Pushkar Ambastha

Roll No.: 210106050
B.Tech - Bio Science and Bio Engineering
Indian Institute of Technology(IIT), Guwahati

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Education

Degree/Certificate	Institute/Board	CGPA/Percentage	Year
B.Tech. Major	Indian Institute of Technology, Guwahati	8.08 (Current)	2021-Present
Senior Secondary	CBSE Board	92.2%	2021
Secondary	CBSE Board	95.2%	2019

Experience

- **Massachusetts Institute of Technology(MIT) Media Labs** *June 2023 - Present*
  Undergraduate Researcher - Remote Cambridge, MA
  *Advisor: **Ayush Chopra** (Camera Culture Group, MIT Media Labs, MIT)*
  – Developing methods to calibrate clinical Agent-Based Models(ABMs) directly from biopsies to have a mean accuracy of **77%** under the Spatial Agreement Measure*(SAM)* Metric, minimizing the number of biopsy samples taken.
  – Designing a novel multi-modal calibrated ABM pipeline to apply gradient-based ABMs to simulate tumour-immune cell interactions. *(for Cytotoxic CD8+ T Cells in multiple carcinomas and melanoma cases)*
  – Extended a novel pip library **AgentTorch** (Pytorch framework to design, simulate, and optimize agent-based models) for the cancer immunotherapy domain. Extracting the parameters from the classification model with an accuracy of **90%**. (IHC stained tissue sections based on the expression of Ki67)

- **Hugging Face** *May 2023 - Dec. 2023*
  Research Intern - Remote Brooklyn, NY
  *Advisor: **Katie Link** (Hugging Face X Health, Healthcare/Medicine at Hugging Face)*
  – Developing novel models derived from the cumulative performance and extrapolation of Segment Anything Model *(SAM)*, Medical SAM *(Med-SAM)*, Fast-SAM, and Faster-SAM.
  – Designed a novel pipeline using the frozen Image encoder of Med-SAM and the decoder architecture from Fast-SAM, leading to a **68%** decrease in inference time and an **82%** decrease in size compared to the Vanilla SAM model.
  – The results, when observed in Modalities such as Pathology, X-Ray, CT, and Ultrasound, gave an average improvement of **0.48** in mean Intersection of Union *(mIOU)* and **0.42** in Dice Score Coefficient *(DSC)*.

- **University of Utah** *Nov. 2022 - Feb. 2023*
  Research Intern - Remote Salt Lake City, UT
  *Advisor: **Tushar Kataria***
  – Analysed Domain Shift in biomedical image segmentation models as a critical insight into Model Explainability. (for both binary and multiclass semantic segmentation instances)
  – Fine-tuned **U-Net, DeepLabV3** model on Dataset like GlaS from MICCAI *(2015)*, CRAG, CPM15 to observe domain dependency of models on the dataset, created a pipeline to improve Image masks **mIOU** and **Dice Score**.
  – The results achieved for metrics like mIOU Loss, Pixel Accuracy, Jaccard Loss, and Dice Score met the standards of prior field experiments, like **0.96** for CRAG and **0.89** for GLAS *(mIOU)*. (Pathological Modality)

Projects

- **Domain-specific Question Answering chatbot** *Dec. 2022 - Feb. 2023*
  11th Inter IIT TechMeet, IIT Kanpur Github
  – Developed a question-answering system by retrieving the top candidate sentences from the corpus, used up to free collab resources, and **quantized** models to keep **latency** less than *1000 ms*.
  – Developed question-answering **pipeline** using techniques like model distillation, sparsification, pruning, and fine-tuning the **DebertaV3-Base** model to decrease inference time and have a minimum loss in accuracy.

- **Cover Generation using OpenAI tools** *Jan. 2023 - March 2023*
  IITG.ai Club, IIT Guwahati Github
  – Developed a **multi-modal** pipeline that converts **audio/text** input into **images** using state-of-the-art **OpenAI** tools. Generated optimal transcripts for the podcasts and songs with **OpenAI Whisper** to create prompts.
  – Designed **pipeline** with Latent Diffusion Models (**DALL-E**) to generate aesthetic cover images from created prompts using **ChatGPT/GPT-2** models.

