

Talk 05/14/2018 - Can we save the planet with AI? by Raphael Koch

Slide 1 -- Welcome

Can we actually save the planet with AI or will it just end in a huge catastrophe?

Today I will give you a look into this topic. I try to show that AI is not just pure evil that will take over the world as Hollywood tries to make us believe. But also the significant drawbacks these solutions take with it.

Slide 2 -- Believers

So is AI the solution? Well according to some of the most influential groups on our planet it is, and they are working hard to make it a reality. For example Microsoft just announced a 50 Billion US Dollar plan. Microsoft is committing 50 Billion US Dollar over the next five years to put artificial technology in the hands of individuals and organizations around the world who are working to protect our planet. The World Economic Forum called it even "an historic moment for AI" but mainly focuses on the economic benefits of this technology, obviously. According to them, 2018 is especially a significant year. It's the year where everyone is starting to see the business value of AI. AI is being propelled out of the research labs and into our everyday lives. But this also includes risks. We already talked about them during this course. Risks include: bias, poor decision making, low transparency, job losses, and malevolent use of AI, such as autonomous weaponry. But today I will focus on guiding us towards a "human friendly AI" but more towards ensuring an "Earth friendly AI". We will look into how we can use this technology to not only have an impact on economy and human health but also how we can transform traditional sectors and systems to address climate change, deliver food and water security all over the world, build sustainable cities, and protect biodiversity and human wellbeing.

Slide 3 -- The Challenges

Our planet is under unprecedented stress. The human industrial development during the industrial revolution has largely come at the expense of the planet. For 10'000 years, the Earth's relative stability has enabled civilization to thrive. But now just in few hundred years we have put this stability at risk. The climate change, which was predicted as early as 1900, has become a reality. The biodiversity decreases everyday and the oceans chemistry has changed. And these are just a few challenges, we as a species have to face to give a future generation a future.

Slide 4/5 -- United Nations Sustainable Development Goals

The United Nations Sustainable Development Goals provide another lens for the challenges facing humanity. Six of the 17 goals apply directly to the environment and human influence over it.

Slide 6 -- Focus points

For this talk I will focus on six problems, which we can hopefully solve with the help of AI.

- Climate change
- Biodiversity and conservation
- Healthy oceans
- Water security
- Clean air
- Weather and disaster resilience

Taken together, these six issues pose an urgent global challenge. The demand of humans from our planet will increase, mainly due to growing population. So to give our future generations a planet to live on, we have to do something.

Slide 7 -- Climate change

Hopefully I don't have to explain climate change and global warming to you, so I will skip this and go directly to the parts where we can change something with the help of AI. So today's greenhouse gas levels may be the highest in 3 million years. And even if everyone will hold up to the Paris Agreement, the global average temperatures in 2100 are still expected to be 3°C above pre-industrial levels, which is already well above the targets to avoid the worst.

The first main point where we can take action is energy. In 2016 only 24% of all the electricity produced, was from renewable source. There are a few leading countries such as Norway with nearly 98% from renewable source but the majority is still way behind. Of course the keyword *power* goes beyond electricity, there is also oil etc. but electricity is currently the core problem or to be more precise the production and transportation of electricity. And that's where AI can help. For example with more intelligent distribution: By getting data from producers and consumers, it is possible to optimize the energy forecasting, and building a smart grid. We can build optimized decentralized and peer-to-peer renewable energy systems with the help of AI and Blockchain for example. Or by analyzing the data of the sun with the help of AI we can predict solar flares and thus protect the power grids.

Another part where AI is a key system is transportation, such as autonomous vehicles or shared transport on-demand. Systems which are more efficient than a human can ever possibly be. But we already heard about this part in a different talk.

Sustainable production and consumption means a monitored and transparent supply chain, and active optimization of the industry by further automating the production. But also smart recycling systems or integrated municipal and industrial waste management, to decrease the waste we produce and to further reuse as much as possible. This will not only help the climate but the planet as a whole.

The use of AI will also not stop before the farming industry. There are huge benefits of this system there. With the help of big data, we build a system that can predict crop yield or nutrition management. With better weather forecasting it will be possible to not only manage the crops better but also detect early on if there are issues. With AI driven satellites we can automate and enhance land-use change detection to avoid deforestation.

Last but not least are smart cities and homes, we already talk about this a lot. So I will only give some further options. For example smart traffic light and parking system for urban mobility management. AI will generally help to analyze a city or a home and automate urban management and planning.

Slide 8 -- Biodiversity and conservation

The Earth is losing its biodiversity at mass extinction rates. One in five species on Earth now faces eradication. Current deforestation rates in the Amazon basin could lead to an 8% drop in regional rainfall by 2050, which will lead to wider consequences for the Earth's atmospheric circulatory systems.

With the help of AI we can get a better understanding of the interlink on the Earth as a whole. For example it makes it possible to predict bird habitats and migration patterns. We can simulate animal and habitat interaction to better protect them or if we can not stop the dying of the bees. We can build AI driven micro drones for pollination and thus also optimize breeding of plants.

With the help of satellites and AI it makes it easier to go against illegal wildlife capture or trading. We can also as mentioned in the part before build an optimized food trading chain and track its origin.

