# Mohit Agarwal

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**Research Interests**

Factuality in Large Language Models (LLMs), Health/Biomedical Machine Learning, Human-In-The-Loop Learning, Human Experimentation Design, Wearable and Ubiquitous Computing

**Education**

**Georgia Institute of Technology** Aug'14 - Dec'20
*MS and PhD* in Computer Engineering, Minor in Computer Science, GPA: 4.0/4.0
Thesis: On The Interplay between Brain-Computer Interfaces and Machine Learning Algorithms
Advisor: Prof. Raghupathy Sivakumar

**Indian Institute of Technology Kanpur** July'10 - May'14
*Bachelors* in Electrical Engineering, GPA: 8.7/10.0

**Work Experience**

**Google** - Research Engineer, Feb'23-Present
*Machine Learning, Large Language Models* at Google Research

- Working on improving the Factuality of Gemini and various student- LLMs.
- Released US-wide postal code and county- level embeddings for general geospatial inference, with SOTA performance on 27 tasks including health, socioeconomic and environmental measures.
- Led and designed Graph Neural Network (GNN) based architecture to build Population Dynamics Foundation Model (PDFM) embeddings, combining search, maps and weather data. [Blog]

**Goldman Sachs** - Quantitative Stratgeist Feb'21-Present
*Knowledge Graph, Data Science, Financial Research* at Asset Management Division

- Building an Investment Research Platform, covering 1.8M+ companies, and 10M+ contacts from multiple data sources to surface investment opportunities and accelerate portfolio value creation
- Leading, designing and developing Knowledge Graph to derive insights from connections with applications in warm introductions, value acceleration, talent management and graph-based search

**Selected Publications**

**Mohit Agarwal***, Duo Xu*, E. Gupta, F. Fekri and Raghupathy Sivakumar, "Accelerating Reinforcement Learning using EEG-based implicit human feebback", *NeuroComputing, 2021*

**Mohit Agarwal** and Raghupathy Sivakumar, "Charge for a whole day: Extending Battery Life for BCI Wearables using a Lightweight Wake-Up Command", *ACM CHI 2020*

**Mohit Agarwal** and Raghupathy Sivakumar, "BLINK: A Fully Automated Unsupervised Algorithm for Eye-Blink Detection in EEG Signals", *Allerton 2019*

**Mohit Agarwal**, Duo Xu, Faramarz Fekri and Raghupathy Sivakumar, "Playing Games with Implicit Human Feedback", *Workshop on Reinforcement Learning for Games at AAAI, 2020*

**Mohit Agarwal**, SK Venkateswaran and R. Sivakumar, "Human-in-the-loop RL with an EEG wearable headset: on effective use of brainwaves to accelerate learning", *ACM WearSys'20*

Y. Jian, C-L Tai, Shyam K. Venkateswaran, **Mohit Agarwal**, Y. Liu, Douglas M Blough, Raghupathy Sivakumar, "Algorithms for addressing line-of-sight issues in mmWave WiFi networks using access point mobility", *Journal of Parallel and Distributed Computing 2022*

**Awards and Achievements**

- **Semi-Finalist** of Qualcomm Innovation Fellowship 2018, USA
  - Research Proposal: Enabling Co-Existence of Autonomous and Human-Driven Vehicles
- Ranked **2nd** in worldwide Melanoma Detection Challenge (2016) organized by ISBI
- Awarded NVIDIA Academic Hardware Grant 2018

**Technical Skills**

Python, Tensorflow, LaTeX**Databases:** MongoDB, ElasticSearch, Neo4J (Graph DB)
Prior experience in C/C++, Java, Web, MATLAB/R, Android Development

**Internships**

**Apple, USA** - Wireless Technologies Group — Summer'18
*Wireless Software Development,* Mentors: Firouz Behnamfar and Velu Elangovan

- Developed a system-level discrete event simulator in C++ to characterize and optimized the parameters of a radio-access technology (undisclosed, and developed in-house)

**Lawrence Livermore National Laboratory** - CASC — Summer'17
*Machine Learning Research*, Mentor: J. J. Thiagarajan

- Automated the Pair-Correlation Function (PCF) estimation for arbitrary point clouds (which traditionally either require manual tuning for estimation, or takes several days for MD simulation)

**Cisco Systems, Inc. USA** — Summer'16
*Deep Learning Research*, Mentors: Rob Liston and Dan Tan

- Designed DNNs using LSTMs in Tensorflow, for action recognition in video clips using UCF-101
- The proposed stateful model performed with more than 25% accuracy over the stateless model

**Syracuse University, USA** - Sensor Fusion Lab — Summer'13
*Wireless Communication Research* Mentor: Prof. Pramod Varshney

- Developed algorithm for automatic identification of digital modulation in wireless communication in the presence of noisy environment having unknown channel parameters using Bayesian model
- Proposed *Collapsed Gibbs sampling* based approach for channel parameter estimation
- Performs with more than 90% correct classification probability for higher-order QAMs

