

Together We Build African Artificial Intelligence

Outcomes of the 2nd Annual Deep Learning Indaba

March 2019



DEEP LEARNING
INDABA

Together We Build African Artificial Intelligence Outcomes of the 2nd Annual Deep Learning Indaba

Together We Build African AI: Outcomes of the 2nd Annual Deep Learning Indaba
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Indaba Abantu

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A Personal Message

The second time doing anything, especially an undertaking as large as the Deep Learning Indaba, is a special event. It signals that what has been done once can be replicated, can be improved, and that an idea that was once a dream, can be transformed into a tradition. And that is how we felt as we approached the second Deep Learning Indaba in Stellenbosch on the 6th of September 2018. It was amongst the oak-lined streets of Stellenbosch and the expansive setting of the Endler Hall that we saw what a year of effort can do. The previous year was not without struggle, and not without crises in confidence and motivation. But it truly was a year of growth, of building our strength and bond as a team, and building a stronger agenda for change that would be the way we strengthen African machine learning and artificial intelligence.

It was in 2018, and the time leading up to the annual Indaba in September, that saw us introduce the IndabaX programme, introduce the Kambule and Maathai awards, and an annual Indaba that almost doubled in attendance. We formed an ambitious programme for change that we are proud of. Ours is now also a model for change that has been taken on by other groups globally, an impact of the Indaba that was hoped for only in secret. A new Indaba brought with it a new theme, *Masakhane* that became the call that galvanised the Indaba community, and then became synonymous with it. But *Masakhane* is more than just a slogan to us, it is the fabric of how we as the Indaba leadership have worked and acted. We remember each of the more than 500 attendees of the 2018 Indaba, and the lessons they have taught us in building a community. They have built us and taught us, much more than they know. We believe the African community of machine learning and AI is stronger now than it has ever been. And like all things, that success began with a small step and simple principle, to which we remain deeply committed.

Masakhane!

Let us all build together, and let us build each other.

*The Indaba Abantu,
March 2018*

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1. Introduction

The Deep Learning Indaba is an organisation whose mission is to Strengthen African Machine Learning. This mission is currently executed using three principal programmes, which *aim to build communities, create leadership, and recognise excellence in research and innovation across our continent.*

Together, these three components form, what we believe, is the basis of a self-sustaining community that builds itself, puts itself forward, and celebrates its successes:

Community building is driven by the annual Deep Learning Indaba, the annual gathering of the African AI community, and the subject of this report.

Creating leadership is driven by the IndabaX programme, which aims to

build local leadership in individual countries across our continent.

The Kambule and Maathai awards *recognise excellence* in research and innovation by Africans across our continent and are awarded annually at the Deep Learning Indaba.

The 2nd Deep Learning Indaba hosted Africa's brightest talent from 35 countries across our continent, and showed that a strong community of researchers and innovators already exists within our continent. We are proud of how strong this community has grown, and the breadth of work that has been done. This report reviews the key outcomes of the 2018 Indaba and our vision for how it will evolve into the future.

2. Recommendations

We recommend several improvements to the Indaba's ongoing work to better support its ongoing work and mission. Our seven recommendations are:

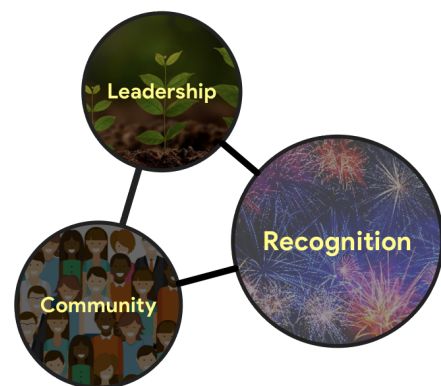
1. Further strengthen participation of Africans and women

A core principle of the Indaba is a transformation of our societies to one that is more equal and inclusive. The Indaba has seen impressive growth in the number of countries that its participants represent as well as a higher percentage of women. To further strengthen this commitment, we recommend a target of 35% female attendees should be made for future Indabas, while maintaining the country-level

representation shown at the 2018 Indaba. The Indaba's location in Kenya in 2019 is an important aspect of this directive.

2. Streamline the Indaba's approach to funding

Funding the Indaba remains a key challenge. The process of funding the Indaba should be streamlined to make it more efficient. This efficiency should come through the



establishment of a dedicated funding committee, and a focus on key funders who through larger and committed investment to the Indaba's vision can reduce the funding concerns that affect the planning of the Indaba and the support it is able to offer students and the African AI community to engage more deeply with each other. Finding key sources of long-term funding for the Indaba should be made a priority.

3. Increased visibility of research outcomes

As the African AI community grows, it will become more important to create avenues for excellent work to be highlighted, as well as a way to stimulate and encourage research work at the highest level to be showcased and shared. The Indaba should seek ways to further encourage and better showcase excellent research work, which can serve as a platform that increases the visibility for African research globally.

4. Increase the footprint of the Kambule and Maathai awards

The Kambule and Maathai awards must increase their visibility and catchment areas, with the aim of receiving more nominations and candidates from across our continent. The awards programme should initially aim to double the number of nominations it receives for both awards programmes and to work towards awards that provide strong developmental support to the awardees. Strengthened awards

programme should then strengthen the main Indaba since it surfaces new speakers, centres of excellent research and future role models and mentors.

5. Establish the legal body behind the Indaba

The legal body behind the Indaba should be established as a matter of urgency, to both enable better funding and to solidify the legitimacy of the Indaba's work as a global organisation. This will also allow the Indaba leadership to strengthen its policies around governance, think through its long-term sustainability, and the ability of its own structures as a mechanism for creating and strengthening leadership in African AI.

6. A marketplace of ideas

The Indaba should begin the work of evolving its programme into one that supports and sustains a marketplace of ideas. As the IndabaX programme takes over the role of introducing the field to new people and supporting stronger leadership in individual countries, the Indaba can now become the marketplace wherein researchers connect and form new collaborations, where funders can meet excellent researchers, where founders can find each other, where startups find the new cohort of employees, where venture teams find the founders of the future, and where governments can find the experts that help drive forward-looking, sustainable and innovative policies. A key part of the

future of the Indaba is, as the popular expression goes, to help talent meet opportunity.

