

## Kumar Ayush

Member of Technical Staff  
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## Education

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| <b>Indian Institute of Technology Kharagpur, West Bengal, India</b><br>B.Tech(Hons.) in Computer Science and Engineering<br>CGPA: 9.49/10.0          | 2013 - 2017 |
| <b>Rajendra Vidyalaya, Jamshedpur, India</b><br>Indian School Certificate (ISC) - 12th Grade<br>Percentage score: 97.6%, <b>ranked 1st in school</b> | 2013        |
| <b>Rajendra Vidyalaya, Jamshedpur, India</b><br>Indian Certificate of Secondary Education (ICSE) - 10th Grade<br>Percentage score: 96.57%            | 2011        |

## Interests

My broad area of interest is machine learning/deep learning. In particular, I am interested in conglomerating deep learning representations with generative modeling and inference in generative models. In future, I wish to work on developing advanced AI technologies for real-world healthcare settings.

## Papers

- Kumar Ayush**, Raja Karamakar, Varun Rawal, Pradyumna K. Bishoyi, Samiran Chattopadhyay, Sandip Chakraborty. **“Supporting Throughput Fairness in IEEE 802.11ac Dynamic Bandwidth Channel Access: A Hybrid Approach”**. *42nd IEEE Conference on Local Computer Networks (LCN)*. 2017. (Accepted, regular paper)
- Gaurush Hiranandani, **Kumar Ayush**, Atanu Sinha, Sai Varun Reddy Maram, Chinnaobireddy Varsha, Pranav Maneriker. **“Enhanced Personalized Targeting using Augmented Reality”**. *16th IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*. 2017. (Accepted, poster)
- Avishek Lahiri, **Kumar Ayush**, Prabir Kumar, Pabitra Mitra. **“Generative Adversarial Learning for Reducing Manual Annotation in Semantic Segmentation on Large Scale Microscopy Images: Automated Vessel Segmentation in Retinal Fundus Image as Test Case”**. *Computer Vision for Microscopy Image Analysis (CVMI) Workshop - CVPR*. 2017. (Accepted, paper link).
- Srinivas S. S. Kruthiventi, **Kumar Ayush**, R. Venkatesh Babu. **“DeepFix: A Fully Convolutional Neural Network for predicting Human Eye Fixations”**. *IEEE Transactions on Image Processing*. 2017. (Accepted, paper link).
- Mayank Singh, Barnopriya Barua, Priyank Palod, Sidhartha Satapathy, Samuel Bushi, **Kumar Ayush**, Krishna Sai Rohith, Tulasi Gamidi, Pawan Goyal, Animesh Mukherjee. **“OCR++: A Robust Framework For Information Extraction from Scholarly Articles”**. *26th International Conference on Computational Linguistics (Coling)*. 2016. (Accepted, poster, paper link, framework link)

## Patents

- Kumar Ayush**, Chinnaobireddy Varsha, Sai Varun Maram Reddy, Gaurush Hiranandani. **“Creating Targeted Content based on Detected Characteristics of an Augmented Reality Scene.”** *US15/454,750*. (Filed)
- Sai Varun Maram Reddy, **Kumar Ayush**, Chinnaobireddy Varsha, Gaurush Hiranandani, Siddhant Jain. **“Product Recommendations Based on Augmented Reality Viewpoints.”** *US62/415,332*. (Filed in multiple countries)
- Chinnaobireddy Varsha, Sai Varun Maram Reddy, **Kumar Ayush**, Gaurush Hiranandani, Atanu R. Sinha. **“Identifying Augmented Reality Visuals Influencing User Behavior in Virtual-Commerce Environments.”** *US15/433,834*. (Filed)

## Internships

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| <b>Big Data Experience Lab, Adobe Research, Bangalore, India</b><br><b>Augmented Reality for Enterprise</b><br>Guide: Gaurush Hiranandani | Summer 2016 |
|---|-------------|

Worked on the development of an end-to-end system to create personalized catalogues for re-targeting with product recommendations embedded in the purchase viewpoint in v-Commerce environment. Designed a predictive model for identification of purchase viewpoint from a user's mobile app session. Built a system for creating personalized catalogues with relevant recommendations embedded in the viewpoint. A novel method for recommendation was designed which retrieves products based on style similarity and theme compatibility. Devised a graph based approach for automatic generation of personalized email content suitable for the catalogue. *Three patents* have been filed in the *US Patent and Trademark Office*. One of the patents was appreciated, by Adobe's Patent Review Committee, as an important technology and has been filed not only in USA but also in India and other countries of Europe. This work has been submitted to *International Symposium on Mixed and Augmented Reality (ISMAR) 2017*.

