AI for Africa:
The State of Artificial Intelligence in Africa

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Outline

- What is Artificial Intelligence?
- AI as a disruptive and transformative technology
- Range of Technological Options
- Selected Emerging Technologies
- Opportunities for Leap Frogging
- Social and Ethical Considerations
- Public Policy Actions
- Conclusions

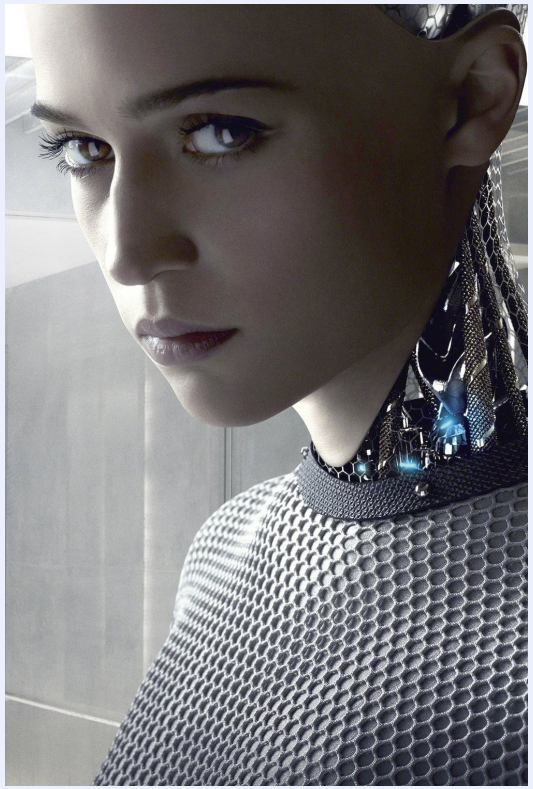
What is Artificial Intelligence?

What Artificial Intelligence is NOT

The Robot Uprising

What AI is NOT

The Machine Obtaining Consciousness



What is Artificial Intelligence?

Short Answer

- Intelligent Automation

From vacuum cleaners...

What is Artificial Intelligence?

Short Answer

- Intelligent Automation

To cooperating drones...

What is Artificial Intelligence?

Short Answer

- Intelligent Automation

To board game winners....

What is Artificial Intelligence?

Short Answer

- Intelligent Automation

To card game winners....

What is Artificial Intelligence?

Short Answer

- Intelligent Automation

To game show winners...

What is Artificial Intelligence?

- AI as a discipline is just over 60 years old
- Research successes during the first 40 years
- Impact beyond research labs in the last 20 years
- A mature diverse field, drawing from various disciplines
- We focus here on sub-areas with recent practical successes
- But AI needs to be viewed holistically
- Failure to do so so risks being left behind in the next wave

AI as a Transformative and Disruptive Technology

AI as a Transformative and Disruptive Technology

- Many factors have contributed to this.
- Brief mention of the most important areas

Semantic Technologies

- Natural Language Processing (NLP)
- Knowledge Representation and Reasoning (KR)

Example: Open domain question answering

IBM's Watson

- "An application of advanced Natural Language Processing, Information Retrieval, Knowledge Representation and Reasoning, and Machine Learning technologies to the field of open domain question answering"
- It comprehensively defeated the all-time best players in the American TV quiz show Jeopardy!

Watson: A Cognitive System

Ken Jennings, famous for winning 74 games in a row on the TV quiz show, borrowing a line from a “Simpsons” episode: “I, for one, welcome our new computer overlords.”

AI as a Transformative and Disruptive Technology

- Perhaps the most important factor

Machine Learning

- Deep Learning—a form of adaptive neural networks
- Progress in hardware technology
- Incredibly large amounts of data—mostly through web-based data gathering

AI as a Transformative and Disruptive Technology

Application of Deep Learning

AlphaGo beat Lee Sedol in a series of Go games

AI as a Transformative and Disruptive Technology

Application of Deep Learning

Libratus beat four top-class human poker players

AI as a Transformative and Disruptive Technology

Deep Learning —- Beneficial effects on other sub-areas of AI

- Computer Vision
- Speech Recognition
- Natural Language Processing
- Automated Decision Making
  - Attributed to Reinforcement Learning
  - Attributed to Deep Learning
- Development of Neuromorphic Computers

AI as a Transformative and Disruptive Technology

Collaborative Systems

- Cooperation with humans or other intelligent systems
- E.g., self-driving vehicles
- Crowd-sourcing
- E.g. Wikipedia

Computational Social Choice

- Social Choice Theory: Maximising Social Good
- Computational aspects brings a practical component

AI as a Transformative and Disruptive Technology

Algorithmic Game Theory

- Game Theory: Study of Strategies and Incentives
- Computational angle brings practical aspect

Internet of Things

- Many interconnected devices
- Lots of information shared
- AI as the driving factor for making sense of this
- E.g., an abstract layer over communications protocols
- Semantic Web is an example of this

Range of Technological Options

Range of Technological Options

Transportation

- Planning and scheduling
- Other advances driven by the availability of large amounts of transportation data
- Real-time prediction and route navigation
- Autonomous transportation (public transport, trucks, cars)
- Main impediments are sociological and psychological

