THE ESSENTIAL AI HANDBOOK FOR LEADERS

FOREWORD BY MARCUS WALLENBERG

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FOREWORD

"To move from the old to the new is the only tradition worth keeping." I enjoy using this quote. It is an excerpt from a letter that my grandfather Marcus Wallenberg wrote to his brother Jacob in 1946 arguing for the family to move out of its railway interests – the old - and into aviation – the new. Major transitions fueled by new technology leaps happened from time to time throughout history.

We are probably in the beginning of a major such game changer. This game changer has many names: the fourth industrial revolution, digitalization, the era of machines, to name a few. It will also bear many faces. But one technology will be an integral part of it every step of the way, and that is artificial intelligence (AI).

It does not matter if you are an executive of a bank, a retail chain, a healthcare company, a transportation company, active in research or in the public sector - AI will improve the way we can do most things. It will

optimize jobs and activities, minimize risks, help us take the appropriate decisions and leave tasks that humanity should not shed one tear over, behind us.

AI can also become the decisive factor in your company's demise. Competitors may move faster, increase efficiency, establish new operating models or manage to tacitly serve their customers in a much more bespoke manner. Whichever path you choose for your company, AI will have to be part of the discussion.

At the end of the day it is not technology that creates success, it is people. It is leaders that take the right decisions based on the most accurate data, insights and their ability to work with the best people. It is the ones who do this faster than the competition that will succeed.

If I would single out the one factor that will matter the most, it is speed. In our connected and globalized world, a decision not to act – the decision not to take a decision – may hit you hard. The speed of change will

depend on getting people on board through a shared vision, a strong narrative on why change is crucial and a convincing story on how it makes the business – and its people – winners. Without that vision and narrative, nothing will happen regardless of having the best technology at your disposal.

The first step to change is insight and knowledge. AI will affect us all. Get to know it and your path.

MARCUS WALLENBERG

CHAIRMAN OF SEB, SAAB AND FAM
VICE CHAIRMAN OF INVESTOR AB AND
THE KNUT AND ALICE WALLENBERG FOUNDATION

Every positive leap for mankind has been fueled by intelligence

EVERY POSITIVE LEAP for mankind has been fueled by intelligence – technical revolutions as well as achievements in sustainability, business or democracy. Now with the advent of artificial intelligence, we give ourselves the opportunity to massively expand our intelligence. This makes AI a monumental asset for positive change – for individuals, organizations and humanity.

Explaining or grasping the speed and breadth of this revolution we find ourselves standing on the brink of is difficult, and AI itself is complicated. With this book we aim to make people understand how artificial intelligence works and the immense potential it holds, so its benefits are made available, usable and affordable for all.

What is AI?

Artificial Intelligence is a set of computer science techniques that allows computer software to learn from experience, adapt to new inputs and complete tasks that resemble human intelligence. The most efficient and popular AI technique today is called Deep Learning.

With Deep Learning, interlinked nodes loosely modeled after the human brain can be trained to do things like detect leukemia earlier than human experts, drive a car, help a restaurant better predict their food demand or optimize the logistics processes for a global retail company.

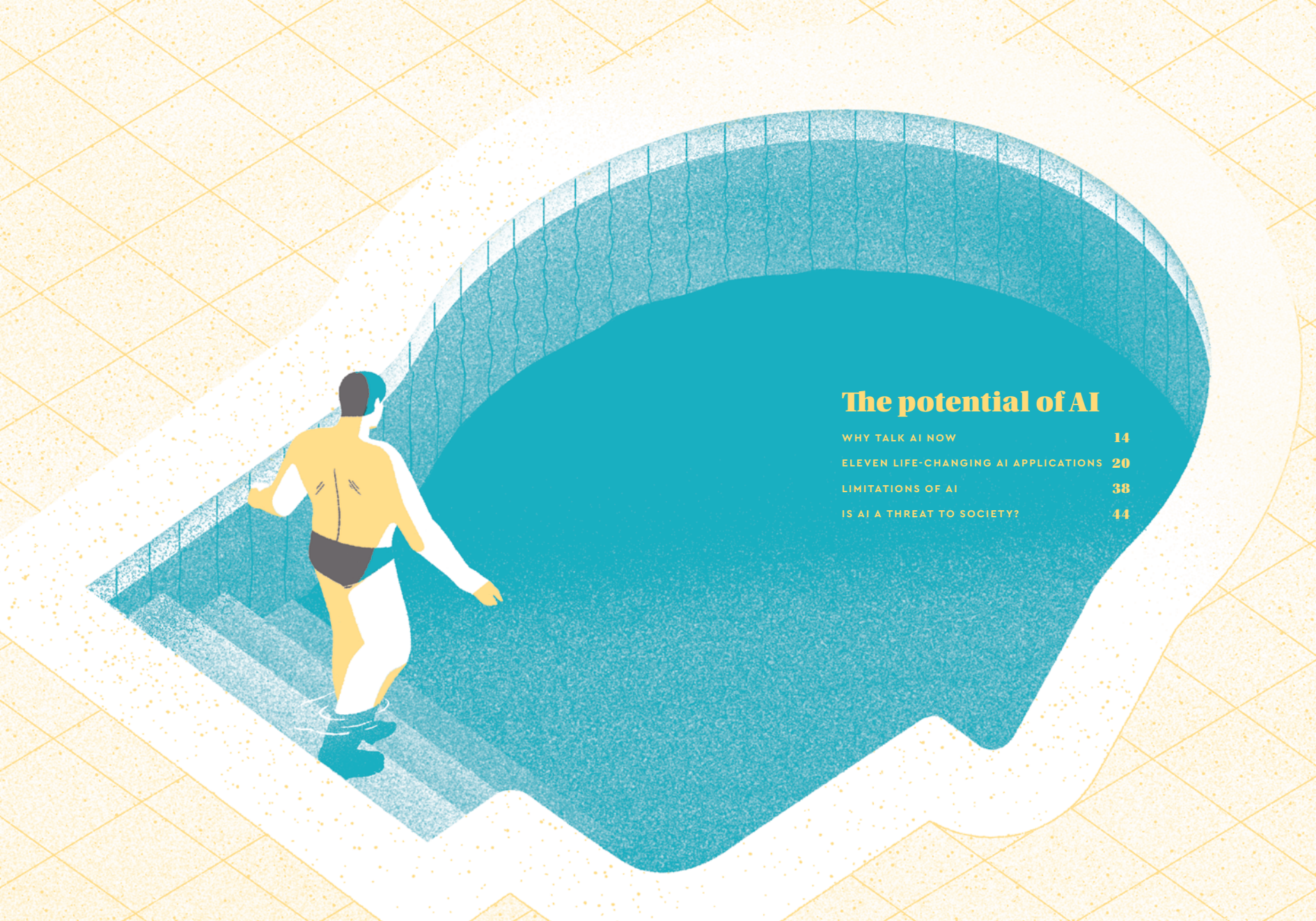
Why should I care about AI?

With the rise of artificial intelligence, we once again find ourselves standing before a fundamental change to our modes of production—faster and bigger than ever before. Its potential is unimaginable: a new

standard for solving problems small and large that will rewrite existing business models and open up entire new ones. These changes will be profound. So the more you learn about AI now, the better chance you'll have to be among the first to benefit from it.

This book is organized in three sections. The first talks about the potential of AI and how it can be put to use for business and society. The second explains the fundamentals of AI and how it works. The third presents how AI can be operationalized in your business and drive it to excel at new levels.

LUKA CRNKOVIC-FRIIS
FOUNDER AND CEO OF PELTARION



The potential of AI

WHY TALK AI NOW

ARTIFICIAL INTELLIGENCE IS nothing new. It has been in and out of the spotlight since the 1950s. So why is everyone saying we're experiencing a revolution unlike anything seen before right now? The reason stems from breakthroughs in computational power, data collection and an AI technique called Deep Learning. Not only did these breakthroughs surprise experts in the field itself, they proved AI was finally ready to be put to work across industries, reigniting an AI revolution garnering billions in investment while putting experts and casual onlookers alike in awe of what's to come.

The graphic card surprise

The rapid proliferation of AI could not have been possible without exponential growth in computing power over the last half-century. The major breakthrough came when graphics processing units (GPUs), originally designed for video gaming and graphics editing, unexpectedly took center stage in the world of AI. This was simply because they happened to be designed to perform the very operations AI requires – arrays of linked processors operating in parallel to supercharge their speed.

Not only did these GPUs prove to be 20 to 50 times more efficient than hardware used earlier for Deep Learning computations, they were also far cheaper. Suddenly AI computations no longer needed to be run on supercomputers in specialized labs. Instead, ever-faster, ever-cheaper computer chips made the hardware required for AI available to organizations of all sizes.

Access to unlimited data

To solve problems and make improvements in manufacturing, medicine, finance, transportation

– everywhere, AI needs data about that specific task or problem to process and learn from. It's no coincidence that today's AI awakening coincides with the rise of Big Data.

