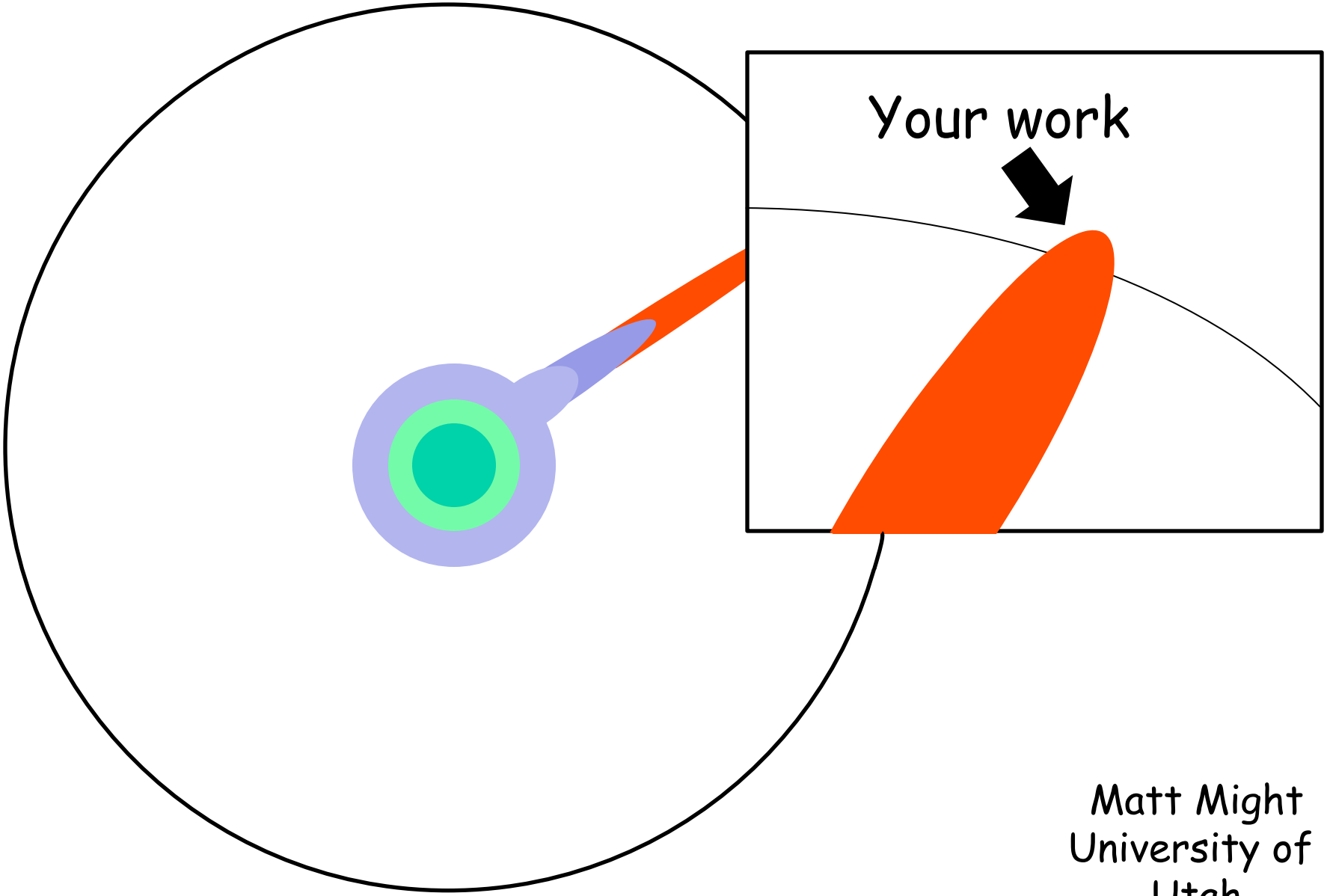
Lesson 3: Learn to criticize productively

- I recommend "An Evaluation of the 9th SOSP Submissions"
  - http://static.usenix.org/publications/library/proceedings/dsl97/good_paper.html
- Practice criticizing work they read
  - Not about being nasty..pointing out things undone…suggesting future work
  - Summarizing is easy, liking something is just summarizing with some sugar added
  - Criticizing requires a higher bar
  - Often start with more superficial criticisms..try to work up to deeper suggestions

- You can't become a researcher until you can teach a community something = must be able to see what is missing

- YOU MUST BE ABLE TO ARTICULATE:
  - The specific problem that you're solving
  - Why that problem is important
  - Why previous solutions are insufficient (related work!)
  - Why your approach has the potential to succeed where others failed

What Is Research?



