CARMA

The Career Magazine

FOREWORD

"It is human nature to stretch, to go, to see, to understand. Exploration is not a choice, really; it's an imperative."

- Michael Collins, Astronaut

To all the readers interested in knowing what people have done, what they are doing and the paths that exist - CarMa, one of the institutes most cherished gazettes, brings to you some interesting accounts of our alumni and faculty.

As the head of ICDPC and a member of the IISER-B faculty, I want you to know that we are there for you - to help you tap into your originality, your exploratory paraphernalia and to equip you with the skills that will give you an edge over the rest. Today, immense possibilities await you and we are there to create awareness about them; awareness, such that you not only have the information but also know how to utilize it.

We are looking forward to your involvement and participation.

Cheers,
Dr Kashyap Rajeevsarathy
Head, ICDPC

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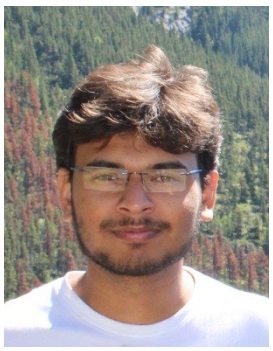
TRANSITION



Ayush Pathak
Currently working at Elucidata, a Delhi based firm which engages in analysis of scientific data and an IISER-B alumnus highlights the contrast between a career in the industry and life in Academia.

Did you always want to pursue Chemistry? What about when you joined IISER?

Initially, my options were Chemistry and Physics. The foundation years' curriculum is comprehensive and helped me consolidate Chemistry as my choice.

What part of your curriculum helped you during your project, programming and in the selection process for Elucidata?

Elucidata had an opening for a 6-8 month internship program. As I liked Computation and programming, I applied as a Data Analyst. The Selection involved a Technical – coding round, a round on reading and understanding a research paper and finally a psychometric round.

Data analysis is not just about building pipelines or coding, but it also involves a sound understanding of the data and the science behind the algorithms. Many courses in IISER are quite programming intensive. The 400 level courses at IISER like Mass Spectrometry helped me in understanding the algorithm and the data that we analyze. This is where my background in chemistry helped me. I learned the basics of programming by taking some of these courses. In my 2nd, 3rd and 4th year, I did summer projects on computational chemistry. Apart from that, I used a number of online sources to learn to programme. These projects and courses equipped me with skills which helped me to clear the technical round as well as throughout my 6-month long internship at Elucidata.

What motivated you to seek an Industrial MS-Thesis Project and how was it different from your previous research experience?

I didn't plan to pursue a PhD immediately after my MS, so I wanted

to experience and explore the Industrial Sector. I learnt about the research going on worldwide through the projects in Elucidata which serves clients like Academic Labs across the globe including Harvard, Yale and Princeton.

I did an internship at IISc organized by the Indian Academy of Sciences on Molecular Dynamics of Liquid Argon atoms. I also interned at Canadian Light Source (CLS), a synchrotron facility, via a 12-week MITACS Globalink Program. I made the APS code work at the SM beamline of CLS.

In a research lab, a small team solves a problem and then publishes a paper. In a company, a bigger team is divided into smaller groups that work on various problems served by the client. The work here is more collaborative and each project helps in the next one.

What kind of an industrial career will you pursue as a Chemistry Major?

A Chemistry researcher can be a Quality Control Chemist, Formulation Scientist, Dry, Organic or Inorganic Synthesis Expert. The scope for Chemistry is vast. I am looking forward to joining Elucidata as a Data Analyst. I have a pre-placement offer from them, I want to explore the industrial sector a bit and later think about my higher studies.

How was your life at IISER-B? How did you balance academics and extra-curriculars?

Our batch has seen this campus evolve with us. We have a different kind of attachment to this place. In our first year, an hourly bus from the transit campus gave us a nice tour of the city. I have had a lot of fun in these five years and I am never going to forget them. I enjoyed extra-curricular activities. They helped take my mind off academics. The two just balanced each other.

What advice would you leave for the students who want to pursue a career in the Industry?

Industrial opportunities for BS-MS graduates, in general, are pretty grim. The students at IISER-B are shrewd and driven, so they can get a position in the industry if they have a mind to. It is essential that one must find the job profile of their interest and equip the skills necessary for it, maybe by interning in a company. It is essential that one applies in many places. It is necessary to be risk-friendly but also to take calculated risks.