7. Measuring and creating impact

Ultimately the key work of the Indaba is to move beyond the building of communities, and of human capital development, and

instead towards longer term and transformative impact on our continent. This requires innovative measurement and assessment of the Indaba's programmes and its effectiveness. The strategic work of determining these measures and reporting their changes over time is critical to the Indaba's long-term sustainability and impact.

3. Masakhane: We Build Together

As a community of technologists, researchers, innovators and learners, we build many things: we build skills; we build software; we build products; we build teams; we build communities; we build leaders. Together, we can do even more. We can build the future of our continent. And this was the theme for the 2018 Indaba: **Masakhane-We build Together.**

As part of the Indaba's theme for 2017, we called on participants to spread what they learnt, and to spread it for the good of our societies: to be the [talking drums of Africa renewed](#). Over this last year, this community has grown and spread enormously; and this growth was seen first-hand at the [2nd annual Indaba](#). In 2017 we received about 750 applications, but our space only allowed us to accept 300. Now, in 2018 we received about 1300 applications and were only able to accept 571. For every person that we accepted there were more than two others who we could not accept. We are succeeding in building a strong and vibrant community. Yet, clearly, much more needs to be done.

For 2018, our call-to-action for every participant and supporter of the Indaba during the week and beyond, was to build new partnerships, projects, and teams; to reach out to others in the community from across the continent, and find new ways of creating value. The Indaba, and those attending, were asked to be as Nelson Mandela expected: 'a partnership of a community determined to take responsibility for its own upliftment'.

Part of the spirit of building together is our ability to work and grow with other organisations and efforts whose mission is aligned with our own. We have been proud over the last year to strengthen our ties with these other organisations, including Data Science Africa, the African Masters in Machine Intelligence at AIMS, Data Science Nigeria, Nairobi Women in Data Science and Machine Learning, AI Kenya, Nairobi AI, Black-in-AI, and the North African Summer School on Machine Learning.



I've left the Indaba feeling the most inspired I've ever felt, ready to use all the knowledge and connections I've gained.

4. Impacts of the Deep Learning Indaba

As a result of its second year, we can characterise the impacts of the Indaba in four areas: in its role in strengthening global AI, in stimulating new research outputs, in supporting more diversity in our global AI meetings, and in media engagements.

Strengthening Global AI

The spirit of the Indaba and of Masakhane has now spread globally and has directly led to a globally stronger AI community. The Indaba's work has led to the creation of efforts to strengthen machine learning in eastern Europe, in south-east Asia, and South America.



Eastern European Machine Learning (EEML)

The [EEML summer school](#) was inspired by the work of the 2017 Deep Learning Indaba. EEML hosted their first event in Cluj, Romania in July 2018. The second edition of EEML takes place in Bucharest, Romania in July 2019.

This is what the Founders and Leads of EEML, Viorica Patraucean and Razvan Pascanu, had to say about the influence of the Indaba on their approach:

"The idea of organising EEML (previously TMLSS) was born from our concerns regarding the negative effects of the brain-drain phenomenon on the education system in our home country, Romania, and on the entire Eastern European region. Indeed, the emigration rates from some Eastern European countries are second only to Syria. The success of the first Indaba edition served as a confirmation that what we wanted to do can be done at scale successfully,

and the Indaba organisers served as examples that great things can be achieved when people start caring. The advice we received from Shakir, Ulrich, and Stephan was invaluable and contributed significantly to the success and quality of EEML."

SEA ML 2019

South-East Asia Machine Learning School (SEAML)

[SEA ML](#) is the effort to strengthen machine learning and artificial intelligence in South East Asia. The first meeting of the South East Asia machine learning community will be on 8-12 July 2019 at the Universitas Indonesia, in Jakarta, Indonesia.

This is what the Founders and Leads of the event had to say about the impact of the Indaba on their thinking and effort:

"The success of Deep Learning Indaba in raising awareness of the underrepresentation problem of Africans in AI and ML, facilitating regional AI and ML enthusiasts to learn from the best in the fields, and creating and fostering a lasting community has inspired us to create a similar organization to solve similar problems in Southeast Asia. The Indaba provides a blueprint on how to achieve our goals and we are honored to have the Southeast Asia Machine Learning School as a sister event of the Indaba."



Khipu Machine Learning, South America

[Khipu](#) AI is the effort to strengthen South American machine learning and artificial intelligence. The name Khipu refers to traditional system of recording common to many South American cultures using knots. Like the Indaba, they have chosen to use the values and history of their region to create new centres for global AI. Their first event will take place from 11-15 November 2019 in Montevideo, Uruguay.

This is what the Founders and Leads of the event had to say about the impact of the Indaba on their thinking and effort:

“In 2017, after learning about the first edition of Deep Learning Indaba and its mission, we immediately felt inspired to initiate a similar effort in Latin America. A year later, amazed by Indaba’s success and positive impact for the African Machine Learning community, we decided to pursue our project. We are thrilled to announce that the first edition of Khipu -- Latin American Meeting in Artificial Intelligence -- will be held in Montevideo, 2019. We hope our event will help to strengthen the local community by fostering collaborations within and outside the region, unlocking talent and encouraging leading research in AI.”

New Research Outputs

The attendees of the Indaba have gone on to create several new outputs since their participation at the 2018 Indaba.

Dataset of African Masks

Indaba attendee Victor Dibia created a project to curate a data set of African masks and then to learn a generative model of these images. He wrote about his lessons in a blog post entitled “[ART + AI – Generating African Masks using \(Tensorflow and TPUs\)](#)”. This work was directly enabled by the TPU access that was made available to every participant of the Indaba for 3 months after the event, courtesy of one of our sponsors, Google. This work was covered in several media articles, where the influence of the Indaba is mentioned: see [VentureBeat](#), [Business Day Nigeria](#), [AfroTech](#).