Widespread adoption of cloud computing, self-monitoring cell phones and a new plethora of tiny, powerful cameras and sensors are offering up trillions of data points for AI to glean new insights from at any given moment. The question is no longer: *When* will powerful AI arrive? It already has. Instead we must ask: *What data do we have for AI?*

Going deeper into Deep Learning

Most of the recent triumphs of AI were made possible thanks to a group of AI techniques collectively referred to as Deep Learning, or more scientifically: Deep Neural Networks. With Deep Learning you teach a Neural Network by exposing it to data and

information about that data. For example, if you want it to identify cats you show the network many pictures of cats and tell it, these are cats.

Neural Networks has been around for some time. However, the recent leaps in computing power and data availability make it possible to construct much more complex Neural Networks with many more connections than before, and the more connections, the greater the intelligence of the AI. Today, we're working with Neural Networks with billions of connections.

If computing power is AI's engine and data is its fuel, then algorithms are its design. An algorithm is a set of specific, programmed instructions used to solve a problem or accomplish a task. For quite some time powerful technology players have been investing heavily in AI, step by step improving the efficiency and accuracy of Deep Learning algorithms to make them sophisticated enough to tackle complex problems.

Finally, computer scientists have harnessed unprecedented computational capacity, vast amounts of data and nuanced algorithms to allow Deep Neural Networks to solve problems or accomplish tasks by making sense of data. This means Deep Learning can be used to find patterns in extremely complex datasets – like images, speech samples, audio, or pretty much anything.

So, what's next?

AI already makes billions of lives better every day through mapping applications, autocorrect, even email spam filters. Giants like Amazon, Facebook, Google and Microsoft, as well as promising startups backed by a surge in funding, are racing to push AI into all their products and services. However, the recent rapid growth of AI paired with a plentiful, almost unlimited access to data democratizes the power, infrastructure and knowledge required for AI

to more than just multi-billion-dollar corporations. Organizations of all sizes now stand to reap the benefits that come with AI's new way of solving problems. Opening doors we could never open on our own – or even see were there in the first place.

The tools and platforms that will allow regular companies to create AI-powered products are emerging. Platforms that make AI more than just the playground for academic researchers and global tech giants.

At this incredible technological tipping point, we each have the option to stay blissfully unaware of what's to come or to explore what's possible in a world opened up by AI. Like innovators of centuries past, we don't know exactly what this new era will look like, except that it holds a bastion of literally unimaginable potential.

From the tech giant's board room to Anita's ten-acre farm

ELEVEN LIFE-CHANGING AI APPLICATIONS

AI IS FOREVER changing how to work and do business. At first glance, it can seem very scientific and theoretical, like science fiction. But it's far from it. AI is all about specific applications, and is already part of our daily lives in search engines, voice recognition or the tailored suggestions you receive from your music and video streaming services. But that's only the beginning.

AI has the potential to advance humanity by augmenting our skills, talents and abilities, allowing us do things faster, better and more efficiently. This goes for the things we do for work, for fun or in our endeavor to solve the world's most pressing global challenges.

To make AI's applications more tangible, we have created a list of examples in practical contexts.

!

"AI could grade the tests for an entire class for me in seconds."

– ALICE, ENGLISH TEACHER

An AI system can be trained to automatically correct and grade tests. This way the teachers can spend more time with each individual child and focus on the actual teaching.

II

"Accurately identifying and predicting brain tumors is time consuming and extremely hard, even for experienced experts."

– SUE, RADIOLOGIST

An AI model can be developed to analyze thousands of brain scans and predict tumors faster and with greater accuracy than the best radiologists and cancer doctors in the world. This means doctors can spend more time actually treating the tumors instead of looking for them.

III

"Involving AI in the real-time data of triage could let us know where to focus our resources in a matter of life-saving seconds."

– PETER, ER NURSE

In the ER it's all about prioritizing, and the right answer isn't always obvious. And since AI, unlike humans, is never limited by distractions, hunger, lack of sleep or stress, they can take on far more complex assignments than us. And make accurate priorities every time, so that nurses and doctors can focus on treating and interacting with patients.

IV

"With AI, real time forecasts can show us exactly where the best waves are at any given moment."

– MARLA, SURFER

AI systems can predict the weather by taking live data from satellites, weather stations, wind farms, and maps. Once trained, the AI weather forecasts can be accurately made in seconds. Way cheaper, quicker and accurate than non-AI methods.

V

"Bringing AI into my ordering could help us predict how many guests will order how much food."

– COREY, FAMILY OWNED RESTAURANT

By pulling data from sales tools, an AI model can accurately predict a business's sales using patterns found in that rich, historical sales data.

VI

“Now that the AI on my phone can read people's lips, I can take classes I never thought I’d get to listen to in college”

– PATRICK, PERSON WITH BAD HEARING

AI can transcribe or translate audio or voice into written text. Suddenly the playing field gets much more level.

VII

“With AI we can predict errors before they even happen."

– DENNIS, MACHINE OPERATOR

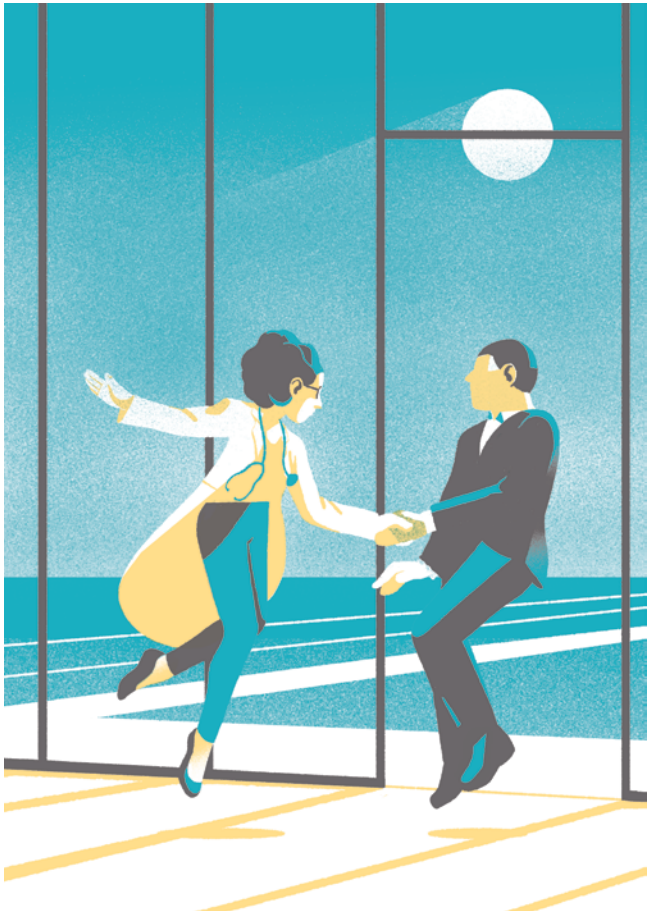
There used to be no way of telling when a machine would wear down and start making errors. But with the data from a machine park, AI can predict any errors before they even happen. That could save a company thousands of man hours and millions of dollars.

VIII

“There’s a million drugs already on the market with unknown potential just waiting to be discovered.”

– ROCHELLE, MEDICAL RESEARCHER

By bringing AI image recognition into clinical trials, we can analyze the anatomy of cells to discover new uses for existing drugs.



IX

“AI lets me maximize what I get out of my land with soil and crop analysis to recommend exactly what to plant.”

– ANITA, TEN-ACRE FARMER

Tools that help farmers know what to plant, how often to water it and how to fertilize it have been reserved for bigger corporate farmers. An AI system can use satellite imagery and weather data and deliver accurate predictions. Saving a lot of both guesswork and money for farmers.

X

“AI in my refrigerator can give me great tips on what to cook for the kids based on what’s left inside."

– TIM, STAY-AT-HOME DAD

An AI system can analyze what’s in the refrigerator and provide tailored suggestions for what to buy and cook. So everyone can have what they like. In addition AI can tell how healthy it is too.

XI

"With a little help from AI, cameras on the back of our tractors can sharp-shoot weeds with no human aid."

JULIEN, CEO INDUSTRIAL FOOD FARM

Million pounds of pesticide are sprayed on crops every year. Instead of spraying every single crop, AI can use cameras and image recognition to identify weeds in milliseconds. And then pinpoint and spray each weed on the fly.

AI has no gut feelings

LIMITATIONS OF AI

AI CAN DO many amazing things, and looking into the next hundred years, the possibilities can seem almost endless. But just because AI can fulfill such a wide range of tasks doesn't mean it can do it all. There are circumstances for which AI is not the best solution.

To begin with, we must differentiate between the two categories of artificial intelligence: Artificial Narrow Intelligence and Artificial General Intelligence. Artificial Narrow Intelligence (ANI) is great at finding ways to conquer specific goals, in ways so creative no human could ever fathom them on their own. This is the most advanced form of AI used today and seen in cases like medical diagnostics or beating the world's best players at Go. Artificial General Intelligence (AGI) refers to AI that's able to reason and understand like humans, and it is still questionable whether or not this is even possible to achieve.

Below are a few scenarios when AI might not be able to solve a problem.

The problem is vague

To solve tasks, AI needs to have a very specific objective. The objective itself can be difficult to solve, like using facial recognition to find one person out of a billion photos, but it must be easy to understand. For instance, the objective can't simply be: make my company more profitable. However, if you know a specific task or piece of information that could help your company become more profitable, like optimizing shipping routes or preparing for changes in weather, AI may be your best available tool.

