Anupama Ray

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RESEARCH INTEREST

I am a Research Scientist at IBM India Research Labs, Bangalore, India, working in the department of AI for Interaction. I completed my PhD from Indian Institute of Technology Delhi, India. My doctoral research focused on developing and applying deep recurrent neural networks for document analysis and computer vision. At IBM, I have been working on building novel learning algorithms for information extraction, natural language understanding and text generation. I am also working on assessment of emotional intelligence cues and distress prediction through deep learning. I have interests in theory of deep learning and applying learning techniques towards societal applications.

RESEARCH EXPERIENCE

Research Scientist at IBM Research Labs, India **Jan 2017 -present**

- Successfully developed and deployed a Deep Parsing based Natural language Understanding module that extracts important attributes from unstructured text on Salesforce services platform leading to better query understanding and improved retrieval. (Best Deployed Paper Award AAAI 2020 and several awards in IBM)
- Lead and developed Automation solutions for different Technical support domains. These solutions (based on Machine learning and Robotic Process automation) aim to automate redundant work done by human agents saving time and costs. (OTAA and RDA awards at IBM)
- Worked on cognitive e-mail assignment problem, which involves construction and continuous learning of diagnostic classifiers to detect and handle concept drifts in email ticketing system for the IT-support domain. (Best Deployed Paper Award AAAI 2019)
- Working on Meta-learning using few-shot learning for depression prediction using Multimodal data (speech, text and video)
- Worked on interaction-based assessment of Emotional Intelligence cues from multimodal data. This work is piloted with an NGO working to improve caregiving to children rescued from trafficking where our intelligent models help in hiring of emotionally aware and intelligent counselors.

Research Associate at **Indian Institute of Technology, Delhi** **June 2012-June 2016**

Project Title: "*Development of Robust Document Analysis and Recognition System for Printed Indian Scripts*"

Sponsored by: Ministry of Communication and Information Technology, Government of India

- Successfully developed an end-to-end script independent (printed) OCR system for 4 Indian languages using LSTM networks.
- Tested across 5000 test pages of each script and achieved an accuracy of 90%+ (over each script)
- Software (submitted as a desktop version) has been tested on Linux. The entire OCR system is real time, allows batch processing of full books and has an interactive GUI which allows selection of several input preprocessing routines, editing and saving outputs.
- Implemented a post-processing module using suffix trees to list top 5 words for every incorrect word, which further increased the accuracy by 4%(average for 4 scripts)
- Implemented a text to braille converter to convert the OCR'ed text to Braille fonts.

EDUCATION

Indian Institute of Technology Delhi, India Jan 2013-Aug 2017

PhD

Deep Learning, Computer Vision

GPA : 8.2

National Institute of Technology, Rourkela 2010-2012
Master of Technology (Biomedical Engineering)
M.Tech Dissertation – *Study of the effect of stress on Heart Rate Variability (HRV) using Statistical machine learning*
GPA: 8.9

West Bengal University of Technology, Kolkata 2006-2010
Bachelor of Technology (B.Tech) in Electronics & Instrumentation Engineering
GPA: 8.3

AWARDS

1. Best paper award "**Deployed Paper Award**" at Conference of **Innovative Applications of Artificial Intelligence (AAAI 2020)**
2. I with my team of 2 undergraduate student interns **won the "Depression Detection Challenge" in AVEC Workshop in ACM Multimedia 2019.**
3. Recipient of "**Outstanding Technology Achievement Award**", IBM Research 2019 for my research innovations and contributions Watson-in-Support. This is the highest achievement for researchers in IBM Research.
4. Best paper award "**Deployed Case study award**" at Conference of Innovative Applications of Artificial Intelligence (**AAAI 2019**)
5. Recipient of "**Research Division Award**", IBM Research 2018 for my research innovations and contributions in QQI and Automation project.
6. Recipient of "**External and Eminence Cash prize award**", IBM 2018 for my contributions in leading the QQI and Automation project and its huge impact that led to 55m$ savings for IBM.

