

Abhinav JAIN

Research Engineer

jabhinav.netlify.app/

+91 951 918 9181 @ User ID: jabhinaviitk@gmail.com

Delhi, India

PROFESSIONAL EXPERIENCE

JUL 2020 JUL 2019	RESEARCHER IBM RESEARCH LABS, INDIA AI FOR DATA SCIENCE <i>Project Manager</i> : HIMA PATEL <i>Description</i> : Assess the quality of data using intelligently designed quality metrics and provide insights on fixing the issues to data scientists for improving the performance of Machine Learning models. It included detecting issues such as bias from multiple but synonymous values of categorical variables, redundant features etc. Services provided as part of IBM's Data Readiness Toolkit . <ul style="list-style-type: none">> Developed a Feature Selection framework that utilises Mutual Information to determine features' relevancy and redundancy in predicting the target variable.> Developed Data Transformation system to programmatically transform data into user-intended homogeneous formats. The system learns a transformation routine from few input-output example pairs showcasing the required string transformation task.> Designed and tested hand-engineered symbolic system and neural-guided statistical systems for synthesizing transformation programs on Flash-Fill dataset. <p>Program Synthesis for Data Transformation Feature Selection Automated AI PyTorch</p>
JUL 2019 JUL 2017	RESEARCH ENGINEER IBM RESEARCH LABS, INDIA PDF DATA EXTRACTION AND REPRESENTATION, WATSON COMPARE & COMPLY <i>Project Manager</i> : DR. SAMEEP MEHTA, DR. ARUN KUMAR <i>Description</i> : For reliable structured data extraction from scanned PDF documents, provided following added functionalities to the existing Watson service for PDF conversion : <ul style="list-style-type: none">> Deep Learning based Page Segmentation using U-Net to extract text lines.> Multi-lingual support for data extraction when language of the text is changed.> Hybrid PDF support for data extraction when documents contain scanned and programmatic content.> Framework for detecting logos, bar-codes and signatures using connected component analysis.> Framework for extraction of Tables, PDF Headers using Object Detection algorithm RetinaNet (Link).> Quality improvement of low resolution document images (72-100 DPI) using SuperResolution techniques like SRCNN, ESPCNN, EDSR, LapSRN and SRGAN. <p>Text Image Processing Tesseract Gradle OpenCV Java</p>
AUG 2016 MAY 2016	INTERN IBM RESEARCH LABS, INDIA COHERENT VISUAL DESCRIPTION OF TEXTUAL INSTRUCTIONS <i>Project Manager</i> : DR. SAMEEP MEHTA <i>Description</i> : Developed a multi-stage framework to provide visual aid for a sequence of text-based instructions in the form of coherent images for better comprehension of the text. <ul style="list-style-type: none">> Mined visualisable phrases consisting of head action verbs and noun phrases for each instruction using standard practices like POS tagging, Dependency parsing and Co-reference resolution.> Retrieved a set of images for each visualisable phrase from sources such as WikiHow, Flickr.> Maintained coherency across instructions sharing common information in the form of latent/non-latent entities using a graph based matching method utilising Dijkstra's algorithm.> Conducted a user study to validate improvement in understanding of text instructions when phrases and images together dictate the action being conducted in the instruction. <p>github.com/jabhinav/Coherent-Visual-Description-of-Textual-Instructions</p> <p>textToImage Content Mining Graph Matching Convolutional Neural Networks Python</p>

REINFORCEMENT LEARNING FOR NEURAL-GUIDED PROGRAM SYNTHESIS

2020

Under Submission

Objective : Generate specification-satisfying programs that correctly transform input examples into corresponding output.

- Demonstrated how expressiveness and conciseness of underlying Domain Specific Language affects the generalization performance of program decoders and how we can scale to solve complex transformation tasks using reinforcement learning.
- Proposed framework rewards all partial program traces that are semantically and syntactically correct to address program aliasing and use execution-guidance to address training-testing objective mismatch.
- Proposed an evaluation scheme to test generalization performance on transformation tasks that require program syntactics and semantics unseen during training time.

