

# SHANU KUMAR

DATA AND APPLIED SCIENTIST, MICROSOFT

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## EDUCATION

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2019 **B. Tech in Electrical Engineering, Indian Institute of Technology, Kanpur** GPA: 8.63/10  
*Silver Medalist, Minor: Machine Learning*

## RESEARCH INTERESTS

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COMPUTER VISION, DOMAIN ADAPTATION, NATURAL LANGUAGE PROCESSING, MACHINE LEARNING

## ACHIEVEMENTS

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2019 Awarded **Proficiency Prize** by IIT Kanpur for outstanding undergraduate research  
2018 Received **A\*** (top 1%) grade for exceptional performance in the course "Neural Network"  
2017 Received **Academic Excellence Award**, awarded to Top 5% students in IIT Kanpur  
2015 Secured **All India Rank - 2499** in **JEE Advanced** among 1.25 lakh Candidates

## PUBLICATIONS

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2019 **ATTENDING TO DISCRIMINATIVE CERTAINTY FOR DOMAIN ADAPTATION**  
*Vinod Kumar Kurmi\*, Shanu Kumar\*, Vinay P. Namboodiri*  
*In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2019 [Paper]*

2019 **ADVERSARIAL ADAPTATION OF SCENE GRAPH MODELS FOR UNDERSTANDING CIVIC ISSUES**  
*Shanu Kumar, Shubham Atreja, Anjali Singh and Mohit Jain*  
*In Proceedings of the International World Wide Web Conference (WWW), 2019 [Paper]*

2019 **ALIGNING THE CERTAINTY OF CLASSIFIER FOR DOMAIN ADAPTATION**  
*Shanu Kumar\*, Vinod Kumar Kurmi\*, Vinay P. Namboodiri*  
*[Under Review]*

## INTERNSHIP

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MAY-JUL 2018 | **ADVERSARIAL ADAPTATION OF SCENE GRAPH MODELS FOR UNDERSTANDING CIVIC ISSUES**  
*Research Intern at IBM India Research Laboratory, Bangalore*  
*Supervisor: SHUBHAM ATREJA*

- Proposed a novel application of existing Scene Graph models by adapting them to generate a **Civic issue graph** for understanding civic issues present in an image.
- Created two **multi-modal** datasets with bounding boxes and descriptions about civic issues.

## RESEARCH PROJECTS


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JAN-APR 2019 | **ALIGNING THE CERTAINTY OF CLASSIFIER FOR DOMAIN ADAPTATION**  
*Undergraduate Project at IIT Kanpur*  
*Supervisor: PROF. VINAY P. NAMBOODIRI*

- Proposed a method for generating **certainty activation maps** of the classifier, and improved classifier's certainty by aligning certainty activation maps across source and target domain.
- Achieved state of the art results on *Office Home*, *Office-31* and *ImageCLEF-2014* datasets.

SEP-NOV 2018 | **ATTENDING TO DISCRIMINATIVE CERTAINTY FOR DOMAIN ADAPTATION**  
*Undergraduate Project at IIT Kanpur*  
*Supervisor: PROF. VINAY P. NAMBOODIRI*

- Proposed a method to identify **adaptable** regions using the **certainty estimates** of discriminator for improving classifier's performance on target dataset.
- Achieved state of the art results on *Office Home*, *Office-31* and *ImageCLEF-2014* datasets.

