Pankaj Singh | **183079036**
Electrical Engineering | **M.Tech.**
Indian Institute of Technology, Bombay | **Gender: Male**
Specialization: Communications Engineering | **DOB: 04-05-1994**

Examination	University	Institute	Year	CPI / %
Post Graduation	IIT Bombay	IIT Bombay	2021	8.81
Graduation	GBPUAT, Pantnagar	College of Technology	2017	77.85%
Graduation Specialization: Electronics and Communication Engineering				

AREAS OF INTEREST

Deep Learning, Machine Learning, Natural Language Processing, Computer Vision, Information Retrieval

SCHOLASTIC ACHIEVEMENTS

- Completed **Deep Learning Specialization**: Series of **5** courses on Coursera | Instructor: Andrew Ng (*2020*)
- Among the **top 5** performers of IIT Bombay Machine Learning course in a class of **184** students (*2019*)
- **Winner** of a week-long **hackathon** organized by **Medical Deep Learning and AI Lab**, IIT Bombay (*2019*)
- Member of runner up team in **Intel Python Hackfury2** with **5193** registration from all over India and awarded **Rs.100,000** worth of Intel product licenses and **Rs.100,000** in cash prize (*2019*)
- Awarded **certificate of merit** from CBSE for outstanding performance in 10^{th} board examinations (*2010*)

PUBLICATION

- **HASOC: Assisting Ensemble of Transformers with Random Transliteration** (*Jun'20 - present*)
  Authors: *Pankaj Singh, Pushpak Bhattacharyya*
  Work accepted in Dravidian-CodeMix, Forum for Information Retrieval Evaluation (FIRE) 2020
  - **Objective:** Detecting Hate Speech and Offensive Content on social media for code-mixed Dravidian languages
  - Proposed a **novel** training strategy to train **multilingual BERT** on **code-mixed** data which involved data augmentation by random transliteration and improved performance of the overall system by **9%**
  - Achieved an **F1 score** of **0.94** on Youtube comments and Twitter data using ensemble of transformers

RESEARCH PROJECTS

- **Master's Thesis | Multilingual Search Query Understanding** (*Jun'20 - present*)
  Guide: *Prof. Pushpak Bhattacharyya, Computer Science and Engineering, IIT Bombay*
  Objective: To build a complete Indian language **query understanding pipeline** for improving the performance of search engines in the **Indian search engine market**
  Completed Work:
  - Curated a dataset having **100k** code/script mixed queries of Entertainment News domain (Hindi-India market)
  - Built a **transformer** based multilingual **domain classifier** for above dataset and achieved an F1 score of **0.98**

  Ongoing and Future Work:
  - Creation of **intent taxonomy** for Entertainment News domain to assist query intent identification system
  - Development of domain specific multilingual **query intent identification** and **entity extraction system**
  - **Extending** the above system to Marathi, Bengali, Tamil and Telugu, and **integrating** with search engines
- **R&D Project | Multilingual Query Intent Detection System** (*Jan'20 - Jun'20*)
  Guide: *Prof. Pushpak Bhattacharyya, Computer Science and Engineering, IIT Bombay*
  - Trained **Linear**, **LSTM** and **Transformer** based models for query intent detection task on **ATIS** dataset
  - Curated a multilingual ATIS intents dataset from the original ATIS dataset using **TextBlob's** translation API
  - Reduced data requirements by **21%** by exploiting multilinguality of the system and achieved **97.31%** accuracy
- **R&D Project | Protein Inter-Residue Distance Prediction using Deep Learning** (*Dec'19 - present*)
  Guide: *Prof. Amit Sethi, Electrical Engineering, IIT Bombay*
  - Trained a **VGG-Unet** architecture with **dilated convolutional layers** on the PIDP-challenge protein dataset
  - Proposed a **novel loss** function to exploit the inherent symmetry in input features and used it with a weighted combination of **MAE**, **MSE** and **BCE losses** and achieved an MAE of **3.29** and an average precision of **0.86**
- **M.Tech. Seminar | Adversarial Attacks on Deep Neural Networks** (*Jul'19 - Dec'19*)
  Guide: *Prof. Amit Sethi, Electrical Engineering, IIT Bombay*
  - Literature survey of the state of the art adversarial attacks against neural networks and their defenses
  - Implemented **FSGM** and **PGD** adversarial attacks which resulted in degradation of NN performance by **96%**
  - **Defended** the neural network from above attacks by **adversarial training** and established the efficacy of this defense strategy for **data augmentation** and **regularization**

TECHNICAL SKILLS

Languages : C/C++, Python, Matlab, HTML
Libraries & Tools : Pytorch, TensorFlow, Scikit-Learn, SK-image, OpenCV, Git, GNU Radio, LaTeX