Deep Learning for Program Synthesis Deep Reinforcement Learning Encoder-Decoder Seq-2-Seq Model PyTorch

VIDEO REPRESENTATION LEARNING FOR FINE-GRAINED SCENE RECOGNITION AND RETRIEVAL

2018-19

github.com/jabhinav/Deep-Video-Understanding

Objective : Recognise critical scenes of a video that raise user anxiety and are finely embedded in some parent activity.

- Posed the problem as ‘relative similarity learning problem’ to distinguish activities finely embedded in the video from remainder of the temporally overlapping events [3].
- Designed a **4-input Siamese Network** with CNN+LSTM architecture as backbone to learn video representations.
- Formulated similarity learning loss to better learn the margin between finer categories of classes in embedding space [4].
- Achieved F1 of **63.15%** in Critical Clip Recognition and F1 of **88%** in shot-boundary detection.
- Demonstrated the effectiveness of the loss in learning a deep metric for measuring similarities by showing an improvement of **10%** in Quadlet Precision and **5%** in NDCG over state-of-the-art baselines in the task of fine-grained video retrieval.

Similarity Learning Event Recognition Content Based Retrieval or Ranking Shot Boundary Detection CNN-LSTM Siamese Nets Loss Formulation

DEEP LEARNING FOR DOCUMENT IMAGE QUALITY ENHANCEMENT

2017-19

github.com/jabhinav/Super-Resolving-Documents

Objective : Extract text from low-quality scanned document images with high token fidelity.

- Formulated a novel **Text Quality Improvement Loss** for the standard Super-Resolution Convolutional Neural Network (SRCNN) that simultaneously optimises perceptual quality of the image and the OCR performance of Tesseract.
- Proposed framework identifies text regions from document images and minimizes localised Mean-Squared Error to improve quality of areas occupied by text while reconstructing the overall image.

SRCNN for SuperResolution Loss Formulation OCR Boosting UNLV Documents Dataset Caffe

TEXT ENRICHMENT

2017-18

github.com/jabhinav/EducationEnrichment

Objective : In the absence of domain knowledge, help the readers avail a complete semantic understanding of formal texts such as journal articles composed of complex terminologies intended to be understood by targeted demographic.

- Proposed an **enrichment system** [2] that mitigates the problem of searching for required information through heaps of sources and augments given text with required concept definitions, applications and concept dependency graphs.
- Identified key-concepts via a sequence of filtering stages - Linguistic Filtering, domain-specific pruning (BBC, StackExchange).
- Identified missing information for a concept based on user discretion by classifying associated text into its definition, application using a CNN-LSTM network with F1 score of **92.83%** and **85.31%** respectively.

NLP AI for Education Text Classification Information Extraction Dependency Parsing CNN-LSTM Network Keras

EVOLVING AI

2017-18

github.com/jabhinav/Model-Learning

Objective : Train a pre-trained image classification model for a new class with limited training data (‘n’ to ‘n+1’ class learning).

- Formulated the concept of **Deep Part Embeddings** [5] which are sub-networks of neuron activation extracted from a trained network identifying a visual and distinguishable element of a class.
- Designed a framework that identifies visual elements intuitively constituting the new class and extracts the corresponding DPEs from the network pre-trained for the classes sharing the identified elements.
- Studied and produced results for DPE integration under two configurations : (i) sequential, when DPEs are sourced from different CNN architectures and (ii) shared; when DPEs are sourced from the same CNN architecture.
- Achieved **superior performance** and **faster convergence** with fewer training samples per class (25, 50) on the subset of Caltech dataset against simple fine-tuning and end-to-end training of the network.

