RITAM MUKHERJEE

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EDUCATION

University of Waterloo **Expected May 2030**
Bachelor of Applied Science in Mechatronics Engineering *Waterloo, Ontario*

EXPERIENCE

Robotics Engineer **Sep 2026 – Present**
WATonomous *Waterloo, Ontario*

- Built the teleoperation data pipeline for a MuJoCo-simulated humanoid arm in ROS 2, streaming joint states and time-synchronized camera data and encoding demonstrations into LeRobot format; recorded a 25-episode imitation-learning dataset for a 4-stage long-horizon manipulation task.
- Traced corrupted demonstrations to dropped joint-state packets, raising publisher frequency and adding state estimation to reconstruct the missing samples.
- Training an ACT visuomotor policy for closed-loop control on the recorded RGB and joint-state episodes.

Student Researcher (Perception) **Aug 2026 – Present**
University of Waterloo, WATiMAKE Lab (Prof. Eugene Li) *Waterloo, Ontario*

- Synchronized two camera views of judo throws to within 1 frame at 30 fps across 12 clips using 2D pose estimation (RTMPose, Pose2Sim), the calibration step before 3D reconstruction.
- Automated position detection from HALPE-26 keypoints (head below the shoulder line, normalized by torso length), with a whole-clip correlation fallback.
- Resampled variable-frame-rate footage to constant rate with FFmpeg and added an independent second-event consistency check, reaching 0-frame disagreement.

Student Researcher (Robotics) **Sep 2025 – May 2026**
University of Waterloo, NanoTech Lab and RoboHub (Prof. Shirley Tang) *Waterloo, Ontario*

- Built a mesh-to-toolpath motion planning pipeline for non-planar printing on curved geometry (femur STL), generating raster and surface-normal paths via raycasting with a 15 mm cap on trace-point spacing.
- Defined a canonical toolpath schema with explicit frame, unit and quaternion conventions plus calibrated TCP-offset resolution, replacing per-script ad-hoc formats.
- Ran generated toolpaths on a physical 6-DOF arm, then hardened the executor into a fail-closed boundary: dry-run by default behind workcell preflight and hash-bound state review.

Software Engineering Intern **May 2026 – Aug 2026**
SuraNeoAge Systems Transformations (Financial NLP) *Remote*

- Built the ingestion-to-training data pipeline (PostgreSQL, FastAPI, Temporal, Docker, AWS, CI/CD) end to end, and fine-tuned FinBERT (110M params) for company NER at 0.76 token F1 / 0.88 recall.
- Fine-tuned Phi-4 Mini (3.8B params) via QLoRA for entity and topic extraction across 2,700+ articles; outperformed the base model and GPT-4o mini in a 100-article blind comparison.

PROJECTS

Autonomous Navigation Stack | *GitHub*
ROS 2, C++, Gazebo, Foxglove

- Built costmap, map memory, A* path planning and pure-pursuit control nodes in ROS 2/C++, driving a rover in simulation to user-clicked goals through an obstacle field on a 20 m × 20 m grid at 0.1 m resolution.
- Eliminated chassis collisions by planning and steering from the chassis centre rather than the lidar-referenced odometry frame (0.8 m offset), and inflating the footprint 0.13 m past the 1.12 m circumscribed radius to absorb pure-pursuit corner cutting.
- Doubled traverse speed to 1.0 m/s, scaling lookahead to 1.8 s of travel and raising the yaw-rate ceiling to preserve the turning radius.

QuantLab | *GitHub* | *Live*
Python, PyTorch, pytest, TypeScript

- Implemented per-tensor, per-channel and group-128 weight quantization for GPT-2 from scratch in PyTorch, sweeping 24 configurations across 48 transformer matrices: 4-bit per-tensor drives perplexity from 26.3 to 5,939, while group-128 asymmetric recovers it to 26.5 at the same bit width.
- Covered the quantization math with 11 property-based unit tests asserting invariants rather than shapes: exact round-trip on the grid, error bounded by half a step, finer groups never worse than coarser ones.

Anthropomorphic Robot Hand
SolidWorks, ESP32, PCA9685, OpenCV

- Built the OpenCV finger-tracking for a 5-DOF tendon-driven 3D-printed hand, mapping webcam flexion to servo angles through per-finger calibration curves.
- Traced a 10° gap between CAD and printed joint travel to pin-joint and tendon-channel tolerance; opening those clearances brought it under 1°.

TECHNICAL SKILLS

Languages: C++, Python, TypeScript, JavaScript, SQL, Bash
Robotics: ROS 2, MuJoCo, Gazebo, LeRobot, MoveIt, Pinocchio/MeshCat, Foxglove Studio, Path Planning (A*), Motion Planning, Pure-Pursuit Control, Kinematics (FK/IK), State Estimation (EKF/UKF), Odometry, Teleoperation, Simulation, SolidWorks
Perception & ML: OpenCV, PyTorch, Computer Vision, Pose Estimation (RTMPose, Pose2Sim), Imitation Learning, Deep Learning, NumPy, FFmpeg
Software: Linux, Git, Docker, CI/CD, pytest, Unit Testing, Debugging, REST APIs, Databases (PostgreSQL), Embedded (ESP32, servos), Real-Time Pipelines, AWS