PUBLICATIONS

1. Anupama Ray, Pooja Aggarwal, Csaba Hadhazi, Gargi Dasgupta, Amit Paradkar (2019). "Question Quality Improvement: Deep Question Understanding for Incident Management in Technical Support Domain", IAAI **Best Deployed Paper Award** (AAAI 2020).
2. Anupama Ray, Siddharth Kumar, Rutvik Reddy, Prerana Mukherjee, Ritu Garg, "Multi-level attention network using text, audio and video for Depression Prediction", AVEC, ACM Multimedia 2019. (**Challenge Winner**)
3. Manoj Sharma, Anupama Ray, Avinash Upadhyay, Megh Makwana, Ajay Pratap Singh, Akkshita Trivedi, Santanu Chaudhury and Anil Saini, "An End-to-End trainable framework for joint optimization of document enhancement and recognition", IEEE, International Conference on Document Analysis and Recognition (ICDAR), 2019. (Core2018 rank-A)
4. A Mandal, N Malhotra, S Agarwal, A Ray, G Sridhara, "Improving IT Support by Enhancing Incident Management Process with Multi-modal Analysis", International Conference on Service-Oriented Computing (ICSOC) 2019.
5. Mandal, A., Malhotra, N., Agarwal, S., Ray, A. and Sridhara, G., 2018. "Automated dispatch of helpdesk email tickets: Pushing the limits with AI", IAAI **Best Deployed Paper Award**, Association for the Advancement of Artificial Intelligence (AAAI 2019).
6. A. Ray, P. Agarwal, C. K. Maurya and G. B. Dasgupta, "Creative tagline generation framework for product advertisement," in *IBM Journal of Research and Development*, vol. 63, no. 1, pp. 6:1-6:10, Jan.-Feb. 2019.
7. A Mandal, N Malhotra, S Agarwal, A Ray, G Sridhara, "Cognitive system to achieve human-level accuracy in automated assignment of helpdesk email tickets", International Conference on Service-Oriented Computing (ICSOC) 2018, pp. 332-341

8. Mohapatra P, Ray A, Dasgupta G, “FuTSe: A Fuzzy Taxonomy Service to Facilitate Product Search”, in Proceedings of ACM India Joint International Conference on Data Science & Management of Data, (CODS-COMAD), 2018.
9. Sharma M, Ray, A., Chaudhury, S. Lall B, “A Noise-Resilient Super-Resolution framework to boost OCR performance”, International Conference on Document Analysis and Recognition (ICDAR), 2017. (Core2018 rank-A)
10. Ray, A.; Chaudhury, S., “Recognition based Text Localization from Natural Scene Images” in Proceedings of the IEEE, International Conference on Pattern Recognition (ICPR2016), 2016. **(Best paper Award)**
11. Ray, A.; Chaudhury, S., “Character Recognition using SVM-HMM in a Multi-hypotheses architecture” in Proceedings of the 2016, 12th IAPR International Workshop on Document Analysis Systems (DAS 2016) (Core2018 rank-B)
12. Ray, A.; Rajeswar, S.; Chaudhury, S., “A hypothesize-and-verify framework for Text Recognition using Deep Recurrent Neural Networks,” in Proceedings of the 2015, 13th International Conference Document Analysis and Recognition (ICDAR 2015) (Core2018 rank-A)
13. Ray, A.; Rajeswar, S.; Chaudhury, S., “OCR for bilingual documents using Language modeling,” at MOCR, 13th International Conference Document Analysis and Recognition (ICDAR 2015) (Core2018 rank-A)
14. Anupama Ray, “Sequence labeling of Image Based Patterns”, Doctoral Consortium, 13th International Conference Document Analysis and Recognition (ICDAR 2015) (Core2018 rank-A)
15. Ray, A.; Rajeswar, S.; Chaudhury, S., “Text recognition using deep BLSTM networks”, International Conference on Advances in Pattern Recognition (ICAPR), 2015
16. Ray, A.; Rajeswar, S.; Chaudhury, S., “Scene Text Recognition using Deep Belief Networks,” in Proceedings of the Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP),2014
17. Ray, A.; Chandawala, A.; Chaudhury, S., “Character Recognition Using Conditional Random Field Based Recognition Engine,” International Conference on Document Analysis and Recognition (ICDAR), 2013. (Core2018 rank-A)
18. A Ray, SK Nayak, B Champaty, DN Tibarewala, P Kunal, “Non-Linear Analysis of Heart Rate Variability and ECG Signal Features of Swimmers from NIT-Rourkela: A Case Study”, In Book-Computational Tools and Techniques for Biomedical Signal Processing, Chapter: 3, Publisher: IGI Global, pp. 56-75, 2017

