

Faizan Muhammad

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EXPERIENCE

Google

July 2020 – Present

Software Engineer

Mountain View, CA

- Building an end-to-end Active Learning pipeline for an Anomaly Detection service that safeguards user experience
- Member of the Engineering Residency program that aims to develop the next generation of technology leaders

Tufts CS Department

Jan 2018 – May 2020

Research Assistant (with Prof. Jivko Sinapov & Prof. Matthias Scheutz)

Medford, MA

- Pioneered the Novelty Handling capabilities of the Tufts AI agent for the DARPA SAIL-ON challenge [1]
- Achieved top results in independent evaluations and led a team to publish the system architecture [9]
- Developed and published an Augmented Reality interface for Human-Robot Interaction [2][10]
- AR interface won \$100K funding from Verizon 5G EdTech Challenge and is still an active project in the lab

CTRL Labs (acquired by Facebook)

May 2019 – August 2019

Software Engineering Intern

New York City, NY

- Interfaced a hexapod robot with a neural interface for neuromuscular teleoperation [3]
- Demoed this experience for the taping of an NPR show episode regarding CTRL Labs [16]
- Devised features for physically contextualized interactions with real-world objects through the neural interface
- Patented these features after prototyping and demonstrating their feasibility

Center for Engineering Education and Outreach (CEEEO)

Dec 2016 – Aug 2017

Research Assistant (with Prof. Ethan Danahy)

Medford, MA

- Created a RESTful API for lab-based IoT devices such as a web-controlled lab sign
- Developed computer vision software to digitize classwork and enhance student engagement and collaboration
- Demonstrated the software by creating a robot programming framework that used paper drawings as code [4]

International Mathematical Olympiad 2016

Sep 2015 – Jul 2016

Participant

HKUST, Hong Kong

- Selected and trained in Algebra, Number Theory, Combinatorics and Geometry for the Pakistani team
- Learned advanced mathematical problem solving skills and represented the country on an international platform

EDUCATION

Tufts University

Sep 2016 – May 2020

Bachelor of Science in Computer Science

Medford, MA

GPA: 3.95 **Honors:** Summa Cum Laude, Lieutenant Commander Robert James Manning Prize

Core Courses: Data Structures, Algorithms, Computation Theory, Programming Languages, Machine Architecture

Elective Courses: Reinforcement Learning, Intro. to Machine Learning, Probabilistic Robotics [5], Autonomous Intelligent Robotics, Computer Vision, Human Robot Interaction, Intro. to Computational Models in Cognitive Science, Ethics for AI

Other Relevant Courses: Digital Circuits [6], Discrete Mathematics, Linear Algebra, Calculus (1, 2 and 3), Logic (Philosophy), Probability and Statistics, Cultures in Computing (Anthropology), Neurobiology

Activities: President @ Tufts Robotics Club [7][11], Co-Organizer @ URSS [12], Founder @ IDIAS [13], Actor/Director @ Hype Mime Troupe [14], Foilist @ Tufts Fencing Club

TECHNICAL SKILLS

Languages: C++, Python, Java, Golang, C#, C, Matlab, VHDL

Frameworks and Tools: ROS, Unity, Git, Docker, IntelliJ, Visual Studio

Libraries: OpenCV, Tensorflow, Scikit, Pandas, NumPy, Matplotlib

Crafting: Laser Cutting, 3D Printing, Circuitry

PROJECTS

- [1] **Novelty Oriented AI Agent for DARPA SAIL-ON** | *Java, C, Python* Tufts CS
- SAIL-ON challenge was created by DARPA to encourage development of AI that can adapt to change
 - Tufts team aims to build a cognitive architecture integrating symbolic approaches (Planning, Logical Reasoning etc.) and neural approaches (Reinforcement Learning, Deep Learning etc.) to participate in this challenge
 - Pioneered development of this architecture, focusing on developing an extensible framework
 - Agent achieved top performance in independent external evaluations against other approaches
 - Led a group of graduate and undergraduate students to publish the system architecture [9]
- [2] **Visualizing a Robot's Perspective in Augmented Reality** | *ROS, Unity, C++, C#, Python* Tufts CS
- Need for a fast, high-bandwidth and accessible medium to convey robot states for Human Robot Interaction
 - Proposed the project for Tufts Summer Scholars and received fellowship and funding to pursue it [15][17]
 - Supports visualizations of robot perception, belief and planning in AR through HoloLens and mobile devices
 - Published the system architecture [10] and won \$100K in further funding from Verizon 5G EdTech Challenge
- [3] **Robot Teleoperation through Neuromuscular Control** | *Golang, Docker, Proprietary Tech.* CTRL Labs
- Humans are capable of very fine control over wrist and hands that can be exploited for next-gen control interfaces
 - Mapped EMG-based readings of muscle activations to a hexapod's appendages for crawling and kicking behaviour
 - Demoted this experience for the taping of an NPR show episode regarding CTRL Labs [16]
- [4] **Programming Robots through Paper Worksheets** | *OpenCV, C++, LabVIEW* CEE0
- Devised a worksheet template format to specify subsections and used Computer Vision to extract them
 - Demonstrated system capabilities by programming LEGO Mindstorms robots through symbolic paper drawings
- [5] **Sound Based Robot Localization** | *Matlab, Machine Learning* Probabilistic Robotics Class
- Indoor navigation for robots in changing physical spaces is difficult due to reduced mapping abilities
 - Some acoustic properties of a room are dependent on room structure and can be used to uniquely identify them
 - Used a Sine Sweep to generate Room Impulse Response (RIR), extract features and train a 90% accurate SVM
- [6] **Clappy Bird** | *VHDL, FPGA, Lattice Radiant* Digital Circuits Class
- Recreated the popular game Flappy Bird in an FPGA using clapping sounds as the means to control the game
 - Developed digital circuits in VHDL and Lattice Radiant to implement the game logic and VGA rendering
 - Game logic and VGA rendering was done completely through clocks, flip-flops, latches and multiplexers
- [7] **Trinity Firefighting Robot Contest** | *ROS, C++, Arduino, Raspberry Pi, Sensors* Tufts Robotics Club
- Yearly international contest held in Trinity College that simulates a fire-emergency in a miniature environment
 - Led the development of the club's first ROS-enabled robot capable of SLAM and point-to-point navigation
 - Won the Olympiad in Senior Individual Category in 2018 and 2019