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Lesson 4: Repeated research model

- Puts you in perfect position for follow-on work
- Learn so much by examining each graph and asking do I understand how this was generated and what "gotchas" might be hiding
- Big fan of repeated research for MS and then build on that work for PhD

- Find a great paper you like, that you think you could have done, that inspires you, a paper for which you can see work undone
- Allow yourself to be instructed by particular papers in the art of doing research!
- If you find a paper that inspires you, see what else the same authors have done
  - Look to connect with them at a conference ☺

Asking advice in email and conferences

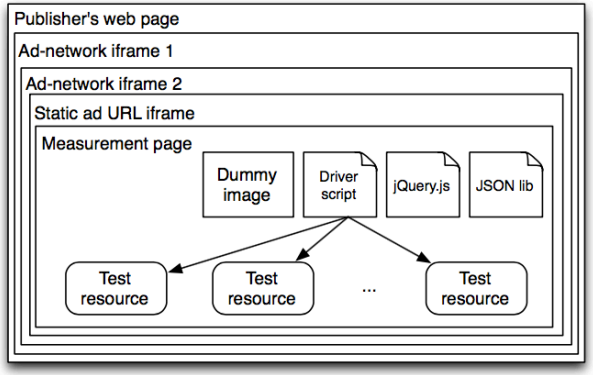
- Some advice for asking questions in email
  - Earn your questions
- Some advice for making the most of conferences
  - Why easier to ask some questions in person
  - Come with a plan for talking to specific authors, asking general advice, connecting with people at specific companies
  - Have summaries of your work ready
  - Don't talk about the weather!
- Advice for getting to conferences

Lesson 5: Look for methods not just results

- When you read paper, don't just look at the results, look also at the methods
  - What data did they use
  - What systems did they use
- Ask yourself how could I use the same data or method to do other things
- Especially good thing to talk to people about at conferences!!

One concrete example

- Measuring the Practical Impact of DNSSEC Deployment, Lian et al., USENIX Security 2013
- Might be interested in results
  - Deployment of DNSSEC was slow… for every ten clients a site protected by using DNSSEC, it self-DoSed about one client
- Might be interested in methodology for a completely different purposes
  - Use ad network to run experiments on clients around the world



Lesson 6: Get concrete

- Do something concrete and hands-on as early as you can
  - Ask how can I gather concrete ground truth data
  - Look for open source software you can build on
  - Read in popular press
  - Collect data
  - Write small sample programs
  - Small groups (and smart groups) look to add targeted changes to open source systems
  - Measure, trace, document, simulate

Tell your self the truth

- You know when you are making a difference, when you have "traction" – if not, then find something you can do
  - Don't exhaust yourself staring at something – say what can I do that is productive
  - That will help tame the angst
  - Think of yourself as having multiple classes/tracks
  - Searching a big dark space with small flashlight..reporting what you find – no one right answer
  - Even failures can be good research if you reflect on them honestly

Good examples of things to ask a remote mentor

- Can you suggest a few publication venues related to my topic/ interests?
- Is my 3-5 sentence problem definition sufficiently focused?
- I am trying to choose between these three topics – can you comment on them?
- Ask "meta-questions" – how did you learn that? What tools do you use? What venues do you like?
- Can you suggest 3-5 recent papers you loved?
- Can you suggest courses, books etc related to my topic?
- Can you suggest a few researchers you respect in my area?

Research is hard

- Know venues and researches in your field
- Read all the papers!
- Learn to criticize and suggest new directions
- Find data sets and partners, master techniques/systems/methodologies
- Remember if we knew the answers it wouldn't be research
- Angst is part of the process – embrace it
- I can't make it easy but I can try to help you work smart…make the time you have to spend count

Outtakes

- Make what you do count
  - Insist on concrete deliverables; finish things
  - Be willing to define your contributions more broadly
  - Document efforts such as forming a reading group, specific papers read
  - Write a research blog
- Chose a topic that inspires you
  - More willing to do what it takes to read related work…more likely you recognize good solution when you see it
  - At least you will be satisfied at the end of the day