

# KARUSH SURI

[LinkedIn](#) ◇ [Google Scholar](#) ◇ [GitHub](#)

Homepage- [karush17.github.io](http://karush17.github.io)

Email- [karush.suri@mail.utoronto.ca](mailto:karush.suri@mail.utoronto.ca)

## RESEARCH INTERESTS

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Karush is a graduate student at the University of Toronto completing his M.A.Sc in Electrical and Computer Engineering. His research focuses on developing novel intelligent agents for hierarchical reinforcement learning, model-based reinforcement learning and planning for robotic control.

## EDUCATION

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### University of Toronto

2019 - Present

*Master of Applied Science*

*Toronto, Canada*

- Thesis: Deep Hierarchical Reinforcement Learning
- Advisors: Prof. Yuri A. Lawryshyn & Prof. Konstantinos N. Plataniotis
- GPA: 3.93/4

### Amity University

2015 - 2019

*Bachelor of Technology*

*Delhi, India*

- Thesis: Application of Deep Learning & Game Theory for Sign Language Recognition using Wearable Sensors ([link](#))
- Advisor: Prof. Rinki Gupta
- GPA: 8.78/10

## SCHOLARSHIPS & AWARDS

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### University of Toronto, Canada

Edward S. Rogers Graduate Scholarship

2019-2021

### Amity University, India

Best in Technical Innovation Award (class of 2015-2019)

2019

Most Frugal Innovation Award

2018

100% Curriculum Merit Scholarship

2015

### Others

Young Achievers Award

2015

## RESEARCH APPOINTMENTS

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### RBC Capital Markets

2019 - Present

*Thesis Researcher*

*Toronto, Canada*

- Proposing Energy-based MIXer (EMIX) networks for few-shot surprise minimization in multi-agent StarCraft II.
- Proposed ESAC combining ES and SAC using AMT for sample efficient and scalable reinforcement learning.
- Developed soft winner selection strategies, hindsight crossovers and energy-based mixer models for multi-agent value factorization.
- Developed Hierarchical Reinforcement Learning pipelines such as HRL and TradeR using policy gradient methods.

## University of Toronto

*Graduate Research Assistant- Reinforcement Learning*

2019 - Present

*Toronto, Canada*

- Affiliated with the Center for Management of Technology & Entrepreneurship (CMTE)
- Developing joint policy optimization algorithms for continuous control and multi-agent reinforcement learning.
- Developed Hierarchical Reinforcement Learning methods for cooperation and competition with Multi-Agent Learning using CapsNet and ConvNet.
- Improved policy gradient algorithms in conjunction with evolution-based methods.

## Amity University

*Undergraduate Research Assistant- Deep Learning*

2017 - 2019

*Delhi, India*

- Affiliated with the Signal Processing & Deep Learning Lab
- Project entitled “Indian Sign Language to Spoken Language Translator using data from Wearable Multisensor Armbands” Funded by the Department of Science and Technology, Government of India, SERB file number ECR/2016/000637.
- Constructed novel CapsNets and ConvNets for non-cooperative games, Master-Slave DNNs and LSTM-RNNs for transfer-learning and dual-stage SVMs for classification and regression tasks.

## PUBLICATIONS

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- Karush Suri, Xiao Qi Shi, Konstantinos N. Plataniotis, Yuri A. Lawryshyn, “*Evolve To Control: Evolution-based Soft Actor-Critic for Scalable Reinforcement Learning*”, Submitted to 4th Conference on Robot Learning (CoRL) 2020, MIT, US. ([website](#)) ([arXiv](#)) ([blog](#)) ([code](#)) ([videos](#))
- Karush Suri, Shashank Saurav, “*Attentive Hierarchical Reinforcement Learning for Stock Order Executions*” Technical Report, 2020. ([pdf](#)) ([code](#))
- Karush Suri, Rinki Gupta, “*Continuous Sign Language Recognition from Wearable IMUs using Deep Capsule Networks and Game Theory*” Computers And Electrical Engineering, Elsevier, Vol. 78, pp.493-503, 2019. ([arXiv](#)) ([doi](#)) ([code](#))
- Karush Suri, Rinki Gupta, “*Convolutional Neural Network Array for Sign Language Recognition using Wearable IMUs*” 5th International Conference on Signal Processing and Integrated Networks, SPIN 2019, IEEE. ([arXiv](#)) ([code](#))
- Karush Suri, Rinki Gupta, “*Transfer Learning for sEMG-based Hand Gesture Classification using Deep Learning in a Master- Slave Architecture*”, International Conference on Communication and Computational Intelligence, 2018, IEEE. ([arXiv](#)) ([doi](#)) ([code](#))

## TEACHING ASSISTANTSHIPS

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- *Computer Organization* (Winter 2019)  
CSC258H, University of Toronto, Canada.
- *Integral Calculus* (Summer 2016)  
MATH, Sai Kripa Orphanage.
- *Numerical Differentiation* (Summer 2016)  
MATH, Sai Kripa Orphanage.
- *Linear Algebra* (Summer 2016)  
MATH, Sai Kripa Orphanage.
- *Introduction to Physics* (Fall 2016)  
PHY, Sai Kripa Orphanage.