ANECDOTES: THEORETICIANS

Faizaan Bhat
an IISER-Bhopal Physics graduate who did his MS-Thesis Project at International Centre for Theoretical Sciences (ICTS, Bangalore) elucidates how to streamline one's efforts to put oneself on the map as a Theoretical Physicist.

About project at ICTS: International Center for Theoretical Physics...

I applied to the International Centre for Theoretical Sciences (ICTS) in my 4th year because it is one of the best places in the world for theoretical physics. I was fortunate to be selected to work with Dr Rajesh Gopakumar, the Director of ICTS- as there were dozen other applicants as qualified as me.

My project was based on Quantum Field Theories. These are studied under a class of Theories all of which have Conformal Symmetries, those which are invariant under scaling, like Fractals for example. I worked in "Conformal Field Theory", and reformulated CFT from position space to Mellin space.

Finding the right mentor...

The courses at ICTS were exceptional and I got to learn a lot from them. One's work experience greatly depends on who his guide is, who he is mentored by. When I worked with Dr Gopakumar, he'd give me something to read without any initial discussion regarding it. I'd then go back, read, make sense of it and then discuss it with him. This would help me understand and interpret it better. Moreover, he was always clear about the key concepts that I was required to pick up along the way and helped me identify the appropriate reading material which made my efforts directed.

All is not about the prescribed course work alone....

One is expected to talk about his project like a mature physicist. This maturity is evident through the felicity with which one can express what he knows and most importantly, what he thinks, right then. It is always good to speak about one's interests or potential work areas in this essence rather than plainly mentioning what fascinated or motivated him or her to get to this stage. In the course of my project, I learnt the right usage of scientific vocabulary and language.

I would strongly advise not to rely on the course work alone. Along with the mainstream course work, it is equally important for the student to have his own thought and effort inputs. Otherwise, it might as well happen that in spite of the professor assigning a lot of reading material, the correct thinking or temperament might not be instilled in the students. When I read literature in Mathematics, I never thought it to be useful unless I could apply it somewhere.

Selecting courses wisely...

The choice of courses must be done wisely. If you want to get into a pool of increasingly better people, you should be prepared to work extremely hard, which may include taking up a course that might not interest you a lot but suits your career prospects. When you get such an opportunity, grab it and make the most of it.

All my math courses were useful. Linear Algebra, in particular, was helpful because it is the language of almost all physicists. Representation Theory is also extremely important for high-energy physics.

Physicists don't need mathematics as an abstract construct per se, but they do need the skills required to use mathematics. These skills include evaluating contour integrals, solving PDEs, and thinking in terms of what you need to learn by setting targets instead of focusing on abstract concepts.

I did my first project with Dr. Ambar Jain. Phenomenology was more numerical and less theoretical than High Energy Theory because I did not know General Relativity and Quantum Field Theory. Those who did the theoretical part well had a much better grasp of the subject at the end of 4th year than I did.

One reason I didn't apply for internships abroad is that I was concerned that I may end up doing something I did not want to do. Never underestimate how much you can learn in a very short time. I did most of the learning for ICTS in my third and fourth years.

For aspiring physics students....

An ambitious physics student must realise that he should possess calculative and problem-solving skills

You can major in mathematics if you are sure about working in some theoretical physics field chiefly involving high-level mathematics. Mathematics gives you structure and a way to think. It reduces the entirety of quantum mechanics to linear algebra, and makes complex ideas simpler, but doesn't improve your calculative skills.

Good grades do make a difference...

If you want to get into a prestigious place like an Ivy League school, you

should have at least a 9 CPI, as most of the applicants do. However, if your CPI is lower than 9 but you have a great research record, that is also good. For those who have a CPI above 9, the next big thing is not to get a 9.5+, but to dedicate extra time into doing something useful.

In the general GRE, if you're well-prepared, you can get a score above 330. English is a must – the lethargy of reading long passages must not get to you. Give a lot of talks, improve your abilities to express your ideas, and enhance your communication, social and interpersonal skills.

Score above 900 in the subject GRE. You can get 14 questions incorrect and still end up with a perfect score. Almost everyone who applies to Ivies and the likes of those has a score above 950. CPI and GRE are merely filters – set good standards for yourself and prepare well. Speed is of the essence in the GRE – getting 100 questions done in 2h 15m is not a joke. Go through old GRE physics papers for practice.

One's research is also impacted by their formative years.

Putting yourself on the map...