Lack of data

We've seen AI act as though it has intuition, but AI has no gut feelings. It needs information, and

plenty of it. Your AI solutions will only be as powerful as the quality of the data you're fueling your AI model with.

If you don't have much data to work with, you only have one solution: Find more. Thankfully, new data sources are being created every day and it's becoming easier and cheaper to store.

Unorganized data

The downside of the near bottomless supply of data is that you may end up having data scattered everywhere, especially if you didn't collect that data with AI in mind. And it's hard work for an AI model to make sense of unorganized data.

So in addition to making AI's tasks specific, the data used for those tasks must be structured, organized and easy to access, preferably all in one central pool.

The problem is too easy

With all the excitement surrounding AI, it can be easy to forget the other tools available that are perfectly capable of solving many problems on their own. Common statistical models can still do wonders in finding patterns in data.

A good rule of thumb is: If you can explain exactly how to solve a problem using rules and equations, then the problem might be too simple to require AI.

It's a far less relevant threat today than AI being used irresponsibly by humans

IS AI A THREAT TO SOCIETY?

AI BRINGS WITH it fundamental changes to society and the workplace. Change is daunting and being skeptical toward changes is deeply embedded in human nature. In popular discussions concerning AI, this skepticism has been fueled by media hype, which has tended to lead with the scariest headlines without fully examining what state the technology is in. Undoubtedly, there are future scenarios that could make the reckless use of AI a problem. But now, with a better understanding of how AI works, we're all in a better place to assess those fears, including the media.

Legitimate concerns may lie behind the doomsday theories that make headlines, but they are very much still only theories. These theories orbit around two main questions: Will AI take all our jobs, and will AI become smarter than humans and destroy humanity as we know it?

Will AI take all our jobs?

AI will never replace all human jobs, but it will affect some industries more quickly than others. If an assignment can be broken down into processes that are easy to repeat, the probability of it being automated by AI is higher. Knowing this, following the progress within the field of AI is important across all industries.

On the other side of the coin though is redeployment of jobs, since AI will create new jobs by augmenting human abilities and skills. AI can open up access to professions that traditionally were closed to many, by simplifying high-skill tasks into lower skillsets.

This emergency alarm has been sounded before: When the cotton gin arrived, when electricity put candlemakers out of business or when the internet started selling everything online. And each time, job growth has kept up with not only those changes but also with population growth. We may not know

exactly which jobs will come with AI, but if history is any lesson, the economy will have time to adapt, and, AI-assisted jobs will be as exciting and prolific as the AI itself.

Beyond what jobs come and go with AI, politics are still very much in the realm of humans, not machines. If people and their governments want to make the transition through this technological revolution as smooth as possible, they have an opportunity to do so. There is a growing international debate on the issue and this is a good thing. We need to understand and talk about it more. And the more people have access to AI the more we will have a more informed discussion.

Will AI become smarter than humans and kill us all?

AI will not be smarter than us any time soon. AI is still only able to perform specific tasks, and while

it's getting much better at many of them – from self-driving cars to backflipping robots – a huge part of what makes humans so uniquely intelligent is our capacity to balance and prioritize millions of small pieces of knowledge, perception and instinct into an intricate decision-making mechanism that not even the world's most sophisticated algorithms are close to replicating. In other words, we can't say if it's possible for machines to reach human levels of intelligence because we don't even have a full picture of how human intelligence works. It could happen, but it will likely take decades or centuries, not months or years.

Is this potential AI of the future dangerous? Well, AI crunch and process vast data sets and teach themselves in ways so complex humans cannot foresee or fully control it. It's easy to see why this is cause for alarm. If a machine's intelligence is superior, it will obviously be impossible to fully predict how it will reason or what decisions it will make. Even

if an AI model has good intentions, the decisions made to fulfill its objective can lead to unexpected consequences simply because the machines would have the ability to control themselves in ways unforeseeable to humans. Powerful minds, like Stephen Hawking and Elon Musk, have made it very clear they believe this danger is real.

On the other side of the debate, there are skeptics. Some who refute the idea that human-level machine intelligence is possible in the first place, and others who believe humans will in fact benefit deeply from machine superintelligence. Like computer scientist inventor Ray Kurzweil, who believes the singularity will usher in an era of unfathomable peace and prosperity where human immortality becomes a possibility.

Whichever side of the prediction debate one might fall on, it's important to remember that, as of now, artificial intelligence is qualitatively different from human intelligence in crucial ways. Machines do

not have feelings, they have code. They do not have beliefs, they have algorithms. Their objectives are all programmed. For this reason, machines reaching human-level intelligence and destroying us is a far less relevant threat today than AI being used irresponsibly by humans.

What to do now?

Everyone working with AI, including governments and regulators, needs to be proactive in ensuring responsible innovation and sustainable solutions to potential societal and ethical implications of the technology.

On an individual level, learning about and working with AI gives society the best chance to see any pitfalls in AI's ascent before they arrive and do something about them rather than letting them simply happen to us.

AI will change society perhaps more rapidly than most technological revolutions ever have. Whether that makes it a threat to humanity and our jobs or a monumental asset to them will depend on how we respond to AI and what we choose to do with it. You've already taken the first step toward making it an asset by reading this book.

Understanding AI

It's pointing to the one dog in a photo full of cats

WHAT IS AI?

THE TERM AI recalls images of science fiction and even in practice can seem like magic, but it's neither. It isn't a polite metal robot with a British accent nor a Terminator sent from the future. AI is not robots. In 1956, mathematician and AI pioneer John McCarthy coined the term "Artificial Intelligence" defining it as "the science and engineering of making intelligent machines." Sounds simple enough.

But things get tricky precisely because intelligence itself is so subjective. What humans would consider relatively simple tasks like making a coffee or pointing to the one dog in a photo full of cats are actually extremely difficult for computers to achieve. While tasks considered impressively intelligent for humans, like linear regressions or calculating the exact time it takes to drive from Paris to Rome, are fairly easy for computers and wouldn't be anointed with the designation of "AI" by most.

As John McCarthy himself complained, "As soon as it works, no one calls it AI anymore."

Regardless, when machines are able to learn from experience, adapt to new inputs and complete tasks that, at least superficially, resemble thinking, whether it's labeled as such or not – it's artificial intelligence.

"As soon as it works, no one calls it AI anymore."

On its journey to replicate human intelligence, there are many independent branches of human performance – perception, language processing, planning, spacial motion, etc. – that machines must learn. While each of these branches may one day meet to create something resembling a human, most AI researchers

are unconcerned with that result, dedicating their work to growing a single branch and nothing else. In this way, Artificial Intelligence should be thought of in two different types: Artificial Narrow Intelligence (ANI) and Artificial General Intelligence (AGI). Let's explore what each one means and how the objectives of each are very different from each other.

Artificial Narrow Intelligence

Artificial Narrow Intelligence (ANI) is the only form of Artificial Intelligence that humanity has achieved so far. This includes everything from email spam filters to cancer tumor prediction models. AI has proven to be good at performing specific tasks, like playing chess, making purchase suggestions or weather forecasting. Almost any specific task where it has access to a lot of data. Computer vision used in self-driving cars and natural language processing

used for real-time translating, though more impressive than ever, are still simply advancing areas of narrow AI.

In essence, narrow AI works within very limited contexts, and though our phones may be packed with many pieces of AI, they're all operating separately and can't take on tasks beyond what they're programmed to do. You can't expect the same code engine that plays your music to, say, order your pizza. No matter how sophisticated it may be, it's not truly thinking independently.

Artificial General Intelligence

The goal to unite the many branches of ANI performance into one "thinking" machine is the quest for what's called Artificial General Intelligence (AGI), and as of now, is purely theoretical.

This dreamed-about moment when machines arrive at an AI level equal to full human intelligence was popularly labeled by inventor, computer scientist and futurist Ray Kurzweil as the singularity. The singularity is imagined as a point of no return where exponentially accelerating technology advances beyond human capacities to comprehend or control its outcomes. In turn, this could provide the world with unforeseen technologies and, according to Kurzweil, gives humans access to immortality as biological and mechanical minds become one.

If this sounds a bit fantastical, it's because it still is, with many years of research and development still required to know if anything close to this scenario could become a reality. But because computing power has followed an exponential growth path so far, and in light of major advancements in machine learning via deep neural networks, the carrot of AGI has come into clear if still distant focus in the mind of experts.

AI history

While advancements in technology have taken AI to staggering new heights in just the past few years, research and excitement around AI have been booming and busting for over 60 years - ever since John McCarthy gave it a name. Following McCarthy's work, AI has experienced several cycles of widespread optimistic interest in the field followed by "AI Winters" when funding and enthusiasm dried up almost entirely.

The resurgence AI is enjoying today is product of AI theories of past decades becoming realities paired with computational power, sophisticated algorithms and data availability reaching the awe-inspiring levels we now find them. Finally decades of underappreciated research is becoming operational.

Go ahead, find the walrus

THE GOAL OF AI is to create systems capable of simulating human intelligence in order to execute tasks. One set of AI techniques is called Machine Learning and has in recent years shown impressive results.

