Amritpal Singh

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Education

- **Georgia institute of technology** — Atlanta, USA
  Master in Computer Science, MS Computer Science, GPA - 3.72/4.0 — *Jan 2022 - Dec 2023(Expected)*
  Machine learning specialisation: *CS6515 Graduate algorithms, CS7643 Deep learning, CS7650 Natural Language, CS7642 Reinforcement learning, CS7641 ML, CS6601 AI, CS7535 Markov Chain Monte Carlo, CS7631 MultiRobot systems*
- **Maulana Azad Medical College** — Delhi, India
  Bachelor of Medicine, Bachelor of Surgery(M.B.B.S) — *Aug 2015 - Mar 2021*
  Courses: *Medicine, Surgery, Dermatology, Radiology, Biochemistry, and others*

Publications

- **Development of Predictive Models for Patient Rehabilitation Outcomes After Spinal Deformity Surgery: Towards Personalized Medicine** : Currently under review, Aug - Oct 2022
- **Roadmap to Autonomous Surgery - A framework to Surgical autonomy arXiv:2206.10516v1** : Apr - May 2022
- **In-Silico drug-target screening for Drug Re-purposing using Artificial Intelligence 10.7303/syn25958848** : Mar -Sep 2021, Using Deep learning methods to re-purpose old drugs for rare diseases.
- **Personalized brain state targeting via Reinforcement Learning** : Sep - Nov 2020, Guide non-invasive brain stimulation to actively induce sleep in insomnia patients using reinforcement learning
- **Validation of expert system enhanced deep learning algorithm for automated screening for COVID Pneumonia on chest X-rays - Nature Scientific reports 10.1038/s41598-021-02003-w** : Apr-Sep 2020
  Novel methods to combine deep learning methods with human expert knowledge to predict COVID-19 on chest X-rays, which is a cheaper alternative to CT and more readily available. Allowed training despite limited data available.

Work Experience

- **BioML(Bio-Medical Informatics and Bio-Imaging) Lab, Georgia Tech** — Aug 2022 - Present
  Multimodality deep learning, Reinforcement learning — *Graduate Research Assistant*
  - Multi-modality deep learning: Using complementary information from 3D imaging(MRI, PET scans), electronic health records, and genomic data. Improved on the previous state of the art on Alzheimer's disease prediction.
  - Deep learning: Explore methods to drive algorithmic and designing architectural advances, implement, hyper-parameter optimization. Trained massive-scale deep learning (2D/3D CNNs, NLP) models for research papers
  - Data cleaning: Analyzing and cleaning 3d image datasets, writing bug-free code to create a solid pipeline to monitor metrics and model gradients during model training.
  - Research publish: Design research plans and evaluation schemes, Review work of other lab members, and improve upon recent papers in machine learning.
  - Advisor: Prof. May D. Wang, Ph.D. Professor of Biomedical Engineering, Gatech
- **Qure.ai** — Sep 2021 - June 2022
  Deep learning in Medical imaging — *Clinical Research Physician*
  - Deep learning: Trained 3D/2D CNN models, performed perturbation analysis of classification/ segmentation models, which resulted in improvement of previously deployed production models
  - Data analysis: Redesigned Image registration pipelines, and tracked clinical, phenotypic, and radio-logical data points. Benchmarked products and measured data shifts to guide model updates.
  - Regulatory approval: Helped in getting 2 FDA approval of medical imaging AI products
- **Vaidyam.ai** — Apr 2021 - Sept 2021
  Probabilistic machine learning — *Co-founder and Data scientist*
  - Probabilistic machine learning: Designed and developed the pipeline to train systems, used this to solve cold start problems using real-world expert data
  - Probabilistic modeling for disease analytics: created a recommendation system for drugs based on physician's training, skill set, and patient history
  - Product research: research about FHIR API guidelines for data integration
  - Stakeholder discussion: Explore the business, regulation, and legal viability, create a final business plan
- **Carpl.ai** — Dec 2020 - Mar 2021
  Deep learning in Medical imaging — *AI Research Intern*
  - Deep learning: trained deep learning models for catheter detection on 2d images.
  - Model fairness: detected bias in deep learning models for patient age, race, and time of scan acquisition.