Natural language processing for South African Languages

Indaba attendee Jade Abbott met Laura Jane Martinus at the Deep Learning Indaba and started a weekly reading group in the area of Natural Language Processing. They began work on a project in the sub-area of machine translation, working on English–Setswana translation. Through their effort, citing the influence of the Indaba sessions and mentorship they received, they were able to obtain state of the art performance in this domain. They wrote their first paper and it was submitted to the Workshop on Machine Learning for the Developing World that was held at NeurIPS2018; NeurIPS being the world’s premier research conference on artificial intelligence and machine learning. They hope to continue their work and make a full conference submission. They wrote about their journey in a blog post entitled [The Journey to NeurIPS](#), directly citing the influence of the Indaba.



Strengthened Universities and Collaborations

The Indaba was fortunate enough to make the connection of the Dean of Engineering of Kenyatta University (in Kenya and the host of the 2019 Indaba) and the Dean of Science at Stellenbosch University (in South Africa and the 2018 host). Their meeting was fruitful, and it was during that time that they rediscovered an existing memorandum of understanding between their two institutions, which we hope will be fruitfully exploited.

The Machine Learning Research groups of Stellenbosch University and the University of the Witwatersrand met for a joint research retreat following the Indaba. This was an opportunity for them to form collaborations, share expertise and to break down the silos between their universities; all the hopes of the Deep Learning Indaba. This strengthened friendships, and paved the way for research collaborations. The photograph at the top of this page was taken at this meeting.

These two research groups went on to have (what we believe to be) the first

two publications authored completely from African institutions, and accepted into the main track of NeurIPS (the largest international machine learning conference globally):

Marom, Ofir, and Benjamin Rosman. "Zero-Shot Transfer with Deictic Object-Oriented Representation in Reinforcement Learning." In *Advances in Neural Information Processing Systems*, pp. 2297–2305. 2018.

Pretorius, Arnu, Elan Van Biljon, Steve Kroon, and Herman Kamper. "Critical initialisation for deep signal propagation in noisy rectifier neural networks." In *Advances in Neural Information Processing Systems*, pp. 5722–5731. 2018.

The immediate outcome of this and the previous Indaba was improved internet facilities at the host university. The Endler Hall, the venue of the 2018 Indaba, did not previously have any internet facility, and was installed as a result of our needs and we were its first testers. The previous Indaba in Johannesburg also saw the University agree to double its internet capacity to the computer labs to enable the types of workflows required for contemporary machine learning to be easier to conduct within the university environment.

Diversified Representation at Major Machine Learning Conferences

The Indaba directly contributes to the diversity of our largest machine learning conference, with at least 35 attendees at the last NeurIPS meeting in Montreal Canada. The Indaba NeurIPS attendees regularly sported their Indaba t-shirts and acted as ambassadors for AI in Africa. As organizers, we are extremely proud of these young scientists, who are all now actively working with us, as a community, to strengthen Machine Learning on the African continent. The Deep Learning Indaba was also talked about in the NeurIPS opening keynote, as a prime example of an effort to make the AI community a more inclusive one. Here is an [image](#) from the conference hall by Benjamin Rosman.



Media Engagements

The Indaba does not yet have a good footprint with the media and its visibility can be improved by stronger media links. Some of the references to the Indaba are:

News Sites

- [*VentureBeat*] [A researcher trained AI to generate Africa masks](#)
- [*Forbes*] [AI Innovators: Meet 2 Women Transforming The AI Ecosystem In Africa](#)
- [*FastCompany*] [How Africa is seizing an AI opportunity](#)
- [*Nature*] [Look to Africa to advance artificial intelligence](#)
- [*Microsoft Care*] [Microsoft supports Machine Learning in Africa](#)
- [*Google in Africa Blog*] [Google AI in Ghana](#)
- [*Packt Hub*] [Deep Learning Indaba presents the state of Natural Language Processing in 2018](#)
- [*Business Daily Kenya*] [How innovation ecosystem is expanding](#)

Podcasts

The Google Cloud Platform (GCP) Podcast.

- [DL Indaba: AI Investments in Africa](#)
- [AI Corporations and Communities in Africa](#)
- [Deep Learning Research in Africa with Yabebal Fantaye & Jessica Phalafala](#)

This Week in Machine Learning and AI (TWiMLAI) podcast

- [Evaluating Model Explainability Methods](#)
- [Learning Representations for Visual Search](#)
- [Acoustic Word Embeddings for Low Resource Speech Processing](#)
- [AI Ethics, Strategic Decisioning and Game Theory](#)
- [Advanced Reinforcement Learning & Data Science for Social Impact](#)
- [ML/DL for Non-Stationary Time Series Analysis in Financial Markets and Beyond with Stuart Reid](#)

Participant Blogs

- Victor Dibia, mentioned earlier, wrote a blog post on [6 Reasons why I loved the Deep Learning Indaba 2018](#), calling the Deep Learning Indaba “the best Deep Learning Meeting I have attended”.
- Jade Abbot wrote an [Open Letter to the Deep Learning Indaba](#) to tell us of the personal impact on her. In her words: “Because what you have done (and continue to do) is absolutely momentous, unimaginable and incredible.”
- From Merelda Wu wrote a blog post on [5 Reasons Why You Should Join Deep Learning Indaba 2019](#). “I took an entire weekend to draft the answers for the conference application. ... I would do exactly the same next year to make sure I can attend again.”

Testimonials

We list a set of additional testimonials from the participant feedback in the appendix.

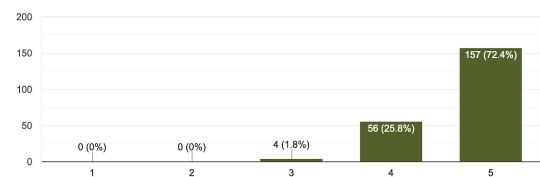
- I think you have created something truly unique and powerful in the DL Indaba event. Attending has been a truly life changing experience for me, the only comparable event for me in terms of its impact on me and my worldview has been the birth of my son.
- I loved the focussed session for Women in Machine Learning. I have spoken to many of my contacts from the Indaba and women I know who use ML in

their work/studies and I would like to start a WiML meet up in Johannesburg.

- Being a Muslim African-Arabic female I was so afraid from being to the Indaba. I was afraid from what people will think of me based on what being told about Muslims and Islam and how they will be treating me maybe no one will talk to me and so on. But the moment I been there EVERY thing disappeared...
- I love the strong emphasis on 'Masakhane' - building together, as well as the reminder of Africa needing to make it happen for ourselves.

