UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

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AI AFRICA CONSORTIUM

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# CONSORTIUM MISSION STATEMENT

The establishment of the AI Africa Consortium, led by the University of the Witwatersrand, aims to provide a mechanism to bring together various role-players who have a vested interest in the success and sustainability of Cirrus. The Consortium Members are comprised of universities, research organisations and government agencies. These institutions are the primary beneficiaries of the infrastructure, engineering capacity, and learning programs developed as part of Cirrus. Therefore, through the Consortium these institutions will be granted the opportunity to provide feedback, help promote the activities and shape the future direction of Cirrus.

# PROBLEM IDENTIFICATION

Advances in Artificial Intelligence (AI) and its application in Africa has the potential to drive innovation in industry and shape the societal landscape of tomorrow.


While Africa was largely absent from the Internet Revolution there is now a growing realisation of the importance of technology in building societal prosperity. With growth in learning and communication, and with several strong and internationally competitive universities there is substantial interest in AI from faculty and students in the region.

Yet the region has not expanded fast enough to fully realise the opportunities presented and there is now a rapidly growing need for talent, infrastructure, and funding to support innovation. To move beyond the hype and be competitive with the substantial accumulation of resources in North America and more recently in Asia, requires efforts on a magnitude far greater than any previous spanning academia and industry.

This has led to the formation of Cirrus, to bring about a step change in the research and application of AI in the region. The AI Africa Consortium aims to bring together all interested role players from across the African region and beyond to participate in the development and progression of Cirrus.

# APPLICATIONS OF MACHINE LEARNING

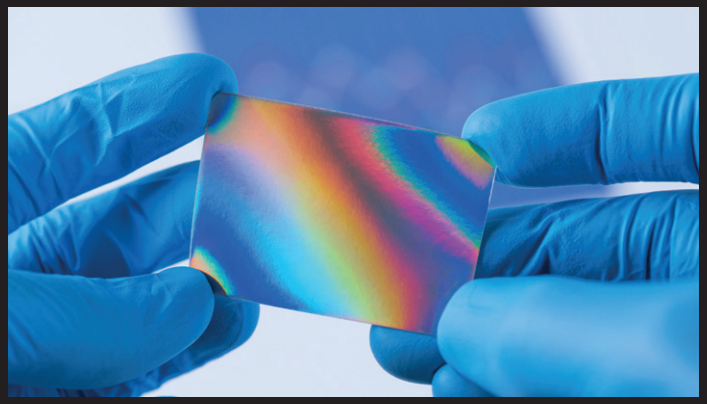
Scientists aspire to understand the workings of nature, people, and society. To do so, they formulate hypotheses, design experiments, and collect data, with the aim of analysing and better understanding natural, physical, and social phenomena.



By processing the large amounts of data now being generated in fields such as the physical sciences, life sciences, engineering, social sciences, and others, machine learning is a key enabler for a range of scientific fields, pushing forward the boundaries of science, engineering and other fields to bring meaningful results for the benefit of society.

In field after field, the ability to collect data has exploded — in biology, with its burgeoning databases of genomes and proteins; in astronomy, with the petabytes flowing from sky surveys; in social science, tapping millions of posts and tweets that fly around the internet. The flood of data can overwhelm human insight and analysis, however, the computing advances that helped deliver it have also conjured powerful new tools for making sense of it all.

Big data has met its match. As we stand on the cusp of a technological revolution, opportunities abound to



[1] The AI revolution in scientific research, Allan Turing Institute, Royal Society of Chemistry)
[2] DeepMind (2018) AlphaFold: Using AI for scientific discovery, available at: https://deepmind.com/blog/alphafold/),

# HEALTHCARE

Today we are generating and have access to more data than ever before. In fact, more data has been created in the past two years than in the entire previous history of the human race. However, the value of this data can only be realised if we are able to analyse, interpret and apply it.

Right across the medical research fields, AI is being used to help researchers decipher this wealth of information with the aim of gaining a better understanding of the diseases we want to treat. It is working hand in hand with researchers to identify new targets for novel medicines, recruiting for and designing improved clinical trials, driving personalised medicine strategies and accelerating the way new medicines are designed and developed.

The use of ML and AI in healthcare organizations can help meet growing medical treatment demands, improve operations, and lower operational costs. At the bedside, machine learning innovation can help healthcare practitioners detect and treat disease more efficiently with more precision and personalized care . ML and AI applications can potentially improve the accuracy of treatment protocols and health outcomes through algorithmic processes.