Range of Technological Options

Robotics

- Robots have started to enter people's homes
- Due to a positive feedback loop involving AI advances and mechanical innovations
- E.g., robot arms have led to research on manipulation

Service Robotics

- Good example of a recurring theme
- Could lead to increased inequality
- But also has the potential for benefitting society as a while

Range of Technological Options

Healthcare

- Progress in Machine Learning
- Coupled with large-scale data collection
- Combined with Semantic Technologies
- Infer possible health risks automatically
- Combination of social and healthcare data
- Prediction on the personal and population level
- Main impediments are sociological, psychological and legal

Range of Technological Options

Education

- Already augmented with various AI technologies
- Natural Language Processing, combined with Machine Learning and Crowdsourcing
- Multiplication of classroom sizes, but addressing individual students needs
- Massively Open Online Courses (MOOCs) — using AI for evaluation
- Machine Translation allows for translation of educational material
- The challenge is integrating the human element with AI technologies

Range of Technological Options

Public Safety and Security

- AI tools have already been deployed (e.g. facial recognition tools)
- Legitimate concerns about the incorporation of AI tools being too pervasive
- But AI can also be used to decrease overbearing policing methods (e.g., targeted better)
- Machine learning is used for predictive crime prevention
- Raises the fear of innocent people being targeted unjustifiably
- But AI can also be used to reduce and remove human bias
- Challenges are sociological, psychological, and legal

Selected Emerging Technologies

Science, Technology, and Innovation Strategy for Africa (STISA-2024) Priority Areas

- Eradicating hunger, ensuring nutrition and food security
- Prevention and control of diseases and ensuring wellbeing
- Communication (physical and intellectual mobility)
- Natural resources management and climate change
- Peace and security
- Wealth creation

Selected Emerging Technologies

Eradicating hunger, ensuring nutrition and food security

- AI tools for scheduling and planning can play an important role
- Have already been applied in areas in the US
- Shift from increased food production to efficient food distribution

Selected Emerging Technologies

Prevention and control of diseases and ensuring wellbeing

- Machine learning and data mining approaches
- Prediction of outbreaks of disease
- Identification of pregnant women at risk of adverse birth outcomes
- Access to relevant data is necessary
- Challenges are not purely technical anymore
- Key factor: implementation in consultation with affected communities

Selected Emerging Technologies

Communication

- Harnessing social networks and reasoning with the data behind them
- AI technologies are well-suited to deal with the dynamic uncertain nature of such networks
- Possible danger: AI systems that exhibit discriminatory behaviour
- But proper and transparent safeguards built in can reduce discrimination
- Will only be successful if affected communities have reason to trust the technology

Selected Emerging Technologies

Natural Resources Management and Climate Change

- Machine Learning to detect patterns in data
- Semantic Technologies to make sense of the patterns
- Examples include:
  - Identification of Afrotropical bees
  - Prevention of rhino and tiger poaching
  - Detection of wildfires

Selected Emerging Technologies

Peace and Security

- AI prediction tools for preempting criminal behaviour based on data obtained from social media
- Danger that such tools can be used to target ordinary citizens unjustifiably
- Crucial to obtain the acceptance of the population at large
- Important to put in strong checks and balances
- The latter can be added as part of the AI tools being used

Selected Emerging Technologies

Wealth Creation

- Huge economic effects on cognitive humans jobs
- Similar to that of automation and robotics in manufacturing
- Danger is that only a small elite will benefit
- Education and re-training can mitigate such effects
- Longer term this is a political issue that needs to be debated

Opportunities for Leap Frogging

- Leap frogging is possible for every AI technology mentioned above
- Some AI technologies have already been deployed in Africa
- Others have been deployed in environments similar to that found in Africa
- Others need minor adjustments to be deployed here
- The global AI community is acutely aware that it has not accorded sufficient attention to Africa and other developing regions
- The time is ripe for more systematic interaction with this community

Social and Ethical Considerations

- A real danger that AI could widen existing inequalities
- How should the economic fruits of AI technologies be shared?
  - Tools and data sets are frequently in the hands of a few
- AI tools may reflect the biases of its designers (or the inherent biases of the data sets used)
- But AI-based decision tools have the potential to reduce bias in critical decisions
- The use of AI tools raises many privacy issues
- Similarly for the potential of AI to predict future behaviour
- The impact of AI on the labour marker
- The success of AI also raises many legal considerations linked to social and ethical issues

Public Policy Actions

- Provide mechanisms for officials at all levels of governance to obtain technical expertise in AI. Otherwise there is a real danger that AI will end up benefitting small elites, and will not reach its potential as an enabling technology for society at large.
- Put measures in place to ensure that there are no obstacles to conducting research on the fairness, security, privacy, and social impact of AI systems.
- Ensure that there is sufficient funding for interdisciplinary studies on the societal impacts of AI.
- Establish an official African AI body. It is necessary for Africa to speak with one voice on the global stage.

Conclusions

- AI, both as a science and as a set of technologies, is currently experiencing unprecedented growth and success worldwide
- This level of growth will continue for the foreseeable future
- AI technologies have tremendous potential for effecting positive change
- To realise this potential there are important ethical and social considerations to be addressed
- For Africa to join in reaping the full benefits of AI, it is vital to make our voices heard on this global platform now