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Manish Bhattarai

Curriculum Vitae

Interests : Artificial Intelligence(AI), Deep Learning(DL), Natural Language Processing(NLP), Computer Vision, Machine Learning(ML), High Performance Computing(HPC), Convolutional Neural Networks(CNNs), Reinforcement Learning(RL), Tensor Factorizations, Parallel programming.

Educational Background

2016 – 2021

PhD, Electrical and Computer Engineering, *with distinction award*, GPA-3.99/4 ,Electrical and Computer Engineering - University of New Mexico . Albuquerque,NM,87106 [**Dissertation**: Integrating Deep Learning and Augmented Reality to Enhance Situational Awareness in Firefighting Environments]

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 [**Thesis**:Algorithm for Computational Imaging on a Real-Time Hardware].

2009 – 2013

B.Tech., Electronics and Communication Engineering(ECE), *GPA-8.7/10, Department of ECE - KL University*, Green Fields, Vaddeswaram, Andhra Pradesh 522502, India [**Thesis**:Optimization in Performance of wireless Communication and sensor networks incorporating compressed sensing].

Experience

2021 –

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

- Developed a distributed tool pyDRESCALk to decompose large scale relational datasets for analyzing dynamic interactions within text dataset, protein dataset.
- Working on novel tensor factorizations tools for data fusion, edge computing, adversarial robustness, data privacy and security.
- Decomposed very large dense and sparse datasets of size 300TB and 9EB respectively to extract latent features on distributed CPU/GPU hardwares.
- Utilize tensor decomposition tools for topic extraction, topic evolution, authors leadership and rankings from large text corpus extracted from semantic scholar, Scopus and arxiv. (programmatic funding through SLIC)
- Design Deep learning based frameworks for identifying DNA binding sites for disease prediction. (funded through NIH)
- Mentor students for application of Tensor factorization for federated learning, protein unfolding and adversarial robustness.

2019
2020

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

- Developed R&D100 award winning distributed libraries pyDNMFk, pyDNTNk, and pyCP_APR for the SmartTensors Project. (funded through LDRD DR)
- Demonstrated the scaling performance of pyDNMFk and pyDRESCALk in 25k GPUs in Summit Cluster and 36k CPUs in Grizzly Cluster.
- Developed a DL framework AttentionNet for the fusion of bio-physical characteristics of DNA with the sequences to improve the tf binding site prediction.
- Worked on Boolen-nNMFk for boolen data factorization and group determination.
- Supervisor to summer intern working on exploring robustness of Tensorial Networks against adversarial attacks for the LANL summer applied machine learning school(AML).

2019
2019

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

- 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 .

- Performed object classification, detection, segmentation and image captioning with custom DL frameworks for infrared datasets from firefighting environment.
- Implemented 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.
- Deployed deep learning models into an edge computing embedded NVIDIA Jetson platform for real time processing of thermal data and routed the processed data through augumented reality into Microsoft HoloLens for situational awareness of firefighters.
- Supervised four 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 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.
- Provided user support for parallelization of the codes for accelerated execution and help them with code efficiency analysis through code benchmarking.

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.
- 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

Google scholar: https://scholar.google.com/citations?user=ilrNKq0AAAAJ [citations:111]

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.**, Kharat, N., Skau, E., Djidjev, H., Rajopadhye, S., Alexandrov, B. Distributed RESCAL of Dense and Sparse Data on Heterogeneous CPU/GPU Architectures with Automatic Model Determination. JPDC(Under review 2022). [`https://arxiv.org/abs/2202.09512`]
- Boureima, I. ,**Bhattarai, M.**, Eren, M., Skau, E., Romero, P., Eidenbenz, S., Alexandrov, B., Distributed Out-of-Memory NMF of Dense and Sparse Data on CPU/GPU Architectures with Automatic Model Selection for Exascale Data. IEEE TKDE(Under Review). [`https://arxiv.org/abs/2202.09518`]
- Eren, M. ,**Bhattarai, M.**, Joyce, R., Raff, E., Nicholas, C., Alexandrov, B. Large-scale Semi-supervised Bulk Classification of Malware Families Under Extreme Class Imbalance via Hierarchical Non-Negative Matrix Factorization with Automatic Model Determination. ACM TOPS (Under review 2022).
- Eren, M., Moore, J. ,Skau, E., Moore, E., **Bhattarai, M.**, Chennupati,G.,Alexandrov,B.General-Purpose Unsupervised Cyber Anomaly Detection via Non-Negative Tensor Factorization. ACM DTRAP.
- Vangara, R., **Bhattarai, M.**, Skau, E.,Chennupati, G., Djidjev, H., Tierney, T., Smith, J., Stanev, V., & Alexandrov, B. 2020. Finding the Number of Topics with Semantic Nonnegative Matrix Factorization. IEEE Access.
- **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.
- Vadlamani, K.,**Bhattarai, M.**, Ajith, M., & Martinez, M. A Novel Indoor Positioning System for unprepared firefighting scenarios. https://arxiv.org/abs/2008.01344