Publications are important. My earlier SOPs were probably rejected because I did not have many publications. When so many great students apply to elite institutes like Harvard and Princeton, publications become a major factor in screening. In High Energy Theory, you cannot simply publish calculations. You need to understand them, make sense of them and have substantial work involved.

Every single paper Dr. Gopakumar has published to date has something substantial to say, and hence it gets read and cited. If you do something actually meaningful, you will be cited and put on the map.

CAREER TREATS

"Biology was very observational, initially Biology was observation and documentation of those observations. As the number of observations became larger, informatics principles [were needed] to digest those numbers."

Dr. Gupta, in response to, "Where did Bioinformatics come from?"

Until the 80s or 90s, there was no concept of generating data in such a huge amount. Up until then, there was biostatistics – you would have numbers associated with biology, you would have these numbers recorded, and you'll do some statistics. One of the first [changes] that started to happen was that they started to look at the physics of biomolecules - You collect data which is similar to a physical problem and those things [end up being] so many numbers that you cannot process it by hand, so you need a computer to process it. This gave rise to computational biology. [It was] associated mostly with biophysics – putting things into a principle or equation.

Bioinformatics particularly came into the picture when there was the advent of sequencing arrays when we started to see the central dogma in its systemic detail – DNA stores the information like the hard disc of the cell, the RNA copies parts of the DNA so it's like programs that are residing on the hard disc and are copied temporarily into the RAM of the cell. The interactions of these programs with the outside world are in the form of proteins, the actual working machines of the cell.

People started to realize that genes and proteins are actually organized as a network and network biology, is essentially a reflection of what happens in algorithms, in computers. In order to process this information, people started to take a look at informatics principles. So bioinformatics brings a parallel between how a computer network works and how a biological network works.

Why should someone be interested in Bioinformatics?

Biology is no more solely observational. Because of the introduction of computers, the number of observations has gone up, we want more precision and throughput in our observations and simultaneously conduct many measurements. In order to make sense of the data being generated and in order to understand what the biological

system is doing, there is no alternative than to bring in informatics.

Key Traits to ace Bioinformatics

According to Dr. Gupta,

- First of all, this notion of separation of subjects has to go. If you want to be good at biology, you have to be good at all the subjects. So, as a science, it is a harder science.
- A good biologist would be a decent physicist, definitely a good mathematician (to understand the numbers and data), and has to be patient – those are the tools of a biologist.
- For a bioinformatician particularly, you need to develop vocabulary both in informatics sciences (physics, math and computer science) and biology – it is a transdisciplinary thing.
- Do not be afraid of math - if you think that you can get away with it, then you are in the wrong profession. It's not information science anymore, you need to be comfortable with numbers.
- A bioinformatician is aware of the vocabulary the biologist speaks and can use the principles of computer science to apply them.
- Currently, people either know biology or they know informatics. There is a need of people who know the vocabulary for both these fields and can act as glue – you can talk to the biologist, understand that problem and translate that problem into an informatics framework and can allow an informatician to do a better job.

And what about careers?

Dr. Gupta believes "this field is going to have the biggest growth." An article on www.datasciencecentral.com by William Vorhies, dated June 19th , 2018, has the heading itself as "The next big thing in data science is… Biology!" And Dr. Gupta absolutely agrees.

Dr. Gupta: In Biology, there is no theory, so it is driven by some form of statistical learning, and some form of data science is going to be involved in biology. So, the core of biology is very principle learning-oriented, that's why data science will pick up in this field. Plus, there are much more complicated problems in biology – the biggest problems in biology haven't even started to apply machine learning because they are so complex.

As the field of Bioinformatics grows, data is always going to increase. Because of this, there will always be a need for a person who specializes in the field. This is why jobs will always be there (although he does clarify that they haven't been incorporated into the Indian system yet). Especially in a country like India – which is not very resource-intensive, which is the reason why computer science as a job became a large thing – Bioinformatics has significant potential.

Some examples of where or how Bioinformatics would take a front seat are :

- Every industry, for example,

hospital industries would have a need for bioinformaticians – someone to take, curate and understand data and ways of making cleaner and throughput ways of taking that data – a computer would look at a file of a patient and be able to say that a doctor would need to spend a lot of time with a certain patient; so that sifting of data will occur. Even simple things like appointments are being handled on a system like Practo (an app for doctors that handles booking of appointments).