Few-shot learning Transfer Learning Deep Part Embeddings CNN Visualisation CNN Activation Filtering

SKILLS

Programming Languages	Python (<i>Proficient</i>), Java, C++, HTML, CSS
Deep Learning Frameworks	PyTorch (<i>Proficient</i>), Keras (<i>Intermediate</i>), Caffe (<i>Intermediate</i>)
Python Libraries	Numpy, AllenNLP, OpenCV
Development Platforms	PyCharm (<i>Proficient</i>), IntelliJ Idea, Eclipse
Operating Systems	Mac OS, Windows, Linux Ubuntu

AWARDS AND ACHIEVEMENTS

2019	RDA, IBM RESEARCH LABS IBM's Research Division Award (RDA) for "Document Conversion and Table Understanding"
2019	CERTIFICATE OF APPRECIATION, IBM RESEARCH LABS Certificate was issued in honour of my contributions to IBM Watson Compare & Comply project which led to significant business and research impact
2016	BEST POSTER AWARD, IBM RESEARCH LABS Achieved recognition for the best project presentation
2014-15	ACADEMIC EXCELLENCE Awarded for exceptional performance in academics at I.I.T Kanpur
2013	JOINT ENTRANCE EXAMINATION Secured All India Rank 655 (amongst 150,000 students) in JEE-Advanced 2013
2012-13	BEST ALL ROUNDER AWARD Awarded Student of the year in the senior year of high school for all-round excellence

PUBLICATIONS, DEMOS AND TUTORIALS

DEC'17	[1] S Mujumdar, N Gupta, A Jain , S Mehta, "Coherent Visual Description of Textual Instructions," in <i>IEEE International Symposium on Multimedia (ISM)</i> .
AUG'18	[2] A Jain , N Gupta, S Mujumdar, S Mehta, R Madhok, "Content Driven Enrichment of Formal Text using Concept Definitions and Applications," in <i>Proceedings of the 29th on Hypertext and Social Media (HT)</i> .
AUG'18	[3] N Gupta, A Jain , P Agarwal, S Mujumdar, S Mehta, "Pentuplet Loss for Simultaneous Shots and Critical Points Detection in a Video," in <i>International Conference on Pattern Recognition (ICPR)</i> .
APR'19	[4] A Jain , P Agarwal, S Mujumdar, N Gupta, S Mehta, C Chattopadhyay, "Radial Loss for Learning Fine-grained Video Similarity Metric," in <i>IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)</i> .
APR'19	[5] N Gupta, S Mujumdar, P Agarwal, A Jain , S Mehta, "Learning Convolutional Neural Networks with Deep Part Embeddings," in <i>IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)</i> .
SEP'19	[6] S Mujumdar, N Gupta, A Jain , D. Burdick, "Simultaneous Optimisation of Image Quality Improvement and Text Content Extraction from Scanned Documents," in <i>IEEE International Conference on Document Analysis and Recognition (ICDAR)</i> .
JUN'20	[7] Contributor, Demo on Data Quality Assessment and Improvement, ACM SIGMOD 2020
AUG'20	[8] Tutor, Tutorial on Overview and Importance of Data Quality for Machine Learning Tasks, KDD 2020
	[9] Paper on Multi-Stage Framework to Boost OCR performance on Low Quality Document Images (Manuscript submitted for publication)
	[10] Paper on Programming-by-Example for Data Transformation using Reinforcement Learning (Manuscript submitted for publication)

- 2018 | **System and Method to Generate Dynamic Personalized Infographics (Under Review)**
A system is proposed to automatically generate info-graphics from floating social media trends, personalised to user interests with the help of unstructured data available across different online platforms like Facebook, Twitter, News etc. The generated info-graphics are personalized by specifying the visual and non-visual elements specific to the user such as sketch or caricature view for the former and personalisation elements such as viewer age-group, emotions, sentiment, sarcasm etc. for the latter.

