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Computer Science & Engineering
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Specialization: Computer Science and Engineering

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M.Tech.
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Examination	University	Institute	Year	CPI / %
Post Graduation	IIT Bombay	IIT Bombay	2020	8.13
Undergraduate Specialization : Computer Science and Engineering				
Graduation	Dr. A.P.J. Abdul Kalam Technical University	Kamla Nehru Institute of Technology, Sultanpur	2016	84.02
Intermediate/+2	CBSE	Kendriya Vidyalaya AFS Gorakhpur	2011	83.40
Matriculation	CBSE	Kendriya Vidyalaya AFS Gorakhpur	2009	90.80

FIELDS OF INTEREST

- Machine Learning, Deep Learning, Natural Language Processing, Computer Vision, Reinforcement Learning

M.TECH THESIS AND SEMINAR

- **Explainable Artificial Intelligence** (M.Tech Project)
Guide: Prof. Pushpak Bhattacharyya | Industry Collaborator: IBM (May'19 - Present)
 - **Product Objective** : To develop an explainability framework which takes a trained deep learning model as input and interprets it with **state-of-the-art methods** like **Integrated Gradients** and **LIME algorithm**. This framework will be distributed as a python package, which can be used either as a **command-line tool** or as a **web service**.
 - **Research Objective** : To develop a model to capture **causal relationships** in natural languages, and differentiate between **causal and correlated factors** using knowledge graphs and deep learning techniques.
- **Explainable Artificial Intelligence** (M.Tech Seminar)
Guide: Prof. Pushpak Bhattacharyya | Industry Collaborator: IBM (Spring'19)
 - **Objective** : Conducted extensive research literature survey of explainability of deep neural networks: Need, Scope, Challenges and state-of-the-art methods.
 - Involved comprehensive study of explainability of deep neural network representation, output and algorithms for explainability: Sensitivity Analysis, Layer-wise Relevance Propagation, LIME, Integrated Gradients, Influence Functions, Sanity Checks for Saliency maps, Attention mechanism, Semantically Equivalent Rules.

RnD AND MAJOR PROJECT

- **Deep Learning for Deep Semantics**
Guide: Prof. Pushpak Bhattacharyya (R&D Project, Jan'18-May'18)
 - **Objective**: To explore deep learning methods for Natural Language Generation using Universal Networking Language(UNL).
 - Implemented a **sequence to sequence network** with attention on the custom prepared dataset using both **random embeddings**(network self-learned the embeddings) and **pre-trained GloVe embeddings**.
 - Achieved **BLEU Score for UNL to English: 0.766923**. Achieved BLEU Score for **UNL to French: 0.602187**.
 - Developed a Web tool with UNL as input and outputs top 10 predicted sentences using **beam search**.
- **International Aerial Robotics Competition**
Innovation Cell (UMIC), IIT Bombay (Aug'17 - present)
 - **Objective**: To design four autonomous drones (gesture and audio controlled) as part of longest-running university-based robotics competition in the world organized by the **AUVSI** foundation.
 - My role has been to apply machine learning/deep learning for various tasks:
 - * **Object Detection**: To detect Letters on boxes, enemy quadcopters, human player: Implemented, Trained, and Tested various CNN architectures (i.e. YOLOv2/v3, RetinaNet) on custom prepared datasets.
 - * **Audio Command Recognition**: Trained and Tested various deep learning models (i.e RNN-based, Deep-Speech).
 - * **Quadcopter Control**: Explored Reinforcement Learning Approaches for quadcopter controls.
 - * **Neural Network Compression**: Performed Experiments for compressing the size of deep learning models without significant compromise in the performance.

KEY COURSE PROJECTS

- **Drone Surveillance** (Science of Information Statistics And Learning, Advisor: **Prof. Manoj G.**, Spring'19)
 - **Objective**: To build a deep learning model for pedestrian detection from an aerial view and investigate model compression for efficient deployment of the model on a quadcopter.
 - **Implemented RetinaNet** architecture in TensorFlow using Stanford Drone Dataset. Achieved **F1 score of .7862**.
 - **Collaboration with FlytBase**: provides **Enterprise Drone Automation Platform** for clients in the US and Europe.

