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

Department of Computer Science, Tufts University Jan 2018 – May 2020
Research Assistant (with Prof. Jivko Sinapov, Dr. Vasanth Sarathy & 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 (CEEO) 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#, SQL, C, Matlab, VHDL

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

Libraries: OpenCV, Tensorflow, Apache Beam, 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
- Demoed this experience for the taping of an NPR show episode regarding CTRL Labs [16]

[4] Programming Robots through Paper Worksheets | *OpenCV, C++, LabVIEW* — CEEO

- 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 — AAMAS 2021

Outlines and evaluates the agent architecture developed for the DARPA SAIL-ON challenge [1]
Accepted for AAMAS 2021 as a full paper to be published after the conference.

[10] Creating a Shared Reality with Robots — HRI 2019

Presents the system architecture for the Augmented Reality Robot Interface [2]

Citation: *Muhammad, F., Hassan, A., Cleaver, A., Sinapov, J. (2019, March). Creating a shared reality with robots. In 2019 14th ACM/IEEE International Conference on Human-Robot Interaction (HRI) (pp. 614-615). IEEE.*

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-andas-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