Within Machine Learning there are a number of subfields. Two of the most popular ones are Deep Learning and Reinforcement Learning. These can either be used separately or work in tandem to complete tasks.

Deep Learning & Reinforcement learning

Deep Learning is the most efficient and popular AI technique available today. Deep Learning algorithms allow software to train itself to complete tasks that resemble intelligence. It was first theorized in the 1940s as a way that computers could mimic the architecture of the human brain to achieve greater

computing power. Today, it is at the forefront of AI technology as those theories increasingly come to fruition. Beating the world champion in Go, predicting cancer, driving cars without humans – almost every conquest in AI to date was reached using Deep Learning. It works by exposing multilayered networks of processing nodes to a lot of data. It is called deep because of the many layers of nodes a Deep Neural Network may have.

But how does a linked array of processors work to create something resembling human intelligence? It's all about training the model with data, and how that's done depends on the kind of problem being solved.

Deep Learning models can be constructed using supervised or unsupervised learning. Supervised learning uses labelled training data to predict or aim towards specific outcomes of new data, while unsupervised learning can reason about data without any need for predefined labeled training data.

Reinforcement learning, on the other hand, uses feedback algorithms to reward and punish the model to achieve the best possible outcomes.

How does it work?

Yes, it can all sound very abstract. So say you wanted to teach an AI model to identify every picture of a walrus on the internet. In a supervised model, you would feed it with thousands of pictures and tell the machine which ones have a walrus in them. This is your training or labeling data. Then, after it's seen plenty of photos, when you feed it a new photo it should be able to accurately tell you whether it shows a walrus or just an elephant taking a nap. The more training data, the smarter (more accurate) the model gets.

An unsupervised model wouldn't be great for determining walrus vs. no walrus, but could be used to identify patterns in images to form separate

clusters of pictures of walruses, pictures of elephant seals and pictures of sea lions, and then let you extract the walruses from there.

With reinforcement learning you start without any data, and instead teach the model to solve problems by trial and error. Say you want to teach a machine to play a game like Mario Kart. In the beginning, the software tries things randomly but by rewarding successes and punishing errors the software learns step-by-step how to keep the car on the road. Reinforcement learning is best suited when the quality of the result can only be determined after a complex sequence of decisions, for example when a robot learns to pick up a delicate object, such as an egg.

Different models for different problems. But of course, walruses are only on the tip of the iceberg. To help understand what methods work for what problems, let's dive into how the training of a model actually works.

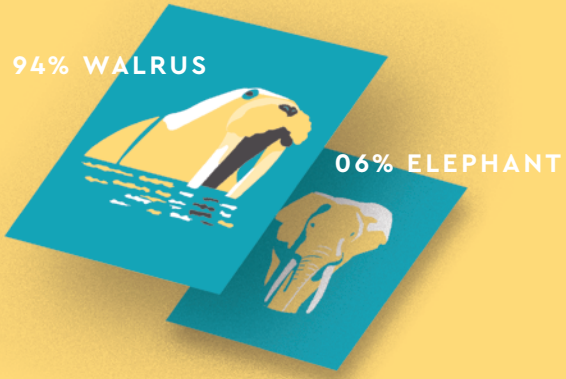
How to train a model

For an AI model to succeed with something like learning to recognize animals, it requires training. No matter what, plenty of good data is needed to start training a model. In our walrus example, that data would not only be thousands of photos, it would be thousands of photos that are already labeled to either have walruses in them, or not.

Those training photos are sent through the network, and the model is told to guess whether each photo contains a walrus or not. Each layer in the model works on a different level of walrus identification, from abstract lines and colors, to higher-level shapes and shades, all through the image's pixels. When the model is told whether it guessed right or wrong, each connection in the model adjusts its weighting to focus in on the features that seem to constitute a walrus (tusks, flippers, blubber), until after thousands or millions of guesses to compare, it gets a pretty good idea of what a walrus looks like.

INPUT

An unlabeled image is shown to the Deep Neural Network. The network in this example is trained to identify walruses.



OUTPUT

The output layer consolidates and returns the output data. In this case takes a guess whether it's looking at a walrus or not.

FIRST LAYER

The first layer of the network identifies simple shapes, like edges.

HIGHER LAYER

In the higher layers the network identifies more complex structures.

TOP LAYER

The networks respond to very complex structures, down to the smallest pixel. It identifies abstract concepts that identifies different animals.

The adjustment that takes place after each training image goes through the model is the algorithm attempting to minimize a common feature in AI models called the cost function. The lower the cost, the better the model. And when perfectly trained, our model would be better at spotting walruses than any polar bear out there, something computers were traditionally very bad at, until now. The power of Deep Learning.

Picking the AI brain

Exactly how neural networks get to their solutions is complex for humans to grasp. We don't know what perfect set of rules the model has made for itself to tell a walrus from a sleeping elephant. But we know that it works. And the process by which it works isn't magic at all. So let's have a look at the inner workings of a deep neural network, the AI brain.

The neurons of an AI model are grouped into three different types of layers:

Input Layer

The input layer brings the raw data into the model. This layer then divides the input data into its component parts to be analyzed more closely in subsequent layers. If an image is being processed, the input layer will send out the smallest pieces of that image to the next layer where they can be rapidly analyzed up close. All of the real analysis done by a model takes place in those following layers called the hidden layers.

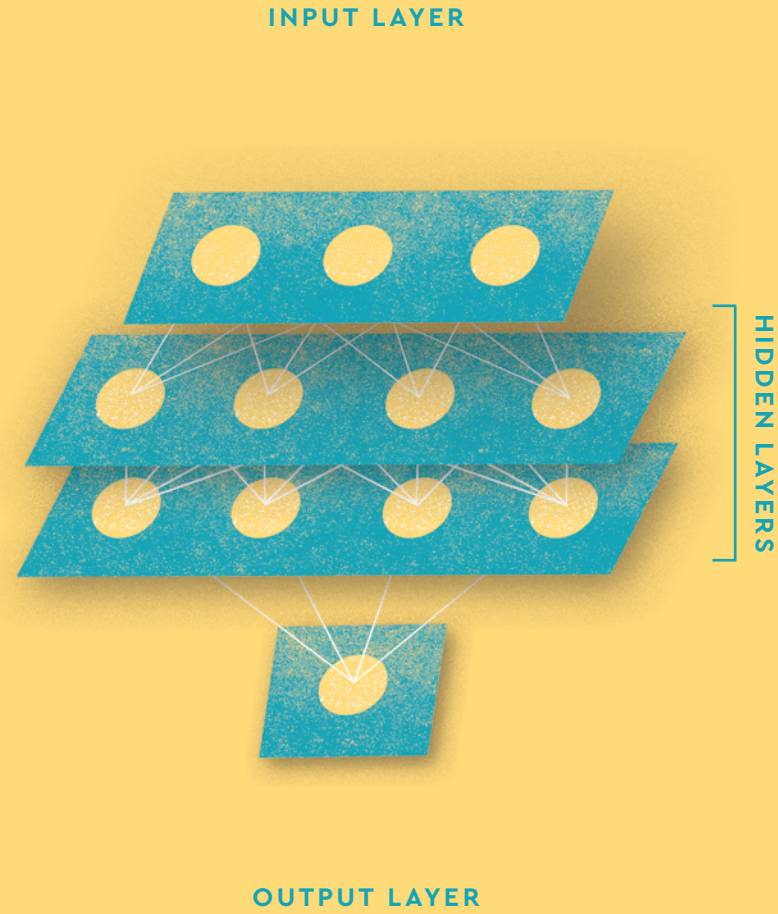
Hidden Layers

The hidden layers perform mathematical computations on our inputs. The first hidden layer in an image detection model will identify the most elemental pieces of the image, like edges and simple shapes. The following layers will identify more and

more complex pieces of the image like, say, a walrus tusk, making its puzzle pieces bigger and bigger until it becomes easier to solve. This is where the "deep" in Deep Learning originates; the more layers, the deeper the network.

Output Layer

The output layer consolidates and delivers the output data, or in the case of our walrus model, takes a guess at what it's looking at. If the output generated by the AI is proven wrong by the training data–understandable, elephant seals look a lot like walruses–the cost function will calculate how far off the model is so it can adjust its calculations accordingly and try again on the next image. This process is done iteratively over the data set, until the output layer returns no more (or far less) mistakes. Then, training is complete and the model can be put to work. Go ahead, find all the walruses.



Machines and humans

While intriguing in theory, it's easy to see why it would be hard for AI to achieve human level intelligence through this process of neural network training. It takes thousands or even millions of pieces of data to train a machine to learn even one simple task, while a human can read an encyclopedia, go into nature and make some pretty accurate guesses about what they're seeing. Such is the power of the human brain.

But when it comes to solving problems one at time, when a machine learns something, it can reach far higher accuracies than humans, work on the problem around the clock, with no need for sleep, weekends or holidays, and will never forget how to solve it. Such is the power of trained Deep Learning AI.

This means the most powerful intelligence we're able to achieve today is artificial and human intelligence working in tandem.