THESIS MENTOR

1. Mentored a Ph.D student at IIIT Bangalore, India (summer intern) on “Multimodal Analysis of Speaker Characteristics for Automatic Ranking of Candidates in Job Interviews”.

2. Mentoring 5 B.Tech students from IIIT Sricity, India for their Bachelor’s Research Project in the areas of Affective computing, behavior prediction and Road Condition prediction..

3. Continued efforts in mentoring 3 students from CSIR-CEERI India leading to two publications in ICDAR 2017, and 2019 respectively on Joint learning of Image Super-resolution and recognition.

4. M.Tech (Graduate) Thesis titled “Text Detection and Recognition in Scene Images”, 2016 leading to a paper in ICPR 2016.

5. M.Tech (Graduate) Thesis titled “Text and Object Segmentation using Deep Learning”, 2016

6. M.Tech (Graduate) Thesis titled “Text Recognition using Deep Learning Methodologies”, 2015 leading to 3 publications in leading conferences for Document Analysis and recognition (ICDAR, and DAS)

Mentored the student on Printed and handwritten text recognition using LSTM networks, scene text recognition using Convolutional Neural Networks and Stacked Denoising Autoencoders.

7. B.Tech (Undergraduate) Thesis titled “Optical Character Recognition of Indian Scripts”, 2013

Mentored the student on Printed Text recognition using Conditional Random Fields and structured Support Vector Machine leading to a paper in ICDAR 2013.

EXTERNAL EMINENCE

- Nominated and Selected as Young Scientist at **Global Young Scientist Summit 2018**, which is a multi-disciplinary summit with globally recognized scientific leaders as speakers, who are recipients of the Nobel Prize, Fields Medal, Millennium Technology Prize, and Turing Award. This summit gives participants an opportunity to take part in lectures, plenary sessions, panel discussions and interact with speakers in informal small group sessions. Beyond these sessions as participants, we got to visit other universities, research centers and Government agencies to learn more about Singapore's local research and innovation ecosystem.
- Collaborated with IBM university relations team and participated in several Faculty development Programme by taking short courses and helping in course curriculum structuring across different institutions in India.
- Organized several workshops at different premier institutes in India, where I have delivered talks and hands-on sessions on Deep learning and its applications in Document Analysis, Computer vision, Natural language Processing and Generation.
- Taught a 5 day course on "Deep Learning and Applications" for a Faculty development programme that had faculty and PhD students as participants from 30+ engineering colleges across India.
- Co-organized Opensession in International Conference of Information and Communication Technologies and Development (ICTD 2019) and delivered talk on "Child trafficking in India: How can technology help?".

TEACHING ASSISTANTSHIP

- Digital Image Processing (2013 fall EEL780)
- Pattern Recognition (2014 spring EEL709)

COURSEWORK

- Pattern Recognition (EEL709)
- Computer Vision (EEL-806)
- Digital Image Processing (EEL-780)
- Soft Computing (EEL-805)

PROGRAMMING LANGUAGES

Python, Tensorflow, pytorch, Shell Scripting, C++

References

1. Prof. Santanu Chaudhury, Director, IIT Jodhpur. Professor, Department of Electrical Engineering, IIT Delhi Email: schaudhury@gmail.com
2. Dr. Amar Prakash Azad, Senior Researcher, IBM Research India Email: amarazad@in.ibm.com
3. Dr. Sumantra Dutta Roy, Professor, Department of Electrical Engineering, IIT Delhi
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