Pollution control will get simpler with AI driven simulations. We can predict them and track them. Analyze it and make something against it.

Slide 9 -- Healthy oceans

The chemistry of the oceans is changing. They absorb greenhouse gases and the result is acidification and warming. This causes unprecedented damage to fish and corals. Over 50% of the world's coral reefs have died in the last 30 years and up to 90% may die within the next century. A world without corals not only means we will have a less diverse ocean, but it will be also

an economic disaster for many people especially in developing countries. Fishery and tourism will have direct impact of this, but also coastal protection especially in areas frequently impacted by hurricanes and tropical storms. The great biodiversity of coral reefs serves as an important source for new medical therapeutics, so losing them is not just a loss of biodiversity and species but also a loss of an possible opportunities.

Here again is mainly monitoring the main usage of AI. We can automate overfishing control and catch thresholds. But also with insights for fisherman. AI can detect and alarm illegal fishing activities and optimize patrol schedules.

Further to fight and prevent further ocean pollution, with marine litter prediction by analyzing and simulating ocean currents, or by AI driven robotic fish to actively fight pollution such as plastic.

AI could also help in form of autonomous vehicles which map and monitor the oceans, to better understand how the whole system works together. This will help us to better protect habitats and conserve what is not lost yet. We can protect species predict their routes. For example by analyzing moving patterns of whales and other big marine wildlife to help giving them safe passages by rerouting container ships and decrease unnecessary contact.

All this points need real-time monitoring which will be made easier with the help of AI driven systems. Monitoring the pH values of the water and the ocean temperature, monitor ocean currents and coral reef ecosystems.

Slide 10 -- Water security

By 2030, we may fall 40% short of the amount of fresh water needed to support the global economy as pollution and climate change affect the global water cycle. The main problem of water usage is, that we tend to forget where fresh water is used. If we think about it mostly the first things that pop up are toilet, shower, clothes and dishes washing, drinking and food production. But by a study in the US they found out that 12% alone of the water usage in households in 2016 was from leaks in the pipes. Another thing is the industry. Here again the first thing that comes to mind is farming. It is indeed a huge consumer in the US in 2010 it was around 36%, but by far not the largest consumer. The largest consumer is thermoelectric power with around 45%, those are power plants such as nuclear, coal or oil.

AI can help in monitoring again. By monitoring the water supply we are able to better manage it. It will be possible to simulate the supply and get a faster understanding of changes in water quality and can step in with self-adaptive water filtration, which costs a lot and can thus lower the cost of fresh water.

We can early on detect algal blooms and thus lower the harm this can take with it. Further on with AI based monitoring of the landscape we can forecast the stream-flow and automate flood centered infrastructure.

Smart homes can monitor and manage the water it uses. we can optimize the industrial water use, predict maintenance of water plants and generate early warning system for water infrastructure. By constantly monitoring the water running through pipes, underground leaks get detected early on and can be fixed more efficiently.

AI driven drones can real-time monitoring of rivers and lakes possible. This will not only help to increase the quality of fresh water but also of oceans. A big amount of the oceans' toxins come from rivers leading into it. And we can ensure adequate sanitation of water reserves.

All this data will also help prediction droughts. We can run simulations for drought planning and thus can lower the impact the drought will have. Like this we can prevent situations from happening as it currently does in Cape Town, California or the Horn of Africa.

Slide 11 -- Clean Air

Around 92% of the world's people live in places that fail to meet World Health Organization air quality guidelines. According to the WHO, around 7 million people die annually from exposure to air pollution. This is one death out of every eight globally!

With AI we can optimize sensor-based air purifying systems. Building carbon capture and storage systems. Real-time air pollution monitoring and simulation allows us to detect the source. With enough data we will even have the ability to forecast pollution

levels. Which will help not only in warning humans but also in transport management.

Well sounds to have the option to forecast air pollution but it would be way better to solution to get rid of pollution as a whole and change to clean fuels. Here can AI also help. AI works better with huge amount of data than humans do, so AI can help the industry and researches to build advanced batteries and fuel-cell designs.

Slide 12 -- Weather and disaster resilience

The number of natural catastrophes has triplet since 1980. In 2016 the world suffered from 772 such events. Storms get stronger with warmer oceans. Climate gets less stable at areas where it was stable before. Droughts get more intense and a lot more people suffer from it.

In addition to better weather forecasting, data analyzing AI can also help in early warning systems for catastrophes, automate mitigation of flood risk, earthquake damage prediction maybe even predict earthquakes itself. All this information makes it easier to protect urban infrastructure and buildings. This can help minimize the impact of a catastrophes and if something happens it helps to coordinate disaster response in real-time.

Slide 13 -- Implementation

So far it sounded really Utopian what I was talking about, but it actually isn't that much of an Utopia any more but rather a reality coming to live. People around the globe working hard on it, started implementing those ideas and testing them. A good example is the autonomous vehicle or in-between car communication. But also system like a smart grid is closer to reality then one might think. Together with other Fourth Industrial Revolution technologies, such as IoT's or Blockchain. Agriculture is getting smarter. Drones are already in use to monitor conditions of the crops. AI plays a significant role in Weather forecasting and climate modeling, it works better with the massive amount of data the climate-science community already gathers.

