

# Akshat Agarwal

<https://agakshat.github.io>  
aa7@cmu.edu | 412.628.5196

## EDUCATION

### CARNEGIE MELLON UNIVERSITY

#### MASTERS IN ROBOTICS

Exp. May 2019 | Pittsburgh, USA

GPA: 4.17/4.33

### INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

#### B.TECH. IN ELECTRICAL ENGINEERING

Minor in Artificial Intelligence

May 2017 | Kanpur, India

GPA: 9.4/10.0

## INTERESTS

Multi-Agent Systems

AI Safety and Transparency

Deep Reinforcement Learning

Human-Machine Teaming

Robotics and Electronics Design

## COURSEWORK

Deep Reinforcement Learning (A+)

Machine Learning (A)

Robot Autonomy (A+)

Math Fundamentals for Robotics (A)

Optimization Techniques for Machine Learning (A)

Multi-Agent Systems: Games,

Algorithms, Evolution (A)

Recent Advances in Computer Vision (A)

Probabilistic Mobile Robotics (A)

Robot Motion Planning (A+)

Image Processing (A)

Data Structures and Algorithms (B)

Probability and Statistics (A)

Digital Signal Processing (A)

Signals and Systems (A)

## TECHNICAL SKILLS

Github: <https://github.com/agakshat>

Languages: Python • C++ • MATLAB

Deep Learning: Pytorch • Tensorflow

Electronics: Altium Designer • EAGLE

Robotics: ROS • Arduino • Raspberry Pi

## WORK EXPERIENCE

### GRADUATE RESEARCH ASSISTANT | AART LAB

Robotics Institute, Carnegie Mellon University

Advisor: Katia Sycara | Oct. 2017 – present | Pittsburgh, PA

- Developing RL algorithms which can adapt quickly to changing environments and evolving teammates. I introduced Space Fortress as a testbed for the RL community.
- Making Deep RL methods more **interpretable** and transparent, to increase trust in humans, improve collaboration and ease debugging.
- Improving **AI safety** by introducing a neuroscience-inspired paradigm of RL

### CO-FOUNDER AND CTO | AGILO TECHNOLOGIES PVT. LTD.

Aug 2015 – Dec 2016 | Kanpur, India

- Spearheaded the development of **evive**, a pedagogical, open source Arduino powered electronics platform for hands-on learning of electronics and robotics.
- Led a successful **crowdfunding campaign on Indiegogo**, raising \$35k USD from over 350 backers in 33 countries and featuring in 25 magazines.
- Designed and implemented the control system and ROS interface for an industrial chemical reactor cleaning robot

## RESEARCH INTERNSHIPS

### INTERACTION LAB | UNIVERSITY OF SOUTHERN CALIFORNIA

Advisor: Maja Mataric | May 2016 – July 2016 | Los Angeles, CA

Worked on a project for exploring the acceptance of robot buddies by children with Autism Spectrum Disorder. Created multi-modal interactive games which interfaced with the MIT DragonBot, and developed ROS wrappers for allowing the robot to detect the child's facial responses in real time.

### IDEA LAB | INDIAN INSTITUTE OF TECHNOLOGY KANPUR

Advisor: Nishchal Verma | May 2015 – July 2015 | Kanpur, India

Developed the **Majority Vote Point** classifier and rigorously proved its generalizability by proving bounds on its VC dimension, along with empirically demonstrating its performance on diagnosis of machine faults from acoustic data.

## PUBLICATIONS

- "Better Safe than Sorry: Evidence Accumulation Allows for Safe Reinforcement Learning" (in review)  
**Akshat Agarwal**, Abhinav Kumar V, Kyle Dunovan, Erik Peterson, Tim Verstynen, Katia Sycara
- "Community Regularization of Visually Grounded Dialog" (in review)  
**Akshat Agarwal**, Swaminathan Gurumurthy, Vasu Sharma, Mike Lewis and Katia Sycara [[Paper](#) | [Code](#)]  
Also presented at ICML/AAMAS/IJCAI 2018 Adaptive Learning Agents Workshop and CVPR 2018 Visual Dialog Workshop [[Poster](#)]
- "Challenges of Context and Time in Reinforcement Learning: Introducing Space Fortress as a Benchmark" (in review)  
**Akshat Agarwal**, Ryan Hope and Katia Sycara [[Paper](#) | [Code](#)]

## ACADEMIC PROJECTS

- **Multi-Agent Reinforcement Learning for Visually Grounded Dialog [Paper]**

Course Project: Deep Reinforcement Learning (Prof. Ruslan Salakhutdinov)

The task of visually grounded dialog involves learning goal-oriented cooperative dialog between autonomous agents who exchange information about a scene through several rounds of questions and answers. We developed a Multi-Agent Dialog Framework where each agent interacts with multiple agents, and showed that this results in more relevant and coherent dialog (as judged by human evaluators) while outperforming all previous state of the art methods on task performance measured by quantitative metrics.

