Statement of Purpose

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I had an early inclination towards building and understanding systems. When I was in middle school, I would spend countless hours trying to understand and modify the source code of various video games I played then. Although those systems were very simple, in comparison to the kind of systems I would work on later in life during my summer internships and undergraduate studies, that early exposure to system engineering really laid the foundations for my interests in computer science. Over the years, I worked on exploring and nurturing my interests, and developed a passion to work in the field of **blockchains, network systems, consensus protocols and cloud computing**. I wish to continue to explore them further during my graduate studies at ———————.

During my undergraduate summer internships, I worked on some of these topics with **Prof. Sandeep Shukla** at IIT Kanpur, India, **Prof. Srinivasan Keshav** at the University of Waterloo, Canada (now at University of Cambridge, UK) and **Prof. David Tse** at Stanford University, USA. I deeply enjoyed all of these experiences. Besides exposing me to the joy of research, working with such amazing researchers made me realise the potential for real world impact of research in systems. Looking forward, during my graduate studies I aspire to grow myself as a researcher and an engineer, and hope to one day have a similar impact as my mentors. I am particularly interested in working on topics related to fault-tolerance and scalability in distributed systems.

My first exposure to research was during my freshman year summer internship, when I worked with Prof. Sandeep Shukla (at IIT Kanpur) to develop a blockchain based framework to solve the double spending problem in the land registry system in India. This is an important issue for a country like India, where there are no set land record requirements and communication between different governmental departments involved, and the process is either delayed or unreliable. We used Hyperledger Fabric as the base framework, and implemented document verification using Merkle trees based standardized tokens. Our work led to a paper titled **"Entangled Blockchains in Land Registry Management"** which we presented at the "Third Advanced winter school in blockchains and cryptocurrencies" at Israel Institute for Advanced Studies (IIAS), Israel, and then later at IIT Bombay, India. This experience not only nurtured my interest in the field of blockchains and systems, but also helped me understand how innovations in computer science can help in solving real world socio-economic problems.

After my sophomore year, I collaborated with Prof. Srinivasan Keshav and his research group at University of Waterloo, where I worked on building a byzantine fault-tolerant membership service for RCanopus (a consensus protocol). Working with them gave me further exposure to the interesting set of challenges that the field of systems, networking, and consensus protocols has to offer. In fact, my experience with him was pivotal in shaping my decision to apply for graduate school in this field. One critical roadblock during our project was establishing secure communication between RCanopus nodes implemented in Golang, and the membership service which was implemented using Concord-BFT engine in C++. I lead our efforts in identifying a solution and implementing it. We bridged the above mentioned communication gap using Google Remote Procedure Calls (gRPC) framework (a high performance, lightweight and open-source universal RPC framework). We finally deployed our system on University of Waterloo's local compute cluster. The current implementations for BFT protocols do not support any run-time changes in topology, and this is one of the problems which I would like to address during my graduate studies. Besides being a very fruitful research experience,

working with the diverse and international research group of Prof. Keshav gave me an opportunity to work with people outside my culture, further broadening my research perspective.

This past summer, I was fortunate to be advised by Prof. David Tse at Stanford University, where I worked on exploring how certain consensus protocols achieve "fairness" and how to design incentive models for blockchain protocols to prevent malicious behavior in the presence of rational adversaries. Initially, I was planning to visit him, but the plans were affected due to COVID-19 related travel restrictions. He was really kind to advise me virtually and also allowed me to attend his graduate-level course on Scaling Blockchains offered at Stanford University. Working with him further solidified my interest in the field of systems and blockchains, and also exposed me to the idea of "fairness" or the human aspect of these systems. Motivated to understand these topics further, I am currently working on my undergraduate dissertation with Prof. Bibhudatta Sahoo (NIT Rourkela) on using blockchains to make container based cloud data centers more energy efficient and to prevent any single point of failures during resource allocation.

Each one of my research experiences was different from the others, and collectively all of them played an important role in shaping my interest in pursuing a career in research. Over the past two years, my interest in systems that started from a freshman year internship, has evolved into a passion that I deeply care about and desire to follow. I believe that graduate school will provide me with the right resources, encouragement, and knowledge to pursue these topics further. I deeply admire the CS department at − − − − − − − − − − − − and would love to work with systems and networking groups. In particular, I am interested in the research works of − − − − − − − − − − − −. I hope to work with them during my graduate studies. I would be delighted to work with any of them. In the long run, after the completion of my graduate degree, I hope to contribute back to my community as an academic.