But there must be a draw back, mustn't it?

Slide 14 -- Drawback

For all the enormous potential AI offers for building a sustainable planet for future generations, it also poses short- and long-term risks. We can not just blindly deploy an AI system into the wild. This can have risk and new dangers which are not that far from Hollywood's Dystopian movies. First of all there is something that is not a risk per se but rather a reality which we already have discussed last week.

Slide 15 -- Data

Data. AI cannot work without it, and data is one of the key factors that keep this system running. We're not talking from some data, somewhere we don't really care about. To build such a system we need get as much data as we possibly can. And this data need to be stored, analyzed and used. The risks this data gathering bares are obvious. So we need find a way to store them safely, reliably, and in a way where it cannot be manipulated. And of course there are privacy issues I will not go deeper into now.

Slide 16 -- Risks

The risks of AI can be divided, broadly speaking, into six categories.

First of all performance risks: This contains risks such as errors or bias. For the most part, the output of AI systems are determined within a "black box" and with little transparency. How do we know that we can trust those outputs? AI algorithms are self-learning and continuously adapting. They are hard to explain and in some cases may not explainable to humans at all. The

inability to rationalize the output of such a system makes it difficult to verify if the output and performance of such a system is accurate or desirable and bares significant risks. So before we can securely deploy AI systems, we have to find a way to build an explainable AI. But this research field is still in its early days. Another ongoing research is "model bias" resulting from biases in training data, which can lead to dangerous decisions when the AI is managing some key systems. It is essential that humans stay "in the loop" on auditing algorithm outputs to mitigate these unintended biases and wider performance risks.

Then we have security risks: Misuse of AI via hacking is a serious threat, as many algorithms being developed with good intentions, as for example for self-driving cars, it could be easily repurposed for causing harm, as for autonomous weaponry. This raises risks of global safety. So we need to ensure good governance to build explainability, transparency and validity into the algorithms. We need to find a way to draw a line between beneficial and harmful AI, but how is still open. Another security risk is the data that is used to train the AI. There we have to make sure that it is "safe" data. Malicious inputs can lead to an AI can be triggered to do unintended things.

Then we have control risks: AI systems work autonomously and interact with one another. This can lead to unexpected output because they start learning from each other and also from errors produced by other AI systems. These things have already happened for example in an experiment let researchers chat several AI driven chat-bots with each other and they created their own language which humans could no longer understand. Or at May the 6th, 2010 a financial crash, known as the flash crash occurred. It was as it was a trillion-dollar stock market crash in the US caused by multiple AI bots speed-trading, which created an artificial market inflation. We cannot let things like this happen to essential system such as power grids or water supplies.

Further we have ethical risks: The use of AI involves three main elements: the use of big data; the growing reliance on algorithms to perform task, shape choices and make decisions; and the gradual reduction of human involvement in many processes. Together these raises issues related to fairness, responsibility, equality and respect for human rights. Many decisions from an AI about individuals are based on inferred group or community attributes. We cannot let loose an racist or biased system. Things like a Jew-hating, Nazi AI already happened, now imagine such an AI is coordination basic systems in a hospital.

If you listened carefully you probably already realized that this also bares economic risks. The most obvious one is job loss. As AI is adopted more and more into the industry and decision making, many human jobs get obsolete. Further, today's world is globalized and moves quickly. Companies that adopt AI first may alter the competitive landscape, which creates winners and losers. Companies which could not adopt this technology quick enough, may loose their position in the market. The nation-state based system we have today on our planet, struggles to keep pace with the globalized digital economy. The result: massive tax losses. Tax erosion could be drag on public spending, including investments in systems that would help the planet.

I already mentioned the job loss situation, this could also be called an social risk. Large-scale automation mainly threats employment in transportation, manufacturing, agriculture and the service sector. Higher unemployment rates could lead to greater inequality in society. A possible solution would be basic income. Another social risk is autonomous weaponry, but we already talk about this on.

The majority of the mentioned risks are still unsolved and we often don't really know how to even solve them, but even with all those risk in mind, for me this system bares an unprecedented opportunity.

Slide 17 -- An opportunity

The opportunity for AI to be harnessed to benefit humankind and its environment as a whole is substantial. It will help us unlock new solutions to society's most pressing environmental challenges. However, AI technology has significant risks and cannot allow to forget them.

Slide 18 -- Our future

AI will change our future. It will change how we live, how we work, probably even how we interact with each other and our environment in the future. So let's take that opportunity we have and lead it into a direction that will benefit all of us.

Thank you.

Resources

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- [8 ways AI can help save the planet - WEF](#)
 - [Harnessing AI for the Earth report 2018 \(PDF\)](#)
 - [Interview with Lloyd Treinish](#)
 - [IBM-research](#)
 - [WWF Publication \(PDF\)](#)
 - [Microsoft blog - Brad Smith](#)
 - [Renewable Energy Statistic](#)
 - [SECORE](#)
 - [How we use water \(epa.gov\)](#)