

Devinder Kumar

PhD Candidate, UWaterloo & Vector Institute for AI
Lead AI Scientist in Residence, NextAI, Toronto
Intel AI Ambassador

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RESEARCH INTERESTS My research centers around Deep Learning and its application in Computer Vision.

EDUCATION **University of Waterloo**, Waterloo, Ontario Canada

PhD Candidate, SYDE, Jan 2017- Present
GPA: 92.5/100

- Dissertation Topic: How A Neural Network Thinks? Explaining the Decision Making Process of Neural Networks.
- Adviser: Dr. Alexander Wong and Dr. Graham Taylor (Vector Inst./ UGuelph)

University of Waterloo, Waterloo, Ontario Canada

MASc. Candidate, SYDE, Sept 2014- Aug 2016
GPA: 91/100

- Dissertation Topic: Deep Learning based Omni-directional Place Recognition for Challenging Environments
- Adviser: Dr. Steven Waslander and Prof. David A. Clausi

National Institute of Technology, Warangal, Andhra Pradesh India

B.Tech, May, 2013
Graduated with distinction

- Dissertation Topic: "MATLAB Based Simulation of Photovoltaic Cell"

HONORS AND AWARDS

Best Paper Award at Transparent and Interpretable Machine Learning Workshop at 31st Neural Information Processing & Systems (NIPS) 2017

Awarded President Graduate Scholarship (PGS) at University of Waterloo 2017

Awarded International Ontario Graduate Scholarship (OGS) (1/5 awards at UWaterloo) 2017

Awarded CIFAR scholarship to attend DL & RL Summer School, MILA, UMontreal, 2017

University of Waterloo International Doctoral Student Award 2017

Magna Cum Laude Award, Annual Meeting of the Imaging Network of Ontario, 2016.

University of Waterloo International Masters Student Award 2015, 2016

Millennium Graduate Bursary, University of Waterloo, 2015

Gold Medal for Excellence in Research (Electrical Department), NIT Warangal, 2013

World Semi-finalist for the Dell Social Innovation Challenge, 2012

Best Paper Award (Undergrad) IEEE Region 10 Paper Contest across Asia-Pacific Region, 2012

Institute Merit Scholarship for excellent Academic performance, NIT Warangal, 2010

Ranked 1st in High School out of 300 student, 2008

EXPERIENCE

NextAI Program (NEXT Canada), Toronto, Ontario, Canada

Lead AI Scientist in Residence

Feb 2017 - Present

Leading a team of AI Scientist in Residence who provide scientific and technical support to start-ups selected in yearly co-hort of NextAI accelerator.

NEXT Canada, Toronto, Ontario, Canada

Ambassador, NEXT Canada

Oct 2017 - Dec 2017

My role was to help identify talented teams and individuals with ambitious ideas and leverage Canada's leadership position in AI to help them to create global companies and make Canada industrial AI hub.

NextAI Program (NEXT Canada), Toronto, Ontario, Canada

AI Scientist in Residence

Feb, 2017 - Sept 2017

Acting as a scientific mentor for 7 new AI based start-ups. I provide scientific and technical support to these teams that are working on a wide variety of projects, and employing a number of tools and platforms.

Philips Research (HQ), Eindhoven, Netherlands

Deep Learning Intern, Data Science Team

Aug, 2016 - Dec, 2016

Worked with the data science team to develop machine learning tools using state-of-the art visualization techniques to visualize the decision making of deep learning networks and finding biases in the learned models.

University of Waterloo, Waterloo, Ontario Canada

Graduate Student

Sept, 2014 - present

Includes current PhD & MASC. research along with Masters level coursework and other research projects.

Teaching Assistant

May 2015 - present

- SYDE 111: Fundamental Engineering Math 1
- SYDE 112: Fundamental Engineering Math 2
- SYDE 211: Advanced Engineering Math 1
- SYDE 223: Data Structures and Algorithms

Duties at various times have included office hours, marking and leading weekly tutorials.

Aimetis Corp. (Now Senstar Inc.), Waterloo, Ontario CA

Machine Learning Intern

Sept, 2015 - Dec, 2015

Developed an efficient conditional random fields based method for background extraction and people tracking.

LIP-6, University Pierre et Marie Curie, Paris, France

Research Engineer

Feb, 2014 - Aug, 2014

Created a new dataset of 101 categories of 101k food images (UPMC-101) and performed deep learning based experiments for fine grained classification task for VISIIR project.

<http://visiir.univ-lr.fr/>

IUPR, Technische Universitat Kaiserslautern, Kaiserslautern, Germany

Summer Visiting Researcher

May, 2012 - July, 2012

Implemented single-shot camera calibration for the camera calibration pipeline of Decapod project. <https://sites.google.com/site/decapodproject/>

Indian Institute of Science, Bangalore, India

Summer Visiting Researcher

May, 2011 - July, 2011

Developed a single camera marker based tool for human motion analysis for applications in biomechanics.