- Pharmaceutical companies are going big on bioinformatics. In pharmacy, to go from the idea of treating a disease to the drug takes about 20 years and often lots of drugs fail. So, what bioinformatics would actually do is allow you to create models that reduce the list of genes they have to go after.
- Molecular diagnostic fields
- OmiX (A technology platform that allows cost-effective DNA testing for early diagnosis and treatment of infectious diseases) based measurements.
- Wellness – Every population across the world needs to be taken care of, and the data scenario differs in different parts of the world. Principles of Bioinformatics are necessary to be able to handle such a huge database. All big companies like Apple and Microsoft are going into health and wellness.

In the field of research, Bioinformatics centres are being set up in multiple locations. Data is taken to these centres in order to assist visualization, processing and mining of that data. These data will be further implemented in research and development and each centre will have its own set of positions for employment.

Technology has bloomed. Its application to biology, though, has only started, unlike other fields. So Bioinformatics is going to grow in the future and create a large number of jobs as it does.

INTERNSHIP ACCOUNTS: EES

Akanksha Singh
Recipient of the proficiency medal of the first batch of EES students, currently a Ph.D. student at the Department of Atmospheric and Oceanic Sciences, University of Maryland, who explains the importance of a good balance between focusing on the present along with the long term efforts towards enriching internships.

Where did you do your internship, in which year and for what duration? What was your project about?

I applied for a foreign internship at many places in my fourth year. I am actually from the Earth and Environmental Sciences Department but I wanted to try something outside my subject so I applied for a Humanities project. I also had an integrated Earth and Environmental Sciences project along with that.

In my fourth year, I applied to many internship programmes including SN Bose, DAAD UTRIP and MITACS. I took up a 12 week Summer Project under the Department of Education and Social Sciences at the Thompson Rivers University in British Columbia, Canada. It involved explaining air pollution to the student community. We designed websites and learning material for different classes and also told the general public about how they can do their bit to prevent air pollution. It wasn't very technical but I wanted to do something outside my subject for a change.

Did you have a keen interest in Earth and Environmental Sciences from Environmental Sciences Department since the beginning or did it develop over time?

When I joined IISER Bhopal I was interested in Chemistry and didn't know about Earth and Environmental Sciences as an option for majors. However, I started liking all the core subjects equally and couldn't really narrow down to one subject because the coursework of IISER is designed that well! So I decided to choose Earth and Environmental Sciences thereby incorporating a lot of

different things.

What did the application process and eligibility criteria entail? What would be a good time to start applying, keeping in mind that you are aiming for a foreign internship?

The application process involved writing an SOP (Statement of Purpose) and a questionnaire asking why you would like to come to Canada. Compared to DAAD it was easier. In SN Bose and DAAD you have to contact the professor from another country individually. It's harder to get an acceptance because you won't know who is interested and who isn't. MITACS makes it easier as they give you a list of projects beforehand and have already spoken to the professors. I would say a good time to target a foreign internship is in your third or fourth year when you are more certain of what to do. You should start from the odd semester before the summer in which you are doing the internship. Also, you should inform your professors and ask for a letter of recommendation well in advance. I wasn't very good at applying but you do get better with time as you keep applying; your SOPs get more refined.

How did you choose which universities to apply to? More importantly, did you have a clear idea about your area of specialization when you applied for the internship?

In EES it's easy to choose universities to apply to as there are very limited options. Also, the faculty in each university are less in number. So it wasn't very hard for me to narrow down on my choices. To be specific, in Earth and Environmental Sciences, I specialize in atmospheric science which is very pertinent to the current global issues.

Did you avail any scholarship? If yes what were the eligibility criteria?

MITACS is a scholarship programme sponsored by the Canadian government scholarship. Any student of an Indian Institute with a CPI above 8 is eligible to apply for it.

How was the internship different from the ones in India in terms of the lab environment particularly? How did you get along with your guide and the lab group?

I had a great time during my foreign internship. There were two other interns with me. We interacted a lot with the local people. I had an excellent rapport with my guide. My guide was very interested to know about India as he had visited it in the past. MITACS also provides a local guide for every intern so that you can roam around the country. This is aimed at attracting students back to Canada for a PhD. They also organise paid field trips to beautiful places as a part of the internship.

In India, I worked twice in IIT Bombay and once in IISER Bhopal itself. These projects were more rigorous, scientific and involved a lot of studying. Communication skills were not very important. In Canada, contrastingly, one of the major parts was communicating my results with the community. Even

in your MS thesis, you not only have to do good research but you also have to communicate it well. That is something important I learnt during this internship. Also, I would like to tell you that internships in India are not bad. There is no compulsion to go abroad. It's a good experience but don't go abroad just for the sake of it.