Red apples, green apples, the more apples the better

AI IS ALL ABOUT DATA DATA DATA

BEFORE ANY AI task can be imagined or evaluated, a foundation of data must be laid to build that task upon. Take this story:

A bank looking to attract more clients went to an AI firm asking them to create a model to predict which prospective clients were most likely to work with their bank. Crucially, this bank had lots of data about their clients to build the model with, making it a great task for AI. The results could give their sales and marketing teams a huge leg-up on bringing in new accounts.

Unfortunately, when the data scientists looked closer at the data, they discovered a fundamental flaw: the bank had only saved data on prospects who actually became clients. Nearly every piece of useful information about the prospects who never became clients had been erased. Why? Because no one at the bank ever imagined that data about

failed conversions could be valuable. But being able to compare those who partnered with the bank against those who didn't was essential to the AI model. The bank narrowly missed a great opportunity and was forced to wait several years to build up enough data to create a viable model. What did we learn?

It's impossible to overstate the importance of data when working with AI.

This story isn't particularly exciting. But it also isn't very unique. Because the world hasn't been preparing for AI until now, the data gathered isn't always suitable for AI projects. So let's talk about how data is used in AI and what makes good data, well, good.

To begin to understand how data works in the field of AI we must first differentiate between the two most common types of Deep Learning techniques: *supervised learning* and *unsupervised learning.*

Supervised learning and labeling data

To train a deep neural network using supervised learning, you need to feed it two things: data and information about that data. Using the example of the bank, they needed both the data on each prospective client and the value of that data. In other words, did they become a client or not? This assigned value (client vs. not client) is called labels and is the component of supervised learning that's doing the supervising, working to show the bank which prospects have the best chance of becoming clients.

Supervised learning is used in a wide range of other AI projects as well, like the image recognition

problem in our walrus example. Similarly, let's say you want to create a model that recognizes apples in images. The way to do that is to feed the neural network a lot of pictures of apples. Red apples, green apples, apples with bites taken out of them. The more apples the better. The system will figure out what an apple looks like and be able to distinguish it from other fruits. But only if it has plenty of data.

This is the technology allowing self-driving cars to differentiate between a pedestrian and a painted sign on the road. Important stuff.

Unsupervised learning

While supervised learning is the more common strategy in AI models and what's used in most business cases today, unsupervised learning has achieved perhaps even more remarkable breakthroughs in recent years.

Unsupervised learning is often what people are

referring to when they talk about computers "teaching themselves," but is in fact just an AI system geared toward finding patterns, associations and clusters of data to make educated guesses rather than seeking out specific targets, like whether an image shows an apple or not. In unsupervised learning, the training data set doesn't contain any labels and the outcomes are unknown, which lends itself to areas in AI like identifying marketing clusters or customer purchasing preferences. This untargeted approach is seen as a crucial step toward General AI, and has been impressively implemented. However, unsupervised learning doesn't yet match supervised learning's effectiveness in business cases.

Data troubles

As the old saying goes: garbage in, garbage out. Here are a few important considerations for your data that will help determine the effectiveness of an AI project.

Lack of data

In training the complex models of deep neural networks, the use of small data sets is a common impediment. The result can be a model that has memorized the training data without learning any important general concepts from it. We need lots of data to draw accurate conclusions. In terms of apples, if you train a machine with pictures of only five apples then throw in a picture of an orange, it might pass for an apple because the machine didn't have more data to test it against. So feed that machine plenty of apples and non-apples so it can tell which is which.

Data diversity

Just like in a political poll, you're not going to get a sense for who's going to win if you only survey a few types of voters. The more unique data you gather, the higher the probability there is to discover a diverse

range of features from that data. If you only show the machine pictures of red apples, you run the risk of its neural network not recognizing green apples at test time.

Biased data

Data bias is beginning to crop up in a lot of AI. If there are any biases in the people or groups gathering the dataset for a neural network model, those biases will be reflected in the model. For instance, if a company in Louisiana is training a system to transcribe voicemails to text, but only has training data from Americans with a Southern accent, the system won't work well for users from London. There are many types of biases that have been identified by statisticians over the years–selection bias, funding bias, reporting bias–and they're all important to safeguard against to ensure accurate results from an AI model.

Be creative, data is everywhere

Today's interconnected world abounds with robust, powerful data. It's easy to think of data as just numbers that only exists in an Excel spreadsheet, but one of the biggest strengths of Deep Learning is that you can feed it all types of data. In a world surrounded by chips and sensors in phones, cameras, cities, homes, farms, cars and drones, the number of potential data sources is almost unlimited.

Here are a few unlikely ways unique datasets have created new assets and solutions with AI:

- Evaluate the economy by counting swimming pools in satellite images.
- Detect early signs of Alzheimer's by analyzing language in audio recordings.
- Analyze smog patterns to determine athlete training schedules.
- Calibrate investments in agriculture using drone images of farmland.

You never know how a batch of seemingly useless information could be transformed by AI to solve one of your most stubborn, pressing problems. You just have to make sure it's stored and structured in a way that makes it useable.

Many problems will of course require concerted data producing efforts to build the intended AI model, but data from unexpected places can be surprisingly quite useful. You should of course be mindful of all consent and relevant data protection rules and regulations, and rightly so.

Solving data problems

Access to quality data isn't always easy. Here are three common roadblocks and ways to get around them:

Scattered or unorganized data

If data is scattered across departments, unorganized and without central ownership. It's hard to know what data is available and what quality it's in.

Solution:

Create or update the company's data policy. Take an inventory of all the data in the company, work to correctly label what's already there and put measures in place to keep that data up-to-date on a single, accessible central platform, or data lake. In a Deep Learning project, you often want to combine many different data sources, so recognizing, aggregating and labeling all data into a single hub will give you the best chance at creating a powerful AI model.

A lot of data is generated, but nobody cares to store it

The bank that didn't save any data on unconverted prospects is a great example of this. Manufacturing machines used at factories is another. They display information for the operator to view while being used. But every day when the machines are turned off, that data disappears. With so many new sources and types of data now available, cases like this are exceedingly common across industries. A part of the problem is the data might not even seem like data at first. AI projects can require years of data collection to become effective, so even if you don't plan to start a project right now, it's wise to scour your organization to start storing all the data you can get your hands on, today.

Solution:

Start simple. Make a list of everything within and surrounding your organization that has potential to

generate data. Dive into each process your business takes part in from sales to operations to R&D; there's data to mine in every process, interaction and procedure. Go through those one-by-one and see if it is possible to collect and store data from that source. Don't be shy. Storing data is relatively cheap and only getting cheaper. And remember to label it from the beginning.

The organization does not generate enough data itself

Ironically, this is a common symptom of organizations that rely on data more than most to make their decisions like hedge funds or consulting firms. But with an ever-expanding palette to pull data from, companies don't need to look far to find valuable data, sometimes for free.

Solution:

Every component of any enterprise has the potential to provide data. Every time a customer places an order, you email a client, someone interacts with your website. And for every source, there is most likely a corresponding market that data can serve. That's right. If you find a way to gather more data than you know what to do with, you don't even have to be the one to use it.

At the same time, many data sources are already public and free. Satellite imagery, weather history and news articles, to name a few, all contain immense data potential ready to unlock with AI.

Operationalizing AI

AI is a business tool like any other

EVERY COMPANY NEEDS to have a strategy for AI and the ones that don't get started soon will have some serious catching up to do. In all the talk around AI it's easy to forget that it is a business tool like any other – only more holistic and powerful than most. The sooner an AI strategy is explored, the sooner an organization can start reaping AI's incredible rewards. The strategy can best be developed at four levels.

1. Come together and learn the fundamentals of AI

Company-wide basic knowledge of AI and the organization's AI strategy will give AI the best chance of making a valuable impact, from the mailroom to the boardroom to the office of the CEO.

To harness the real power of AI you can't just go to an AI consulting firm and ask them to optimize your profits. The process of building an AI model must start within the organization itself, at the top to be specific. Educate the organization and top management about AI and its potential.

This doesn't mean everyone has to be or become an expert. But introducing and effectively integrating AI may encourage certain changes in the organization and data management practices. So, in order to succeed with AI, knowledge and strategy are best distributed top to bottom to avoid misunderstandings and conflicting approaches to the technology.

2. Pick the right problems

What can AI do for you? Potential AI projects should be oriented around core business problems, opportunities or challenges. To create business solutions with AI, the problems being solved must be well-defined

but can be as complex and far-reaching as the data is. The problems your AI can solve may be in places your organization has never gone before but are right under your nose. List as many problems as you can and, consider the following questions to find a problem suitable for AI:

What are our most pressing problems right now?

Just like any other tool in business, AI should be viewed as a tool that can help make your organization more effective, profitable or streamlined.

What parts of our business generate revenue but currently have low profit margins?

These revenue streams could provide fertile ground for automation and acceleration via AI.

Where would we like to cut costs?

Review your costs and pinpoint the ones you'd like to reduce. AI can help you better understand what

generates costs and identify areas that could be optimized or changed to reduce them.

Where do we make a high percentage of errors in our work?

A well-trained AI model has the capacity to perform with far less margin of error than humans.

What work do our employees do that they don't particularly like?

If it's repetitive or annoying for a human to do, there might be a component of the task better done by AI.

