Leron K. Julian

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Research Interest

My research interest lies in the intersection of computer vision, image processing, computational photography, and deep learning.

Education

Carnegie Mellon University   2019 - Present
- *Doctorate of Philosophy* in Electrical and Computer Engineering
- Advised by Prof. Aswin Sankaranarayanan (ECE, CMU)
- Graduate Research Assistant in the Image Science Lab at CMU

Carnegie Mellon University   2019 - 2022
- *Master of Science* in Electrical and Computer Engineering
- Completed as a part of "Masters on the way to PhD" course requirement.

Morehouse College   2015 - 2019
- *Bachelor of Science* in Computer Science
- Ronald E. McNair Scholar, Bonner Scholar, Microsoft Scholarship Recipient
- Research Assistant in the Culturally Relevant Computing Lab at Morehouse College

Publications

- **Leron Julian**, Aswin Sankaranarayanan, "Precise Forecasting of Sky Images Using Spatial Warping". Accepted at Physics Based Vision meets Deep Learning (PBDL) Workshop, IEEE International Conference of Computer Vision (ICCV) 2021.

- **Leron Julian**, Kinnis Gosha, Earl W. Huff Jr., "The Development of a Conversational Agent Mentor Interface Using Short Message Service", ACM SIGMIS, 2018.

- **Leron Julian** and Kinnis Gosha, "Using SMS as an Interface for a Virtual Mentoring System", ACMSE, 2018.

Internships & Experience

Image Science Lab at CMU, Pittsburgh, Pennsylvania   Summer 2020/2021
Graduate Research Assistant
- Developing deep-learning solutions to forecast/predict the trajectory of clouds in sky-image video sequence frames using various motion tracking and prediction methods such as optical flow and activity forecasting.
- Developing un-distortion algorithms for wide-angle FOV fisheye images to preserve spatial resolution at periphery.
- Fabrication of wide-angle fisheye lenses/mirrors.

Idaho National Laboratory, Idaho Falls, Idaho   Summer 2019
Nuclear Power Plant Data Analyst Intern
- Analyzed data of vibration signals to automate the manual actions of checking on the status of the nuclear sensors.
- Using Artificial Neural Networks (ANN) and Data Science, developed a model to predict crack length in various aluminum specimens given piezoelectric (PZT) sensor data and constant fatigue loading profiles.

- Assisted in developing the model for the online monitoring (OLM) of Nuclear Power Plant assets such as generators using Machine Learning and Data Science.

NBCUniversal, New York, New York   Summer 2018
Software Engineer Intern

- Used Node.js, JavaScript, GraphQL, MongoDB, and React.js to upgrade and update existing larger scale CNBC website from old technology powered by PHP and MySQL through Agile development.
- Using the same Full-Stack: Began initial development for website for the reboot of the Deal or No Deal show.
- Developed Front-end components using React.js and CSS on dealornodeal.cnbc.com
- Experienced configuring and documenting computer systems and server infrastructures that power web applications, client-server applications and online services using REST APIs.

Ronald E. McNair Scholar, Morehouse College   Summer 2017
Research Assistant

- Program designed to prepare undergraduate students for doctoral studies through involvement in research and other scholarly activities.
- Developed a conversational agent mentor that uses short message service (SMS) for dialogue as a virtual mentor.
- This was used to mentor undergraduate computer science majors at a Historically Black College (HBCU) who are considering pursuing a graduate degree in computing.
- This research project was developed using JavaScript, Node.js, the Twilio API, and Heorku

Projects

Dynamic Graphs For Point Cloud Completion   Spring 2022

- Tackled the problem of point cloud completion (inpainting) using a deep learning approach.
- Investigated how adding dynamic graphs into the learning pipeline better helps the model understand the overall structure of the input and leads to a more accurate reconstructed point cloud.
- Utilized k-NN as dynamic graph as a loss function and evaluation metric.
- Trained and tested on ShapeNet dataset and real-world data from iPhone 13 Pro LiDAR camera.
- Used PyTorch and PyTorch3D

Novel View Synthesis of Transparent Objects using NeRF   Fall 2021

- Improve traditional NeRF for novel view synthesis of transparent objects using 3 proposed solutions:
- <u>Shape from distortion</u>: using a synthetic dataset consisting of background and distorted images.
- <u>Shape refinement</u>: Given a set of depth maps corresponding to camera poses, the 3D scene can be reconstructed using non-linear least squares.
- <u>Virtual camera alignment using NeRF</u>: Fix the camera poses for the object scene, and compute corresponding backgrounds through virtual cameras.