WORK EXPERIENCE

- **Generative Conversational Chatbot** (*Mar'20 - Jun'20*)
  Seasons Of Code 2020 | Web and Coding Club, IIT Bombay
  - Developed text-to-speech and speech-to-text modules of chatbot using **gTTS** and **speech_recognition** APIs
  - Trained LSTM based encoder-decoder generative network on pre-processed **Cornell movie-dialogs corpus**
  - Integrated sub-modules to build an **End-to-End** system with input as user voice and output as chatbot response
- **Automatic Measurements of Fetal Head in Ultrasound Images using Deep Learning** (*May'19 - Aug'19*)
  Seasons Of Code 2019 | Web and Coding Club, IIT Bombay
  - Trained a **UNet** with modified **ResNet** as encoder network for image segmentation task in Ultrasound Images
  - Improved the performance of the system by **8%** by implementing **data augmentation** techniques including distortions, random noise, random flips and random rotations in **Pytorch** dataloader
  - Used **BCE**, **Dice** and **Inverse Dice** loss to achieve a mean absolute difference of **3.40mm** on measurements
- **Assistant System Engineer Trainee | TATA Consultancy Services** (*Mar'18 - Jul'18*)

KEY COURSE PROJECTS

- **Image Retrieval System based on ORB and SIFT Features** | Computer Vision (*Feb'20*)
  - Implemented brute force and **FLANN** feature matching for ORB and SIFT features using **OpenCV**
  - Re-designed above system as **attendance and student locating system** in the IITB classroom
- **Calibrating Camera using OpenCV for Intrinsic Parameter Calculations** | Computer Vision (*Feb'20*)
  - Calibrated camera of mobile phone to obtain **camera matrix** and achieved re-projection error of **0.55**
  - Computed **focal lengths** (f_x and f_y) using camera matrix and manufacturer's camera sensor specification
- **Clustering Images using Metric Learning**| Computer Vision (*Mar'20*)
  - Trained a **Siamese network** with **Contrastive Loss** to get separable 2D embeddings of MNIST dataset
  - Enhanced the robustness of the model towards Euclidean transformed MNIST digits by **data augmentation**
- **Augmented Reality: Overlaying a Virtual Object on Real World Images** | Computer Vision (*Mar'20*)
  - Projected the 3D real world points on 2D image plane to **augment** a virtual book on a real world image
  - Used **perspective transformation** to obtain 3 views of the virtual book from different camera angles
- **Neural Style Transfer to obtain IHC stain images from H&E images** | Advance ML (*Oct'19 - Nov'19*)
  - Extracted **content** and **style** representation of images using VGG-19 model pre-trained on **ImageNet**
  - Implemented **Gram matrix** and calculated **style & content loss** to iteratively transfer the style
  - Generated **IHC stain** images (worth **$76** per slide) from cheap **H&E** images (worth **$7** per slide)
- **Tilt Correction in Text Images** | Image Processing (*Aug'19 - Nov'19*)
  - Developed a **cam-scanner** like application in python using **OpenCV** for tilt correction of scanned text images
  - Extracted corner points with Canny operator and Hough transform and performed perspective transformation
- **Automatic Speech Recognition** | Speech Processing (*Aug'19 - Oct'19*)
  - Pre-processed **(end-pointing, pre-emphasis)** and augmented Google Speech Commands Dataset version 0.01
  - Implemented **VQ code-book** matching (bag of frames), template matching using **DTW**, and achieved an accuracy of **84.92%** on clean test data and **79.045%** on noisy test data
- **Automatic Image Captioning** | Machine Learning (*Sep'19 - Nov'19*)
  - Implemented CNN-LSTM **encoder-decoder** based image caption generator and trained it on Flickr8 dataset
  - Exploited **transfer learning** by using **pre-trained** Inception-V3, Resnet50 and Glove embeddings to get representations and achieved BLEU-1 score of **50.23** for generated captions
- **Artificial Neural Network from Scratch using Numpy** | Machine Learning (*Sep'19 - Oct'19*)
  - Implemented **back-propagation** algorithm to train a fully connected NN using SGD and Adam optimizers
  - Reduced the number of trainable parameters by **85.86%** with CNN for **C**IFAR dataset to get the same accuracy

RELEVANT COURSES

- Foundations of Machine Learning
- Digital Signal Processing and its Applications
- Advanced Topics in Signal Processing
- Computer Vision
- Image Processing
- Natural Language Processing (Audit | Ongoing)
- Speech Processing
- Advanced Topics in Machine Learning

POSITIONS OF RESPONSIBILITY

- **Student Companion: Institute Student Companion Program, IIT Bombay** (*Apr'19 - Mar'20*)
  - Mentored 7 PG students in institute activities, course selection, technical and non-technical development
- **Research Assistant: Wadhwani Electronics Laboratory, EE, IIT Bombay** (*Jul'18 - Present*)
  - **Communications Lab:** Designed and evaluated weekly lab sessions and lab exams for **140+** students
- **Coordinator of ACCOLADE: Cultural and Fine Arts Fest of GBPUAT, Pantnagar** (*Jul'14 - Jul'17*)
  - **Headed 50+** members team and managed the hospitality of judges, band artists and **1500+** participants
  - Designed the structure and timeline of promotion of **20+** events and systematized budget of **1.2M INR**

EXTRACURRICULAR ACTIVITIES

- **Rhythm guitarist** in the band **ARTH** (**Winner** of Decibel – The band war in ACCOLADE'16) (*2016*)
- **NSS 'C' certificate:** 120 hours of social service and 7 days long social awareness camp in a rural area (*2015*)

Scholastic achievements and extracurricular activities are not verified by the Placement Cell