For example, deep learning is increasingly being used in radiology and medical imaging. Using neural networks that can learn from data without any supervision, deep learning applications can detect, recognize, and analyse cancerous lesions from images. Furthermore, faster processing speeds and cloud computing infrastructures have allowed ML and AI applications to detect anomalies in images beyond the capabilities of the human eye, providing a novel diagnostic tool and aiding in the treatment of diseases. It is clear that future advancements using ML and AI in healthcare will continue to transform and shape modern healthcare.



[3] The AI revolution in science, Tim Appenzeller 2017, July, ScienceMag)
[4] Big Data: 20 Mind-Boggling Facts Everyone Must Read, Bernard Marr, Forbes Magazine, Sept 2015)
[5] Data Science & Artificial Intelligence, Jim Weatherall, Vice President, Data Science & AI, R&D, AstraZeneca, 2021)
[6] Transforming healthcare with AI: The impact on the workforce and organizations March 10, 2020, Executive Briefing, A. Spatharou, S. Hieronimus, and J Jenkins. McKinsey and Company)

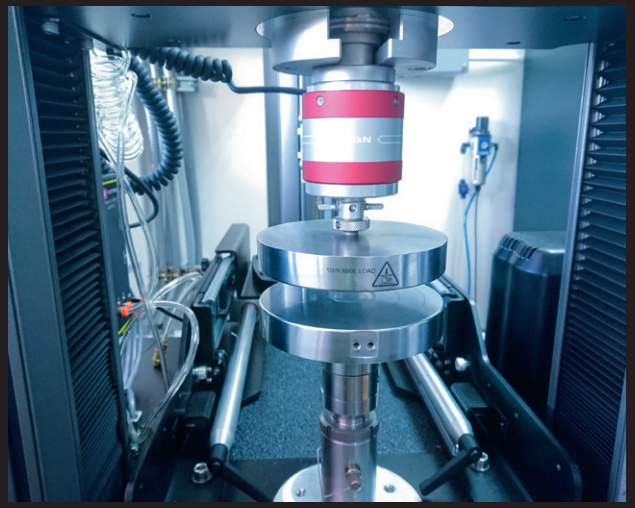
# ENGINEERING

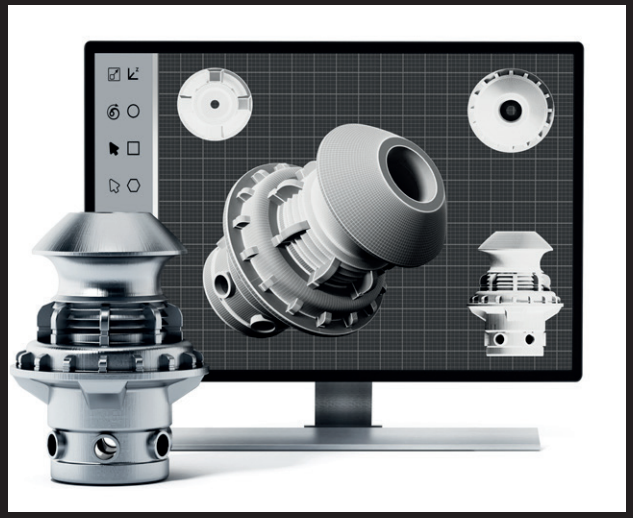
In recent years, machine learning algorithms have aided in solving domain specific problems in various fields of engineering from detecting defects in reinforced concrete to monitoring natural disasters.

AI and machine learning tools bring drastic new capabilities to engineers relative to what they are capable of without it. Through organic latticing tools, weight-saving capabilities like never before are possible. With generative design, design options can be explored that would never have been imagined.

As these tools are slowly implemented into computer aided design (CAD) and engineering systems, an engineer's capabilities will only be expanded.







Design and data management, perhaps the most impactful aspect of AI innovation in engineering will have massive effects on workflow management. With AI extending far beyond the design process and stretching into data management. Looking at the bigger picture, engineers are making ever more use of the Internet of Things. AI will surely help engineers manage designs and improve interoperability, but it will also break down barriers between departments and between tasks.

[7] Applications of machine learning methods for engineering risk assessment – A review, Safety Science Volume 122, February 2020, 104492)

[8] How Machine Learning and AI Will Impact Engineering, Trevor English, February 2020, *Interesting Engineering)*

# PHYSICAL SCIENCES

The use of AI methods aim to accelerate the design, discovery, and evaluation of new materials, and to advance the development of new hardware and software systems used by scientists to conduct experiments and generate their data. Further, to identify new science and theories within increasingly high-bandwidth instrument data streams; to improve experiments by inserting inference capabilities in control and analysis loops; this enables the design, evaluation, autonomous operation, and optimization of complex systems from particle accelerators to HPC data centres and to advance the development of self-driving laboratories and scientific workflows.

