CHAITANYA KHARYAL

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SHORT RESEARCH STATEMENT

Through evolution and millions of years of testing in demanding and challenging environments, the human brain, and arguably complete human anatomy, has become very complex. So complex that it has become a challenge for humans even to understand our own abilities, let alone enabling computers to match our performance. Yet, this seemingly impossible task is the grand goal of many areas of research like Machine Learning, Deep Learning, Computer Vision, Robotics, and Reinforcement Learning, which is why they intrigue me as much as they do. My long term goal is to contribute to this grand goal of achieving human-level intelligence. By working towards this goal, I wish to understand more about our behaviours and decision making abilities while developing breakthrough intermediary technologies for the short term. I am particularly fascinated by the idea of combining existing classical model-based techniques with data-driven methods to make them more robust to unpredictable real-world scenarios.

EDUCATION

International Institute of Information Technology - Hyderabad, India *2017-2021*
- *B.Tech. Electronics and Communication Engineering (Hons.)* ***CGPA:*** *9.04*
- ***Honours:*** *Robotics* ***Advisor:*** *Prof. Madhava Krishna*
- ***Awards and Honours:***

  - *Research Award*
  - *Dean's List* 5/8 semesters

PATENTS

Name redacted as the patent is under process with Microsoft *Under review*
- Pawan Sahu, ***Chaitanya Kharyal****, Ankur Tyagi, Manish Sharma*

PUBLICATIONS

GLIDE-RL: Grounded Language Instruction through DEmonstration in RL *Submitted to AAMAS'24*
- ***Chaitanya Kharyal****, SaiKrishna Gottipati, Tanmay Kumar Sinha, Srijita Das, Matthew E. Taylor*

One of the final frontiers in the development of complex human - AI collaborative systems is the ability of AI agents to comprehend the natural language and perform tasks accordingly. To thhis end, we present a novel algorithm, GroundedLanguage Instruction through DEmonstration in RL (GLIDE-RL) that introduces a teacher-instructor-student curriculum learning framework for training an RL agent capable of following natural language instructions that can generalize to previously unseen language instructions.

Do As You Teach: A Multi-Teacher Approach to Self-Play in Deep Reinforcement Learning *NeurIPS'22 DRL workshop, Extended abstract accepted at AAMAS'23*
- ***Chaitanya Kharyal****, Tanmay Kumar Sinha, SaiKrishna Gottipati, Srijita Das, Matthew E. Taylor*

We present a novel Multi-teacher approach to Self-play for sparse reward environments. Empirical results in Fetch-Reach and a novel driving simulator demonstrate that our proposed algorithm allows one agent (i.e., a teacher) to create a successful curriculum for another agent (i.e., the student). Surprisingly, results also show that training with multiple teachers actually helps the student learn faster.

Spatial Relation Graph and Graph Convolutional Network for Object Goal Navigation *CASE'22*
- *D. A. Sasi Kiran,* ***Chaitanya Kharyal****, K. Anand, G. Kumar, N. Gireesh, S. Banerjee, R. dev Roychoudhury, M. Sridharan, B. Bhowmick, M. Krishna* Paper

We present a novel framework for the Object-goal navigation task that uses a history of walks to learn a Spatial Relational Graph (SRG) and a Graph Convolution network (GCN). While the SRG captures the inter region and object to region relationships, the GCN tries to capture valid trajectories to reach the goal. We also use a novel SRG based Bayesian approach to classify the regions in robots view just by using the visible objects. We report significant improvement in performance over relevant baselines.

Multi-Teacher Curriculum Design for Sparse Reward Environments *ALA workshop '22*

- ***Chaitanya Kharyal**, Tanmay K. Sinha, Matthew E. Taylor* Paper / Video

We present Adversarial Multi-Teacher Curriculum Design with Traces to learn efficiently in the sparse reward environments. This technique involves multiple independent teachers engaged in a game against a goal-conditioned student. The primary algorithmic novelty, relative to existing work, is engaging multiple teachers and using a behavior cloning loss. In addition, we also introduce a new sparse reward environment for simulated driving in PyBullet. Empirical results show the potential of our algorithm in this novel domain.

RP-VIO: Robust Plane-based Visual-Inertial Odometry for Dynamic Environments *IROS'21*

- *Karnik Ram, **Chaitanya Kharyal**, Sudarshan S. Harithas, K. Madhava Krishna* Paper / Code

We present a monocular visual-inertial odometry (VIO) system that uses only planar features and their induced homographies, during both initialization and sliding-window estimation, for increased robustness and accuracy in dynamic environments. We evaluate on diverse sequences, including our own highly-dynamic simulated dataset, and show significant improvement over a state-of-the-art monocular VIO algorithm in dynamic environments.

WORK EXPERIENCE

Microsoft, India *June 2021 - Present*

Software Engineer

- Working in Azure Compute team, building a client workload certification pipeline which automatically detects failures, and ensures smooth functioning of the Azure services. This framework will further send failure reports to the corresponding teams and create IcMs for the same.

Robotics Research Center, IIIT - Hyderabad *May 2019 - Present (Part time)*

Researcher

- Worked on Object Goal Navigation task. Work accepted in CASE'22.
- Worked on improving the performance of Visual-Inertial Odometry (V-IO) algorithms in highly dynamic environments. Work accepted in IROS'21.

Matchday.ai *May 2019 - June 2019*

Computer Vision and Machine Learning Intern

- Worked on ML and CV pipeline. Included ground segmentation of football fields, player classification and tracking, integration of different camera views etc.

IIIT-Hyderabad, India

Teaching Assistant

- Embedded systems workshop (Approx 100 students) *Spring 2019*
- Linear Algebra (Approx 200 students) *Monsoon 2019*

RELEVANT COURSEWORK

Machine Learning and AI: Statistical Methods in AI, Probabilistic Graphical Models, Topics in Machine Learning (RL), **Robotics:** Mobile Robotics, Planning and Navigation **CS Theory:** Data Structures, Algorithms and Operating Systems, **Maths:** Probability and Random Processes, Linear Algebra and Graph Theory, Linear PDEs, **Other relevant courses:** Digital Image Processing, Computer System Organization, Signals and Systems

RELATED PROJECTS

Sparse Reward RL

- A self-lead research project trying to improve the learning of RL algorithms in sparse reward environments using asymmetric self play.

Gradient Evolution Code / Blog

- Rediscovering the idea of gradient evolution presented in **The Evolutionary-Gradient-Search Procedure in Theory and Practice** from scratch.

Evolution Simulation Code

- A simple simulation which simulates the evolution of simple organisms with simple traits such as speed, size, consciousness etc. using the Evolutionary Algorithm.

AWARDS, HONOURS AND ACCOMPLISHMENTS

- Winner of **Culture Award at Microsoft for Innovation**: Presented to be for developing a data-based solution that helped cut the cost incurred by the team by 3x.
- Winner of **ALA Cogment challenge at AAMAS**
- Winner of RL Hackathon by AIcrowd
- Winner of JKPMSSS scholarship

REFERENCES

Matthew E. Taylor *University of Alberta*
- Research Advisor
- matthew.e.taylor@ualberta.ca

Roopesh Rajamani *Microsoft*
- Software Engineering Manager
- roopesh.rajamani@microsoft.com

K. Madhava Krishna *RRC, IIIT-H*
- Research Advisor
- mkrishna@iiit.ac.in