AUG-OCT 2018	<p><b>KNOWING WHEN TO ADAPT: A BAYESIAN APPROACH FOR DOMAIN ADAPTATION</b>  <i>Undergraduate Project at IIT Kanpur</i>  <i>Supervisor: PROF. VINAY P. NAMBOODIRI</i></p> <ul style="list-style-type: none"> <li>Proposed a <b>Bayesian framework</b> for domain adaptation by transforming both the Classifier and Discriminator into Bayesian Neural Networks using <b>Monte Carlo-Dropout</b> approach.</li> <li>Achieved improvement over the Non-Bayesian Model on <i>Office Home</i> and <i>Office-31</i> datasets.</li> </ul>
JAN-APR 2018  <a href="#">report</a>	<p><b>HIERARCHICAL WORD SENSE DISAMBIGUATION USING WORDNET SENSES</b>  <i>Undergraduate Project at IIT Kanpur</i>  <i>Supervisor: PROF. HARISH KARNICK</i></p> <ul style="list-style-type: none"> <li>Developed an end to end <b>Hierarchical model</b> based on synset and lexicographer number of <b>Word-Net</b> senses for predicting senses sequentially for each word in the sentence.</li> <li>Applied <b>convolutional neural networks</b> on word vectors for capturing the context of the word and the local features around a neighborhood of the word.</li> </ul>

## COURSE PROJECTS

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FEB-APR 2019  <a href="#">report</a>	<p><b>SEMI-SUPERVISED LEARNING WITH DEEP GENERATIVE MODELS</b>  <i>Course Project for Topics in Probabilistic Modeling and Inference under Prof. Piyush Rai</i></p> <ul style="list-style-type: none"> <li>Implemented and studied research papers on semi-supervised learning: "<i>Semi-supervised Learning with Deep Generative Models</i>" by Kingma and "<i>Auxiliary Deep Generative Models</i>" by Maaløe et. al.</li> <li>Studied the research papers: "<i>Infinite Variational autoencoder for Semi-supervised Learning</i>" by Ehsan et. al and "<i>Categorical Re-parameterization with Gumbel-Softmax</i>" by Eric et. al.</li> </ul>
MAR-APR 2019  <a href="#">report</a>	<p><b>UNSUPERVISED DOMAIN ADAPTATION FOR SEMANTIC SEGMENTATION</b>  <i>Course Project for Visual Recognition under Prof. Vinay P. Namboodiri</i></p> <ul style="list-style-type: none"> <li>Studied the research paper "<i>Learning to Adapt Structured Output Space for Semantic Segmentation.</i>"</li> <li>Improved the unsupervised semantic segmentation of IIT Kanpur Surveillance videos by adapting the domains in a progressive manner: from GTA V to Cityscapes, then to IITK dataset.</li> </ul>
FEB-MAR 2019  <a href="#">report</a>	<p><b>ATTENDING TO COARSE CLASS-BASED ACTIVATION FOR FINE-GRAINED CLASSIFICATION</b>  <i>Course Project for Visual Recognition under Prof. Vinay P. Namboodiri</i></p> <ul style="list-style-type: none"> <li>Developed end to end hierarchical model for predicting the fine classes using Soft masking by conditioning the fine class probabilities using the coarse class probabilities.</li> <li>Improved the fine grained classification by attending to the coarse class visual activation maps.</li> </ul>
OCT-NOV 2018  <a href="#">report</a>	<p><b>MINING AND PREDICTION OF CIVIC ISSUES FROM COMPLAINTS</b>  <i>Course Project for Data Mining under Prof. Arnab Bhattacharya</i></p> <ul style="list-style-type: none"> <li>Proposed a way to automate the process of assignment of complaints to specific authorities or engineers by predicting category of a civic issue using title, description, or image of complaints.</li> <li>Predicted civic issues from various methods like SVM, Random Forests, LSTM using the title.</li> </ul>
JAN-APR 2018  <a href="#">report</a>	<p><b>UNSUPERVISED MACHINE TRANSLATION USING STRUCTURED LATENT SPACE</b>  <i>Course Project for Natural Language Processing under Prof. Harish Karnick</i></p> <ul style="list-style-type: none"> <li>Implemented the research paper: "<i>Unsupervised Machine Translation using monolingual corpora only</i>"</li> <li>Proposed <b>graph convolutional networks (GCN)</b> based autoencoder that imposes structure into the latent space representation for languages with complex grammar rules.</li> </ul>
JAN-APR 2018  <a href="#">github</a>	<p><b>VISUAL MOTOR CONTROL OF ROBOTIC ARM</b>  <i>Course Project for Neural Network under Prof. Laxmidhar Behera</i></p> <ul style="list-style-type: none"> <li>Implemented neural network based <b>Single Network Adaptive Critic (SNAC)</b> and <b>Self-Organizing Maps (K-SOM)</b> for visual motor control of a robotic arm in TensorFlow.</li> </ul>
AUG-NOV 2017  <a href="#">report</a>	<p><b>BIDIRECTIONAL ATTENTION FLOW FOR MACHINE COMPREHENSION</b>  <i>Course Project for Machine Learning under Prof. Purushottam Kar</i></p> <ul style="list-style-type: none"> <li>Studied and implemented research paper: "<i>Bidirectional attention flow for machine comprehension</i>"</li> <li>Included grammatical structure in the word embeddings by using part-of-speech embedding.</li> </ul>

