# SURENDER SINGH LAMBA

*"In automation, we trust"*

Tokyo, Japan  
+81 70 8431 7224  
B.Tech CSE IIT Bombay  

github.com/surender7522  
sslamba10@gmail.com

## HIGHLIGHTS

### Innovative work

- Patent application under process for an innovative method to manage lifecycles of physical, virtualized or containerized network functions, network services, network slices, network infrastructure like kubernetes or bare metal elements and their composed hierarchical elements by the use of an intent based, distributed transaction based, fault tolerant microservice in a multicloud environment primarily for telco carrier grade edge and 5G core components including their provisioning, healing, load based or predictive scaling and decommissioning **[2020]**
- Patent application under process for an innovative design for a horizontally scalable correlation and policy engine microservice which provides closed loop automation together with the above system in a multicloud environment primarily for telco carrier grade edge and 5G core components by enabling stream processing of alarms from the network and creating partial pattern based forests for both strict order and random order policies **[2020]**

### Entrepreneurial work

- **Co-Founded** an edutech startup **Erdos Technologies** 6th semester **in college** to target aggregation of irregular education sector in India to pipeline edu content providers through introduction of credit based technology financed through ads and providing alternate funding to schools besides direct fees from pupils enabling democratization of knowledge where children cannot afford it **[2016]**
- Served as a **Co-ordinator for Media** team, Mood Indigo, Asia's biggest college cultural festival
- Dealt with event brands like Insider, Allevents and managed photography teams like The Hawkeyed Photographers and wrote a script to **batch process terabytes** of pictures to reduce turnaround time from days to minutes
- **Guided IIT aspirants** in cracking the exam as part time tutor at **Toppr.com** for Mathematics, Physics, Chemistry and Reasoning and wrote exam preparation blogs on **Toppr Bytes**, the publishing arm of Toppr.com **[2016]**

### Scholastic Achievements

- Secured **All India Rank 30** out of **1.4 million** candidates in Joint Entrance Examination Advanced '14 jointly conducted by Indian Institutes of Technology(IITs) and Science(IISc)
- Secured **99.96 percentile** in Joint Entrance Examination Mains (B.Tech) '14 out of **1.4 million** candidates conducted by CBSE under Ministry of Education
- Secured **99.90 percentile** in Joint Entrance Examination Mains (B.Arch) '14 out of **1.4 million** candidates conducted by CBSE under Ministry of Education
- Secured **Rank 69** out of **0.4 million** candidates in Engineering Agricultural and Medical Common Entrance Test (EAMCET) '14 conducted by Jawaharlal Nehru Technological University, Hyderabad
- Stood amongst **top 1%** candidates in **National Standard Examination in Junior Science '11** conducted by Indian Association of Physics Teachers
- Stood amongst **top 10%** in institute in test conducted by Association of Mathematics Teachers of India and **HBCSE** '10
- Received **Merit** certificate for 21st Inter State Maths Competition '10 for remarkable mathematical ability
- Secured **State Rank 14** in Sir C.V. Raman young genius awards talent search examination 2012
- Secured **State Rank 47** in Science Talent Search Examination '11 conducted by Dr. A.S. Rao awards council

### Miscellaneous

- Trained and served a year in **National Cadet Corps(NCC)** the youth wing of **Indian Armed Forces** under 2 Maharashtra Engineer Regiment **[2014]**
- Gave a paper critique and presentation on "*An Enhanced Routing Method with Dijkstra's Algorithm and AHP Analysis in GIS Based Emergency Plan*" in a course on **Introduction to Geographic Information Systems** under Prof. Surya Durbha
- Presented a paper critique on "*PupilScreen: Using Smartphones to Assess Traumatic Brain Injury*" as a part of course on **Mobile Computing** under Prof. Vinayak Naik
- Stood **first** in glider making competition for range and endurance amongst 10 teams as part of a course on Introduction to Flight under Prof. Rajkumar S Pant