**Video Analytics Lab, Indian Institute of Science, Bangalore, India**

Summer 2015

**DeepFix: A Fully Convolutional NeuralNetwork for predicting Human Eye Fixations**

Advisor: Prof. R. Venkatesh Babu

Worked on the development of a fully convolutional neural network for accurate saliency prediction. DeepFix is designed to capture semantics at multiple scales while taking global context into account using network layers with very large receptive fields and also modeling location dependent patterns (e.g. centre-bias) by incorporating a novel Location Biased Convolutional layer. We evaluated the proposed method on multiple challenging datasets, and were able to outperform other recent methods by a huge margin. This work is under review in *IEEE Transactions on Image Processing*. Our model, DeepFix, won the *1st prize* in the *Saliency Prediction* task at *Large Scale Scene Understanding Challenge (LSUN) 2016*, organized by *Princeton University* in conjunction with *IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2016*.

**Video Analytics Lab, Indian Institute of Science, Bangalore, India**

Summer 2015

**Combining Class Conditioned Representations in CNN for Salient Object Segmentation**

Advisor: Prof. R. Venkatesh Babu

Worked on the development of a CNN framework followed by Dense Conditional Random Field (CRF) for Salient Object Segmentation. Proposed a deep fusion architecture which not only combines class-conditional representations but also introduces scale invariance by combining it via inception like module (inspired from GoogleNet). We evaluated our model on MSRA-1000 and CSSD datasets and were able to perform at par with state-of-the-art models.

## Academic Projects

**Bachelor's Thesis, Indian Institute of Technology Kharagpur, India**

Spring 2017

**Generative Adversarial Learning for Reducing Manual Annotation in Semantic Segmentation on Large Scale Microscopy Images**

Advisor: Prof. Pabitra Mitra

CNN based semantic segmentation require extensive pixel level manual annotation which is daunting for large microscopic images. The work is aimed towards mitigating this labeling effort by leveraging the recent concept of generative adversarial network(GAN) wherein a generator maps latent noise space to realistic images while a discriminator differentiates between samples drawn from database and generator. We extend this concept to a multi task learning wherein a discriminator-classifier network differentiates between fake/real examples and also assigns correct class labels.

**Indian Institute of Technology Kharagpur, India**

Autumn 2016

**Supporting Throughput Fairness in IEEE 802.11ac Dynamic Bandwidth Channel Access: A Hybrid Approach**

Advisor: Prof. Sandip Chakraborty

IEEE 802.11ac supports *Dynamic Bandwidth Channel Access (DBCA)*, where a wireless station selects channel bandwidth dynamically based on the availability of the secondary channels. But the widely-used contention based medium access mechanism provides an opportunistic access of secondary channels and affects the performance of DBCA. Consequently, unfairness in channel access is increased in DBCA, which further reduces average throughput of stations. In this work, we develop a hybrid adaptive resource reservation mechanism, *Hybrid Adaptive DBCA (HA-DBCA)*, for supporting fair channel access in DBCA. In HA-DBCA, a polling based online learning mechanism is designed to avoid starvation of primary channel users.

**Indian Institute of Technology Kharagpur, India**

Spring 2016

**Researcher Recommendation System**

Advisor: Prof. Pawan Goyal and Prof. Animesh Mukherjee

Developed a search and recommendation engine for Scientific Research Community, as a part of Term Project for the completion of Information Retrieval Course. Used beautiful soup and selenium in python to parse MAS to generate the data set for the project (1 lakh authors and their publications). Used clustering techniques to cluster similar authors based on their co-author graph to recommend new co-authors to an author. Used LDA to model topics from the keyword database of an author and recommended top 100 authors based on their rank (gained a 25% increase in recall). Further developed a full-fledged Scientific Search Engine.

**Indian Institute of Technology Kharagpur, India**

Autumn 2015

**OCR++: A Robust Framework For Information Extraction from Scholarly Articles**

Advisor: Prof. Pawan Goyal

An open-source framework designed for a variety of information extraction tasks from scholarly articles including metadata (title, author names, affiliation and e-mail), structure (section headings and body text, table and figure headings, URLs and footnotes) and bibliography (citation instances and references). Extensive evaluations were conducted on a test dataset to compare OCR++ and state-of-the-art systems which shows significant improvement in each of the retrieval tasks along with fast implementation speed-ups and batch processing functionality. Our work has been accepted for poster presentation at the *International Conference on Computational Linguistics (Coling) 2016*. The framework is accessible online at <http://www.cnergres.iitkgp.ac.in/OCR++/home/>

**Indian Institute of Technology Kharagpur, India**

Autumn 2015

**TinyC Compiler**

Advisor: Prof. Partha Pratim Das

Designed and implemented a compiler for a C-like language (a subset of C language), as a part of Term Project for the completion of Compilers Course.

## Other Projects

**Image Deblurring using Convolutional Neural Networks**, Machine Learning Term Project Autumn 2016

Implemented a deep convolutional neural network structure for image deconvolution. A series of convolution steps were used for approximating deconvolution. The system uses two modules corresponding to deconvolution and artifact removal.

