

Current affiliation: PhD student, Visual Geometry Group, University of Oxford

Branch of study during undergrad: Electrical Engineering, IIT Bombay

Webpage/CV link (for others to view your career trajectory):

https://yashbhalgat.github.io/data/CV_YashBhalgat_May2022.pdf

1. What was your first research experience? How did you get that opportunity? When did you get it (undergrad, graduate, when working, etc.)?

My first research experience was my first internship at Focus Analytics, a very small (3-4 people) startup. This was a one-month internship right after my 3rd semester of undergrad (Dec, 2014), which I got through the Placement Cell of IIT-B.

2. Did you have any role models in research when you started? Was there anything specific (e.g, a book, essay, lecture, or video) that influenced you or you would recommend to someone starting out and exploring research as a career?

I was quite naive during my undergrad. The only role models I had were my IIT-B seniors. I followed my immediate seniors and worked on small robotics projects during my first year. These projects gave me a sense of what areas interested me. So, I delved deeper into these areas (specifically Computer Vision) via blogs, online courses. Personally, I didn't find the courses taught at IIT-B any useful.

Also, if you are working in an applied field like I did, I would highly recommend interning in industry labs. For Machine Learning folks, that would be Microsoft Research, Google Research, IBM India Research Lab - Bangalore, etc (nowadays, TCS Research does good ML research too).

3. What are some opportunities that a life outside of research would probably not have given you? Conversely, are there things that you feel you are missing out on having committed to a research-focused career?

Research life gives me freedom. I can work on problems that genuinely excite me. I think I wouldn't have gotten this in a Software Development role, especially at a big company.

Conversely, research can be painful. Painful, because many times you don't know if an idea will work. You just have to try. Some people have great intuition about this; I don't. 95% of the ideas I try fail. It can be disappointing, but you have to push through. That's how it is. It can also get lonely as you specialise more and more. There will be lesser people that understand what you do or even find it worthwhile. You have to learn to work independently, with minimal supervision. In the long term, these experiences prove very useful. Going through the ups and downs of research teaches you perseverance and makes mentally strong. These are qualities needed when you want to tackle cutting-edge problems in the industry, for example.

4. How did you figure out what field you wanted to specialize in? Has this changed over the years? How did you navigate the explore-exploit tradeoff as you navigate the question of discovering your interests?

In my first year, I was fascinated by robotics, so I did some small robotics projects hosted by the Robotics Club and Tinkerers' Lab at IITB. These projects involved pretty rudimentary Image Processing (using OpenCV, no Machine Learning involved) but it was quite gratifying to see instant **visual** (because, images!) results of what I was implementing. This got me

interested in Computer Vision and I read more about this area by myself. It wasn't until my 3rd year (circa 2016) that I got to know about Neural Networks and I delved deeper into Deep Learning.

Although my focus has stayed constant on Computer Vision and Deep Learning, I have pivoted many times! It took my 4 years of experience -- mostly failures, rejections from PhD applications which I am truly grateful for -- to get a good idea of the field and understand what's worth investing my efforts into. So, my advice would be NOT to rush into a PhD. For atleast 2 years after your undergrad, work with different researchers from different areas, do internships/RAships with industry or academic labs. Then, you can **think** if you really even need/want a PhD.

5. How would you recommend a beginner find a good project/problem, and navigate the abundance of information, literature, and hype available today?

The key is aggressive exploration. Do online courses, learn skills beyond your required curriculum. Don't follow the hype - work on your fundamentals. Try to work on diverse topics atleast for initial 2/3 years -- don't specialize. **IMHO, the most important thing is to work with more people -- could be seniors/PhD/professors/industry.**

6. Have you experienced impostor syndrome? If yes, how did you deal with it?

Yes, and I still experience it at Oxford. I have 2 solutions:

1. Have people around you (friends / family) that constantly remind you of your self-worth. Get rid of people (friends / family) that make you feel any lesser.
2. "karmany-evadhikaras te ma phaleshu kadachana ma karma-phala-hetur bhur ma te sango 'stvakarmani" -- this shloka from Bhagwad Gita has always been my north-star. Basically, don't care about the results, don't care about how good other people are. Keep giving your best and remember that everyone has their own journey. That's what I try to do. :))

7. Have you experienced any form of discrimination in your work? If yes, how did you handle it?

Not discrimination really, but there's quite a lot of politics in research. Recommendations matter a lot. I don't have connections with top researchers from my field. So, it has always been quite difficult to get professors to work with me. I have seen other students finding it easier because of good recommendations to back them.

The only solution is to keep trying to approach different professors, build a strong research profile. And of course, learn the lesson and start building good connections with researchers you work with.

8. In your experience, what are some prominent qualities of researchers you have worked with? Are there any stereotypes that don't hold? What should students look for in prospective mentors?

1. They know what is the "right" problem to work on
2. They know when to give up on a research direction and pivot
3. High adaptability. They can easily change their area of research (e.g. from "compilers" to "efficient deep learning"), gain sufficient expertise quickly and publish high quality research

In a mentor/advisor, one should look for someone who has the above qualities but also someone who is empathetic and a good human being. Research is difficult, so you need someone who will support you in the hard times.

9. As a part of your research pursuits, have you had experiences that you would classify as “failures”, and if yes, what was your response to said situation(s)?

Oh, many failures! The only response I have is to understand that failures are inevitable in research. You have to keep trying. Also, it is important to have an open-mind and ask yourself if you need to pivot to a different direction/problem.

10. What does impact mean to you in the context of research? How important is it to you that your research moves the needle on something in the real world in the foreseeable future? How much should someone starting out worry about making an impact?

This is a very deeply philosophical question. As of 2022, here's my take on this:

Personally, I would like my research to have an impact on the real world. Even better, I would like my research to have a **positive** impact on society (and not just helping people play high definition video games). But I think that's a very high bar for research in most areas, even applied ones. If you are doing truly radical research, you probably won't see the needle move at all for a long time. So, I think it's important not to worry too much about real-world impact. You should always have a positive real-world impact in the back of your mind, but you should also just enjoy the process of research and do what you can best.

11. Is it ever too early or too late to start a career in research?

Never. I have seen students start doing mind-blowing research right from their first year. And I have seen people go into industry for 10 years and then come back to academia for a PhD. Both are great ways to start your career in research.

12. Did you face a decision to consider an advanced degree from India vs. outside? How did you make that decision?

Sadly, in 2013, the state of Machine Learning research in India (considering top IITs, IISc, IITs and industrial labs) wasn't at par with the top 20 in the US or top 10 in Europe. Specifically, the research wasn't as advanced and there wasn't much infrastructure (e.g. GPUs) to perform cutting-edge research in deep learning.

13. Are there any “sacrifices” (broadly interpreted; could be personal or professional) you've made which you think were specific to the demands of your career in research?

Left my job in the US to pursue a PhD at Oxford. This has two consequences:

1. Financially, my income dropped 20x (!) -- PhD stipend in the UK is almost ½ of that in the US. In the US, the drop would have been 10x
2. I had a H1B VISA in the US, which I gave up. I don't regret this necessarily since I intend to go back to India after my PhD anyway.

14. Any other message to those starting off their research journeys (2nd, 3rd year undergraduate students)?

I would just emphasise my advice that you should use your initial years to explore as much as possible. Work with different people from academia and industry, and from different areas of research.

Upskill yourself from online resources -- there are a lot of these nowadays.