- **Neural Network Compression** *(Computer Vision, Advisor: Prof. Arjun Jain, Spring'19)*
 - **Objective:** To explore ways to compress deep neural networks, so that the state of the art performance can be achieved over a resource-constrained devices eg. embedded devices.
 - **Implemented compression approaches** inspired by the papers: **SqueezeNet** and **Deep Compression**.
 - **Datasets:** CIFAR10, MNIST-60000. **Models compressed:** LetNet-300-10 , LeNet-5 and VGGNet.
- **RL agent to play FIFA 14** *(Foundations of Intelligent and Learning Agents, Advisor: Prof. Shivaram K., Autumn'18)*
 - **Objective:** To demonstrate the performance of a reinforcement learning agent on FIFA 14 skill games such as dribbling, passing and improve the baseline score by at least 10%.
 - **Implemented epsilon-greedy, deep Q-Learning.** Player, and Score extraction using **YOLO, MobileNet**.
 - Demonstrated the effectiveness of reinforcement learning in playing adversarial games.
- **Semantic Image Segmentation** *(Fundamentals of Digital Image Processing, Advisor: Prof. Ajit Rajwade, Autumn'18)*
 - **Objective:** To address the problem of semantic segmentation using U-Net(deep learning approach) and contrast it with traditional image processing approaches.
 - **Datasets:** ISBI Challenge 2012 Dataset, Kaggle Carvana Challenge, Open Street Dataset.
 - **Implemented the U-Net architecture** using TensorFlow and showed the results across above mentioned datasets.
- **Music Composition using GANs** *(Advanced Machine Learning, Advisor: Prof. Sunita Sarawagi, Spring'18)*
 - **Objective:** To compose music using generative models based on learned expertise in training.
 - **Implemented RNN, LSTM-GAN** using TensorFlow.
- **Diabetic Retinopathy** *(Foundations of Machine Learning, Advisor: Prof. Ganesh R., Autumn'17)*
 - **Objective:** To classify retinal images according to various degree of the disease.
 - Created dictionary using **bag of visual words** as feature.
 - **Implemented** various approaches: **SVM, Random forest, Logistic Regression.** **F1 score** achieved: **.70** using SVM.

WORK EXPERIENCE

- **Research Assistant** *(Computer Center, IIT Bombay, Jul'17 - Present)*
 - Developed a **new email infrastructure** for IIT Bombay, serving **35000 email accounts**.
 - Implemented python modules for **log analysis, automated email reply, filters** and **signature migration** from old email infrastructure to new email infrastructure.
 - Created training modules (Bash/Python Scripting, Log Analysis, Server Configuration) for incoming batch of Research Assistants of Computer Center for smooth work transition.
 - **Machine Learning based spam classification system** (ongoing): Objective: To upgrade the heuristics-based spam classification system to Machine learning-based system trained on **encrypted email data**.

POSITION OF RESPONSIBILITY

- **ML-Lead for IARC Team** *(IIT Bombay, Aug'17 - Present)*
 - **Lead ML Sub-system** of 4 members to extensively study and **implement deep learning-based pipeline:** data collection, data pre-processing, deep learning models to solve tasks (related to Object Detection, Audio command recognition, and Quadcopter Control), validation, testing and integration of the models with rest of the system.
 - **Mentored 5 Undergraduates** from four different departments i.e., EE, Mech, Aero, Chem for Applied Machine learning, and Deep learning, for smooth work transition.
 - Conducted **hands-on workshop** (6 hours) on **Git: Basics + Advanced**, to fine-tune the development workflow for the IARC team of 20 members.
- **Student Companion - ISCP** *(IIT Bombay, July'18 - May'19)*
 - Worked in a team of **177 members** to organize Institute Orientation, Course Registrations, lab visits and Interactive sessions for **1673 students** and Parent Orientation for **400+ parents**.
 - **Mentored 6 students** for the whole year, helping them on academic and non-academic fronts.

TECHNICAL SKILLS

- **Programming Languages:** Python 3, C, C++, Core Java, JavaScript, PHP, Bash
- **Frameworks & Platform:** PyTorch, TensorFlow, Keras, SciPy, Scikit-Learn, Git, AWS, Linux

KEY COURSES TAKEN

Machine Learning, Advanced Machine Learning, Computer Vision, Digital Image Processing, Science of Information Statistics and Learning, Learning Agents, Network Security and Cryptography, Software Architecture

ACHIEVEMENTS AND EXTRA-CURRICULARS

- Won **Best Presentation Award** at the **International Aerial Robotics Competition, Beijing, China.** (2018)
- Recipient of **Secure and Private AI Challenge Scholarship** by Udacity and Facebook AI. (2019)
- Secured **98.30 percentile** in GATE. (2017)
- Organizing committee member for MHRD's **Smart India Hackathon Finale.** (2019)
- **Lead** FoundationAI : amongst 11 teams to be selected for **I-NCUBATE program** by GDC, IIT Madras. (2019)