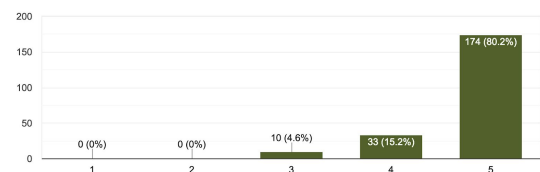
How would you rate the Indaba overall?

217 responses



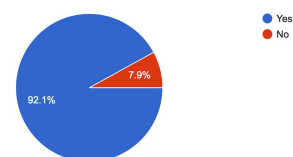
Will you be sharing the Indaba material and your experiences with others?

217 responses



Did you find it useful to have sponsor stands (Google, DeepMind, Microsoft, RMB, InstaDeep, etc) during the week, to discuss careers and opportunities?

214 responses





”
I found new role models. Women in machine learning always inspire me to push forward!

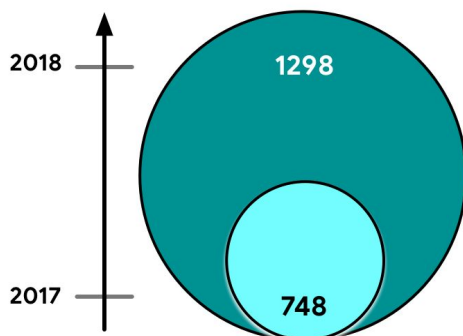
5. Highlights of the 2018 Indaba

We reached several new highs with the 2018 Indaba.

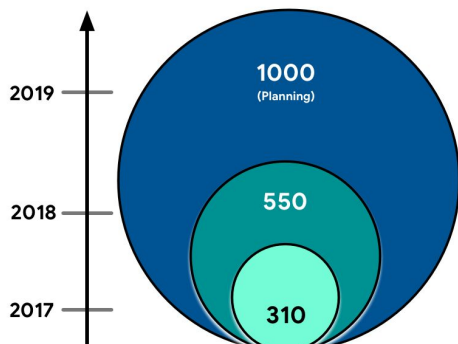
Growth in applications and attendance

Our applications are growing rapidly, which means that we can continue to expand the scale of the Indaba to truly make it the annual gathering of the African AI community. In 2019 our target (budget permitting) is to host 700 attendees.

Growth in Number of Indaba Applications



Growth in Indaba Attendance

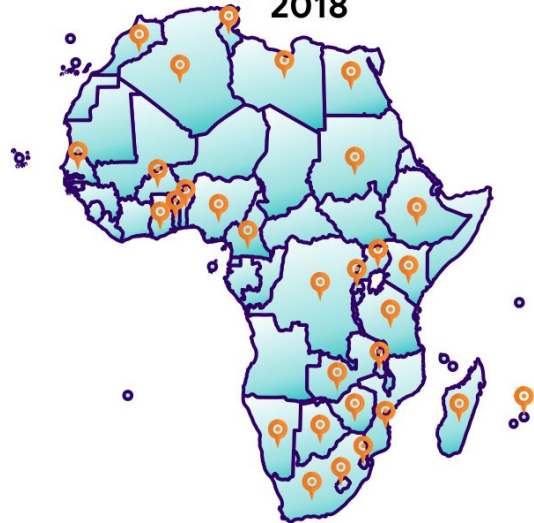


Attendees

The Indaba continues to expand and include more countries and energetic innovators and students into the conversation and developments in AI. Both the number of African and

international countries is increasing showing that there is a broad appeal of the Indaba to both bring different communities together and still discuss AI at the state-of-the-art. In total **571 of the 1298 applicants** were accepted to attend the Indaba, this is approximately a **44% acceptance rate**.

Country Representation 2018

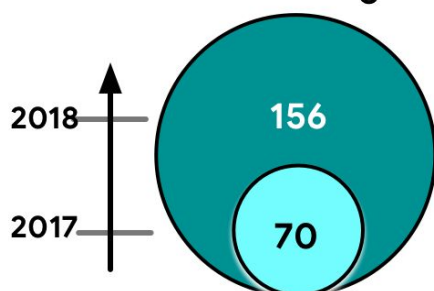


Women in Machine Learning

We continue to put emphasis on equalising the participation of female technologists at the Indaba. We have only minimally improved our representation from 22% to 28%. *This will be the focus of new programmes from the Indaba.*

The 2018 Deep Learning Indaba also hosted the **first ever African Women in Machine Learning event**, which was kindly organized by Microsoft, one of our sponsors.

African Women in Machine Learning



Prizes and Judges

One of the pillars of our activities involves recognising excellence and this is achieved through the Kambule and Maathai awards, but also through prizes awarded during the week for excellence demonstrated in the presentation of research during the poster sessions.

In total 86 prizes were awarded:

- 25 winners of the \$1000 Google cloud computing credits.
- 20 winners of book prizes from the MIT press.
- 6 winners of book prizes from the Cambridge university press.
- 30 winners of signed copies of the AlphaGo documentary DVD.
- 3 winners of Titan V GPUs from NVIDIA.

- 1 winner of a cash prize for excellent research from IBM
- 1 winner of a travel award to NeurIPS2019 from Microsoft.

The mechanics of judging the posters, required a wider set of judges. The prizes are an important part of recognising the excellence and effort of the Indaba attendees. *Identifying these prize sponsors early is needed.*

Selection Process and Transformation

The call for applications was opened on 6 April 2018 and the last acceptance notifications were sent out on 12 June 2018. During the application period, we received 1298 applications for roughly 500 slots. We received applications from 702 unique affiliations, 75 nationalities, 183 PhD students, more than 90 Academics, 227 Industry professionals, 54 students from coding academies, 24 PostDocs and almost 400 undergraduates. The criteria for selecting amongst these candidates was guided by several objectives.

Inclusion and representation. The field of Artificial Intelligence, like many fields in computing, is plagued by lack of diversity and representation. Because of the pervasiveness of AI methods, our continuing effort, which is central to our mission, is to ensure that as many voices are included in the development of these algorithms and systems and the policies that govern their deployment, especially the voices of African citizens. Our aim is to create an Indaba attendance and environment that is biased towards including under represented groups such as women and black people, towards an intercultural and multidisciplinary cohort of participants.