## INDUSTRY EXPERIENCE

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### **EdAuthority**

2019-2020

*Content Management Intern- Data Science*

*Delhi, India*

- Drafted, Edited and Published articles on modern-day trends and advancements in Data Science.
- Backend Website management and development of marketing solutions for digital platform and end-to-end marketing.

### **Airtel**

2018

*Network Management Intern*

*Delhi, India*

- Project entitled “Fundamentals of Network Communication”.
- conducted Fault Management and Throughput Handling by being an active part of the Radio Network Team.

### **Reliance Jio**

2017

*Summer Engineering Intern*

*Delhi, India*

- Project entitled “Excel Data Processing Automator using Python Programming”.
- Devised novel automated algorithms for creation, updating and deletion of spreadsheets consisting of Throughput and Connectivity Loss data.
- Received Letter of Recommendation from Mr. Hemant Jha (General Manager) for excellent innovation during the project.

### **Sony**

2016

*Summer Engineering Intern*

*Delhi, India*

- Project entitled “LCD Television Systems and BRAVIA Engine Applications”.
- conducted circuit assessment and analysis of BRAVIA engine Television sets along with their maintenance.

## SELECTED PROJECTS

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### **TradeR: Trade Execution using Reinforcement Learning**

2020

*Reinforcement Learning*

*RBC Capital Markets*

- Hierarchical Reinforcement Learning agent capable of trading on stock orders using a customized buy-sell simulator
- Trading operations using variable policies and multi-agent framework
- TradeR has traded over 70 stocks from the S&P 500 index at 1 minute intervals for the 2019-2020 fiscal year.

### **EMIX: Energy-based MIXer for Few-Shot Surprise Minimization**

2020

*Reinforcement Learning*

*RBC Capital Markets*

- Few-Shot multi-agent transfer using a surprise value function in conjunction with an energy operator
- EMIX presents sample-efficiency and performance improvement on StarCraft II multi-agent maps

### **Evolution-based Soft Actor-Critic for Scalable Reinforcement Learning**

2020

*Reinforcement Learning*

*RBC Capital Markets*

- Proposed ESAC combining ES and SAC for sample efficient and scalable reinforcement learning with improved hyperparameter robustness
- Developed and improved robotic learning algorithms for MuJoCo and DeepMind control suite continuous tasks.

**Attentive Hierarchical Reinforcement Learning for Stock Order Executions** 2020  
*Reinforcement Learning* University of Toronto

- S&P 500 stock order execution pipeline utilizing Hierarchical Reinforcement Learning and Attention for high frequency trading.
- Developed and tested on a total of 6 tickers with 2 minute granularity during the COVID-19 outbreak.

**Facebook: Real-Time Image Generation from Deep Generative Models** 2019  
*Deep Learning* University of Toronto

- REST API capable of reconstructing images in real-time from CAEs and GANs deployed on serverless Lambda and scheduled for background runs using Eventbridge.

**Continuous Sign Language Recognition from Wearable IMUs using Deep Capsule Networks and Game Theory** 2019  
*Deep Learning* Amity University

- Construction of 1D Capsule Networks for sign language recognition and their comparison with CNNs using real-time non-cooperative winner-take-it-all games.

**An EMP Jamming Robotic System using Arduino Programming** 2018  
*Robotics* Amity University

- Mobile robot capable of jamming 2.4GHz signals using circular patch antenna.
- Won the award for Most Frugal Innovation at the Annual Poster Presentation and Technical Competition (APPTeC 2018)

## ORGANIZATIONAL WORK & SERVICES

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**Elevate** 2019  
*Event Volunteer* Toronto, Canada

- Event Volunteer at the Elevate Toronto Tech Festival.
- Worked in a team of 10+ members to manage and assist industry professionals at the Meridian Hall.

**Graduate Management Consulting Association** 2019  
*Member* Toronto, Canada

- Student member of the GMCA for 4 months (December, 2019 - March, 2020).
- Engaged and collaborated in management consulting events with focus on professional development and business networking.

**IEEE Signal Processing & Integrated Networks (SPIN)** 2017-2019  
*Lead Organizer* Delhi, India

- Head of the stage team at 6<sup>th</sup> SPIN.
- Member of the coordinating committee at 5<sup>th</sup> SPIN.
- Member of the volunteering committee at 4<sup>th</sup> SPIN.

## CERTIFICATIONS

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- Big Data (IBM), ([link](#)) 2019.
- Customer Analytics (Wharton Business School), ([link](#)) 2019.
- Machine Learning (Stanford University), ([link](#)) 2017.

## TECHNICAL SKILLS

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**Languages-** Python, Lua, MATLAB, HTML, SQL, C, Assembly, Markdown, L<sup>A</sup>T<sub>E</sub>X.

**Frameworks-** PyTorch, Tensorflow, torch7, Keras, Theano, Numpy, scikit-learn, Matplotlib.