- **Super Resolution Photographic Mosaic** *March 2023 - April 2023*
  Coding Club, IIT Guwahati Github
  – Developed a **Computer Vision** pipeline that enhances the images by **super-resolution** and stitching.
  – Designed multi-model **pipeline** consisting mainly of Latent Diffusion Upscaler model for super-resolution and Image Stitcher for creating a **panorama**.

- **Re-colorisation of monochrome images using conditional GANs** *Aug. 2022 - Sep. 2022*
  Coding Club, IIT Guwahati Github
  – Trained a conditional Generative Adversarial Networks model (Discriminator and Generator) based on **U-Net** block with **Resnet18** backbone and devised **Image Processing** strategies for colorization of monochrome images.
  – Deployed a web app using **Streamlit** library on HuggingFace for the fine-tuned model over the **COCO** dataset.

- **Captcha Breaker Project** *Aug. 2022 - Dec. 2022*
  Consulting and Analytics Club, IIT Guwahati Github
  – Deployed a **Computer Vision** program using **Streamlit** library on HuggingFace that recognizes Text-based **Captcha** images and converts them into writable text.
  – Developed the **pipeline** involving the **RCNN** model, giving Connectionist Temporal Classification**(CTC)** Loss *0.03*.

Skills

- **Programming**: Python, PyTorch, Tensorflow, OpenCV, Keras; C/C++; LaTeX; Matlab; JAX*; FLAX*
- **Web technologies**: HTML, CSS, Streamlit, Gradio, Javascript*, Flask*
- **Machine Learning/Data Analysis**: Deep Learning, including CNNs, RNNs, VAEs, GANs, Bayesian NNs, Transformers; Machine Learning, KNN
- **Wet laboratory skills**: techniques in bioengineering, biochemistry, bacterial cell culture ** Elementary proficiency*

Key courses taken

- **Mathematics**: Linear Algebra, Basic Calculus, Complex Analysis
- **Computer Science**: Data Structures and Algorithms, Computer Lab
- **Biology**: Genetic Engineering, Biochemistry, Microbiology, Cell and Molecular Biology
- **MOOCs(Coursera)**: Machine Learning, Deep Learning, Computer Vision, Natural Language Processing *(NLP)*

Positions of Responsibility

- **Research Head**, IITG.ai Club, IIT Guwahati *May 2023 - Present*
- **Coordinator**, Coding Club, IIT Guwahati *June 2022 - May 2023*
- **Associate**, Consulting and Analytics Club, IIT Guwahati *Aug. 2022 - May 2023*
- **Associate**, IITG.ai Club, IIT Guwahati *Sep. 2022 - May 2023*

Achievements

- **Inter IIT Tech Meet 11.0**, Secured **Gold** Medal in High Prep problem statement by DevRev.ai *2023*
- **Kaggle 4*X* Expert**, Reached Expert tier in all the categories of Kaggle *2023*
- **Bronze Medal (85th Place)**, Open Problems – Single-Cell Perturbations, Kaggle *2023*
- **Bronze Medal (99th Place)**, HuBMAP – Hacking the Human Vasculature, Kaggle *2023*
- **IITG.ai Hackathon**, Secured **6th** rank in hackathon conducted by IITG.ai club *2022*
- **Joint Entrance Examination (Mains)**, Achieved a percentile of **99.29** among **1.2** million candidates *2021*
- **Joint Entrance Examination (Advanced)**, Secured All India Rank **8512** among **2,50,000** applicants *2021*
- **NEST 2021-22**, Secured All India Rank **140** among **1,00,000** candidates *2021*
- **PRMO 2019**, Qualified for the Pre Regional Mathematics Olympiad *2019*
- **NTSE 2019**, Secured a seat (first stage) in the top **8000** out of **12,00,000** candidates. *2019*