PUBLICATIONS

- [9] **A Novelty-Centric Agent Architecture for Changing Worlds** Submitted to AAMAS 2020
- Outlines and evaluates the agent architecture developed for the DARPA SAIL-ON challenge [1]
Currently awaiting acceptance decision
- [10] **Creating a Shared Reality with Robots** HRI 2019
- Presents the system architecture for the Augmented Reality Robot Interface [2]
Citation: *Muhammad, Faizan, et al. "Creating a shared reality with robots." 2019 14th ACM/IEEE International Conference on Human-Robot Interaction (HRI). IEEE, 2019.*
Paper Link: <https://ieeexplore.ieee.org/abstract/document/8673191>
Demo Link: <https://youtu.be/WjxJnggaNr8>
Talks given at:
- * HRI Conference Late-Breaking Report Track, Daegu, South Korea (2018)
 - * Tufts Summer Scholars Presentation Session (2018)
 - * Tufts Engineering Advisory Board (2019)
 - * Tufts Campaign Committee (2019)

ACTIVITIES

- [11] **Robotics Club @ Tufts** | *President* 2018 - 2019
- Led development of projects such as fire-fighting robots [7] and the Tufts teams in robotics competitions
 - Improved diversity, accessibility and member retention through reimagination of club roles and support system
 - Encouraged modular and iterative design and development to allow for material reuse and improved performance
- [12] **Undergraduate Research and Scholarship Symposium @ Tufts** | *Co-Organizer* 2019 & 2020
- Held annually to showcase the work of hundreds of student researchers through presentations, panels and posters
 - Managed logistics for marketing, submissions, presentations, documentation and event management
 - Reinvented the conventional symposium into a virtual experience due to the COVID pandemic
- [13] **Interdisciplinary Data Intensive Applications Society @ Tufts** | *Founder* 2019 - 2020
- Provides a platform for collaboration across diverse domains including robotics, environment, sociology and sports
 - Optimized for learning, skill-sharing and community-building by prioritizing the cohort experience for newcomers
 - Organizes hackathons focused on common tools (Colab, Jupyter, Py Libs) and applications (NLP, GIS, Ethics)
- [14] **Hype! Mime Troupe @ Tufts** | *Actor, Writer, Director* 2016 - 2020
- Produced skits for university-wide shows every semester telling human stories in a minimalistic format [18]
 - Collaborated with other performance groups for fundraising and outreach shows

PRESENTATIONS AND MEDIA

- [15] **Research and Activism Forum** Tisch College
- Invited as a panelist to talk to the new cohort of Tufts Summer Scholars and other undergraduate researchers about the intersection of research and activism in AI
- Article Link: <https://tischcollege.tufts.edu/news/tufts-students-discuss-research-and-activism>
- [16] **Digital Telekinesis For the Future You?** Future You @ NPR
- Introduces the technology behind CTRL Labs and their neural interface, CTRL Kit. Includes the demo of my neuromuscular teleoperation project there [3]
- Video Link: <https://youtu.be/cdZLg4IORc0>
- [17] **Hands-on Research for Undergraduates** Tufts Now
- Features the Augmented Reality project [3] and my experience with Tufts Summer Scholars
- Article Link: <https://now.tufts.edu/articles/hands-research-undergraduates>
- [18] **Mime Skits Playlist** Hype! Youtube Channel
- Features some of the mime skits I have been involved with as an actor, director or writer [14]
- Playlist Link: https://www.youtube.com/playlist?list=PL74VX_wnv15E9dwS8Zwey6lO_8Y6gSIa6s