3. Do a data inventory

Data is the fuel to any AI solution and can present itself in unexpected places. So the next step is to seek out possible sources of relevant data for each problem on your list.

You may not have enough of the proper data for all of the problems on your list. If that's the case, think

about how you can create, find or even buy that data. The mere act of looking for data in your organization can help spark helpful practices that yield exactly what you need to get an AI project off the ground.

4. Pick the right tools

The final step is choosing the right tools. AI tools used to be geared towards academic research and proof of concepts. But, now a new generation is emerging, allowing organizations to build reliable AI fast for a reasonable cost. Since software and hardware used for AI is going through rapid development, make sure the solutions you choose are scalable and future-proof – to avoid costly maintenance. Choose tools, depending on goals, budget and available in-house competencies, time to market and total cost of ownership.

Finally, since AI is bound to affect multiple aspects of your business, go for a tool that makes collaboration across the organization possible.

AI CHECKLIST

FOLLOW THESE STEPS to explore, devise and implement a successful AI strategy.

I.

ESTABLISH COMPANY-WIDE BASIC KNOWLEDGE OF AI AND ITS POTENTIAL TO EXCEL THE BUSINESS

- Ensure broad adoption of AI principles across all levels of an organization, from the mailroom to the boardroom.
- Do NOT disregard AI as a technical challenge and pawn it off to only one department.

II.

LIST PROBLEMS/OPPORTUNITIES FOR AI TO ADDRESS

- Ensure enough knowledge among key positions throughout the company to identify the right problems for AI to address.
- Gather top management/key stakeholders and list all your business's problems and opportunities.
- Prioritize that list in regard to estimated impact on the business.
- Monitor what's happening with AI in your industry/area.

III.

DATA INVENTORY

- What data associated with the problems listed do you have? If none or too little, why?
- How is the data structured and formatted? Make sure it is not scattered across your organization.
- Do the right people have access to your data?
- Is the data updated continuously?
- Can we buy data we need but can't generate ourselves?
- Who is responsible for our data?

IV.

REVIEW AI TOOLS AND PLATFORMS

- Ensure the tool/platform is future-proof to avoid costly maintenance.
- Align current and possible future in-house AI competencies with the tool/platform.
- Make sure the tool/platform can handle not only the data types that you have today, but also data types you may want to use in the future.
- Review the technical capabilities of the platform. Traditional Machine Learning can solve far fewer problems than Deep Learning.

- Review supplier data policies – are you comfortable with having your data and AI locked into a specific vendor?
- Look for end-to-end operational AI solutions where production deployment is tightly integrated with development. The more tools you use, the greater likelihood of one of them being the weak link or causing trouble.

V.

REVIEW AI COMPETENCE

- List existing and lacking AI competencies within your organization.
- Bring in external expertise as needed.

GETTING VALUE FROM AI

SINCE STARTING PELTARION in 2004, we have operationalized AI at a variety of organizations across different industries. In each of those projects we learned new facets of the technology but also identified recurring patterns. Keys to successfully operationalizing AI.

"I've failed over and over and over again in my life, and that is why I succeed."

We agree with Michael Jordan that we cannot succeed without failure. We also believe that if we can share the lessons of our failures with you, our mutual path to success will get faster and faster.

The most important place to start is from the insight that a successful AI model in a lab is nowhere near the same thing as an operational AI model deployed in the real-world.

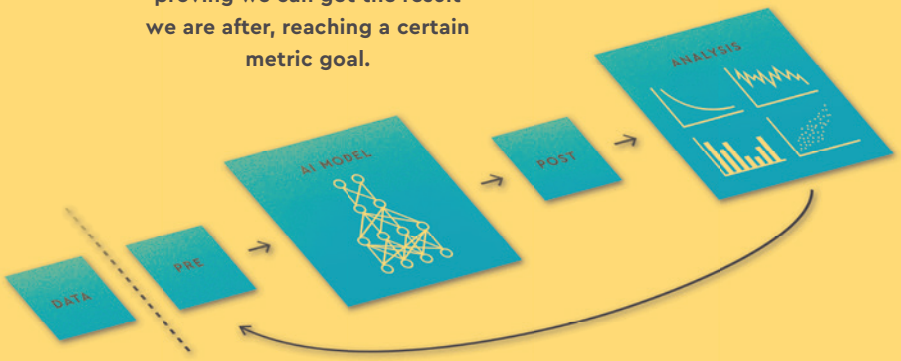
It is important to understand the differences between a proof of concept AI model – a published paper or initial research results – and an operationalized AI model functioning within products, applications or services.

Having a properly trained model in and of itself does not create any value for your organization; the model must be operational. And that comes with a variety of requirements, dependencies and considerations beyond those inherent to the model.

To better understand the difference between theory and function, the next two pages will outline a basic comparison between a proof of concept (POC) and an operational AI model.

AI WORKFLOW

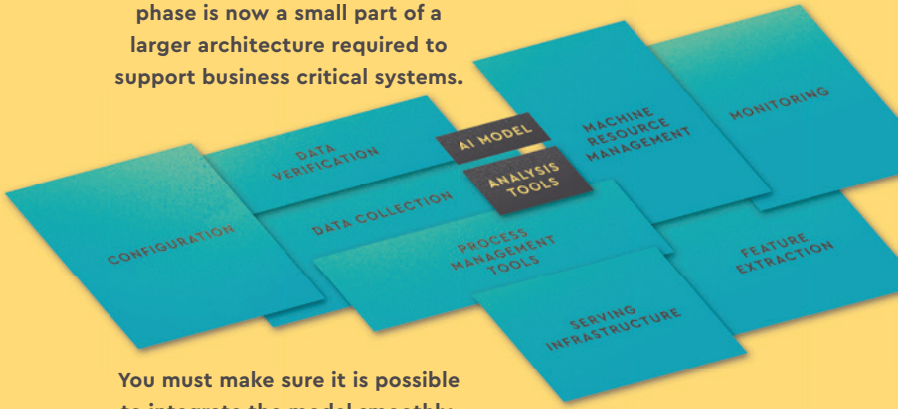
This first figure offers a simplified view of a proof of concept AI workflow. The model is all about proving we can get the result we are after, reaching a certain metric goal.



The workflow includes preparation of data, iterations of building and training AI models, and analyzing the results until you achieve acceptable levels of accuracy. When that happens, it's exciting to see what an AI model can do. It's a crucial step, but it's only the first. Knowledge has been generated, yes, but no actual value has been created yet.

OPERATIONAL AI SYSTEM

As you can see in this figure of an operational AI system though, things get exponentially more complicated. The AI model that performed so well in the POC phase is now a small part of a larger architecture required to support business critical systems.



You must make sure it is possible to integrate the model smoothly, maintain it easily, and document everything along the way. In short, you don't want this built on spaghetti code that is impossible to untangle when you need to change something. We've done it countless times. It takes forever. You need a structured architecture you can rely on.

Source: Hidden Technical Debt in Machine Learning Systems (Sculley et al, 2015)

Summary of 15 years of learnings

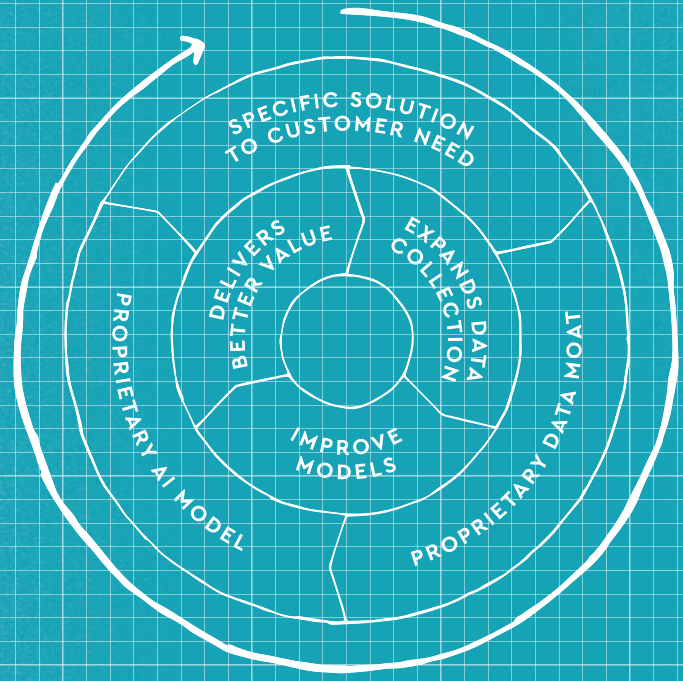
With the goal of operationalizing AI always in mind, we have used our failures to shape the very foundation of our product. We wanted to make working with AI faster. Easier to maintain. More collaborative. And in the end, we wanted to be sure our progress would bring the full power of AI into the products and services that stood to benefit from it.

Among all the lessons we learned about working with AI over the last 15 years, these are the key takeaways that kept coming back.