Pan-Africanism. To make our contribution towards pan African unity, strengthening our aims towards greater inclusion, are committed that there would be at least 2 funded individuals for each African country.

Indaba Ambassadors: The Indaba has two kinds of ambassadors.

IndabaX Organisers: The IndabaX programme forms one of the three pillars of the Indaba triple of programmes. To strengthen the bonds of this community, we allocated **1 place at the Indaba to each of the 13 IndabaXs.**

Tutors and Mentors: Individuals that had tutored at any level past 3rd year of undergraduate were allocated points. These individuals were encouraged because they have already demonstrated an interest in knowledge sharing.

Promoting and supporting ongoing research. The annual Indaba is currently a technical workshop. We allocated points to researchers who demonstrated depth in technical know-how, either by

discussing their favorite ML resource (paper, blog, tool), by elaborating on their current work and/or by sharing with us a strong motivation for why they should be accepted to the Indaba. To get through this task, we ran a double-blind review, and each **application received at least 2 reviews.**

Budgetary Commitments. The Indaba is a free event for students and a relatively cheap event for faculty/researchers and entrepreneurs (less than \$400 per attendee for the week). In order to meet our financial targets, we automatically allocated 150 slots for either Academics or Industry practitioners who could cover the cost of their attendance. **That said, we made sure to target individuals who were actual practitioners in ML so as to preserve the core purpose of our work.**

Allocation Model. The Indaba committee developed an allocation model to decide on awarding of financial support to individuals. This is described in Box 1.



This has impacted me both personally and academically I have already realised what I need to change both on my work and how I approach problems.”

Box 1. Step-by-step application of the scoring system.

Appendix C gives the specific categories that were used. The rows highlighted in green there are given scores in a given range, using the written responses that required a judgement from reviewers. The rows that are not highlighted have scores automatically assigned, and aren't seen by reviewers. Reviewers also do not see applicant names, country of origin, or any of the affiliation information.

- A. Some fields have a baseline of 0, and it is expected that this will be zero unless we want to really encourage for any reason, e.g., encourage different fields of study like physics, social science, ethics; or because we found the set of responses very compelling and the reviewer felt strongly about it.
- B. We then filter within two categories:
 - a. types of applicant (PhD student, MSc student, undergraduate, postdoc/academic, industry)
 - b. Country of applicant: from host country, or outside host.
 - c. Also potentially filter by whether they attended previously. We wish to maintain a continuity by having some attendees from the previous year if possible. And if someone gives a good reason, they should be seriously considered.
- C. As a final selection we agree on rough quotas for each group and fill the top scoring candidates in each group to reach the quota. A simple quota is:
 - a. 60% host country and its economic area (this year this is the countries of Southern Africa) candidates and 40% external to host.
 - b. In terms of education levels, we aimed for the following percentages, 30:30:5:10:15% for PhD:MSc:Undergrad:Academic/postdoc:Industry

6. Addressing the 2017 Recommendations

There were several key recommendations from the 2017 Indaba that we reflect on here and on the extent to which they were achieved.

1. Widen African participation

We were proud to increase the participation of attendees from across our continent, increasing the number of countries that were represented from 23 to 30 countries. We had appreciable representation from countries like Cameroon, Kenya, Nigeria, Ethiopia, South Africa and Sudan, while the remaining countries had on average 2 attendees from each country. This can be improved and it is why

increasing participation further remains as a recommendation for the year going forward.

2. Continued emphasis on diversity, inclusion and community-building

The 2018 Indaba saw us increase the participation of women from 23% to 28% of participants. We also introduced a code of conduct that is meant to apply to the main Indaba and all its related events such as the IndabaX events. The makeup of the

Indaba in terms of its speakers continues to balance genders and country representations with the aim of surfacing many underrepresented groups of scientists and to demonstrate the diversity of scientific excellence that exists in the field of AI to our attendees. All sponsor-hosted events were expected to operate within a mandate of community building and mentorship and this led to a fireside event hosted by Google to meet some of the researchers from their new Ghana lab. Microsoft hosted a Women in Machine Learning evening that allowed for deep conversation between our attendees and a panel of senior female scientists. Capitec and Nedbank also held successful mentorship sessions and information sessions on the role of data scientists for commercial problems.

3. Participation from all stakeholders: more universities, startups, and policy-makers

The number of universities and academics represented was increased significantly, and coupled with the increase in the number of attendees from more countries. The 2018 Indaba included parallel sessions on *The Life of a Machine Learning Startup*, and a session on *Ethics and Policy*. The startups session invited startups and venture capitalists to talk about success and failure in building new companies, and the process of building a startup. And the ethics and policy session saw guests from policy sectors talk about the challenges of

government and regulation in this area and what the current approaches and landscape looks like. The ethics session is recommended to be part of the plenary sessions for the next Indaba, and that these types of sessions should become part of the tradition of the Indaba.

4. Influence a change in South African research funding policy

We have made written statements to the South African funding agencies to emphasise the importance of strengthening research and incentivising collaboration within the university environment and between universities. Such processes of change are slow and we continue to follow-up on this process.

5. Increase student mentorship opportunities

Mentorship appears as the regular request from attendees. We addressed this need during the week by hosting evening sessions for Women in Machine Learning, evening sessions on How to Write a Research Paper, and encouraging sponsors to host mentorship sessions. A programme for long-term sustainable mentorship remains elusive and is something that we continue to explore.

6. Expanded participation of academics

Our intention was to increase the number of academics (i.e. university lecturers and professors) to enable this cohort to also benefit from

technical presentations at the state of the art, to provide an additional source of mentorship to attendees, and importantly, to make visible where and who across the continent is working, researching and teaching in machine learning across the continent, and where the centres are from which one can obtain higher degrees in this area. There remain obstacles to increasing participation from academics, in particular funding for travel and strengthening the case for participation.

7. Establish a careers fair

We chose not to create a dedicated careers fair. This may become a priority in future. The emphasis was instead on strengthening the base of sponsors and to use the stands that are given to sponsors during the week as a type of ongoing careers fair.