**Course Management System**, Databases & Management Systems Term Project

Spring 2016

Developed a web based application for online course design, course calendar publishing, students registrations for self-paced learning, content administration, assignments, and assessments. Implemented using PHP, HTML5, CSS3, Bootstrap and MySQL. Features like mail, file transfer, chat forum, calendar, notifications and quizzes have also been implemented using MySQL as database.

**PlotEx**, Open Soft (inter-hostel tech competition), IIT Kharagpur

Spring 2016

Detecting graphs from scanned documents and producing the corresponding data tables for the graphs. Used OpenCV, open source libraries like tesseract to detect text from image and plotted data table from the information obtained. Was mainly involved in mentoring a team of sophomores for the event.

**Software Component Cataloguing Software**, Software Engineering Term Project

Spring 2015

A fully functional system, implemented as a JAVA Applet and GUI realised in JAVA Swing. The project involved designing and developing a complete GUI Software which maintains a catalogue of various available Software Components, and showcases all the details and information about each component, to allow their potential code reuse. Provided full documentation of the software including UML diagrams.

## Academic Honors and Awards

**Best Bachelor's Thesis Award**

2017

Received the Best Undergraduate Thesis Award in the graduating batch of the Department of Computer Science & Engineering.

**Gandhian Young Technological Innovation (GYTI) Award**

2017

Awarded for our work, OCR++, by SRISTI (Society for Research and Initiatives for Sustainable Technologies and Institutions). These awards are given every year during the Festival of Innovation (FOIN) at Rashtrapati Bhawan (Office of the President of India) in the month of March.

**IBM Day - System Demonstration Contest - Third Prize**

2016

Awarded for our work, OCR++, by a panel of delegates from IBM India, from a pool of 20 submissions.

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| <b>Large Scale Scene Understanding Challenge (LSUN) - Saliency Prediction Winner</b><br>Our saliency model, DeepFix, won the 1st prize in LSUN which was organized by Princeton University (in conjunction with IEEE Conference CVPR 2016).<br>Team VAL - <a href="http://lsun.cs.princeton.edu/2016/">http://lsun.cs.princeton.edu/2016/</a> | 2016 |
| <b>Best Term Project - Speech &amp; Natural Language Processing</b><br>Our work, OCR++, was felicitated as the best project from a pool of 30 projects by the course coordinator and Flipkart (an Indian e-commerce company). The award also included a grant of 1000\$.  | 2015 |
| <b>Indian Academy of Sciences - Summer Research Fellowship</b><br>for funding a summer internship at Indian Institute of Science, Bangalore, India.<br>Awarded jointly by Indian Academy of Sciences, Indian National Science Academy, and The National Academy of Sciences, India.   | 2015 |
| <b>Kamalavati Syngal and Goralal Syngal Memorial Scholarship</b><br>for academic excellence at IIT Kharagpur.   | 2014 |
| <b>Jagadish Bose National Science Talent Search (JBNSTS) Scholar</b><br>Awarded to 34 candidates in the state of West Bengal.   | 2013 |
| <b>Kishore Vaigyanik Protsahan Yojana (KVPY) Scholarship</b><br>by Dept. of Science and Technology, Govt. of India for exceptional aptitude in basic sciences.  | 2013 |
| <b>Abhay Seva Sansthan Gold Medal</b><br>Awarded for scoring 100% in Computer Science in ISC (12th grade) examination.  | 2013 |
| <b>S.P.Sinha Scholarship</b><br>Awarded full scholarship for 11th & 12th grade for outstanding performance in ICSE (10th grade) examination.  | 2011 |

## Technical Skills

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**Proficient:** C, C++, Python, Tensorflow, Numpy

**Familiar:** Matlab, Java, OpenCV, HTML, Javascript, Scikit-learn, Caffe, PHP, MySQL

## Relevant Coursework

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|   |                         |                                     |
|---|-------------------------|-------------------------------------|
| Probability & Statistics                  | Matrix Algebra          | Information Retrieval               |
| Speech & Natural Language Processing      | Algorithms I & II       | Discrete Structures                 |
| Formal Languages & Automata Theory        | Machine Learning        | Image Processing                    |
| Performance Modeling of Computer Networks | Artificial Intelligence | Theory of Computation               |
| Adv. Image Processing & Comp. Vision      | Deep Learning           | Principles of Programming Languages |

## Extra Curricular Activities

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| Student Academic Mentor under the Student Welfare Group (SWG) of IIT Kharagpur.<br>Mentoring a group of 5 freshmen to ease their transition into college life. | 2015 - 2017 |
| Member of the OpenSoft (inter-hostel tech competition) team of<br>Meghnad Saha Hall of Residence, IIT Kharagpur.   | 2016        |
| National Sports Organization (NSO)<br>Involved in Athletics as a part of NSO, IIT Kharagpur for two years.   | 2013 - 2015 |
| Won Medals in 100m & 200m sprints, and long-jump during school period.   |             |