Kale-ab Tessera

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About me

Kale-ab is a PhD student working on Multi-Agent Reinforcement Learning (MARL) at the Autonomous Agents research group at the University of Edinburgh, under the supervision of Stefano Albrecht. He has 7.5 years of experience (three years in software development and four and a half years in machine learning). Prior to his PhD, he was a research engineer at InstaDeep, working on MARL research.

He is also passionate about using technology to help the African continent. To this end, he has worked on projects that aim to have a high impact in Africa and has also worked on increasing diversity and representation in machine learning.

Education

Doctor of Philosophy - PhD, Focusing on Multi-Agent Reinforcement Learning   Edinburgh, UK
University of Edinburgh   September, 2023 –Present

- Working on Multi-Agent Reinforcement Learning at the Autonomous Agents research group, under the supervision of Stefano Albrecht.
- Fully-funded by the Informatics Global PhD Scholarship.

MSc in Computer Science, Focusing on Deep Learning, *Distinction*   Johannesburg, South Africa
University of Witwatersrand   2018–March, 2021

- Dissertation (*83%*): "On Sparsity in Deep Learning: The benefits and pitfalls of Sparse Neural Networks and how to learn their architectures" - link.
  Supervisor: Prof. Benjamin Rosman, Collaborators: Sara Hooker
- Coursework (*85%* Average): Adaptive Computation and Machine Learning, Reinforcement Learning, Robotics, Artificial Intelligence, Large Scale Optimization for Data Science and High Performance Computing.
- Received the Postgraduate Merit Award from the university, Microsoft Prize from the Deep Learning Indaba, and had an accepted paper at the "Sparsity in Neural Networks" workshop titled "Keep the Gradients Flowing: Using Gradient Flow to study Sparse Network Optimization".

Honours in Computer Science, *Distinction*   Pretoria, South Africa
University of Pretoria   2016

- Received Academic Honorary Colours for academic excellence.

BSc. in Computer Science   Pretoria, South Africa
University of Pretoria   2013–2015

– Received an award from Amazon for a final year project on using CNNs to automatically identify different stink bug species, was invited to join the Golden Key Honour Society (top 15% of degree) and received a Merit Certificate for Leadership from the university.

For more information on awards, please see the "Scholarships and Awards" section.

EXPERIENCE

Research Engineer   Johannesburg, South Africa
InstaDeep   March, 2021 - September, 2023

Working as a Research Engineer in the MARL research team focusing on cutting-edge scientific research and applications to challenging real-world problems.

Achievements:

– Multiple workshop papers accepted at ICML, ICLR and NeurIPS.
– Manage a team of three research engineers and an intern, working on applying MARL to challenging real-world domains.
– Manage a team of four research engineers working on MARL research.
– One of the first authors on Mava, a scalable framework for Multi-Agent Reinforcement Learning - repo, paper and blog.

For more details on papers please refer to publications.

Machine Learning Engineer   Johannesburg, South Africa
Multichoice   Apr 2019 - Feb 2021

Worked on using machine learning to model and predict the behaviour of over 15 million customers.

Intermediate Software Engineer   Johannesburg, South Africa
Entelect   Nov 2017 - March 2019

Built highly scalable, fast, responsive websites for major clients.

Software Engineer   Pretoria, South Africa
RetroRabbit   Jan 2016 - Oct 2017

Built robust backend APIs with multiple system integrations.

PUBLICATIONS

[1] A. Kapoor, S. Swamy, K.-a. Tessera, M. Baranwal, M. Sun, H. Khadilkar, and S. V. Albrecht, "Agent-temporal credit assignment for optimal policy preservation in sparse multi-agent reinforcement learning", in *Coordination and Cooperation for Multi-Agent Reinforcement Learning Methods Workshop at RLC 2024*, Paper, 2024.

[2] O. Mahjoub, R. de Kock, S. Singh, W. Khlifi, A. Vall, K.-a. Tessera, and A. Pretorius, "Efficiently quantifying individual agent importance in cooperative marl", *(Oral) eXplainable AI approaches for deep reinforcement learning (XAI4DRL) Workshop @ AAAI*, 2024, Paper.

[3] S. Singh, O. Mahjoub, R. de Kock, W. Khlifi, A. Vall, K.-a. Tessera, and A. Pretorius, "How much can change in a year? revisiting evaluation in multi-agent reinforcement learning", *eXplainable AI approaches for deep reinforcement learning (XAI4DRL) Workshop @ AAAI*, 2024, Paper.

[4] J. C. Formanek, C. R. Tilbury, J. P. Shock, K.-a. Tessera, and A. Pretorius, "Reduce, reuse, recycle: Selective reincarnation in multi-agent reinforcement learning", in *(Oral)* *Workshop on Reincarnating Reinforcement Learning at ICLR 2023*, Paper, Website, Mar. 2023.

[5] A. Smit, P. Duckworth, N. Grinsztajn, K.-a. Tessera, T. Barrett, and A. Pretorius, "Are we going MAD? benchmarking multi-agent debate between language models for medical q&a", in *Deep Generative Models for Health Workshop NeurIPS 2023*, Paper, Oct. 2023.

[6] K.-a. Tessera, C. Tilbury, S. Abramowitz, R. de Kock, O. Mahjoub, B. Rosman, S. Hooker, and A. Pretorius, "Generalisable agents for neural network optimisation", in *Workshop on Advancing Neural Network Training: Computational Efficiency, Scalability, and Resource Optimization (WANT@NeurIPS 2023) and OPT 2023: Optimization for Machine Learning*, Paper, Poster, Oct. 2023.