 EDUCATION

- JUN 2017 | **INDIAN INSTITUTE OF TECHNOLOGY, KANPUR, INDIA**
JUL 2013 | BACHELOR OF TECHNOLOGY (B.TECH) IN ELECTRICAL ENGINEERING
Cumulative Performance Index, CPI : **9.0/10.0**
- APR 2013 | **JAWAHARLAL NEHRU SCHOOL, BHOPAL, INDIA**
APR 2012 | ALL INDIA SENIOR SCHOOL CERTIFICATE EXAMINATION, AISSCE, CLASS XII
Percentage : **91.8%**

 ACADEMIC PROJECTS

- Nov'16 | **TOPIC MODELLING**
Aug'16 | *Supervisor* : Dr. Gaurav Pandey, Dr. Piyush Rai, I.I.T KANPUR
Course : UNDER-GRADUATE PROJECT
- > Used Topic Modeling to discover underlying latent themes (topics, meta-topics) of Newsgroup Corpora.
 - > Analysed algorithms - Poisson Factor analysis (PFA), PFA with Sigmoid Belief Networks, Deep PFA (DPFA) and Discriminative-DPFA based on their formulation, underlying assumptions, performance on document label classification.
- Topic Modelling | Document classification | Gibbs Sampling | Probabilistic Machine Learning
- Jul'15 | **VISION BASED SURVEILLANCE AND TRACKING SYSTEM FOR UAVS**
May'15 | *Supervisor* : Dr. N.K. Verma, I.I.T KANPUR
Course : SUMMER PROJECT
- > Implemented object tracking algorithms like Optical Flow Approach, Background Subtraction, Interest Point Tracking and Real-Time Compressive Tracking.
 - > Extensive real-time testing and comparison of the algorithms' robustness against the following factors - pose variation, illumination, occlusion, and motion blur.
 - > Integrated the best performing, Real-Time Compressive Tracking with UAVs for live demonstration.
- Unsupervised Algorithms | Object Recognition and Tracking | Computer Vision
- Dec'16 | **BAYESIAN OPTIMIZATION FOR HYPER-PARAMETER TUNING**
Aug'16 | *Supervisor* : Dr. Purushottam Kar, I.I.T KANPUR
Course : OPTIMIZATION TECHNIQUES
- > Studied Gaussian Process and Deep Network based Bayesian Optimization frameworks.
 - > Demonstrated improvements offered during hyper-parameter tuning by Bayesian optimization over random selection and grid-search in the task of MNIST digit classification using sparse auto-encoders.
- Gaussian Process | DNGO | Spearmint | Bayesian Optimisation | Matlab | Python
- Apr '16 | **GESTURE RECOGNITION USING HIDDEN MARKOV MODEL**
Jan '16 | *Supervisor* : Dr. Piyush Rai, I.I.T KANPUR
Course : PROBABILISTIC MACHINE LEARNING
- Performance analysis of dynamic models such as Hidden Markov Model, Dynamic Time Warping and static models such as SVMs, Naive Bayes Classifiers in the task of temporal gesture classification.
- Gesture Recognition | Python

ONLINE COURSEWORK

Deep Reinforcement Learning*
Self-Driving Cars Specialization*
Introduction to Program Synthesis*
Probabilistic Graphical Models Specialization*

COMPLETED COURSEWORK - IIT KANPUR

Data Structures and Algorithms	Signals, Systems & Networks
Probabilistic Machine Learning	Probability and Statistics
Introduction to Stochastic Processes	Image Processing
Partial Differential Equation	Visual Recognition
Online Learning and Optimization	Linear Algebra

EXTRA-CURRICULAR ACTIVITIES - I.I.T KANPUR

2015	Event Coordinator, Antaragni Leadership Initiative(ALI)
2013-14	Runner-Up, Football Freshers Inferno
2014-15	Secretary, Fine Arts Club
2013-15	Member, Formula SAE

OUTREACH AND VOLUNTEERING

2020	CERTIFICATE OF APPRECIATION Certificate awarded for assisting Bharat Scouts and Guides, M.P during Covid-19 pandemic in distributing food to underprivileged families across my hometown
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