Abhinav Peri

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Education

UT Austin Turing Scholars:

Completed Classes:

- CS 439H: Operating Systems Honors
- CS 377P: Programming for Performance
- M427L: Vector Calculus Honors
- CS314H: Data Structures Honors
- CS311H: Discrete Math Honors
- CS178H: Intro to CS Research Honors
- CS429H: Computer Architecture Honors
- M362K: Probability
- M427J: Differential Equations with Linear Algebra
- CS394R (Graduate Course): Reinforcement Learning

Skills

Coding Skills:

- LabVIEW, Java, Python, C, Git, Linux/Ubuntu, Verilog

AI/ML/RL Development:

- PyTorch, PyTorch Lightning, PyTorch Geometric
- TensorBoard, Optuna, Gym, Robosuite, Mujoco

Robotics(Rovers and Drones):

- ROS/ROS2, OpenCV, Controls Theory, Practical Robotics Experience, PX4, Gazebo, Nav2, Isaac Sim

Team Management:

- Team Lead of 10 Programmers, DevOps with Git, Task Delegation, Creating Roadmaps

UT-Austin Activities

Activities:

- Participating in UT's **RL reading group** (January 2024 - Present)
- Doing research for UT's **MIDI** Lab (January 2024 - Present)
  - Working on various papers centered around teaching a **6DOF UR5e** robot to play air-hockey with **Reinforcement Learning**
- Worked with the **Texas Aerial Robotics Group** (August 2023 - December 2023)
  - Learned about **PX4** and various other tools used for UAV software developent
  - Wrote a controller to make a drone autonomously track **AprilTags** in **ROS2**

Class Projects:

- Implemented a **physics engine** in as extra credit using a Bounding Volume Hierarchy (video1, video2) for CS 314H (Data Structures)
- Implemented an **interpreter**, **compiler** in C for a custom language with **functions, control flow, and arithmetic** in CS 429H (Computer Architecture)
- Implemented an **emulator** for a subset of the ARM instruction set in CS 429H
- Implemented the **heap**, and **co-routines**, in C for CS 429H
- Implemented a **pipeline** in **Verilog** for a custom ISA in CS 429H
  - Uses **stalling, forwarding,** and **branch prediction** to reduce CPI as much as possible
- Implemented **DP, Monte Carlo, N-step, Sarsa Lambda,** and **Reinforce** as class assignments for CS 394R (Reinforcement Learning)
- Implemented **AlphaZero** on Connect 4 as a final project for CS 394R
- Implemented a kernel with **preemptive multithreading, reference counting, ext2 file system, virutal memory, mmap,** and **basic syscalls** in CS 439H
- Linked in subset of **OpenGL** for final project

Work Experience (Interim Secret Clearance)

UAV Swarm Drone Development Intern at CACI: (5/28- 8/16 2024)

Leadership:

- Set the roadmap to better define, adapt, and solve highly nonlinear project requirements
- Mentored many full time employees in ROS2, Ubuntu, PX4, and general hardware experience
- Led various meetings to brainstorm project structure, teach new concepts, and coordinate team strategy

Skills Used (Majority of work is classified):

- Self learned **ROS2**, parts of **DDS** middleware, the **PX4** firmware, **Gazebo**/**ISAAC SIM** simulation, navigation software stack architecture, and the bring-up of real flight hardware
- Integrated 2D LiDAR SLAM based navigation example in Nav2 with a custom Gazebo drone model running PX4 firmware

Intern at NASA JSC: (7/1 - 8/14 2023)

Leadership:

- Managed a project involving a rover to autonomously navigate a rock yard simulating extraterrestrial environments
- Delegated various tasks like **telemetry**, **kinematics**, **path following**, and **path generation**
- Worked at a high level to unblock teammates and solve major project issues

Implementation:

- Created a **multiprocessed/multithreaded** setup through SSH on a Raspberry PI
- Implemented sensor fusion for LSM6DSOX + LIS3MDL IMU and GPS sensor using the **Madgwick** and **Kalman Filters**
- Experimented with **ORBSLAM 3** using a Realsense Depth camera

Associate at KatanaGraph: (May - September 2022)

- Assisting with the AI pipeline development within the HLS department to accelerate Drug Discovery
- Worked on AI Models for **predicting drug-target interactions** and **synthetic lethality**
- Recreated and developed AI Models using **PyTorch**, **PyTorch Geometric**, **PyTorch Lightning**, **Tensorflow**, and **Tensorboard**
- Working DeepCDR Reimplementation
- AGMI Reimplementation (unable to recreate results)
- Tuned hyperparameters using **Optuna**, and managed training/logging in a **GPU Cluster**
- Experimented with frameworks for graph rewiring such as **Graph Ricci Curvatures** and **Neural ODEs**

High School Robotics (2019-2023)

2023 FRC Charged Up Robotics Season (code not public)

- Implemented **homography** based **pose estimation** from **apriltags** using **ROS**
- Improved swerve codebase and turned it into an easy-to-use template
- Developed better models of mechanisms using **motor physics** and **latency simulations**
- Wrote PID-based controls/state machine for the cascade/wrist scoring mechanism
  - Used **motion profiling** within a **state machine** for cascade movement and a state machine for scoring positions
- Managed **integration** through git and creating various tools and commands for ease of codebase usage and setpoint tuning
- Implemented a **Kalman Filter** in LabVIEW

2022 FRC Rapid React Robotics Season

- Experimented with coprocessor based vision processing **(Used ROS)**
- Wrote our FRC team's first swerve codebase, implementing the necessary **kinematic models**, substitutions, and etc
- Wrote a custom dashboard for getting the robot ready for matches
- LabVIEW **Trajectory Optimization** implementation from this website

2021 FRC Infinite Recharge Robotics Season

- Won various awards for autonomous at home challenges and at the Texas Cup tournament

2020 FTC Skystone Season

- Learned **OpenCV** to write our Skystone detection pipeline
- Learned basic control methods like **PID**, **Motion Profiling**, **Path following**, and **Trajectory Generation**

Miscellaneous Personal Projects

- Implementing the DeepNash algorithm to solve the game of Stratego (2024)
- Implemented **Computer Vision** Algorithms (**Homography** and **Monocular Visual Odometry**) for localizing robots (2020 summer)
- Wrote a **ROS** program that controlled an MIT Racecar build to follow walls using its onboard **LiDAR** sensor (2020 summer)
- Implemented an **MLP from scratch** using numpy which successfully classified MNIST digits (2021 summer)
- Implemented a **ResNet** using **PyTorch** to classify a kaggle dataset of cardiograms from pneumonia patients (2021 summer)
- Used an **LSTM** model which I used to solve the **OpenAI XOR Warmup Problem** (2021 summer)
- Implemented **Graph Neural Networks** using **PyTorch Geometric** to classify the PPI Dataset (2021 fall)
- Implemented a **Fourier Epicycles** demo that draws shapes using spinning arrows (2022 summer)