8. Improve selection process and remove selection bias

The selection process was driven by a rubric that was used to score every participant. The resulting scores were sorted and then used in conjunction with other selection priorities, such as ensuring breadth of African-country representation, ensuring an appropriate number of industry applicants, and the prioritisation of certain degree levels (such as ensuring more PhD candidates, and fewer undergraduates due to the relative importance to career paths). This

was a successful approach that allowed us to improve representation and solidify the selection process. This process was limited by the limited number of reviewers to handle the significant number of applications received. Future years will have to significantly increase the number of reviewers for applications and the tool that is used.

9. Improve the learning experience and split practicals into two levels

The overall learning experience was improved by allowing a greater diversity of topics by having the Friday sessions be a set of parallel sessions allowing attendees some ability to choose topics in their area of interest. These parallel sessions typically were three in parallel, split amongst theoretical, applied, and industry tracks. The practical material was also modified to allow for two tracks of learning. More advanced candidates would follow the more advanced track, and newer participants would follow the more patient track. This was also coupled with a significantly strengthened set of tutors to support the learning process, many of them attendees from the previous Indaba. The parallel session approach that was used for the main sessions should be experimented with to allow for further growth in this area. The 2018 programme is included as an appendix.

7. Financing the Indaba

Financing the operations of the Indaba remains the most challenging and time consuming task which affects the ability of the Indaba to do its work. The fundraising for the Indaba is allocated in six categories shown in the table below.

A summary of the key indicators:

- Income through sponsorship: ZAR 4,546,414 / \$ 324,743 / £ 252,578.
- Income from registration: ZAR 750,000
- Number of sponsors: 28 (5 at Nile tier, 1 at Congo tier, 5 at Zambezi tier, 10 at Limpopo tier) – see Appendix B for a full list.

- Funded 114 travel awards (both flight and accommodation), and an additional 51 accommodation awards.

A recommendation as part of the ongoing streamlining of the Indaba's operations, is to set up a dedicated sponsorship and fundraising team who can focus on raising the funds. This will continue to be a challenge and a long-term solution will need to consider more long-term funding solutions through membership, through fee mechanisms, or other funding rounds.

Categories	Budget	Notes
Events and catering	33.1%	All catering, networking events, cleaning, etc.
Student support and travel	44.1%	Travel for 100 sponsored students from host country, 50 students from the rest of Africa, and 50 academics
Materials and facilities	6.3%	Facilities, poster boards, AV, transport, assuming our venue is sponsored
Teaching support	0.4%	Cloud computing, networking, prizes
Community and programmes	7.0%	IndabaX and community support
Administration	9.1%	Legal, finance, risk, paramedics, comms

8. Key Challenges

There were several challenges in hosting the 2018 Indaba for which early mitigation will need to be established earlier for forthcoming years.

Visa challenges

Visas for travel to South Africa remained a challenge for many attendees. We were lucky to eventually have a liaison through the South African Department of Science and Technology that was able to assist us with visa requests. This was done late in the process and identifying such contacts earlier and sending lists of

travellers needing visas earlier will be needed, if subsequent hosts have a general need for visas for short visits.

Organisational load

The Indaba is organised by a team of volunteers, and as its scope and ambitions have increased, so too has the organisational and personal load on this

set of volunteers. Addressing this challenge is a key factor to the ongoing success of the Indaba.

Travel arrangements

We have continued to rely on university support to arrange travel for our

speakers and sponsored students. As we have increased this number, this has become a significant organisational load and identifying travel co-ordinators and corresponding budget to support this function will be needed, and should be made as early as possible.

9. The Future

The second Deep Learning Indaba exceeded our wildest imaginations. It saw the establishment of a community committed to building pan-African scientific excellence that truly embodied the spirit of Masakhane, and that builds and supports itself. We have seen growth in the attendees, and literally their personal growth over the course of a week. When the first thought of the Indaba project was conceived at the end of 2016, we never would have thought that by 2019, African AI would become a topic of such intense global attention. And we remain committed to playing a role in seeing African AI continue to flourish.

Indaba in Kenya

The Indaba now fulfils the commitment from last year to move across our continent, and will take its first step to the technology hub and vibrant African city of Nairobi in Kenya. This move will come with a new set of organisational challenges, a new set of needs, and new opportunities to experiment with the Indaba project and the mission of Strengthening African Machine Learning.

The Indaba Foundation

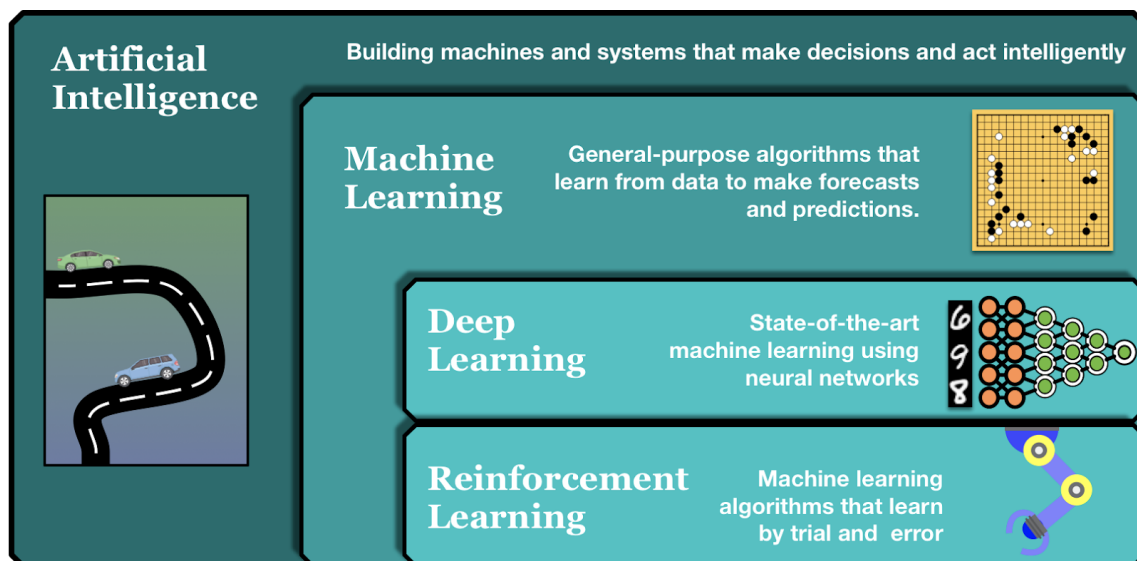
As we strengthen our work, the next phase will see us professionalise our activities further with the aim to see the long-term sustainability of the Indaba and further structuring of its governance processes. This will involve establishing a formal body behind the Indaba that established itself as a charity, which is able to operate across our continent and internationally. We have already been able to obtain pro-bono support from the legal firm Baker McKenzie, and will be working on this in earnest over the next year.