What do they look for in a foreign intern? Any special set of skills associated with the lab or otherwise?

Apart from communication skills, it's good to have computational skills. Languages like C, C++ or MATLAB can be learnt in your free time. These computational skills will serve as an asset in any field that you pursue. Apart from the usual requirements of good grades and having an interest in the subject these things are the needs of the hour.

How did you make use of your knowledge regarding computational skills in your work?

One part of my project was to analyse the data of PM 2.5 in a spatial and temporal scale across Canada. There was a huge amount of data to deal with so I had to develop codes to streamline it. Knowing data analysis helped me with that. In my opinion, the first years must pursue any kind of computational skill in the summer. It will set a good pace for your other internships.

In what way does a foreign internship give an extra edge to an IISER student? Does this open up more doors in terms of securing a job or a PhD position?

It definitely has given me an extra edge as the MITACS program also continues to sponsor a PhD for two years if it is in Canada. As a result, Canadian universities favour MITACS students as they only have to aid the PhD for the rest of the duration. But you can get equivalent benefits in India. If you do a project under a reputed professor you might get a strong recommendation which will increase your chances of getting a PhD position abroad.

Now that you are in your 5th year, what are your future plans? What opportunities do you see yourself getting in the field of Earth and Environmental Science?

My first option for a PhD is in the USA. If I don't end up in any of my dream colleges, I'll turn to Canada. It's more of a backup and safe option for me right now!
Also, about GRE and TOEFL: I strongly suggest giving your GRE in the third or fourth year. Drawing from personal experience, it just gets too hectic in the 5th year. It's just English and basic quant [quantitative reasoning] so when you have time get it done because the scores are valid for 5 years.

The opportunities for an Earth and Environmental Science major are plenty! UPSC conducts Combined Geo-Scientist and Geologist Examination for EES graduates. Even the field of geophysics has amazing job opportunities. I think EES is the most job-oriented field because you can directly get placed in any of the oil

companies or other government jobs.

On a lighter note, I heard you won shark tank last year. What was your idea? Is there any scope of integrating entrepreneurship with earth science?

Yes, I did win Shark Tank last year! (laughs) A lot of food gets wasted in our mess. So my idea was to reduce this wastage by levying a fine against it. Eventually, lesser food will have to be cooked thereby reducing our mess fees. We also came up with a system to know how much food was being wasted, by placing a barcode on each plate and linking it to an individual account so that the money gets directly deducted.

Even though I am not interested in entrepreneurship I do think EES can be integrated with business. I know a few people who developed low cost sensors for CO2 and other harmful gases. So if you can develop any potential technology, then you can definitely pave the way to a successful business.

How has your overall experience as a student at IISER Bhopal been?

I love IISER Bhopal! I think you need to participate in a lot of events and I always had a great time in each of them. It was a very good learning curve. If you don't participate you miss out on a lot. It's not just about studies - you also have to have fun!

SURFING TO COLUMBIA

Navin Sridhar
An IVY who worked at Caltech for a Summer Project with the SURF Scholarship, did his MS-Thesis Project at TIFR and is currently pursuing his PhD in from Columbia University, narrates anecdotes from life back in IISER-B

Have you always wanted to pursue a major in physics? What has been your main inspiration?

Yes. I used to ask numerous questions when I was in my middle school (Not that I don't do now!) and was encouraged by my science teacher then, to ask more such questions. That definitely motivated me to get inclined towards natural sciences. Physics, in particular, has always been fascinating to me. It reminds me every now and then, that we humans know so little about the Universe and the particles that make up everything around us! This aspect of physics teases me to know more, and it keeps me motivated.

What skills do you think IISER B equipped you with, and how does it feel to be in the outside world, now?

Communicating in Hindi, maybe? (Although my friends would deny it :/). Among all the various set of skills that I could pick up during my journey at IISER-B, I would regard 'Communicating science to the public' to be the most valuable one. Answering the second part of your question -- I definitely feel humbled, juxtaposed against the giants out there.

Do you think taking part in extracurricular activities visibly aids the development of a person?

"Having mastery over one tool is sufficient, Morty; learning many tools make one efficient." - Rick

At least from what I could see from the lives of some of my seniors and mentors, those who have taken part in extracurricular activities and actively learnt newer skills on the go, have developed themselves into persons who can thrive in austere situations. If you

would call that the development of a person, then the answer would be an affirming yes.

Could you give us some insight about your experience of the internships in ISRO and TIFR?