PUBLICATIONS

A. Ziletti, **D. Kumar**, M. Scheffler and L. M. Ghiringhelli. The face of crystals: insightful exact classification using deep learning. **Nature Communications** (*Accepted: NCOMMS-17-22548*), 2018

D. Kumar, Graham W. Taylor, Alexander Wong. CLEAR-DR: Interpretable Computer Aided Diagnosis of Diabetic Retinopathy, 31st Neural Information Processing & Systems (NIPS) Transparent and Interpretable ML Workshop, 2017. *Best Paper Award*.

D. Kumar, Graham W. Taylor, Alexander Wong. Opening the Black Box of Financial AI with CLEAR-Trade: A Class-Enhanced Attentive Response Approach for Explaining and Visualizing Deep Learning-Driven Stock Market Prediction. Journal of Computational Vision and Imaging Systems (JCVIS), 2017.

D. Kumar, Graham W. Taylor, Alexander Wong. Explaining the Unexplained: A Class-Enhanced Attentive Response (CLEAR) Approach to Understanding Deep Neural Networks. Computer Vision and Pattern Recognition (CVPR) Workshop, 2017 (*Oral*)

D. Kumar, M.J.Shafiee, A.G. Chung, F. Khalvati, M.A. Haider and A. Wong. Discovery Radiomics for Pathologically-Proven Computed Tomography Lung Cancer Prediction. 14th International Conference on Image Analysis and Recognition (ICIAR), 2017 (*Oral*)

D.Kumar, H. Neher, A. Das, D. Clausi and S. Waslander. Deep Learning based Omni-directional Place Recognition for Challenging Environments. 14th Conference on Computer and Robot Vision (CRV), Edmonton, AB, 2017 (*Oral*).

D. Kumar, V. Menkovski. Understanding Anatomy Classification Using Visualization. 30th Neural Information Processing & Systems (NIPS) Machine Learning for Health (MLH) Workshop, 2016

A.G. Chung, M.J.Shafiee, **D. Kumar**, F. Khalvati, M.A. Haider and A. Wong. Discovery Radiomics for Multi-Parametric MRI Prostate Cancer Detection. Proc. Annual Meeting of the Imaging Network of Ontario, 2016. *Magna Cum Laude Paper Award*.

Shafiee, M. J., A. Chung, **D. Kumar**, A. Wong, F. Khalvati, and M. A. Haider. Discovery radiomics via StochasticNet sequencers for cancer detection. 29st Neural Information Processing & Systems (NIPS) Workshop on Machine Learning in Healthcare, 2015

A. Wong, A.G. Chung, **D. Kumar**, M.J.Shafiee, , F. Khalvati and M.A. Haider. Discovery Radiomics for Imaging-driven Quantitative Personalized Cancer Decision Support. Vision Letters, 2015

X.Wang, **D. Kumar**, N.Thome, M.Cord, and F.Precioso. Recipe Recognition with large multimodal food dataset. IEEE International Conference on Multimedia & Expo Workshops (ICMEW),pg:1-6, 2015.

D.Kumar, A. Wong and D. Clausi. Lung Nodule Classification Using Deep Features in CT Images. 12th Conference on Computer and Robot Vision (CRV), Halifax, NS, June, 2015.

A.Das, **D. Kumar**, A.E.Bably and S. Waslander. Taming the North: Multi-Camera Parallel Track-

ing and Mapping in Snow-Laden Environments. In proceedings Field and Service Robotics (FSR), June, 2015.

A. Singh, S. Karanam, and **D. Kumar**. Constructive Learning for Human-Robot Interaction. IEEE Potentials, Vol. 32, Issue: 4, pp(s): 13-19, Aug, 2013 *IEEE Best Student Paper Award (Region 10)*.

S. Karanam, A. Singh, **D. Kumar**, A. Choubey, K. Bacchuwar. Analysis and Improvement of SNR using Time Slicing. 3rd International Conference on Digital Image Processing, Proc. SPIE 8009, Issue: 1, 2013.

D.Kumar , A. Singh, S.N. Omkar. A Novel Visual Cryptographic Method for Color Images. International Journal of Image, Graphics and Signal Processing, Vol. 6, Issue. 6, pp. 49-56, May, 2013

S. Karanam, A. Singh, **D.Kumar**. Karate with Constructive Learning. International Journal on Image and Video Processing , Vol. 2, Issue-3, pp: 382-386, February, 2012.

D. Kumar, A. Singh. Occluded Human Tracking and Identification using Image Annotation. International Journal of Image, Graphics and Signal Processing , Vol.4, No.12, November 2012.

D. Kumar, A. Singh. Annotation Supported Occluded Object Tracking. International Journal on Image and Video Processing, Vol. 3, Issue: 1, August, 2012.