Your Support

To achieve the aims of the Indaba, we will require ongoing support from all sectors. If you, an organisation, or any other stakeholders you know can support our mission in any way—as a financial supporter, as a sponsor of prizes, in outreach, fundraising and awareness, or other ways—please reach out: info@deeplearningindaba.com

With our first two bricks laid, we now build further, to continue to build African machine learning, and to build together.

Appendix A: Artificial Intelligence, Machine Learning and Deep Learning



Appendix B: List of Sponsors

We are grateful to all our sponsors. Without their commitment to strengthening African machine learning, the Indaba would not be possible.



UBER

CONGO TIER



Artificial Intelligence
www.elsevier.com/locate/artint

IBM

NEDBANK CIB

RMB
A division of FirstRand Bank Limited

salesforce

MaSS
DST-NRF CENTRE OF EXCELLENCE IN MATHEMATICAL & STATISTICAL SCIENCES

ZAMBEZI TIER



Africa Oxford Initiative

UNIVERSITY OF OXFORD

AIMS
African Institute for Mathematical Sciences
SOUTH AFRICA

amazon

ALLAN GRAY

AMBRITE

AngloAmerican
PLATINUM

CAPITEC BANK

FNB
First National Bank

ELEMENT AI

dataprophet™
machine learning specialists

InstaDeep™

LIMPOPO TIER

Appendix C: Participant Testimonials

- "Last year, **before the Indaba:**
 - I stuck on my MSc – emotionally I couldn't finish it. I felt like I'd made all the wrong choices in doing it...
 - Feeling lonely in my research; feeling unsupported in my ML work in industry; feeling like no one else was around to talk to; Feeling like I was behind with current research

After the Indaba:

- I managed to get the courage to finish my MSc. I learnt it was not a waste of time. The RL community really helped me know I was on track
- I became confident about my ML attempts within Industry, understanding that I wasn't doing something totally stupid
- I felt more confident reaching out for help (both locally and internationally)
- I started reading papers and blogs again and starting writing blogs to share my experience
- I started presenting at conferences and meetups to show people how they can get into ML and show them how to implement their own models. In fact, I think I totalled at 20 speaking opportunities between then and now
- I started building and hiring ML expertise at my company
- I helped start up Women In Tech ZA JHB Chapter

And I attribute all of this to inspiration and expertise I received at the Indaba"

- I think the organisation was amazing. Congratulations to everyone for pulling that off. I also think the attendees were very diverse and well balanced. I do feel though that the next Indaba should have into consideration accessibility of the country to majority of africans. Too much money is spent on unnecessary visa applications to come to South Africa.
- The Deep Learning Indaba was the best event I have ever attended. Everyone was so passionate about their work and willing to share their knowledge and advice. The entire event had a buzz of excitement and optimism. I've left the Indaba feeling the most inspired I've ever felt, ready to use all the knowledge and connections I've gained. Thank you so much for all the effort you guys put in – I can imagine it was a hectic task in setting on this up – if there were any complications and hitches nobody noticed (except for the screen projector failing right at the beginning of the conference).
- I think you have created something truly unique and powerful in the DL Indaba event. Attending has been a truly life changing experience for me, the only comparable event for me in terms of is impact on me and my worldview has been the birth of my son. This event has lit a fire in me, and in many others at the event to pursue AI/ML to advance Africa, and AI/ML for the good of the world. The spirit of generosity, inclusivity and support was beyond any other conference I have attended. You and the exceptional presenters you brought will probably never realize how truly inspirational this has been and the impact this will make on the future. I feel like I have come home. Thank you beyond all words. Masakhane.

- Massive thanks to the organisers! This was honestly the best week of my year. I met so many incredible people and I was exposed to so many interesting ideas. The Indaba is an amazing initiative and I think it will have a massive impact on ML research and interest in Africa. Being able to speak with all the inspiring speakers throughout the week was also a highlight. I can't wait for Indaba 2019 in Kenya!! I think it's great to move to other countries in Africa.
- The Indaba of the future should allow conference paper submissions. It should be both relevant to newbies in ML/AI and to advanced practitioners. I'd like more participation from leading African researchers from African institutes.
- Thank you for thinking of us, thank you for putting all this together, thank you for walking with us through this journey of discovery. I loved every day of Indaba, I could literally feel my life changing before my eyes. I might never be able to thank you enough what you did, I will however do it the best way I know how, by paying it forward and helping someone else. I am grateful my first time on plane was on my to Indaba. You people are awesome.
- I would like to first say THANK YOU , for organizing such a world class event, it was a very beautiful experience, i loved every moment of it. Thank you for choosing me as one of the 500 people to attend this year's indaba. This have impacted me both personally and academically i have already realized what i need to change both on my work and how i approach problems. The line of speakers you brought AMAZING... wow it was an amazing learning curve for me and i cannot wait to attend the next one.
- I loved the focussed session for Women in Machine Learning. I have spoken to many of my contacts from the Indaba and women I know who use ML in their work/studies and I would like to start a WiML meet up in Johannesburg. If you have any thoughts or contacts for me to get this up and running faster or with some experience, I'd be very grateful.
- I'm convinced the host, Willie, and organising team are actually superheroes.
- I love the strong emphasis on 'Masakhane' - building together, as well as the reminder of Africa needing to make it happen for ourselves. The Indaba committee has definitely paid great attention to inclusion and diversity, and that could be felt in the sessions, and the participation of people. Thank you for putting so much of your volunteering time into realising this.
- For the organizers, I would like to thank each and all of them for giving me the chance to be in such motivating, useful and respectful community like this. thanks for the funds, for organizing this beautiful Indaba and for giving me memories for life. About diversity and inclusion I am not actually that kind of person that can discuss well but I will tell my experience. Being a Muslim African-Arabic female I was so afraid from being to the Indaba. I was afraid from what people will think of me based on what being told about Muslims and Islam and how they will be treating me maybe no one will talk to me and so on. But the moment I been there EVERY thing disappeared the very welcoming organizers, the very generous speakers and the lovely participants made it easier for me to engage and connect. and for that Indaba will always be in my heart and I will do my best encouraging more people to come so thank you for every one who made me feel like I am home.

