Manish Bhattarai

Curriculum Vitae

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, Albuquerque, NM 87106
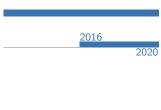✆ +1-505-715-7429
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Interests : Deep Learning(DL), Computer Vision, Machine Learning(ML), Artificial Intelligence(AI), High Performance Computing(HPC), Convolutional Neural Networks(CNNs), Reinforcement Learning(RL), Tensor Factorizations.

Educational Background

2016
2020

PhD, Electrical and Computer Engineering, *with distinction award*, GPA-3.99/4 ,Electrical and Computer Engineering - University of New Mexico . Albuquerque,NM,87106
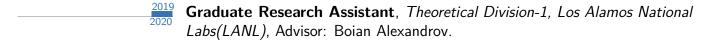
2014
2016

MS, Electrical Engineering with specialization in Signal Processing, *GPA-3.9/4, Department of Electrical and Computer Engineering - University of New Mexico*, Albuquerque,NM,87106.
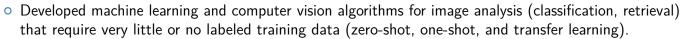
Experience

2020 **Postdoc Research Associate**, *Theoretical Division, Los Alamos National Labs(LANL)*, Advisor: Boian Alexandrov.

- Deep learning for disease prediction based on DNA sequences.
- Exploring if Non-Negative Matrix Factorization is vulnerable to adversarial noise.
- Working on dPynNTD and dPynNCPD libraries i.e. distributed python libraries for Non-negative tucker decomposition and Non-negative Canonical Polyadic Decomposition.
- Exploring acceleration of deep learning frameworks with Tensor factorisation.

2019 **Graduate Research Assistant**, *Theoretical Division-1, Los Alamos National Labs(LANL)*, Advisor: Boian Alexandrov.
2020

- Developed PyNMFk and dPyNMFk libraries, ie. shared-memory and distributed-memory based python libraries for Non-Negative Matrix Factorization and efficient latent dimensions determination.
- Worked on Boolen-nNMFk for boolen data factorization and group determination.
- Developed dPynNTTk library i.e a distributed memory based python library for Tensor train decomposition to achieve high data compression.
- Supervisor to summer intern working on exploring robustness of Tensorial Networks against adversarial attacks for the LANL summer applied machine learning school(AML).

2019 **Summer Intern** , *Applied Machine Learning School ,Los Alamos National Laboratories(LANL)*, Advisor: Diane Oyen, Liping Yang, Brendt Wohlberg .
2019

- Used ML/DL techniques to automate the understanding of information contained in hand-drawn figures, technical diagrams, and imagery produced for scientific inquiry.

- Developed machine learning and computer vision algorithms for image analysis (classification, retrieval) that require very little or no labeled training data (zero-shot, one-shot, and transfer learning).
- Developed matching and retrieval frameworks based on domain generalization, domain adaptation, cross-domain learning and manifold learning.

2016
2019
Graduate Research Assistant , *Machine Learning Lab ,UNM* , Advisor:Manel Martinez-Ramon .

- Classification of objects of interest in RGB and Infrared Datasets using transfer learning in cutting edge models including Inception, VGG16, Resnet.
- Object detection and tracking using RGB and Infrared Datasets for Fire-Fighting Applications with Region Proposal-based frameworks such as RCNN, FRCNN, YOLO and SSD.
- Use of GANs for data augmentation to synthesize RGB imagery into infrared datasets.
- Action Recognition in RGB Video datasets (2 approaches): 1. Feature extraction based on optical flow and SIFT flow features followed by ensemble classification with Random Forests, KNN and ANN. 2. CNN/ Auto Encoder/RBM based feature extraction followed by Deep ANN Classifier.
- Implementation of Reinforcement Learning(RL)-based search techniques to aid firefighters in identifying optimal paths to reach objectives. Scene modeling utilizes cost function algorithms associated with it.
- Deployment of deep learning models into an embedded NVIDIA Jetson platform for real time processing of thermal data and deployment of augumented reality into Microsoft HoloLens for situational awareness of firefighters.
- Supervised two undergraduate students for the senior design project. The project was to build the hardware prototype for the proposed fire-fighter situational awareness system with Hololens and Jetson boards.

2018
2019
Graduate Assistant, *UNM Center For Advanced Research Computing (CARC)* .

- Implemented message passing paradigms in distributed computing frameworks such as MPI, open MPI, GNU Parallel for embarrassingly parallel and tightly coupled parallel systems.
- Wrote bash scripts for parallelization of code written in Matlab and Python over distributed CPU Cores.
- Parallelization of code written in deep learning libraries such as Tensorflow, Pytorch, Keras over distributed GPU cores.
- Wrote documentation for CARC users to a repository via Git. Topics Covered: Distributed Tensorflow, MPI for Python, Job status script, benchmarking the statistical performance of the distributed systems with respect to efficiency, throughput and speedup.
- Troubleshooting user codes for possible bugs and assisted them in parallelization of their code across nodes.