Note Recognition in Renditions of Piano Instrumentals   Spring 2021

- Using audio from WAV files, trained a classification model to classify notes being played by a piano.
- Visualized the audio waveforms using a spectrogram and extracted features using Linear Discriminant Analysis (LDA).
- Experimented with Logistic Regression, Support Vector Machines (SVM), and Multi-layer Perceptron's as classification models.
- Achieved 95.73% accuracy for the model on test data.

Precise Forecasting of Sky Images Using Spatial Warping   Spring 2021

- Developed a deep learning solution for forecasting the movement of cloud cover in sky-image video sequence frames captured by a Total Sky Imager (TSI),.
- Developed a spatial warping algorithm to achieve uniform apparent motion of clouds both at the zenith and periphery of the wide-angle FOV hemispherical mirror on the TSI to improve optical flow predictions.
- Combats the problem of sharpness in predicted frames by utilizing a combination of loss functions constraints on sharpness and motion when training model.

Color-Filtered Aperture for Image Depth Segmentation   Fall 2020

- Single-capture depth from objects at varying distances from a camera using a RGB coded aperture.
- RGB coded aperture placed in a certain orientation in camera lens causes a misalignment of each plane leading to a wavelength shift disparity in each color channel in which depth can be computed.

Semi-Supervised Learning For Image Classification Spring 2020
- Using PyTorch, investigated the effects that traditional regularization and consistency regularization methods had on performance of the self-training semi-supervised learning (SSL).
- Tested model on MNIST and STL-10 Datasets
- Proved that these methods could boost the performance of SSL given ample amount of data.

Black & White to Color Image Computer Vision Algorithm Spring 2019
- Using a Convolutional Neural Network (CNN) developed an algorithm to convert black and white images to color.
- Utilized a pre-trained CNN by transfer learning the last layer to a specific category of images.
- Developed in Python using Tensorflow.

Gender Recognition Algorithm Fall 2018
- Using K-Nearest Neighbor, developed an algorithm to classify an image of an individual as a male or female using Computer Vision and Machine Learning.
- Developed in Python using OpenCV, Supervised Learning, and other Classification machine learning models.
- Developed a Graphical User Interface (GUI) using Python's Tkinter GUI Interface.

Embodied Conversational Agent Virtual Mentor Summer 2017
- Conducted and published research as a Ronald E. McNair Scholar with aid of Research Mentor Kinnis Gosha, PhD.
- Using Natural Language Processing Techniques, developed a Virtual Mentor Embodied Conversational Agent using Short Message Service and compared the effectiveness of it to a human mentor.
- Used the Twilio API, TwiML, JavaScript, Node.js, and hosted on Heroku application hosting.

Skills

Programming Languages:
- C++ (Proficient), Python (Proficient), Java, R, MATLAB
- HTML (Proficient), JavaScript, CSS, React.js, Node.js, GraphQL, MongoDB

Machine Learning/Computer Vision Related:
- PyTorch, OpenCV, Pandas

Scholastic Achievements

- **Recipient of Fritz Family Fellowship, 2020-2021**

- **Recipient of National GEM Consortium Fellowship, 2019-2020**

- **Recipient of Microsoft Tuition Scholarship, 2016-2017**

Conferences and Workshops

- Oral Presentation on "Precise Forecasting of Sky Images Using Spatial Warping" at the ICCV Physics Based Vision Meets Deep Learning Workshop, 2021, held Virtually.

- Invited talk on "Using SMS as an Interface for a Virtual Mentoring System" at the Association of Computer and Information Science/Engineering Departments at Minority Institutions, 2018, held in New Orleans, Louisiana.

- Presented paper on "The Development of a Conversational Agent Mentor Interface Using Short Message Service" at the Association for Computing Machinery Special Interest Group on Management Information Systems, 2018, held in Buffalo – Niagara Falls.

- Presented poster on "Using SMS as an Interface for a Virtual Mentoring System" at the Association for Computing Machinery Southeast, 2018, held in Richmond, Kentucky.

Teaching Experience

- Teaching Assistant for "Machine Learning for Engineers (18-661)" at CMU Taught by Gauri Joshi & Yuejie Chi, Fall 2020
- Teaching Assistant for "Programming II (CSC 160)" at Morehouse College Taught by Prof. Amos Johnson, Spring 2019
- Instructor for C-SCORE Program teaching Marine ROTC Students Python and Computer Vision, Spring 2019

Graduate Coursework

- 33-353   Intermediate Optics
- 18-738   Sports Technology
- 16-889   Learning Based Methods For 3D Computer Vision
- 16-822   Geometry-Based Vision
- 18-752   Estimation, Detection & Learning
- 15-862   Computational Photography
- 10-701   Machine Learning
- 10-725   Convex Optimization
- 16-720   Computer Vision
- 18-793   Image & Video Processing