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Gunbir Singh Baveja

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Pre-Prints

Iris and Palmprint Multimodal Biometric Recognition using Novel Preactivated Inverted ResNet and Hybrid Metaheuristic Optimized DenseNet
Indu Singh, *Gunbir Singh Baveja*, Shruti Khatri, Sunaina Luthra, and Tanvi Singh
IEEE Transactions on Machine Learning in Communications and Networking

Exploration and Adaptation in Non-Stationary Tasks with Diffusion Policies
Gunbir Singh Baveja
The report is available as pre-print here: arXiv:2504.00280

Work Experience

Deep Learning Researcher **September 2024 - Present**
UBC Multifaceted Innovation in NeuroTechnology (MINT) *Vancouver, BC*

- Designed and deployed state-of-the-art neural network architectures to control Mujoco-simulated legged robots, achieving a 35% improvement in directional movement precision guided by neural signals.
- Spearheaded collaboration with a multidisciplinary team to integrate cutting-edge deep learning models with neural decoding algorithms, enabling real-time mind-controlled robot navigation with 95% signal accuracy.
- Enhanced reinforcement learning algorithms for humanoid locomotion, resulting in a 40% efficiency boost in movement stabilization, utilizing innovations derived from the open-source repository LearningHumanoidWalking.

Visiting Student Researcher, KAIST, Seoul, Korea **June 2024 - August 2024**
- Conducted a comprehensive literature review on continual reinforcement learning, re-implementing 3+ seminal papers on the intersection of passive non-stationarity and active Markov Games, contributing to new insights on dynamic adaptation.
- Collaborated with Professor Joseph J. Lim, refining methodologies to tackle non-stationary environments in multi-agent systems with a 15% improvement in long-term performance stability.

Software Team Lead, Open Robotics **November 2023 - Present**
- Leading a team of six developers for the Pianobot project, delivering innovative robotic solutions with 100% sprint completion rates.
- Directed the end-to-end development of MIDI and Arduino translators, ensuring seamless hardware-software integration, achieving 20% faster processing times.
- Implemented advanced reinforcement learning algorithms to optimize for technical efficiencies, enabling autonomous behavior and real-time improvisation in the Pianobot system.

Research Intern, Delhi Technological University **June 2023 - August 2023**
- Supervised by Dr. Indu Singh, designed a novel multimodal recognition architecture incorporating histogram equalization and pre-activated Inv-ResNet with spatial attention, achieving a 97.2% accuracy in biometric identification.
- Developed a hybrid global-local JFPA-ROA search-matching algorithm, resulting in a 25% reduction in computational overhead while maintaining superior model performance.

Machine Learning Intern, Bausch + Lomb **April 2020 - July 2020**
- Applied advanced data augmentation techniques, expanding the training dataset by 50%, improving model robustness against diverse scenarios.
- Leveraged incremental learning methodologies, enabling continuous model improvement and achieving a 20% increase in stock-level prediction accuracy across global datasets.
- Developed scalable, large-scale predictive models, facilitating real-time analytics and driving measurable operational efficiencies.

Education

Bachelor of Science, Major in Computer Science **Exp. Graduation 2026**
University of British Columbia, Vancouver

- GPA: 3.95/4.0, Dean's List 2023, 2024
- MOCCA Lab Reading Group, Software Lead@Open Robotics, Undergraduate Mathematics Society, UBC Sikh Association
- Relevant Coursework: **Graduate** Deep Reinforcement Learning (top $\sim 1/32$, A+); **Undergraduate** Machine Learning (A+), Advanced Data Structures & Algorithms (A), Statistical Inference (A), Linear Algebra (A+)

Projects

Continual Diffusion and Data-Efficient Exploration in Non-Stationary Tasks **March 2024 - April 2024**
`https://github.com/sheeerio/continual-diffusion`

- Designed and implemented diffusion models for reinforcement learning in non-stationary, vision-based tasks, achieving a 30
- Developed and trained Diffusion Policies using Denoising Diffusion Probabilistic Models (DDPM), enabling superior policy generation under shifting environmental conditions.
- Benchmarked against state-of-the-art algorithms such as PPO, DQN, GoExplore, Rainbow, and Curiosity in Procgen and D4RL environments, demonstrating 20% higher sample efficiency and robustness in long-term performance.
- Conducted extensive performance analysis and comparative studies, proving the combined framework's scalability and effectiveness for vision-based and competitive reinforcement learning scenarios.

Schizospeak: An Esoteric Programming Language **July 2023**
`http://npmjs.com/package/schizospeak`

- Developed a full-stack Parser, Lexer, and Interpreter in TypeScript, incorporating advanced expressions, declarations, identifiers, and literal types to support dynamic program execution.
- Engineered a depth-first search algorithm and recursive logic to solve complex lexical morphology challenges, achieving a 40% reduction in execution latency compared to similar esoteric languages.
- Designed support for Expressions (assignment, binary, call, member), Declarations (variable, function, if, for), and Literals (numeric, string, object), ensuring scalability for creative programming tasks.

Alokhe: Transliteration API and Discord Bot **February 2022**
`https://github.com/sheeerio/alokhe`

- Built a symbolic Python-based transliteration system using phonosyntactic rules of linguistics, achieving 98% accuracy in converting English to Hindi text.
- Developed and hosted a REST API using Flask to provide seamless access to transliteration capabilities across platforms.
- Created a Discord bot in JavaScript, integrating the Alokhe API and OpenAI API, enabling users to transliterate English to Hindi and Hinglish (Hindi in Latin script) to Hindi, serving 500+ unique users in initial deployment.

Presentations

Scalable Unsupervised RL with Metric-Aware Abstraction **June 2024**
KAIST · Reinforcement Learning Reading Group

Skill-based Model-based Reinforcement Learning **March 2024**
KAIST · Cognitive Learning for Vision and Robotics Group

Skills

Frameworks	PyTorch, Spark, SciKit/XGBoost, Swing, React, NumPy, openCV, fastai
Programming	Python, Java, C/C++, Git, JavaScript, TypeScript, LaTeX, Matlab, MarkDown
Graphics	Blender, Autodesk Maya, Unreal Engine, Adobe Illustrator

Awards and Grants

- **Work Learn International Undergraduate Research Award:** NSERC, nominated by UBC Computer Science ($6,000$)
- **Undergraduate Research Award:** AML-TN ($5,000$)
- **International Work Terms Grant:** UBC Vancouver Co-Op ($1,000$)
- **Outstanding International Student Award:** UBC Vancouver ($10,000$)
- **Second Award, Global Youth Science and Technology Bowl:** independent project. Awarded by The Hong Kong Federation of Youth Groups.
- **Grand Award, IRIS National Fair:** Selected amongst around 1000 teams to represent India at the Intel Science and Engineering Fair. Awarded by the Ministry of Science and Technology of India.
- **Finalist, Intel Science and Engineering Fair.** Represented India for my research at the largest science fair in the world.
- **Most Outstanding Exhibition in STEM, IRIS National Fair:** awarded by Yale Science and Engineering Association at the IRIS National Fair.
- **Bronze Medal, Asia Pacific Linguistics Olympiad (APLO):** selected as member of alternate team for India at the International Linguistics Olympiad (IOL) 2022. *APLO Rank 8, PLO Rank 11.*
- **Top 10 Leaderboard, NeurIPS Concordia Challenge:** Developed cooperative AI agents in text-based environments, achieving a top 10 position on the leaderboard among international participants.