Projects Link to website

- **Distributed control of decentralized Multi-robot system for efficient blood pumping in bionic heart**: achieve contraction and rhythm control for efficient coordination to pump blood
  - Solved as two sub-problems: 1. Reward engineering based on fluid dynamics and max-flow between agents. 2. Learn optimal coordination policy amongst robots using reinforcement learning(Q-learning) algo.
  - Results: our solution improved power efficiency by 4% as compared to the baseline
- **Learning new emergent behavior to increase football team efficiency using reinforcement learning** : encouraging new behavior to promote team collaboration, by rewarding cooperation inside the team
  - Multi-agent Reinforcement Learning algorithm - QMIX algorithm with Deep Q learning algorithm as its base.
  - Finally, trained models with new behaviors for improved cooperation, power efficiency, and preventing a strong enemy takeover by intra-team ball passing.
- **EyeAI - Retinopathy detection on images via android app**: Detect diseases using eye's retina images on phone
  - Javascript-based app, with Pytorch deep learning model, deployed. Downloaded over 50+ times on google play store. The final model achieved 0.95 accuracy, 0.92 F1 score
- **Surgical behavior emergence using reinforcement learning in physics simulation**: multi-agent reinforcement learning algorithm to learn co-ordination between 4 arms of a surgical robot
  - Built my own custom scalable reinforcement learning environment of a 4-arm (6 degrees of freedom each) surgical robot, using the mujoco physics simulator to model robot kinematics.
  - Learned reinforcement learning algorithms to train robotic arm coordination, using reward engineering for behavior shaping.
- **Robotic control via kinematics for suturing demonstration**: Path planning of 5 DOF robot
  - Forward and inverse kinematics to perform the 4 steps: Aligning, Insertion of the needle, picking the needle from the other end, and realigning. Design end-effector to allow more efficient needle holding.
- **Detection and localization of medical catheters on 2D x-ray images**: multiclass multilabel image classification
  - Performed image preprocessing, K-cross validation training of CNN networks and created final ensemble of 5 models.
  - Results: Final model reached 0.86 F1 score, with GRADCAM explainable AI for model predictions
- **Detect credit default probability using real trading data**:
  - Data wrangling, cleaning, and modeling: Feature selection(using forward methods dimension reduction-PCA and tSNE), Trained clustering, K means, Gaussian mixture models, Xgboost, and neural network algorithms. Benchmarked our results against previous state-of-the-art models. The final model achieved 0.86 Accuracy, 0.942 AUC, 0.884 GINI Score.
- **DermaAI - Deep learning based Skin lesions Classification**:
  - Image preprocessing, training, and selecting CNN models to detect 3 common skin lesions. Built a user-friendly GUI for prediction and GRADCAM explainability. The final model achieved 0.92 Accuracy

Competition and Hackathons

Kaggle: (Kaggle Expert in all 4 categories: Competitions, Datasets, Discussions, Notebooks) Link to Kaggle Profile

- **MLB Player Digital Engagement Forecasting** : 65th/852 rank(top 7%)
- **OSIC Pulmonary Fibrosis Progression**: 131th/2097 rank(top 6%)
- **Sartorius - Cell Instance Segmentation** : 230th/1505 rank(top 15%)
- **CommonLit Readability Prize**: 305th/3633 rank(top 8%)
- **Optiver Realized Volatility Prediction**: 356th/3852 rank(top 9%)

Hackathons

- **MIT Hack 4 Rare hackathon**: Drug re-purposing for rare disease using Deep learning
- **Prague healthcare hackathon**: Build deep learning based solution for patient monitoring

Leadership and Awards

- Ma Amriteshwari Charity Sansthan (MACS) Achievement Award, India - July 2019
- General secretary, Azad medicos association (Student union), Maulana Azad medical college, India - 2018
- Gurukool: Founding member, an organization to promote personal, leadership, and research in undergraduates, Maulana Azad medical college, India - 2017

Skills Summary

- **Research interest**: Machine learning — Multi-modality deep learning — Reinforcement learning — Robotics
- **Languages, Frameworks**: Python — JavaScript — Matlab —Pytorch — TensorFlow — RL Baselines — MongoDB — Git