- **Symbiotic Localization [Report]**

Course Project: Robot Autonomy (Prof. Oliver Kroemer)

We developed a symbiotic localization system and deployed it on a pair of planetary rovers, enabling them to be localized with much greater accuracy than if they were operating alone. The relative bearing measurements were done using a HTC Vive Tracker, with obstacle detection and environment mapping handled by an Intel Realsense. We demonstrated leapfrogging behavior using only the relative bearing measurements by combining two TEB planners in ROS.

- **Emergent Reciprocity in Iterated Prisoners' Dilemma [Report]**

Course Project: Math Fundamentals for Robotics (Prof. Michael Erdmann)

Investigated the emergence of reciprocal cooperative behavior between artificial agents in the Iterated Prisoners' Dilemma. Using an approach which reasons about and anticipates the learning of other agents, and accounts for that while updating its own strategy, I implemented opponent modeling using an expectation-maximization approach which only requires the agent to observe its opponent's actions, hence removing a major assumption made in the paper.

- **Real-Time Obstacle Detection for Autonomous Vehicles [Report]**

Undergraduate Project (Prof. Gaurav Pandey)

Used stereo cameras to detect unoccupied on-road space in front of a vehicle, faster than real-time. We used a columnar representation similar to stixels to represent obstacles, reducing computational complexity.

- **Disparate Image Matching [Report]**

Course Project: Image Processing (Prof. Tanaya Guha)

Finding corresponding points between two images is a fundamental step for image matching, 3D reconstruction etc. We implemented the Duality Descriptor and the Multi-Modal Image Detector, a combination of which outperformed image matching algorithms like SIFT, SYMD and J-SPEC at much lower computational cost, while also being highly repeatable.

- **Quadrotor Localization and Landing [Report]**

Course Project: Probabilistic Mobile Robotics (Prof. Gaurav Pandey)

Integrated data from ArUco markers, PX4 optical flow sensors and IMU in ROS with an Unscented Kalman Filter and rotation compensation implemented from scratch, for localizing a quadrotor and landing it on the ArUco marker.

- **Underwater Search and Surveillance Vehicle [Report]**

Undergraduate Project (Prof. Bhaskar Dasgupta)

We built a wirelessly tele-operated underwater vehicle capable of manoeuvrability with 6 degrees of freedom, and implemented a PID controller for autonomous stabilization against water currents.

- **Dense Object Detection in Real Time [Report]**

Course Project: Recent Advances in Computer Vision (Prof. Gaurav Sharma)

Conducted a parameter study on the YOLO (You Only Look Once) CNN-based real-time object detection framework and obtained improved detection and localization results in cluttered scenes. We also adapted the YOLO network and trained it on the KITTI object detection benchmark.

## ACHIEVEMENTS AND AWARDS

- Selected for the "Leaders in Innovation Fellowship" by the Royal Academy of Engineering UK, and **won 1<sup>st</sup> place** in the elevator pitch competition among 60 participants.
- Won an Academic Excellence Award from 2014-16 at IIT Kanpur
- Received the prestigious KVPY Fellowship in 2013
- Top 1% in the National Standard Examination in Physics 2013 among 40,000 students
- All India Rank 429 in JEE Advanced 2013 (75000 students)
- All India Rank 129 in JEE Mains 2013 (1 million students)

## VOLUNTEER WORK

- Teaching Assistant (drafting and grading assignments and tests) for the **English Proficiency Program, IIT Kanpur**, to teach English to students and workers from underprivileged backgrounds
- Tutored academically weak students in Fundamentals of Computing, as a volunteer of the Counseling Service, IIT Kanpur
- Personally mentored 9 students through their freshman year to help them acclimatize to college life, as a volunteer of the Counseling Service, IIT Kanpur