## OTHER PROJECTS

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- MAY-JUN 2017  
Project Supervisor Prof. Harish Karnick  
[github](#)
- RELATION CLASSIFICATION USING BIDIRECTIONAL LSTM TREE
- Developed a model to classify the relation between two given entities in a sentence.
  - Applied **Bidirectional tree structured LSTMs** on the shortest dependency path between a pair of entities in dependency tree for jointly representing both entities and relations.
- NOV-DEC 2016  
Project Supervisor Gaurav Agrawal, Assistant Secretary, Department of Agriculture, India  
[github](#)
- AUTOMATIC QUALITY ASSESSMENT OF WHEAT GRAIN
- Facilitated the process of automatic quality assessment of grains with impurity from images.
  - Created a dataset of different qualities of wheat grain images, captured from Anaj Mandi.
- NOV-DEC 2016  
Project Supervisor Prof. Vinay P. Namboodiri  
[github](#)
- KERNELIZED CORRELATION FILTER BASED OBJECT TRACKING
- Studied research paper: "High-Speed Tracking with Kernelized Correlation Filters" by Joao et. al.
  - Tried to improve KCF tracker by using the feature maps from pretrained VGG16 network.

## TRAVEL GRANT AWARDS

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- Received Conference Travel Grant from Microsoft Research India for attending CVPR 2019
- Received Conference Travel Grant from Indian National Academy of Engineering for attending CVPR 2019
- Received Conference Travel Grant from Microsoft Research India for attending WWW 2019

## CONFERENCES AND WORKSHOPS ATTENDED

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- Presented my work on *Discriminative Certainty based Attention* in a poster session at CVPR 2019 in Long Beach
- Presented my work on *Unsupervised Adaptation of Scene Graphs* in a poster session at WWW 2019 in San Francisco

## RELEVANT COURSEWORK

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Probabilistic Modeling & Inference	Probability & Statistics	Visual Recognition	Machine Learning
Natural Language Processing	Data Structure & Algorithm	Linear Algebra and ODE	Neural Network

## TECHNICAL SKILLS

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Programming Languages	Python, C, C++, Lua
Deep Learning Libraries	Torch, PyTorch, TensorFlow
Tools	NumPy, Scikit-learn, MATLAB, Django, $\text{\LaTeX}$ , Git

## HACKATHONS

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- 2017  
[github](#)
- QALEARN, Microsoft Code.Fun.Do.
- Developed a Web Application for **open-domain question answering** on ebooks using BiDAF model.
- 2016  
[github](#)
- AUTOMATED LIBRARY, Microsoft Code.Fun.Do.
- Developed a Web Application in Django to catalogue bibliographies and library members for Gymkhana library and Prayas (a student endeavour to teach marginalized kids).
- 2016  
[github](#)
- TRAVELEX, Google Devfest
- Developed an app for finding nearby hotels and restaurants by using Zomato and Expedia API.