I worked at ISRO as an IAS-INSA-NASI Summer Research Program fellow during the summer of 2015. I could not concentrate much on my project, as I was also working on a project at the Indian Institute of Astrophysics (IIAp) in parallel. As a result, I did not perform to my fullest at ISRO. That's when I learnt the hard way, not to take more than what I can have on my platter. I started working at TIFR as a VSRP fellow during the summer of 2016. The first of the many-more-to-come projects that I took up at TIFR was something related to what I worked on at ISRO. I started understanding the field, much better this time, and slowly started appreciating it.

I was working on this particular project for more than 8 months, most of my time from wherever I was – be it from TIFR, a bus, train, IISER B hostel, flight, home or even from a vacation. It was at the verge of being finished and we were planning to submit the paper. That's when we realized that the assumption of a parameter with which I had done all the analysis was off by a factor of ~2%. I was devastated knowing that. I clinched myself, redid the work, and got our results published in a paper. Anyone who takes up research will definitely go through such moments. Persistence is the key. The earlier one faces such situations, the better it is.

One of the other valuable rewards of working there was the connection I could make with some of the most prominent scientists in India working on my field of research.

The Caltech SURF is a prestigious scholarship. How did you bag it?

The Caltech SURF program and its application procedure are unlike many other internships. It follows the model of a grant-seeking process, where one essentially 'wins' the grant to pursue a research project at Caltech, for the project proposal that they write. I developed an idea of some of the most interesting and longstanding problems in the field of compact objects (Black holes and Neutron stars) from my previous research projects and a couple of conferences that I attended earlier. Based on that, I devised my final year thesis project, wrote a rough draft of a research proposal based on it and sent it to a prospective mentor at Caltech. They liked it, and then we iterated a few times over the course of a couple of months to make it more reasonable. This proposal was then submitted along with the rest of my application (personal essays, CV, recommendation letters and the other usual stuff). I then received a mail from Caltech on April 3rd breaking the news of me being offered a grant to pursue a part of my thesis research project at Caltech as a part of the SURF program – what an unforgettable moment it was! I could go on writing an entire booklet describing my experience at Caltech, which I will not go over, here...

Where and what are you currently studying?

I have chosen to join Columbia University, New York for my PhD. Here, I study the physics of compact objects,

developing and putting theories into test using high-performance computing simulations from first-principles, and also through observations using large arrays of telescopes on Earth and satellite-based ones.

How does the work ethic differ there in comparison to IISER?

Each place I have been to has its own working ambience… I haven't, unfortunately, gotten a chance to perform any research project at IISER-B due to the lack of faculties pursuing research in the field of my interest and methods. So, I cannot comment on that aspect very well. However, from what I have gathered from my friends, I think IISER-B is doing a fine job in imparting the students with a friendly, and a more or less independent research environment. One general observation of mine is that, people here at Columbia and some of the other places that I have been to invest more of their resources on high-risk high-gain projects than on the safer ones.

What skills do you think IISER students can work on, now that you've had some work experience yourself?

Science outreach -- Taking science to the public is a responsibility of scientists, and making it accessible to all is a skill I would yearn to develop.

Asking (the right) questions.

Writing – be it about the institute and the activities at IISER-B, about oneself or anything else for that matter. Writing coherently about a topic for a niche audience is a skill that is acquired as a result of persistent practice. Also, writing in academic and public outreach journals is a highly regarded skill in academia, and will get one a long way.

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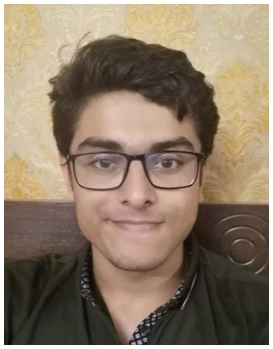

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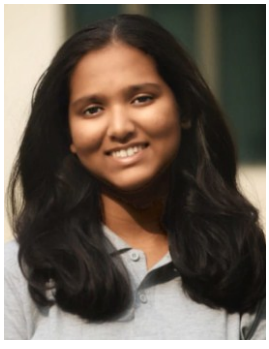

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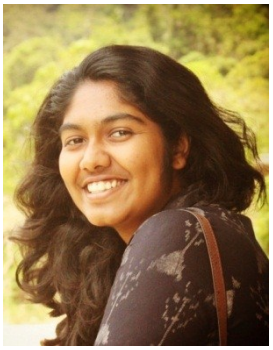

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