2018
2019
Graduate Teaching Assistant , *Machine Learning(ECE 517)* .

- Assisted faculty in designing assignments to facilitate improved understanding of students with respect to application of machine learning tools in solving real world problems. Emphasized hyperparameter tuning and cross validation for generating optimal models.
- Worked closely with students individually and in small groups during office hours to help them understand fundamental concepts needed to complete their assignments as well as how these concepts could be applied to solve their research problems.
- Presented course material covering CNNs and their application.

2014
2016
Graduate Research Assistant , *Center for High Technology Materials, UNM* , Advisor: Majeed M. Hayat .

○ *Masters Thesis: "Algorithm for Computational Imaging on a Real-Time Hardware"*: Robust image compression and reconstruction techniques based on compressed sensing algorithms where a preconditioning of image data is embedded with sensing matrix to minimize the noisy projections

Publications

Patents

○ Martinez,M. , **Bhattarai,M.** , Deep Learning Systems for Scene Understanding, Path Planning and Navigation of Fire Fighter Teams (STC Ref. 2019-104)

Journals

○ **Bhattarai,M.**, & Martínez-Ramón,M, "A Deep Learning Framework for Detection of Targets in Thermal Images to Improve Firefighting," in IEEE Access, doi: 10.1109/ACCESS.2020.2993767.

○ Abrol, A., **Bhattarai, M.**, Fedorov, A., Du, Y., Plis, S., Calhoun, V., & Alzheimer's Disease Neuroimaging Initiative. (2020). Deep residual learning for neuroimaging: An application to predict progression to alzheimer's disease. Journal of Neuroscience Methods, 108701.

○ Ghasemi, J., **Bhattarai, M.** , Fiorante, G. R., Zarkesh-Ha, P., Krishna, S., & Hayat, M. M. (2017). CMOS approach to compressed-domain image acquisition. Optics Express, 25(4), 4076-4096

○ **Bhattarai, M.**, & Martinez, M. Optimizing Human Recognition Algorithms Under Fire: A Real Time Detection And Tracking Of Humans And Objects Using Thermal Imagery And Region Based CNNs, under preparation 2020.

○ **Bhattarai, M.**,Chennupati,G.,Skau,E.,Vangara,R. Djidjev,H., & Alexandrov,B.2020. A Distributed Non-Negative Tensor-Train Decomposition. (Under Preparation)

○ Vangara,R.,Skau,E.,Chennupati,G., Djidjev,H., Tierney,T., Smith,J., **Bhattarai,M.**, Stanev,V., & Alexandrov,B. 2020. Finding the Number of Topics with Semantic Nonnegative Matrix Factorization. (Under Review).

Conferences

○ **Bhattarai, M.**, Oyen, D., Castorena, J., Yang, L., & Wohlberg, B. (2020). Diagram Image Retrieval using Sketch-Based Deep Learning and Transfer Learning. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (pp. 174-175).

○ Castorena, J., **Bhattarai, M.**, & Oyen, D. (2020). Learning Spatial Relationships Between Samples of Patent Image Shapes. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (pp. 172-173).

○ **Bhattarai, M.**, Ghasemi, J., Fiorante, G. R., Zarkesh-Ha, P., Krishna, S., & Hayat, M. M. (2016, October). Intelligent bias-selection method for computational imaging on a CMOS imager. In Photonics Conference (IPC), 2016 IEEE (pp. 244-245). IEEE.

○ **Bhattarai, M.**,Chennupati,G.,Skau,E.,Vangara,R. Djidjev,H., & Alexandrov,B.2020. High Performance Non-Negative Tensor-Train Decomposition. IEEE HPEC Conference 2020.(Accepted)

○ **Bhattarai, M.**,Curtis,A., & Martinez,M. An embedded deep learning system for augmented reality in firefighting applications. ICMLA 2020. (Accepted)

○ **Bhattarai, M.**, & Martinez, M. A deep Q-learning based path planning and navigation system for firefighting environments. ICAART 2021(Accepted)

○ Vangara,R.,Skau,E.,Chennupati,G., Djidjev,H., Tierney,T., Smith,J., **Bhattarai,M.**, Stanev,V., & Alexandrov,B. 2020. Semantic Nonnegative Matrix Factorization with Automatic Model Determination for Topic Modeling. ICMLA 2020.(Accepted).