**Relevant Research Projects**

**On Using Brainwaves as Implicit Human Feedback in RL** — Aug'18 - Dec'20
*BCIs, Human-In-The-Loop Experiment Design, RL* [NeuroComputing'21] [RL4G, AAAI'20] [ACM WearSys'20]
Prototyped and developed an end-to-end Human-in-the-loop system to accelerate RL algorithms via implicitly generated human feedback (EEG brainwaves)

- *Human Experiments and Systems Research:* Designed experimental protocols and system frameworks to perform IRB approved human experiments and collect high-fidelity EEG data.
  - Conducted in-lab experiments for 25+ users on 5 virtual/robotic spaces, 20k+ stimulations.
  - Benchmarked manual feedback against EEG-based implicit feedback on accuracy and latency.
- *Error-Potentials (ErrP) Research*: Experimentally validated and proposed algorithm to learn ErrPs in a zero-shot manner across environments, with 9.61% accuracy improvement.
- *Integration with RL Algorithms:* Integrated ErrP based feedback to accelerate RL training using action biasing, control sharing and reward shaping approaches (1.52x acceleration on DQN)

**Low-Power WakeUp Command Detection for BCI Wearables** — Aug'16 - Aug'18
*BCIs, Human Experiment Design, Wearable Computing* [ACM CHI'20] [IEEE Allerton'19]

- *Human Experiments and Systems Research:* Created experimental protocols to collect four eye-blink datasets: 2.5k+ eye-blinks, 80+ users, multiple EEG headsets, and user activities.
  - Characterized the battery life of BCI wearables (using OpenBCI) with experimental insights into the energy consumption of control knobs, to determine the low-power mode specifications.
- *EEG Signal Processing Research:* Proposed eye-blink detection algorithms, and implemented wake-up command detection on OpenBCI (Arduino, C++) to experimentally validate the system performance for accuracy, latency, power implications and end-user usability.

- BLINK - a self-supervised eye-blink detection algorithm (98% accuracy, 0.934 precision)
- Trance - a wake-up command detection strategy and algorithm (2.7x battery life).

**Academic Projects**

**VisualAIDS: An Interactive visualization of HIV/AIDS data** Oct'17 - Nov'17
*Information Visualization Project* (Information Visualization: Prof. Alex Endert)

- An interactive visualization designed in d3/js to investigate and explore HIV/AIDS data for various countries over time. More information at www.agmohit.com/VisualAIDS/

**Modelling the Rehearsal Effect of Humans** Oct'16 - Nov'16
*Neuroscience and Machine Learning Project* (Computation and Brain: Prof. Santosh Vempala)

- Demonstrated the notion of forgetting and rehearsal in humans in the realm of neural networks
- Successfully simulated Ebbinghaus forgetting curve and learning curve, and explored various rehearsal properties by building a Recurrent Neural Net in Tensorflow

**Skin Lesion Analysis towards Melanoma Detection** Mar'16 - Apr'16
*Deep Learning Project (Deep Learning: Prof. Zsolt Kira)*

- Automated skin cancer detection by proposing CNN based architectures for skin lesion segmentation, feature extraction and classification of skin lesion images
- Won 2nd prize for the classification (81.3%) and feature extraction (90.3%) in ISBI 2016 Challenge

**General Game Playing Agent** Jan'13 - Apr'13
*Artificial Intelligence Project (Artificial Intelligence: Prof. Amitabha Bhattacharaya)*

- Developed an artificial gaming agent, capable of playing any game without human intervention
- Selected amongst top 5 projects, to compete on a global scale in GGP competition in AAAI

**Academic Courses**

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| **Computer Science** | Machine learning, Deep Learning, Artificial Intelligence, Computation and Brain, Applied Cryptography, Mobile Computing, Advanced Programming Techniques, Android Application Development, Information Visualization, Data Structure and Algorithms |
| **Mathematics** | Probability and Statistics, Linear Algebra, R Programming |
| **Telecom/SP** | Information and Coding Theory, Random Processes, Digital Communication Networks, Communication Systems, Digital Signal Processing, Statistical Signal Processing, Advanced Digital Communications, Wireless Communications and Networks, Convex Optimization in SP/COM |

**Grants**

NSF Award #1837369, *CPS: Small: Multi-Human Assisted Learning for Multi-Agent Systems using Intrinsically Generated Event-Related EEG Potentials* ($500,000 PI: Prof. Sivakumar, Co-PI: Prof. Fekri, Jan'19 - Dec'21): Co-authored the awarded proposal with significant technical contribution

**Professional Service**

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| **PC Member** | ICWSM 2020 |
| **Session Chair** | Allerton 2019: Statistical and Signal Processing |
| **Reviewer** | Neurocomputing'25,24,23,22, IMWUT'23,22,20,19, ACM CHI Play'22, Biomedical Signal Processing and Control'22, ACM CHI'20, , CogSci'24,23,20, ACI'19, MobileHCI'19, ICWSM'20,'19, AutomotiveUI'19, IEEE Transactions on Mobile Computing'17,'18,'19 |