A. Singh and **D. Kumar**. Integrating Occlusion and Illumination Modeling for Object Tracking using Image Annotation. International Journal of Image, Graphics and Signal Processing, Vol. 4, Number. 10, pp: 40-47, September 2012

A. Singh, **D. Kumar**, K. Bacchuwar, A. Choubey, S. Karanam. Annotation Supported Contour Based Object Tracking With Frame Based Error. International Journal of Machine Learning and Computing (IJMLC), Vol. 2, No. 4, pp (s): 521-525, August 2012

A. Singh, **D. Kumar**, P. Srikanth, S. Karanam, N. Acharya. An Intelligent Multi-Gesture Spotting Robot to Assist Persons with Disabilities. International Journal of Computer Theory and Engineering, Vol. 4, No. 6, pp(s): 998-1001, December, 2012

A. Choubey, A. Singh, S. Karanam, **D.Kumar**, K. Bacchuwar. A Novel Signature Verification based Automatic Teller Machine. International Journal of Information and Electronics Engineering, Vol. 2, No. 4, pp (s): 570-574 , July 2012

P. Srikanth, A. Singh, **D.Kumar**, A. Nagrare, V. Angoth. A Comparison of Machine Learning Classifiers. Elsevier: SCOPUS International Journal of Advanced Materials and Information Technology Processing, 271-273, pp 149-153, 2011.

A. Singh, K. Bacchuwar, A. Choubey, S. Karanam, **D.Kumar**. An OMR Based Automatic Music Player. 3rd International Conference on Computer Research and Development, pp. 174-178, 2011.

A. Nagrare, A. Singh, P. Srikanth, **D.Kumar**, C. Dwith. A Comparison of Biclustering with Clustering Algorithms. 3rd Pacific-Asia Conference on Circuits, Communications and System (PACCS 2011), pp. 1-4, 2011

TALKS

Invited talk at **Industrial Research Assistance Program (IRAP)- NRC meeting**, Toronto, Canada - "Future of commercialization of AI research and how SMEs in Canada could exploit the opportunities in global context", Oct 2017

Invited Keynote Speech at **Big-Data/AI Toronto**, Confernece, Toronto, Canada - "Challenges for Future AI- Scalability and Interpretability", May 2017

Invited talk at **Fritz-Haber-Institut der Max-Planck-Gesellschaft**, Berlin, Germany - "Visualizing the Decision Making Process of CNNs" Dec 2016

Invited talk at **Gustave Roussy Cancer Research Institute**, Paris, France - "Discovery Radioms for Cancer detection: Intelligent bio-markers" May 2016

- MEDIA COVERAGE** My research has been published and covered by the following media organizations and reports:
- "This Researcher Wants to Open the 'Black Box' of Financial AI", VICE's Motherboard, Oct 2017
 - "New software could make it easier to adopt and trust AI systems that set insurance premiums", Canadian Underwriter Magazine, Oct 2017
 - "Scientists developed software to make artificial intelligence systems more trustworthy", Technology.org, Oct 2017
 - "Waterloo research paves the way for use of complex AI in the financial sector", Exchange Magazine, Oct 2017
 - "Waterloo research paves the way for use of complex AI in the financial sector", Waterloo Media Relations Press Release, Oct 2017
 - "Building trust in AI", Invesment Executive, Oct 2017
 - "Reading the minds of deep learning AI systems", Engineer the Future Magazine, Sept 2017
 - "Reading the minds of deep learning AI systems", Waterloo Stories, June 2017

- REVIEWER** I am now the managing editor for Journal of Computational Vision and Imaging Systems (JVIS). In past I have acted as a reviewer for the following:
- International conference on Medical Imaging with Deep Learning (MIDL), 2018
 - Bio-Med Central (BMC) Medical Imaging, Springer (journal)
 - IEEE Canadian Journal of Electrical and Computer Engineering
 - Computer Assisted Radiology and Surgery (CARS) conference, 2017
 - International Journal of Computer Assisted Radiology and Surgery (IJCARS)
 - IEEE International Conference on Robotics and Systems (IROS), 2016
 - Elsevier: Measurement: the Journal of the International Measurement Confederation (MEAS)

COMPETITION PRESENTATIONS D.Kumar, A. Dahal, H. Gautam. QR code: Emerging Threat To Mobile Security and A Protective System. IT Security for the Next Generation, Kaspersky MEA and Asia Cup, Hong Kong, March 2012.

POSITIONS HELD Chairman, Computer Vision & Image Processing Cluster, IEEE Student Branch NIT Warangal 2012-13

- COMPUTER SKILLS**
- Languages: Python, some use of Unix shell scripts.
 - Deep Learning Packages: Pytorch, Keras, Theano, TensorFlow, MatConvNet,
 - Cloud Platforms: Amazon (AWS), Microsoft Azure
 - Applications: MATLAB, Open-CV, \LaTeX , common Windows database, spreadsheet, and presentation software.
 - Operating Systems: Unix/Linux, Windows.