[7] K.-a. Tessera, C. Matowe, A. Pretorius, B. Rosman, and S. Hooker, "Just-in-time sparsity: Learning dynamic sparsity schedules", in *Dynamic Neural Networks, ICML Workshop*, Paper, Poster, Slides, 2022.

[8] A. Pretorius, K.-a. Tessera, A. P. Smit, C. Formanek, S. J. Grimbly, K. Eloff, S. Danisa, L. Francis, J. Shock, H. Kamper, *et al.*, "Mava: A research framework for distributed multi-agent reinforcement learning", *arXiv preprint arXiv:2107.01460v1*, 2021, Paper, Framework, Blog.

[9] K.-a. Tessera, S. Hooker, and B. Rosman, "Keep the gradients flowing: Using gradient flow to study sparse network optimization", in *Sparsity in Neural Networks Workshop*, Paper, Poster, Slides, 2021.

[10] I. S. Yusuf, K.-a. Tessera, T. Tumiel, S. Nevo, and A. Pretorius, "On pseudo-absence generation and machine learning for locust breeding ground prediction in africa", in *AI + HADR and ML4D NeurIPS Workshops*, Paper, Blog, Code, 2021.

Scholarships and Awards

- **CIFAR Inclusive AI Scholarship**, CIFAR   2024
  Scholarship to attend the CIFAR Deep Learning + Reinforcement Learning (DLRL) summer school in Toronto, Canada.

- **Informatics Global PhD Scholarship**, University of Edinburgh   2023–2027
  A competitive full PhD scholarship awarded by the School of Informatics to students who achieved high academic performance for their most recent degree.

- **Postgraduate Merit Award**, University of Witwatersrand   2019–2020
  An award (with full tuition funding) given to the top postgraduate students, who earn an average above 75%.

- **Microsoft Prize - Best Poster at Deep Learning Indaba**, Deep Learning Indaba   2019
  Received the prize for the best research poster at the Deep Learning Indaba. This was the top prize out of 194 presented posters. The prize was a sponsored trip to NeurIPS 2019 in Vancouver.

- **Conference Travel Scholarships**, Deep Learning Indaba and MLSS   2019
- **Academic Honorary Colours**, University of Pretoria   2017
  Was awarded Academic Honorary Colours by the University of Pretoria for achieving my honours degree with distinction (Average of 80.75 %).

- **Amazon Prize for Best Mobile Application**, University of Pretoria   2015
  Awarded the team prize for developing the best mobile application in our final-year computer science project, which involved creating a website and app that used CNNs to automatically identify and tag different species of stink bugs.

- **Merit Certificate for Leadership**, University of Pretoria   2015
- **Deputy Head Boy**, PEPPS College   2012
- **Matric (Final Year High-School) Academics**, PEPPS College   2012
  Notable achievements include being in the Top 1% of IEB IT Matric Students in South Africa and receiving 7 Distinctions with an average of 87%.

Research Presentations

- Presented a talk at the University of Pretoria titled "Introduction to Deep Reinforcement Learning"- slides.   2023
- Presented a talk at Indaba X Ghana titled "Introduction to Deep Reinforcement Learning"- slides.   2022
- Presented the "Introduction to ML using JAX" and "Introduction to Reinforcement Learning" practicals at the Deep Learning Indaba.   2022
- Presented a Spotlight talk at the Deep Learning Indaba 2022 - video, slides and poster.   2022
- Presented a talk at the Indaba X South Africa titled "Playing Starcraft and Saving the World Using Multi-agent Reinforcement Learning"- video, slides and notebook.   2021
- Presented a talk at Deep Learning: Classics and Trends (DLCT) - slides, website.   2021
- Presented a talk at the Google Brain Sparsity Reading Group - slides.   2021
- Presented a Spotlight talk at the Deep Learning Indaba 2019 - video, slides and poster.   2019

Open Source

- Deep Learning Indaba Practicals (2022, 2023, 2024) - A collection of high-quality practicals covering a variety of modern machine learning techniques.
- Mava (GitHub) - A library of multi-agent reinforcement learning components and systems.
- Pseudo Absence Generation and Locust Prediction (GitHub) - Locust breeding ground prediction using pseudo-absence generation and machine learning.
- Baobab (GitHub) - Baobab is an open source multi-tenant web application designed to facilitate the application and selection process for large scale meetings within the machine learning and artificial intelligence communities globally.
- DQN Atari (GitHub) - Deep Q-Learning (DQN) agent playing pong.

See a full list of open source projects on GitHub.

Skills

- **ML Frameworks:** JAX, TensorFlow 2+, Keras, Scikit-learn, Pytorch, Deepmind's Acme, Deepmind's Reverb.
- **Programming:** Python, JavaScript (React), C/C++.
- **Distributed ML:** Ray, Pyspark, Deepmind's Launchpad.
- **Tools/Cloud:** LaTeX, Git, Docker, Linux, Amazon AWS, Google GCP.

Volunteering, Organizing and Reviewing

- Co-host an RL Reading Group   2024 - Present
  Reading group, YouTube.
- Conference Paper Reviewer   2023, 2024
  NeurIPS (2023, 2024), AAMAS (2023), Black in AI (2017, 2018)
- Practicals Committee Chair   2022, 2023
  Chair of the Practicals Committee for the 2022 and 2023 Deep Learning Indaba. Developed the "Introduction to ML using JAX" practical and helped develop the 2022 and 2023 RL practicals.
- Africa to Silicon Valley Educator   2022
  Taught an "Introduction to Machine Learning" Course to talented African students at Africa to Silicon Valley.
- Deep Learning Indaba Steering Committee   2022
- One of the organizers of the ML Efficiency Workshop at the Deep Learning Indaba   2022
- Deep Learning Indaba Application and Selection Committee   2020