**Dec '20 - Present**
Technical Lead

**5G Slice Orchestration - E2E Orchestrator**                    Rakuten Mobile Inc., 楽天市場, **Tokyo**

- Designed a cloudnative 5G slice orchestration system building upon the **Hierarchical Lifecycle Manager** to manage service orders and deployments of **eMBB, uRLLC, mmtc** based slices over **shared and non-shared** Networks Slice, Network Slice Subnet and Network Service deployments
- Handled automated preparation and config push to subdomains in **Transport** networks via SDN controller and **Radio Access** Network, **Core** Network through Network service FSMs
- Designed and Developed **dynamic path selection** capability in the FSM for various layers to achieve automated deployments in a declarative manner for **Helm** and other application packages on Kubernetes
- Defined integration points for Correlation & Policy Engine to establish closed loop interaction at different layers of network topology to achieve **state maintenance** of the network elements
- Defined integration points for resource manager to do feasibility checks for service and slice profiles requested by the user

**Mar '20 - Present**
Technical Lead

**Correlation & Policy Engine - E2E Orchestrator**              Rakuten Mobile Inc., 楽天市場, **Tokyo**

- Designed a cloudnative **stream processing** system from scratch for **Complex Event Processing** and **Multi Layered Correlation** competing providing wider set of pattern specification than existing Bigdata CEP engines like **Apache Flink** while allowing rules to be inserted at **runtime** whereas Flink needs a complete stop due to **compiled patterns**
- Designed a custom datastructure to create **partial pattern forests** enabling efficient pattern matching on the stream enabling Flat, **Topology** based and multi layered correlation by creating synthetic events after enrichment from Active Inventory of the system
- Utilized kafka partitioning, lazy commits and key based **consistent hashing** alongside python's Processpool to create a stateless, fault tolerant and horizontally scalable system which enables **5k events/sec/core** with preliminary scale tests going to **110,000 events/sec**
- Utilized WebAssembly System Interface **(WASI & WASM)** to bring in rust based evaluation system promising 20x speedup to existing system
- CP Engine alongside Hierarchical Lifecycle Manager enables closedloop automation for various components in cloudnative 5G core, edge components to enable the vision for **Level 4 autonomous network** after enabling ML/DL based rule generation systems

**Mar '20 - Present**
Technical Lead

**Hierarchical Lifecycle Manager - E2E Orchestrator**          Rakuten Mobile Inc., 楽天市場, **Tokyo**

- Designed and developed a generic FastAPI **ASGI** based LCM microservice to drive pluggable Finite State Machines in an **intent based** fashion to reach a particular state from the current being tolerant to faults following **SAGA pattern of distributed transactions**
- The generic nature allows the user to bring in any network function, network service, slice, kubernetes cluster or baremetal element and define the FSM or a composed fsm of the above in **zero code** fashion enabling the vision for **zero touch provisioning and management** of **5G core, edge, IoT** including closed loop automation alongside zero touch correlation policy engine
- Designed the service to be fault tolerant and highly scalable by being stateless while offloading workflow execution to kubernetes jobs ensuring scalability

**Jan '20 - Mar '20**
Software Developer

**Service Onboarding & Bundle Builder**                         Rakuten Mobile Inc., 楽天市場, **Tokyo**

- Designed and developed microservice based backend for 3rd party vendor's service application onboarding for cloudnative apps including a versioning and cold storage of bundles which contain artifacts including **HELM charts**, robin bundles, configuration files, observability **alarm libraries**
- Integrated with self hosted **object storage** like Minio utilizing its **S3 api** for manipulating the bundles as well as enforcing access policies for the onboarding teams and vendors
- Designed one touch deployment flows after the bundle is approved, to push observability configurations, prime the deployment clusters by **pre caching** images and other artifacts, pushing **Day0 and Day1 configuration** to CMaaS modules

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| Nov '19 - Jan '20<br>Software Developer | **Internal Virtual Network Function Manager** | **Rakuten Mobile Inc., 楽天市場, Tokyo** |

- Designed and developed a **VNF manager** to handle lifecycle of Network Functions and Network Services including **Virtualized RAN for 4G** carrier grade networks on self hosted **openstack** clusters following ETSI MANO standard interfaces including triggers for Day0 and Day1 configurations
- Developed a two-tier microservice system including a synchronous flask WSGI framework to front requests from OSS maintaining **configurations of VNFs** in the network and a workflow system on Airflow to offload long running tasks increasing the overall throughput of the system
- Reduced time required to deploy VRAN for 4G from days in human effort to **5 minutes** and handled fortnightly parallel upgrades of qcow images and **auto healing** through reboot or redeploy across the distributed RDC and GC network in Japan

