TOLGA AKTAS
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EDUCATION

Rochester Institute of Technology   August 2021 - Present
Doctorate in Imaging Science
- **Coursework:** Noise & Random Signal Modelling, Fourier Methods in Imaging, Radiometry, Human Visual System, Image Processing, Computer Vision, Deep Learning for Computer Vision
- **Research Area:** Lifelong Machine Learning, Self – Supervised Learning

University of Rochester   August 2015 - *May 2020*
Bachelor of Science Electrical & Computer Engineering, Minor in Computer Science
- **GPA:** 3.6 out of 4.0
- **Relevant Coursework:** Deep Learning, Computer Vision, Reinforcement Learning, Digital Signal Processing, Image Processing, Autonomous Mobile Robotics, Stochastic Processes, Computer Audition, Data Mining, Detection & Estimation Theory
- **Tools & Skills:** C++, Python, Java, Tensorflow, PyTorch, ROS, CUDA C, OpenGL, C*,* Keras, MATLAB, Scikit-Learn, CMake
- **Online Learning:** *Deep Reinforcement Learning*, *AI For Healthcare,* Modern C++, Natural Language Processing, PyTorch DL Fellowship, Private & Secure AI, Neural Networks and Deep Learning, Convolutional Neural Networks, Sequence Models (Recurrent Neural Networks), Structuring ML Projects, Improving DNNs: Hyperparameter tuning, Regularization and Optimization

ELECTRICAL ENGINEERING AND COMPUTER SCIENCE EXPERIENCE

Research Assistant, kLab, Rochester Institute of Technology   *October 2021 - Present*
- Investigating the use of SwinTransformer model as a general backbone for visual understanding and integrating it into REMIND model of Hayes et. al 2020 using **PyTorch**.
- Studying alternative self-supervised learning architectures for lifelong machine learning tasks.

Software Engineering Intern, Google Geo 3D & Photogrammetry   *May 2020 – September 2020*
- Implemented a 3D reconstruction pipeline in **C++** for camera parameter estimation and dense point cloud generation towards building a high-fidelity textured 3D reconstruction from satellite imagery.
- Implemented image filtering algorithms in **Python** for texture processing, feature extraction and building contour detection, and super-resolution tasks on 30cm multi-spectral satellite imagery.

Research Assistant, VISTA Lab at University of Rochester   *October 2019 – April 2020*
- Investigated different visual and text embedding models for improving the accuracy on Visual Question Answering (VQA) tasks. Studied style-conditioned GAN model literature for high-fidelity image generation tasks.

E5 Entrepreneurship Fellow, Ain Center of Entrepreneurship at University of Rochester   *September 2019 – April 2020*
- E5 is a competitive fellowship granted to U of Rochester students with an entrepreneurial mindset in order to pursue their entrepreneurial efforts as part of their undergraduate education.
- Lead a project that aims to design a wearables-based solution to provide real-time workout activity recognition and tracking.
- Implemented signal processing methods for cleaning ECG, EMG and accelerometer data and detecting salient biometric features for real-time exercising analytics.
- Designed different experiment settings for building an annotated dataset of ECG, EMG and accelerometer data to be collected during workout sessions.

Software Engineering Intern, Qualcomm Technologies Inc.
Extended Reality (XR) Systems   May 2019 – September 2019
- Built OpenGL ES application in **C++** for avatar rendering using OBJ files developed in Autodesk Maya.
- Implemented eye-tracking algorithm in **C++** to integrate eye tracking capabilities
- Implemented facial landmark detection and tracking algorithm in **C++** to add real-time gesture tracking capabilities
- Worked on variational/conditional VAE to generate avatar facial texture images using **TensorFlow.**
- Investigated deep learning-based methods for alternative generation of occluded facial landmarks from speech and/or occluded image.

Xerox Undergraduate Research Fellow, Robotics & AI Lab, University of Rochester   June 2018 – August 2018
- Explored hardware architecture models on different platforms to perform prediction and perception tasks more efficiently and faster for real-time robotic operations
- Implemented perception, mapping, localization and controller algorithms in **C++,** built a **ROS**-based software stack for mobile robotics.
- Set up experiments and built an image dataset of moving robots & objects collected from TurtleBot 2.
- Gained practical and theoretical experience in parallel programming and optimization on **CUDA C**.

PUBLICATIONS
- Songyang Zhang, **Tolga F. Aktas**, Jiebo Luo, "Mi YouTube es Su YouTube? Analyzing the Cultures using YouTube Thumbnails of Popular Videos"
- Ian Lawson, Gazi Naven, **Tolga F. Aktas** "Speech Accent Classification and Unsupervised Accent Clustering"

PROJECTS

Fully Autonomous Mobile Robots:
- Built a fully autonomous system on TurtleBot-II for CSC 232: Autonomous Mobile Robots final challenge. Extensively used **ROS**, **C++** and **Git** control throughout the semester-long project.
- Built modules on ROS runtime for simultaneous localization and mapping, perception, path-finding controller, *A* search* path planner for shortest distance path to the goal points.

