Viraj Bagal

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Publications

- Viraj Bagal et al., 'MMBERT: Multimodal BERT Pretraining for Improved Medical VQA', ISBI 2021.
- Minesh Mathew, Viraj Bagal et al., 'InfographicVQA', WACV 2022.
- Viraj Bagal et al., 'MolGPT: Molecular Generation using Transformer-Decoder Model', JCIM 2021.

Experience

AI Scientist April 2021 – Present

Synapsica Healthcare — YC W20 *Bangalore, India*

- Experienced in working with highly imbalanced datasets and problems like multi-class multi-label classification, object detection, semantic segmentation, keypoint detection.
- Improved F1 score of the initial classification model by **23%** by extensive data cleaning, regularization and by more than **3%** using generalization techniques like SWA and self-distillation.
- Implemented active learning pipeline that significantly reduced the labelling cost.
- Converted a regression problem into keypoint detection in Spine X-rays using heatmaps. Resulted in **>100%** improvement in prediction acceptance compared to previous model.
- Implemented batch processing instead of sequential processing and ONNX runtime accelerator in production pipeline. This resulted in **30%** and **65%** reduction in production pipeline runtime respectively.
- Made the product interactive that can allow user based changes in the AI predictions with responses in the order of **1 millisecond**.
- Instruction finetuned open sourced LLMs like **Dolly, Falcon** for tone changes and conversion of medical text in different formats
- Thus, I have contributed in improving multiple model performances in training, made them more robust and generalized, and also significantly reduced production pipeline runtime.

Deep Learning Research Intern May 2020 – April 2021

Generative NLP, CCNSB Lab, IIIT *Hyderabad, India*

- Worked on building models for scaffold and property conditioned molecule generation.
- Implemented graph based models like vanilla GNNs, GCNs, GATs for molecular generation using Python, Pytorch and Geometric Pytorch.
- Developed custom transformer decoder model similar to GPT that is **94%** smaller and achieved new state-of-the-art results (increase in performance) on conditional molecular generation. Interpretability addressed using saliency maps.
- Implemented RNNs, LSTMs, VAEs, AAEs, GANs for performance comparison against our model. Plots created using matplotlib and seaborn.
- Shorter version of research paper accepted at **AAAI-SDA 2021** workshop. Longer version accepted in **Journal of ChemInformatics (JCIM)**. Virtually presented my work at AAAI 2021 (Conference H5-index: **126**, Impact Score: **25.57**). Click here for the paper. Click here for repo.

Deep Learning Research Intern May 2020 – April 2021

Multimodal (CV + NLP) Understanding, CVIT Lab, IIIT *Hyderabad, India*

- Proposed and implemented a novel interpretable visual question answering (VQA) model on medical images, questions and answers.
- The model achieves new state-of-the-art performance with increase in accuracy and bleu score by **5%** while being **66%** more efficient than previous best models.
- Implemented self-supervised training with Masked Vision-Language Modeling and Image-Text Matching on multimodal BERT model using multi-GPU DDP trainig, HuggingFace, Pytorch Lightning, and monitored results using wandb (W&B).
- Implemented various CNN variants like ResNets, DenseNets, EfficientNets for image feature extraction and LSTMs, GRUs for text feature extraction.
- Research paper accepted at **IEEE ISBI 2021** (Conference H5-index: **43**, Impact Score: **6.6**). Click here for the paper. Click here for repo.

Education

Indian Institute of Science Education and Research Pune, India
MS/MSc in Physics, Minor in Mathematics. ***GPA: 9.3/10*** *Aug. 2016 – June 2021*

Projects

LLM based Language Learning Web App March 2023

- Developed language learning app with **LLM** support for learning languages like English, Chinese, Spanish, Russian, French, etc.
- Added features like learning new everyday used words, gamification of translation exercises and AI role playing. This required heavy **prompt engineering** for **ChatGPT and GPT-4 APIs**.
- Used **Amazon Polly** for text to speech
- **langchain** library for prompt, AI response, and memory management.
- Coded many APIs for file-transfer, processing, etc. using **FastAPI**.
- Deployed on **AWS EC2 instance.** Click here for website. Click here for code

AI based Content Insights April 2023

- Developed **LLM** based content insight product that can summarize and allow Q&A on any CSV, PDF, Doc, Image, Youtube video.
- Performed **prompt engineering** for **ChatGPT and GPT-4 APIs**.
- Used **Eleven Labs** for text to speech
- Used **OpenAI embeddings** for creating embeddings of the content. Used **Activeloop Deeplake** as the vector database and **retrieval augmented generation** for Q&A. Used **langchain** to perform all this.
- Coded many APIs for file-transfer, processing, etc. using **FastAPI**. Coded frontend using **Streamlit**
- Deployed on **AWS EC2** instance using docker compose and traefik for reverse proxy. Click here for product

MLOps Jan 2023

- Image classification app where the result is stored in mongodb and the image is stored in MinIO.
- MlFlow is used to load model in production stage. MlFlow server has postgresDB as backend store and MinIO as the artifact path. Project GitHub Link

MLOps October 2021

- Model monitoring using Weights and Biases, and Training configuration setup using Hydra.
- Data Version Control using DVC and Model Packaging using Fast API + ONNX + Docker.
- CI/CD using GitHub Actions, and created Container Registry using AWS ECR.
- Serverless Deployment using AWS Lambda and Prediction Monitoring using Elasticsearch Cluster + Kibana.

Achievements

- Secured **All India Rank 69** in KVPY 2016.
- Secured **All India Rank 2302** in JEE Advance 2016.
- **National Top 1%** in National Graduate Physics Examination 2019.
- 2× Kaggle Expert. Only **8%** of total Kaggle competitors are at this or above this rank
- Three publications. One in IEEE ISBI 2021, one in WACV 2022 and one in Journal of ChemInformatics (JCIM).

Skills

- Technical: Machine Learning, Deep Learning, Computer Vision, Natural Language Processing, Python, Pytorch, TensorFlow, PySpark, SQL, Docker, AWS EC2, AWS ECR, AWS Lambda, Git, DVC, ONNX, API Gateway, AWS ElasticSearch, CI/CD, MLOps, FastAPI, Prompt Engineering, MongoDB, LangChain, Transformers, Diffusers
- Non-Technical: Good at communicating technical aspects in simpler manner. Good at technical writing. Have experience in managing a team of 2 people at the current company.
- Open Source Contribution: Made contributions to Albumentations library (widely used in COmputer Vision) and Pytorch Lightning.