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| May '17 - Jul '17<br>Summer Intern | **Samsung Pay Instrumentation** | **Samsung R&D Institute, Bangalore** |

- Used **Android Espresso** Framework from Android testing support library to achieve **automated functional UI testing** of Samsung Pay application
- Added support to automatically document testing results across avenues of PayTM, UPI and cards for increased productivity
- Achieved a code coverage of **20-30 percent** as a collateral to UI testing under different contextual events
- Circumvented **limitations** of Espresso Framework for Samsung Knox, Samsung's on device security and QR scanning in **device farm** like environment

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| May '16 - Jul '16<br>Summer Intern | **Learning Management System** | **Stratbeans Consulting Pvt. Ltd., Gurgaon** |

- Made a full fledged **iOS App** which is a part of a large **LMS** (Learning Management System) and provides offline content, quizzes and reports
- Made a **Virtual Reality** app in Unity using Cardboard SDK which coordinates with the android LMS app and helps in solving quizzes in a virtual world
- The VR app got featured in the **mLearnCon '16 in Austin,Texas**
- Made a **Facebook based ChatBot** in Nodejs which helps in support automation for the company and augments their already available **Elasticsearch** engine

## COURSE PROJECTS

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| Jan '19 - Apr '19 | **Software framework for Serverless/Function as a service**<br>Guide: Prof. Purushottam Kulkarni | **Indian Institute of Technology, Bombay** |

- Implemented a software framework to create a **docker swarm** cluster out of any COTS/consumer hardware like laptops and host any compilable binary of a user defined function providing managed provisioning, telemetry and **auto scaling**(not natively supported in vanilla docker) of the function
- Utilized dockerd, cadvisor, custom golang based server to expose the function and its metrics creating a **closed loop** with prometheus based alert manager enabling scaling of such functions
- Created and visualized load on the setup using grafana enabling the user to edit alert rules on prometheus and making the system as **reactive or adaptive** as possible and scaling down the functions when not in use to reduce costs
- Enforcing compiled binary allows image sizes **under 10 MB** allowing for low bootup times and faster teardowns
- Open sourced the project on github which is now archived as part of the **Github Arctic Vault**

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| Jan '17 - Apr '17 | **Handwritten Digit Recognition**<br>Guide: Prof. Shivaram Kalyanakrishnan | **Indian Institute of Technology, Bombay** |

- Implemented **multi-class perceptron classifier** for set of scanned handwritten digit images and achieved accuracy of **74%**
- **Analyzed performance** over different training set sizes, data points seen and classifier with different update rule like **MIRA**
- Implemented a **feed-forward neural network** in keras using MNIST dataset and analyzed performance with variance in hyperparameters like batch size, hidden layers and learning rate and achieved an accuracy of **94.5%**

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| Jan '17 - Apr '17 | **Pacman AI** |
| | **Guide: Prof. Shivaram Kalyanakrishnan**          **Indian Institute of Technology, Bombay** |

- Implemented various search strategies for Pacman like **breadth first search, depth first search, uniform cost search, A\* search** with different heuristics like manhattan distance and euclidean distance
- Implemented simple reflex agent and generalized version of **Minimax algorithm** which can work with any number of ghosts
- Implemented **generalized Expectimax algorithm** modelling probabilistic behavior of agents which make suboptimal choices

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| Jan '18 - Apr '18 | **Markerless Augmented Reality Android** |
| | **Guide: Prof. Vinayak Naik**          **Indian Institute of Technology, Bombay** |

- Designed and implemented an Augmented Reality application for Android to display **RICH content** in Markerless AR
- Implemented **smart graffiti** to draw over real world without using specialized hardware on high end phones
- Used **Google's location API** to **smartly cache** nearby content for seamless experience
- Used **AWS cloud** and **EasyAR's SDK** to make the content fully stream-able resulting in lightweight app