- **Bhattarai, M.**, Skau,E.,Nebgen,B., Chennupati,G., Alexandrov,B. 2020. Is NMF Vulnerable to adverserial noise? (Under Submission)

- **Bhattarai, M.**, & Martinez, M. Tensor decomposition for infrared dataset. (Under Submission)

- **Bhattarai, M.**,Chennupati,G.,Skau,E., Djidjev,H., & Alexandrov,B.2020. High Performance Non-Negative Tucker Decomposition.(Under Preparation)

- Pulido,J. , Patchett,J. , **Bhattarai,M.**, Alexandrov,B. , Ahrens, J. 2020. Selection of Optimal Salient Time Steps by Non-negative Tensor Decomposition. (Under Preparation)

Poster Presentations

- **Bhattarai, M.**, Vadlamani,K., Abrol,A., & Martinez, M. End-to-End Deep Learning Systems for Scene Understanding, Path Planning and Navigation in Fire Fighter Teams. Shared Knowledge Conference,2018,UNM. and **state of New Mexico Legislature**

- **Bhattarai, M.**, & Martinez, M. End-to-End Deep Learning Systems for Scene Understanding, Path Planning and Navigation in Fire Fighter Teams. Rocky Mountain Advanced Computing Consortium(RMAC), 2019

- **Bhattarai, M.**, & Martinez, M. Smart and Connected Firefighting System Design, FDIC International, 2019

- **Bhattarai, M.**, & Martinez, M. Smart and Connected Firefighting System Design, Innovate New-Mexico, 2019

- **Bhattarai, M.**, Oyen,D., Yang, L. , Wohlberg, B.,Patent Image Retrieval Using Sketch-based Deep Learning And Transfer Learning. CODA 2020 Conference , SantaFe

- **Bhattarai, M.**, Oyen,D., Yang, L. , Wohlberg, B.,Diagram and Patent Image Retrieval Using Deep Learning. AI and Tensor Factorization Conference,2020, SantaFe

News Features

- **UNM News** http://news.unm.edu/news/unm-researcher-develops-technology-aimed-at-preventing-injury-and-deaths-in-a-fire
- **Daily Lobo** https://www.dailylobo.com/article/2019/02/firefighting-tech-unm
- **KRQE News Channel** https://www.krqe.com/news/albuquerque-metro/unm-student-developing-technology-to-save-lives-of-firefighters/1758838319
- **KOB News Channel** https://www.kob.com/new-mexico-news/unm-researcher-develops-life-saving-technology-for-firefighters/5224015/
- **Fire Engineering** https://www.fireengineering.com/articles/2019/02/unm-researcher-firefighter-location.html
- **UNM Center for Advanced Research Computing** http://carc.unm.edu/research/fire-navigation-research-to-be-presented-to-nm-legislature.html
- **UNM ECE Department** http://ece.unm.edu/featured-students/ece-student-presents-research-to-nm-legislature.html

Professional Services

Reviewer
- IEEE Access
- Journal of Applied Remote Sensing,SPIE
- Journal of Electronic Imaging,SPIE
- IEEE SmartGridComm Conference
- International Conference on Machine Learning and Applications(ICMLA)

Individual Projects and Competitions

- **Kaggle Project 1: Lung Cancer Detection** Developed a 3D CNN for feature extraction followed by a Deep Neural Network(DNN) for classification along with cross implementation on multiple existing frameworks such as Resnet, Unet. Accuracy Achieved: 80%
- **Kaggle Project 2: Statoil/C-CORE Iceberg Classifier Challenge** Preconditioned the data with augmentation techniques followed by transfer learning with Inception, VGG-16, and Resnet to achieve better classification accuracy. Achieved accuracy: 86%
- **Kaggle Project 3: Music Genre Classification** Developed a ML and DNN system to extract MFCC features followed by DNN classifier with overall accuracy of 80 % for > 10 classes.
- **Kaggle Project 4: Human Protein Atlas Image Classification** Performed transfer learning on Inception-ResnetV2 architecture with a focal loss and achieved a top 30 accuracy in the leader board.
- **Classification and Prediction of Disease in Medical Datasets** Achieved accuracy level of >80%.

Skills

Languages	Python, C, Matlab,LaTeX
Tools:	Command Line, Tensorflow, Keras, PyTorch, OpenCV , Sklearn, Scipy, shell scripting
Deep Learning Capabilities:	- Creation and application of deep learning frameworks such as CNN, NN, ML techniques for classification and regression, AI search techniques for optimized path planning, Region-Proposal CNN techniques for object detection and tracking in real-time. - Utilization of deep learning frameworks such as GAN, RNN, LSTM, Reinforcement Learning, RPCNN and other ML frameworks such as GMM, PCA, ICA, MUSIC, HMM, MDP

Relevant Coursework

Advanced Neural Networks, Machine Learning, Data Structures and Algorithms, Big data, Principles of AI Machines , Advanced Image Processing, Statistical Learning, Statistical Inferences, Optimization Theory, Estimation and Detection Theory, Computer Graphics, Probability and Stochastic Process, Digital Signal and Image Processing.