The incorporate of domain knowledge into AI methods to improve the quality and interpretability of the models which drives the need to develop software environments to enable AI capabilities to seamlessly integrate with large-scale HPC models and the need to automate the largescale creation of “FAIR” (findable, accessible, interoperable, and reusable) data, given the central role of data in an AI-centric future science landscape
Recent advances in experimental and computational methods in materials science are increasing the quantity and complexity of generated data.

This massive amount of raw data needs to be stored and interpreted in order to advance fields such as materials science, chemistry and physics by identifying correlations and patterns from large amounts of complex data. Modern computational materials science is being used to uncover complexities and design novel materials with enhanced properties.

Currently, various ML applications are being widely applied to chemical research areas involving such fields as exploratory data analysis, signal processing, multiway data analysis, classification and regression, multivariate calibration and imaging. Physicists have made use of ML applications in everything from high-energy physics to quantum mechanics and condensed matter applications.



[9] Scientific AI in materials science: a path to a sustainable and scalable paradigm, BL DeCost et al, 2020 Mach. Learn.: Sci. Technol. 1 033001)
[10] Recent advances and applications of machine learning in solid-state materials science, J. Smidt et al, Nature computational materials, volume 5, 83 (2019))
[11] Machine learning for condensed matter physics, Edwin Bedolla et al 2021 J. Phys.: Condens. Matter 33 053001)

# CONSORTIUM RESPONSIBILITIES AND BENEFITS

## Consortium Members have access to:

*Cooperation programs*
Supporting interdisciplinary cooperation spanning academia and industry around the world, boosting the application of ML and AI technologies and ensuring the transformative potential benefits the region.

*State-of-the-art computing infrastructure and engineering*
Supported by teams of hardware, software, machine learning and data engineers. Bringing together engineering teams, researchers, computing infrastructure and extensive scientific instrumentation to enable a step change in research efforts of academia and industry in the region.

*Open Learning*
Ensuring inclusive participation, the dissemination of knowledge and ideas, and the development of the next generation of African AI enabled researchers.

*Cirrus FOUNDRY and Cirrus FOUNDRY Fund*
To bridge the "Valley of Death" and overcome the challenge of turning a start-up idea or scientific research into large-scale commercial application.

## Consortium Membership Classes

*Tier 1 Consortium Members*
Tier 1 Consortium Members are entities that appoint Ambassadors and are therefore able to influence Consortium activities and governance through the Ambassador Advisory Network. Tier 1 Consortium Members have a higher priority for accessing Cirrus resources and for collaborating on new funding opportunities.

*Tier 2 Consortium Members*
Tier 2 Consortium Members are entities that do not appoint Ambassadors, but still have access to many Cirrus resources.

*Ambassadors*
Ambassadors serve as community builders, making connections between people and resources. Ambassadors will be senior strategic individuals within their local institution and will be supported by a project manager where necessary.

# CONSORTIUM BENEFITS

| No. | Benefits | Tier 1 | Tier 2 |
|---|---|---|---|
| **Cirrus** | | | |
| 1 | Global Collaboration Network | Integration with Ambassador Advisory Network | Not available |
| 2 | Partner and Affiliate program | Integration with Ambassador Advisory Network | ● |
| 2 | Co-development program | Integration with Ambassador Advisory Network | ● |
| 3 | Open Learning | ● | ● |
| 4 | Summer and Winter programs | ● | ● |
| 5 | Salons and teatime sessions | ● | ● |
| 6 | Academic programs | Priority Access | ● |
| 7 | Research to Communication program | Priority Access | ● |
| | Digital asset Locker | Priority Access | ● |
| 8 | Sandbox | Priority Access | ● |
| 9 | HPC platform | Priority Access | ● |
| 10 | Research support | Priority Access | ● |
| 11 | Infrastructure programs (FABRIC hank node, Open Storage Network etc. | Priority Access | ● |
| 13 | Right to host events at Consortium forums | ● | Not available |
| 14 | Inclusion on Consortium led contracts | Priority inclusion through Ambassador Advisory Network | ● |
| 15 | Ambassador Advisory Network | ● | Not available |
| 16 | Distribution of Consortium Member's marketing material | ● | Not available |
| **Cirrus Foundry** | | | |
| 17 | Monthly classes events and workshops | ● | ● |
| 18 | Academic program | Priority Access | ● |
| **Cirrus Foundry Fund** | | | |
| 19 | Pre-seed | ● | ● |
| 20 | Seed | ● | ● |

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