

MINI-SCHOOL

NITheCS

National Institute for
Theoretical and Computational Sciences

Fundamentals of Artificial Neural Networks

Dr Tian Theunissen, Dr Randle Rabe & Dr Coenraad Mouton (*North-West University*)

Attend three online lectures:

Wednesdays, 13, 20 & 27 May 2026 | 14h00-15h00 SAST

This series of lectures serves as a compressed introduction to artificial neural networks (ANN), focusing on the fundamentals common to virtually all deep learning implementations. Beginning with the basic building blocks of a neural network, we develop intuition for how shallow and deep architectures process and learn from data.

The series then turns to the theoretical and practical challenges of building ANN-based models, covering the central tension between overfitting and underfitting, the optimisation procedures that drive learning, and the regularisation strategies that improve generalisation. A session on practical implementation bridges theory and implementation, with attention on the day-to-day decisions involved in hyperparameter tuning and model development.

This series builds a foundation for exploring more advanced machine learning and AI topics. A basic understanding of machine learning is assumed.

LECTURES

1. What makes an ANN? | 13 May

This lecture by Dr Tian Theunissen introduces artificial neural networks, explaining what they are and how they work. It provides a simple, intuitive overview of how inputs are processed through interconnected nodes, how signals are transformed across layers, and how the network learns patterns from data to make predictions.

Dr Theunissen is an AI researcher specialising in ANN, with a focus on learning with noisy targets and time series modelling. He completed his PhD at North-West University in 2021. After four years as a postdoctoral researcher in the MUST Deep Learning group, he is now a senior researcher. He has been a NITheCS Associate since 2025 and serves as PI for the Knowledge Discovery in Complex Sequential Data work package.



2. How to Build an ANN-Based Model: Theory | 20 May

This lecture by Dr Randle Rabe explores the theoretical foundations of building ANN-based models, focusing on key challenges such as overfitting and underfitting. It introduces core concepts in optimisation and regularisation, highlighting how these techniques improve model performance and generalisation.

Dr Rabe is a machine learning researcher specialising in deep learning, with interests in its theoretical foundations. His work spans training dynamics, feature learning, physics-inspired methods, and kernel-based approaches. He received his PhD in Physics from the University of Pretoria in 2022 and is currently a postdoctoral researcher at MUST Deep Learning.



3. A Practical Guide to Building ANN-Based Models | 27 May

This lecture by Dr Coenraad Mouton focuses on the practical aspects of building ANN-based models, covering implementation techniques and workflows. It highlights practical know-how, including model setup, training, and evaluation, with a particular emphasis on hyperparameter tuning to improve performance and reliability.

Dr Mouton is a machine learning researcher specialising in adversarial machine learning and robust deep neural networks. His work focuses on model behaviour under distribution shift, with applications in medical imaging and computer vision. He completed his PhD at North-West University in 2024 and is currently a postdoctoral researcher at MUST Deep Learning.



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