- 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

Conferences

- Eren, M. , Richards, L. , **Bhattarai, M.**, Yus, R., Nicholas, C., Alexandrov, B. FedSPLIT: One-Shot Federated Recommendation System Based on Non-Negative Joint Matrix Factorization and Knowledge Distillation. ACM RecSys (Under review 2022).
- Boureima, I. ,**Bhattarai, M.**, Eren, M., Alexandrov, B., Distributed Out-of-Memory SVD on CPU/GPU Architectures. IEEE HPEC(Under submission 2022).
- **Bhattarai, M.**, Vangara, R., Qian, S., Chiu, T., Rasmussen, K., Bishop, A., Duan, J., Rohs, R., He, X., Alexandrov, B. Deep Learning Modeling of Transcription Factor Binding Specificity Using DNA Biophysical Properties. ASGHC 2021.
- Kabir, K. ,**Bhattarai, M.**, Shehu, A., Alexandrov, B. Single Model Quality Estimation of Protein Structures via Non-negative Tensor Factorization. ICCABS 2021.
- Pulido, J. , Patchett, J. , **Bhattarai, M.**, Alexandrov, B. , Ahrens, J. 2020. Selection of Optimal Salient Time Steps by Non-negative Tensor Decomposition. EuroViz Workshop 2021.
- 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.
- **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).
- **Bhattarai, M.**,Chennupati,G.,Skau,E.,Vangara,R. Djidjev,H., & Alexandrov,B.2020. High Performance Non-Negative Tensor-Train Decomposition. IEEE HPEC Conference 2020.
- 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.**,Curtis,A., & Martinez,M. An embedded deep learning system for augmented reality in firefighting applications. ICMLA 2020.
- **Bhattarai, M.**, & Martinez, M. A deep Q-learning based path planning and navigation system for firefighting environments. ICAART 2021.(Best Industrial paper award)
- **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.

Dissertation/Thesis/Reports

- **Bhattarai, M.** (2021). Integrating Deep Learning and Augmented Reality to Enhance Situational Awareness in Firefighting Environments. arXiv preprint arXiv:2107.11043.
- **Bhattarai, M.**, 2017. Algorithm for Computational Imaging on a Real-Time Hardware.
- Hamke, E.E., Norris, T., Ladd, J.E., Eaton, J.K., Malveaux, J.J., **Bhattarai, M.**, Jordan, R. and Martinez-Ramon, M., 2019. Mesh node communication system for fire figthers.

Softwares

- **pyDNMFk**: Python Distributed Non Negative Matrix Factorization with determination of hidden feature. `https://github.com/lanl/pyDNMFk`.
- **pyDRESCALk**: Python Distributed Non Negative RESCAL decomposition with determination of hidden feature. `https://github.com/lanl/pyDRESCALk`.

- **pyDNTNK**: Python Distributed non-negative tensor networks. `https://github.com/lanl/pyDNTNK`.
- **pyCP_APR**: Non-negative Poisson tensor decomposition algorithm on GPU with anomaly detection interface. `https://github.com/lanl/pyCP_APR`.
- **pyTensorToolbox**: A unified python framework for latent feature estimation from sparse/dense dataset with CPU/GPU support. `https://github.com/lanl/pytensortool`.[EIDR under approval]

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

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

Activities

- Session chair at the conference on Computational advances in bio and medical science (ICCABS 2021).
- Presented an invited talk on "AI-based Next-Generation Smart and Life Saving Technology Applied to the Firefighting Environment" at GE Healthcare.
- Contributed in proposal writing for LDRD projects at LANL and computing proposals for Chicoma and Summit.

Mentorship

Student Name	Institution	Year	Project
Maksim Eren	UMBC	2021-	Tensor decomposition of Malware detection
Namita Kharat	CSU	2021	High performance Tensor decomposition tool design
Kazi Lutful Kabir	GMU	2021	Tensor decomposition for bio-applications
William Zhao	UC Berkley	2020	Adversarial robustness of Matrix and Tensor decompositions
Aura Jensen-Curtis	UNM	2019–2020	Embedded deep learning system for firefighting applications
Hans Hofner	UNM	2017	Thermal Imaging object and human recognition

Skills

Languages Python, C, Matlab,LaTeX

Tools: Command Line, Tensorflow, Keras, PyTorch, OpenCV , Sklearn, Scipy, shell scripting