- We wanted to be able to collaborate as a team around our AI projects, both in modeling and training, as well as invite extended team members to evaluate results and engage with the project's data requirements.
- We didn't want to find ourselves in the weeds if someone left a given project, so the work needs to be structured and documented with full traceability and reproducibility, preferably automatically.
- It was and remains essential that our AI models can integrate easily with a variety of other systems in an organization.
- Managing your own hardware can be expensive and time consuming. The field moves very fast and new products arrive in rapid succession. Let the cloud providers handle this heavy lifting for you.
- Make sure you can keep your old projects running. Models often need to be retrained or updated. This can be challenging. An AI project typically has a lot of dependencies on third party libraries, hardware, drivers and so forth, and all of these are constantly updating and evolving.
- We want the ability to both build models and run experiments in parallel and see which ones perform best. One at a time simply takes too long.

- Stay aware of costs. It can take just a few keystrokes to fire up a whole array of machines to work on your problem. But there is a cost to it. And without careful monitoring and tools to see how well the potential solutions perform it is easy to just forget about those costs. Until the bill lands.

All these insights now make up the foundation of a workflow for real-world AI projects. Over the following pages we'll share early sketches of how we built that workflow. We hope it adds value and inspiration to how you shape the process for your own AI projects.



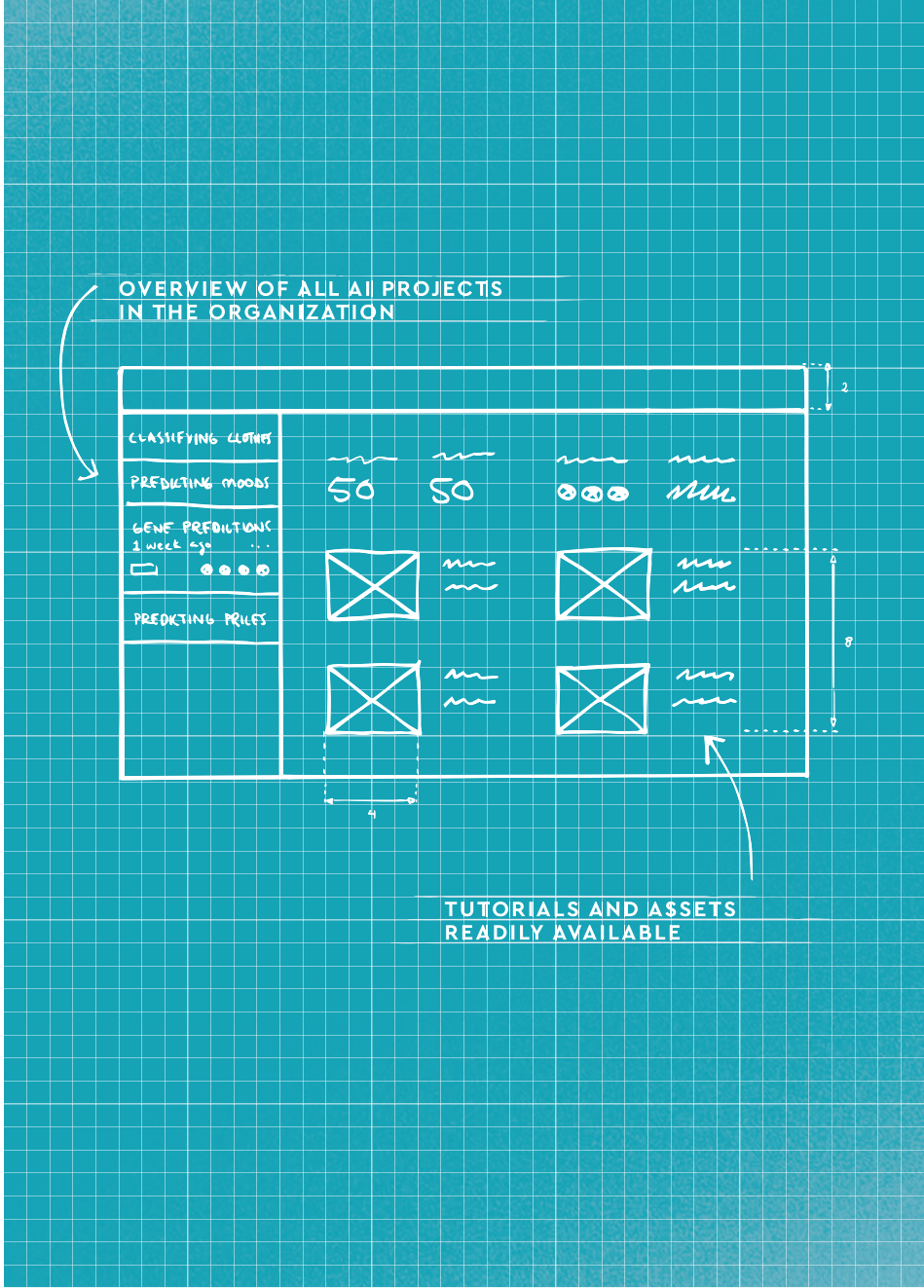
TO TRULY BECOME AI FIRST, WE NEED A WORK-FLOW THAT ALLOWS FOR CONSTANT EVOLUTION OF DATA, MODELS AND SERVICES

1. Team focused, a clear overview and ease of access

Often all the knowledge surrounding a project ends up sitting with one single expert individual which can make it next to impossible for anyone else to contribute to the same project.

As AI increasingly is integrated in business-critical parts of organizations, it becomes more and more necessary to treat it as an integral part of the organization, a cross-functional asset that everyone understands and works with.

When you develop and operate an AI project for an organization, it is essential to have a clear overview of the larger context. There will be projects that individuals work on, as well as collaborative efforts executed by larger groups. But either way, without a shared sense of the reach and depth of the project, the arrangement can quickly become a major administrative headache.

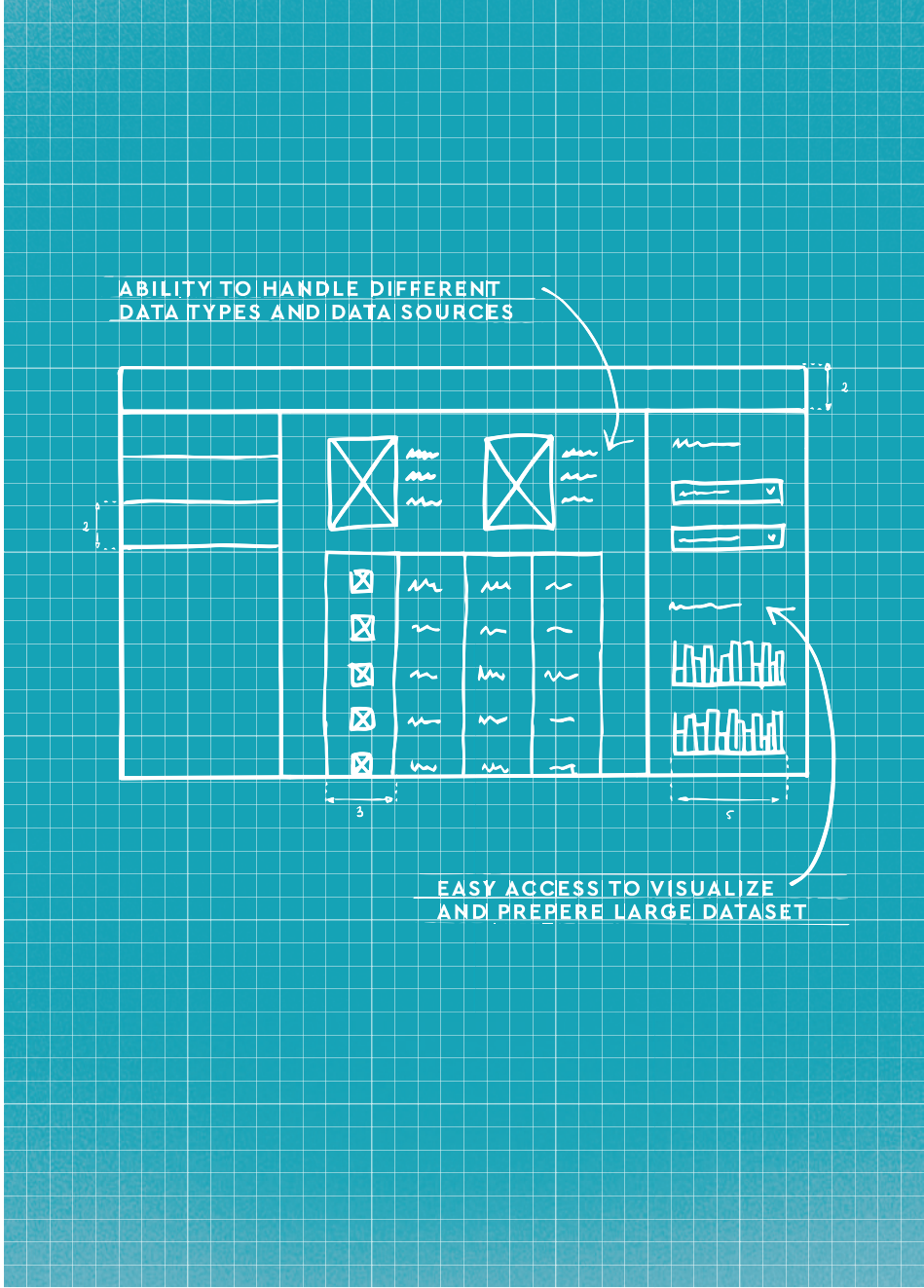


2. Making data "less data"

At the start of all AI projects, you decide on which data will be used to train the AI model. This process typically includes sampling different combinations of datasets, sources of data, and a variety of data types; numeric, text and images. The sources will vary depending on what data is readily available inhouse, what can be bought, and whether there are any publicly available datasets that could be relevant.