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| Jan '16 - Apr '16 | **Simulation of SQL Queries over GIS** |
| | **Guide: Prof. Surya S Durbha**          **Indian Institute of Technology, Bombay** |

- Used **spatial RDBMS** to analyze vector data and extract required spatial features
- Used Postgres as backend server for running SQL queries and **GrassGIS** for frontend simulation of spatial queries over data

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| Jan '17 - Apr '17 | **Compiler for a Subset of C** |
| | **Guide: Prof. Uday Khedker**          **Indian Institute of Technology, Bombay** |

- Developed a **language processor** which performs **lexical parsing, syntactic and semantic checking**, and ultimately
  generates assembly code for basic C constructs including loops, conditional statements and recursive function calls
- Implemented an algorithm for dead code elimination using **live variables analysis** on compiler generated intermediate code

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| Jan '16 - Apr '16 | **Streaming Colour Interpolator** |
| | **Guide: Prof. Supratik Chakraborty**          **Indian Institute of Technology, Bombay** |

- Designed **finite state machines** to model interpolation of noisy RGB images inputted as a stream of binary data
- Used **FIFO queues** to periodically store and remove streamed data for **continuous bilinear interpolation** of every pixel
- Developed a program in **VHDL** and designed multiple test benches to verify code correctness

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| Jan '16 - Apr '16 | **Socket Programming** |
| | **Guide: Prof. Kameswari Chebrolu**          **Indian Institute of Technology, Bombay** |

- Implemented a **distributed password cracking system** over a network in C++
- Used custom implementation of sockets with a **three tier system** of server, client and workers
- Server handled multiple clients delegating and distributing tasks to workers to attain **maximum utilization** of resources

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| Jul '15 - Nov '15 | **Rube Goldberg Machine** |
| | **Guide: Prof. Sharat Chandran**          **Indian Institute of Technology, Bombay** |

- Simulated a Rube Goldberg Machine featuring mechanism of closing a tap when a container is full
- Implemented in C++ object oriented design using **Box2D**, a physics simulation engine written in C
- Made use of **Google's LiquidFun** library to model 2D rigid-body and **fluid simulation**

| Jul '14 - Nov '14 | **Sudoku Autosolver** | |
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| | Guide: Prof. Supratik Chakraborty | **Indian Institute of Technology, Bombay** |

- Implemented a full Sudoku game and autosolver in C++ following **object oriented design** patterns
- Integrated **SFML** multimedia library for graphics, animation, sound and event handling
- Implemented autosolver using **backtracking** algorithm and implemented a separate standalone hexagonal sudoku game

## EDUCATION

| 2019 | **Bachelor of Technology** | |
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| | Computer Science & Engineering | **Indian Institute of Technology, Bombay** |
| | Ranked 1 in QS World University Rankings 2021, India | |
| | CPI of 6.58 out of 10 including two summer internships | |

| 2014 | **Intermediate/Junior College** | **Board of Intermediate Education, Andhra Pradesh** |
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| | Grand total of 980 out of 1000 including 100% in Mathematics and Physics | |

| 2012 | **Matriculation** | **Board of Secondary Education, Andhra Pradesh** |
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| | CPI of 9.8 out of 10 including 100% in STEM subjects | |

## KEY COURSES UNDERTAKEN

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| Topics in Virtualization and Cloud Computing | Principles of Data and System Security |
| Mobile Computing | Artificial Intelligence |
| Discrete Structures & Automata Theory | Introduction to Geographic Information Systems |
| Economics | Network Security and Cryptography |

## KEY TECHNOLOGIES USED

Extensive usage: C, C++, Python, Android(Java), Bash, LaTeX, Redis, MongoDB, MySQL, Airflow, Camunda, ASGI, WSGI, FastAPI, Flask, Django, Hypercorn, Gunicorn

Familiar usage: C#, Android(Kotlin), Java, Robot Framework, FluxCD, ArgoCD

Exploratory usage: Rust, Golang, AWS, GCP, Apache Flink, Apache Spark, Jmeter

Platforms: Kubernetes, Docker, Docker Swarm, Linux, Centos, Alpine, Ubuntu, Android, iOS, Arduino

Able to think clearly, Can pick up any other tool very fast.