KAREEM ELSAWAH

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OBJECTIVE

Create a lasting positive impact by utilizing my experience in autonomous vehicles, robotics, and machine learning. Specifically, I am seeking challenging applied research opportunities where I can apply knowledge from various fields, such as perception, control, planning, and generative models, in real-life settings with significant impacts.

EDUCATION

MSc in Applied Computing, University of Toronto, Department of Computer Science   Expected Dec 2024
Courses: ML for healthcare, Computer Vision for Robotics, Algorithmic Fairness, Statistical Learning Theory

Bachelors (Hons) of Computer Engineering, Ain Shams University   Sep 2018 - July 2023
Specialization: Data Science   GPA: 3.89, Ranked 1st/130 students
Thesis: Autonomous Drones for Environment Mapping
- Implemented **real-time off-board Stereo Visual SLAM** for drones in GPS-denied environments.

EXPERIENCE

Autonomous Racing, Team Leader   Nov 2019 - July 2023
ASU Racing Team   *Cairo, Egypt*

- Led Formula AI and Shell AI teams for the 2021 and 2022 seasons, winning several international awards. The 2021 system is described in this research gate article.
- Developed a **LiDAR**-based cone detection pipeline achieving sub-centimeter accuracy at higher than 100 fps.
- Created heuristic and **transformer-based planners** achieving robustness to extremely noisy perception.
- Implemented **Graph-SLAM** using LiDAR-based Odometry for creating a map of cones in real-time.
- Implemented **Model Predictive Control** for obtaining, updating, and following the optimal racing line, in the lap-time sense, at 10 fps.
- Completed a full-autonomous lap using a **previously unseen vehicle** in the Formula Student UK competition using less than a total of 6 hours for testing.
- Held a summer AI & Robotics workshop with over 200 applicants filtered to over 50 participants.

Machine Learning Intern   July 2022 - October 2022
Microsoft, Advanced Technology Lab   *Cairo, Egypt*

- Implemented various transformer-based baselines for low-resource machine translation.
- Improved the baseline for **low-resource machine translation** by 4% (BLEU) using rescoring during training rather than inference (language model prior).

Perception Engineering Intern   Jan 2021 - Sep 2021
ARL, Autotronics Research Lab   *Cairo, Egypt*

- Fused LiDAR and RGB Cameras to detect objects in 3D using **PVCNN**.
- Tracked objects in 2D and 3D using **SORT**, **DeepSORT**, and similar 3D variants.
- Created a visualizer in **Unreal Engine** to view all of the cars' perceptions (surrounding cars, lanes, etc.)

Junior Machine Learning Engineer   Aug 2021 - Oct 2021
Omdena

- Performed **data wrangling**, cleaning, and pre-processing on raw SQL data for a real-life problem.
- Created early baselines using **SARIMAX** and implemented a **Bayesian AR** model using PyMC3 with a learned prior enabling few-shot learning.

PROJECTS

Scalable Latent Neural SDEs: A novel method that improves neural stochastic differential equations in terms of **scalability** compared to previous methods, specifically for the latent SDE model where observations over time are assumed to be a function of some continuous-time stochastic latent function; this has the advantage of being able to use **irregularly sampled observations** while being computationally lighter compared to previous latent neural SDE methods.

GANVAS: PyTorch implementation of various **generative models** including: Autoregressive models, Normalizing Flows, Variational Autoencoders, and Denoising Diffusion models.

Why: a **causal inference** library for structural causal modeling and identification. "Why" implements a variety of algorithms including the PC algorithm for causal discovery; GNN and CGNN for edge orientation; COM, GCOM, and TARNet estimators; Backdoor adjustment; Bounds and Sensitivity analysis.

Zeta: Implementation of **REINFORCE**, **A2C**, and **PPO** from scratch using only NumPy including an implementation of a deep learning framework with CNNs. Trained on several OpenAI gym environment. Additionally, created a 3D physics engine from scratch to create custom environments such as a walking spider and a drone.

AWARDS

Formula AI, 5th place UK, 2023

Dell - Hacktrick.23, 2nd place Egypt, 2023

International Conference on Smart Cities Competition, 2nd place Egypt, 2023

Shell Eco-Marathon, Pitch the future, 1st place Global, 2022

Shell Eco-Marathon, Autonomous Programming, 5th place Global, 2022

Machathon 1.0, 2nd place Egypt, 2020

AI Crowd, AI Blitz 3, 4th place Global, 2020

SKILLS

Machine/Deep Learning: PyTorch, NumPy, Pandas, Scikit-learn
Topics: Computer Vision, Generative Models, Probabilistic Graphical Models, Reinforcement Learning, Causal Inference, NLP
Programming Languages: Python, C++, Javascript
Software Frameworks: ROS, Flask, Node.js
Game and Simulation Development: Unreal Engine 4/5, Blender, CoppeliaSim, AirSim, Carla

EXTRA-CURRICULAR ACTIVITIES

Technical Team Leader, STP   Oct 2020 - March 2023

- Organized the Machathon 4.0 **autonomous driving competition** using both simulations and real-life cars.
- Led three teams to deliver workshops on Machine Learning, Web & Cloud, and Python & Arduino with a focus on projects and implementing algorithms from scratch.
- Organized the Machathon 3.0 competition with a focus on Computer Vision: **reading car license plates**.
- Delivered advanced sessions on Machine Learning with a focus on Natural Language Processing.
- Organized the Machathon 2.0 competition with a focus on **Arabic NLP**.