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Raman Kumar

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ABOUT

I am a Research Associate at IIT Delhi, working with Prof. Aaditeshwar Seth on applying machine learning to geospatial datasets. Previously, I collaborated with Prof. Prem Kalra on computer vision applications for medical datasets. Additionally, I have five and half years of industry experience as a Machine Learning Engineer.

EDUCATION

IIT Delhi, India
B.Tech, Computer Science and Engineering (2014)

PUBLICATIONS

1. **R. Kumar**, R. R. Dhanakshirur, R. Singh, C. Arora, P. Kalra, A. Suri, *A deep learning approach for objective evaluation of microscopic neuro-drilling craniotomy skills***,** accepted for publication at Computers in Biology and Medicine Code
2. **R. Kumar**, A. Seth, *Multi-resolution UAV and satellite data processing for contextually relevant Land use Land Cover,* manuscript in preparation Code
3. C. Bansal et al. Beyond Flat Classifiers: Practical Methodologies for Regionally Accurate and Relevant Land Use and Land Cover Classification Using Landsat and Sentinel Data under review at Remote Sensing Code

RESEARCH PROJECTS

Multi-resolution UAV and satellite data processing for contextually relevant LULC (Current)

- Developed a novel methodology for accurate differentiation and delineation of scrublands, plantations and farmlands using high-resolution UAV as well as sentinel imagery
- Leveraged weak supervision on entropy, Hough transforms, size etc to train model that outperforms Google's Dynamic World LULC
- Containerized the entire workflow using Docker to streamline deployment and reproducibility
- Developed a hybrid pipeline utilizing local compute (NVIDIA RTX A5500 GPU) and Google Earth Engine to process 2,200 sq. km in under 3 hours; actively used by Core-Stack and Well Labs
- Currently authoring a **first-author** manuscript

Automatic assessment of microscopic neuro-drilling craniotomy skills (Finished in Apr '24)

- Developed a computer vision-based system to grade training for the critical neurosurgical procedure of microscopic craniotomy
- Collaborated with neurosurgeons to curate a high-quality annotated dataset of micro-drilling procedures on ovine skulls and scapulae
- Developed a geometry-constrained training strategy for Transformer and CNN models on limited data, surpassing human-level accuracy
- Integrated the best performing model with surgical micro-drills in NETS lab at AIIMS
- **First-author** paper currently under review at *Computers in Biology and Medicine*

- This project was a part of **NeuroMentor** which received Prix Galien India award 2024

Identifying Ecotypes(Current)

- Developed a methodology to automatically identify ecotypes (e.g., Orans of Rajasthan, barren hilltops of Sahyadris) requiring ecological restoration
- Developed a bottom-up methodology which uses pixels identified by environmental rules on reference sites and use Simple Non-Iterative Clustering (SNIC) on NDVI time-series to generate superpixels patches for ecotypes
- Currently exploring symbolic regression to automatically derive rule sets from multiple data layers (LULC, terrain, rainfall, elevation, tree canopy, land degradation, etc.)

Large-Scale Cropping Intensity Classification Using Unsupervised Learning (Current)

- Developed an unsupervised method to classify annual cropping intensity at 10-meter resolution across India using time-series vegetation indices from optical satellite data
- Designed a systematic sampling strategy and collaborated with grassroot NGO to validate our methodology

Forecasting Forest Fire using Climate and Human variables(Current)

- Worked on classifying small and large forest fires using Landsat dataset and curated a dataset of historical forest fires clusters over the past 9 years on 6 eastern states of India
- Modeled forecasting of forest fire using climate forecast variables CFSV2: NCEP Climate Forecast System Version 2
- Currently in the process to adding human variables like human settlements and infrastructure development

Surgical Tool tracking (Finished in Jan '24)

- Developed a library to simultaneously capture 6D tool position and RGB frames from optical and infrared camera on Polaris Vega: a tool tracking system used in neuro-surgery
- Developed a pipeline on gstreamer to extract RGB frames from network packets and overlay the 2D projection of tool position on the frames
- The library is currently in use to collect data for **SLAM** based endoscopic tracking

INDUSTRY EXPERIENCE

Euler Systems Inc., Mumbai, IN July '18 – Apr '22
Tech Lead

Complaint Classification System: (Gojek)

- Designed and implemented an end-to-end system to classify customer complaints into 100+ categories, aiding customer service representatives in resolving issues more efficiently
- Developed an ML pipeline inspired from a paper titled COTA which uses a pointwise ranking algorithm resulting in higher accuracy compared to a standard multi-class classifier.
- Designed and Implemented a distributed architecture consisting of a training cluster and inference cluster, and a ten stage data pipeline to preprocess incoming data, train, and deploy the model across API serving containers.
- Serialized distributed ML model using mleap to deploy on lightweight API servers, achieving

millisecond response time.

Data Plan Optimization: (Kore Wireless)

- Developed a product that predicts optimal data plans to decrease data overage and cost for an American SIM card provider
- Developed an heuristic based dynamic bin packing algorithm to find optimal plan
- Saved $600K per year with optimal predictions

Doctor Recommendation System: (Dhani)

- Lead a team to build recommendation system which recommends doctors based on patient's history
- Developed a software to allocate doctors in real-time for video calling from a pool of doctors
- Reduced the waiting time for patients from 65 secs to 12 secs with efficient allocation

Backend Development: (Nykaa)

- Implemented e-commerce search, product recommendations and price and inventory management system for Nykaa
- Migrated Nykaa's monolith architecture to microservice architecture

Ikarus, Gurgaon, IN Nov '16 – Jul '18
Software Engineer

Robotic Process Automation(RPA):

- Worked on Named-entity Recognition(NER) to extract entities like items, prices from unstructured text documents
- Developed an algorithm to detect tables in scanned documents by identifying lines using Hough Transforms
- Worked on auto orientation correction of scanned documents to increase OCR accuracy
- Implemented scalable and distributed data pipeline on pyspark to process millions of documents in batches

TECHNICAL SKILLS

Languages	Python, Java, C#, C/C++, scala
Libraries	PyTorch, Keras, mxnet, Scikit-Learn, Numpy, Pandas, NLTK, matplotlib, spacy, OpenCV
GIS	Google Earth Engine, GDAL, QGIS, Rasterio
Frameworks and Tools	Pyspark, Git, Docker, AWS Lambda, AWS EC2, Elastic Search, mleap, redis, bash

HOBBIES

Drumming, hiking and reading fiction

REFERENCES

Prof. Aaditeshwar Seth (IIT Delhi), Prof. Prem Kalra (IIT Delhi), Sandeep Kadam (CTO, Kissht)