Appendix D: Indaba Programme

	SUNDAY 9 Sep	MONDAY 10 Sep	TUESDAY 11 Sep	WEDNESDAY 12 Sep	THURSDAY 13 Sep	FRIDAY 14 Sep
07:30		Coffee & Registration <i>Endler foyer</i>	Coffee <i>Endler foyer</i>	Coffee <i>Endler foyer</i>	Coffee <i>Endler foyer</i>	Coffee <i>Endler foyer</i>
08:00						
08:30		Opening <i>Endler hall</i>	Practical 2 <i>MARGA computer labs</i>	Generative Models <i>Endler hall</i>	NRSM FOCV VS 3124 VS 2121 VS 1046	RL2 VS 3124 VS 2121 VS 1046
09:00						
09:30		Deep Learning 1 <i>Endler hall</i>				
10:00						
10:30		Coffee <i>Endler foyer</i>	Coffee <i>Endler foyer</i>	Coffee <i>Endler foyer</i>	Coffee <i>Endler foyer</i>	Coffee <i>Endler foyer</i>
11:00	Registration	Deep Learning 2 <i>Endler hall</i>	Probabilistic Thinking <i>Endler hall</i>	Kambule and Maathai <i>Endler hall</i>	Fireside discussion <i>Endler hall</i>	Real-life Machine Learning <i>Endler hall</i>
11:30	<i>VdSterr foyer (entrance 1)</i>					
12:00		Lunch and posters	Lunch and posters	Lunch and posters	Lunch and posters	
12:30		<i>Neelsie and Endler foyer</i>	<i>Neelsie and Endler foyer</i>	<i>Neelsie and Endler foyer</i>	<i>Neelsie and Endler foyer</i>	
13:00						Prizes & Closing <i>Endler hall</i>
13:30						Lunch <i>Neelsie</i>
14:00	Practical 0 <i>MARGA computer labs</i>	Practical 1 <i>MARGA computer labs</i>	Recurrent Networks <i>Endler hall</i>	Reinforcement Learning <i>Endler hall</i>	Recent Advances in RL <i>Endler hall</i>	
14:30						
15:00						
15:30						
16:00	Break	Coffee <i>Endler foyer</i>	Coffee <i>Endler foyer</i>	Coffee <i>Endler foyer</i>	Coffee <i>Endler foyer</i>	
16:30	Maths for ML <i>Van der Sterr building</i>	Convolutional Models <i>Endler hall</i>	Practical 3 <i>MARGA computer labs</i>	Practical 4 <i>MARGA computer labs</i>	GM&H FoNLP VS 3124 VS 2121 VS 1046	
17:00						
17:30						
18:00						
18:30	Transport to event	Break	Break	Break	Transport to event	
19:00	Welcome event <i>Root 44</i>	Movie WiMIL <i>Pulp Cinema STIAS</i>	Movie Topical session <i>Pulp Cinema VdSterr 1046</i>	Movie Sponsor events <i>Pulp Cinema TBA</i>	Farewell event <i>Seven Sisters Estate</i>	
...						

Appendix E: Application Scoring Rubric

Question	Response in form	Scoring	Weight
Field of study	0 - 1	1-encourage field, 0 baseline	8
Why attend Indaba	Reviewer judgement	1- poor, 5 excellent	15
How will share	Reviewer judgement	1- poor, 5 excellent	12
Have you been a tutor	0-1	0-N, 1-Y	5
Favourite resource or paper	Reviewer judgement	1- poor, 5 excellent	11
Have you conducted any research? Elaborate	Reviewer judgement	1- poor, 5 excellent	11
Race	B,W,C,I,O	C:4, O:3, B:2, I:1, W: 0	15
Gender	M/F/O	0-Male, 1-else	13
Overall impression	Reviewer adjustment	2 - encourage, 1 support, 0 - baseline	10

Appendix F: List of Indaba Organisers and Advisory Board

Indaba Abantu

- Shakir Mohamed, Staff Research Scientist, DeepMind
- Ulrich Paquet, Staff Research Scientist, DeepMind
- Vukosi Marivate, Senior Researcher, Council for Scientific and Industrial Research
- Willie Brink, Senior Lecturer, Stellenbosch University
- Nyalleng Moorosi, Senior Researcher, Council for Scientific and Industrial Research
- Stephan Gouws, Senior Research Scientist, DeepMind
- Benjamin Rosman, Principal Researcher, Council for Scientific and Industrial research (CSIR), and Senior Lecturer, University of the Witwatersrand
- Richard Klein, Associate Lecturer, University of the Witwatersrand
- Avishkar Bhoopchand, Research Engineer, DeepMind
- Kathleen Siminyu, Africa's Talking
- Muthoni Wanyoike, InstaDeep, Kenya.
- Daniela Massiceti, University of Oxford
- Herman Kamper, Stellenbosch University

Advisory Board

- Bitange Ndemo, Univ of Nairobi, Safaricom, Former Permanent Secretary
- Bubacarr Bah, Research Chair, African Institute for Mathematical Sciences
- Bonolo Mathibela
- Danielle Belgrave, Microsoft Research Cambridge, Imperial College
- George Konidaris, Assistant Professor, Brown University
- Joy Buolamwini, MIT and Algorithmic Justice League
- Komminist Weldemariam, Chief Scientist, IBM Research Africa
- Nando de Freitas, Principal Scientist, DeepMind
- Rachel Thomas, Fast.ai co-founder, Univ San Francisco