DotLip: Lip Reading with Deep Neural Nets
- Implemented a spatio-temporal CNN + recurrent neural network architecture in **Tensorflow** and **Keras** for performing lip-reading transcription from image and image + audio.

Wavelet-based Statistical Speckle Reduction in Ultrasound Images
- Implemented the statistical filtering methods in **Python** proposed by Gupta et. al (2004) for reducing speckles in medical ultrasound images.
- Implemented 12 filtering methods and evaluated their comparative performance on edge preservation and noise suppression.

Speech Source Separation using Deep Neural Networks
- Implemented fully connected and LSTM-based neural networks to separate human voice from the background audio waveforms in **PyTorch**.

English Accent Classification from Speech
- Implemented clustering algorithms to apply an unsupervised learning scheme to map different voice datapoints into different clusters.
- Implemented a Bidirectional LSTM with Attention mechanism to classify different English accents from speech in **PyTorch**

Senior Capstone: Real-time Library Patron Monitoring
- Implemented human body detection and tracking algorithms using **Tensorflow**.
- Built a full-stack solution using **Vue.js**, **NodeJS** and **MySQL** to process and store anonymized human body count and location for librarian personnel's use.

Online Learning Projects

Sequential Models and Applications
- Trained a LSTM-based neural network by using both **Tensorflow** and my own implementation of LSTM for generating 30-second long Jazz-style audio files.
- Implemented RNN and LSTM networks from scratch for character-level language modelling using **Numpy**, for learning word embedding matrices, and debiasing the embedding model in terms of gender.
- Implemented and experimented with Attention networks for machine translation tasks, and a simple trigger word detection algorithm using **Tensorflow**.

Convolutional Neural Networks with Applications
- Implemented the forward & backprop algorithms for CNNs, auxiliary functions, residual convolutional networks using **Python**.
- Implemented the YOLO algorithm for a car detection and localization task, a CNN algorithm using **Tensorflow** for face recognition and detection tasks.

Natural Language Processing
- Studied part-of-speech (PoS) tagging, named entity recognition, stemming and lemmatization, stop word removal using **NLTK** toolkit. Built an elementary Bayes Spam Classifier to detect spam emails. Studied Hidden Markov Models (HMM), implemented Viterbi algorithm. Built a HMM for PoS tagging.
- Studied NLP feature extraction methods and paradigms such as bag of words, TF-IDF, word embeddings, word2vec, GloVe, DL-based embeddings, t-SNE. Studied and implemented topic modelling using Latent Dirichlet Analysis (LDA). Implemented and compared gradient-boosted DT classifier and RNN for sentiment analysis.
- Studied sequence-to-sequence encoder-decoder models, attention models, self-attention and transformers. Implemented word preprocessing, simple RNN, RNN with embeddings, Bidirectional RNN, and encoder-decoder RNN models for end-to-end machine translation from English to French using **Keras**.
- Created and deployed an Amazon Alexa skill using **Alexa Skills Kit (ASK)**
- Studied the fundamental topics in Automated Speech Recognition (ASR) such Fourier analysis, feature extraction with MFCC, DL for speech-to-text translation tasks, Connectionist Temporal Classification (CTC) loss function. Implemented and compared the performance of RNN, RNN + TimeDistributed Dense (TDD), CNN + RNN + TDD, Deep RNN + TDD, Bidirectional RNN + TDD neural networks using **Tensorflow** and **Keras** for end-to-end ASR task.

Modern C++ Development
- Built a system monitoring application like htop in practicing advanced OOP techniques.
- Studied modern memory management paradigms of C++ such as memory allocation types, dynamic memory allocation, memory copying policies, move semantics, smart pointers. Optimized the memory management of an example chatbot application using smart pointers and move semantics.

- Studied multithreading concepts such as running threads, data passing, mutexes and locks. Built a multithreaded traffic simulator using a real urban map

Deep Reinforcement Learning
- Introduction to Deep RL:
  - Implemented Monte Carlo prediction for estimating action-value function, and constant – alpha MC control for estimating optimal policy.
  - Implemented TD Control Sarsa, TD Control Q – learning (Sarsamax), Expected Sarsa algorithms for studying Time Difference methods.
  - Implemented an RL algorithm in **Python** to train a taxi agent in OpenAI Gym's Taxi-v2 environment to pick passengers and drop off at correct locations.
- Value – Based Methods:
  - Studied Deep Q-Network (DQN) algorithm and relevant early literature, implemented DQN to solve **OpenAI Gym's LunarLander** environment, using **PyTorch**. Further studied improvements on DQN such as Double DQN, Prioritized Experience Replay, Dueling DQN and implemented Double DQN algorithm.
  - Implemented and trained a RL agent that uses DQN in **Unity ML-Agents** environment to navigate a flat world environment and collect reward points.