Working with large, dispersed datasets can quickly become messy. And it becomes even more complicated when you have to realign different versions of a given dataset to match each AI project, which is often the case.

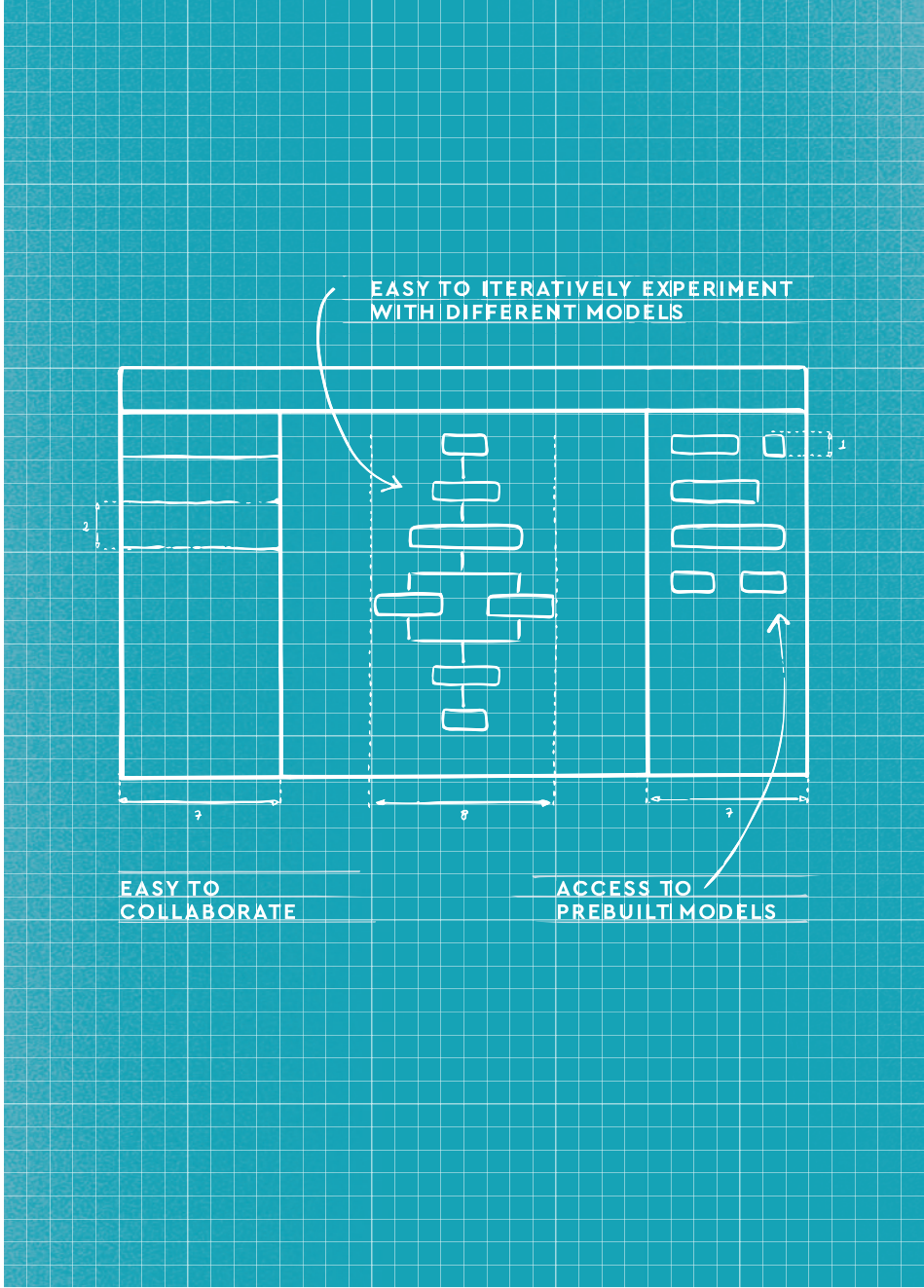
Making visualizations of the data, making it easy to commit changes, and versioning the work are all important features of properly prepared project data. As is the ability to connect and work with different data sources, easily and securely.



3. Modeling and iterating together

Modeling is the process of building the architecture of your AI model. The neural network consists of an input layer, hidden layers, and an output layer. Modeling is all about how you structure these layers to get the results you're aiming for.

It's ideal to run multiple experiments and see which model performs best, and even better if they're able to run quickly. Building AI models is an iterative process. So it's key to learn from and share with your peers along the way, to build on the work of others and test large pre-built neural network structures. The iteration and collaboration process, in a well structured workflow, becomes exponentially easier and faster with a graphical user interface (GUI).

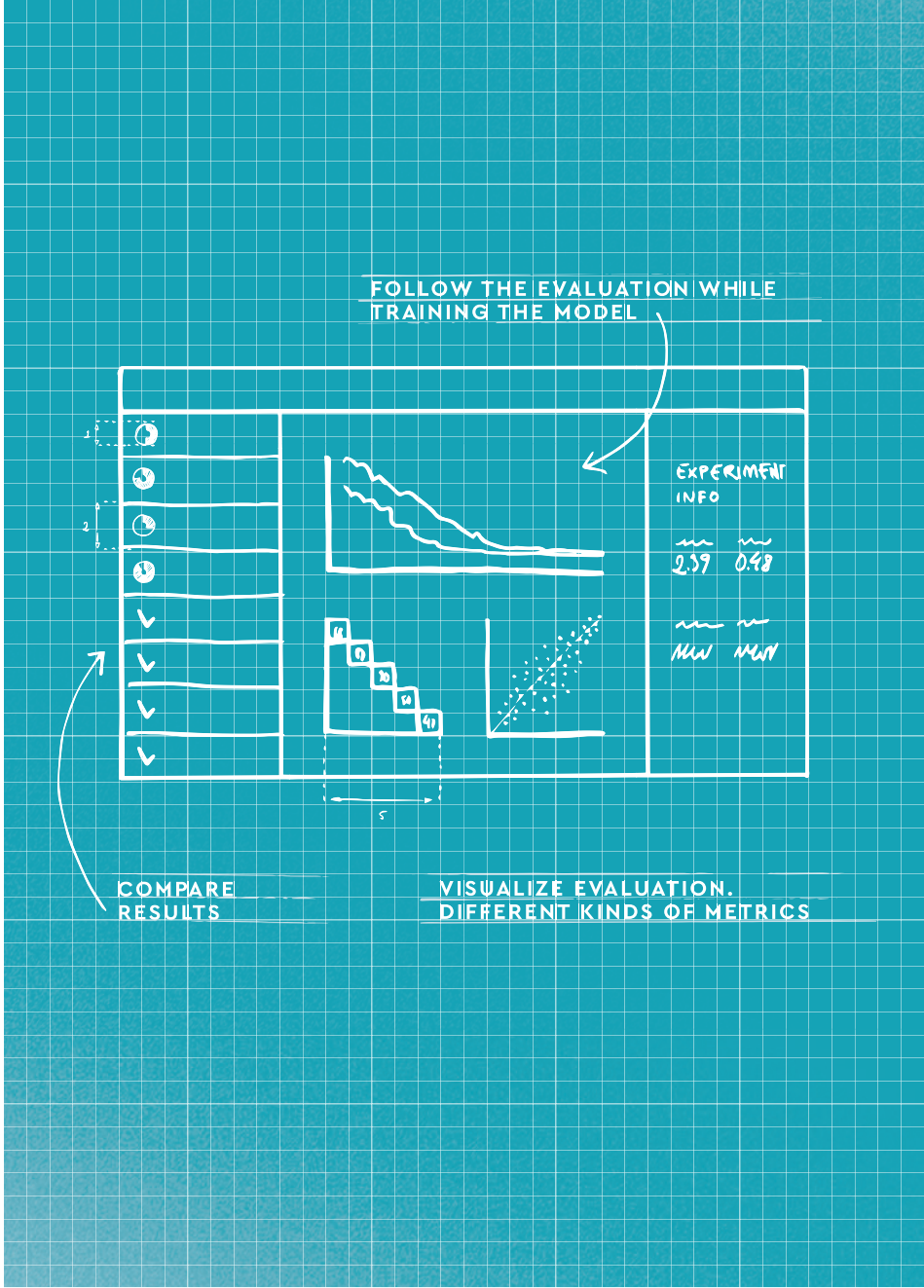


4. Does the AI bring any value?

The fourth step is to understand how your models perform with the data they've been trained on. The performance of your model uses metrics like, most commonly, accuracy, which is the percentage of correct predictions out of total predictions.

In order to truly evaluate an AI project, we want to be able to compare the results of different models and use a variety of metrics to see how those models are satisfying the project's goals. In this step, we'll often invite other members of the organization to discuss and analyze the results using visualizations of the model outputs as a basis for discussion.

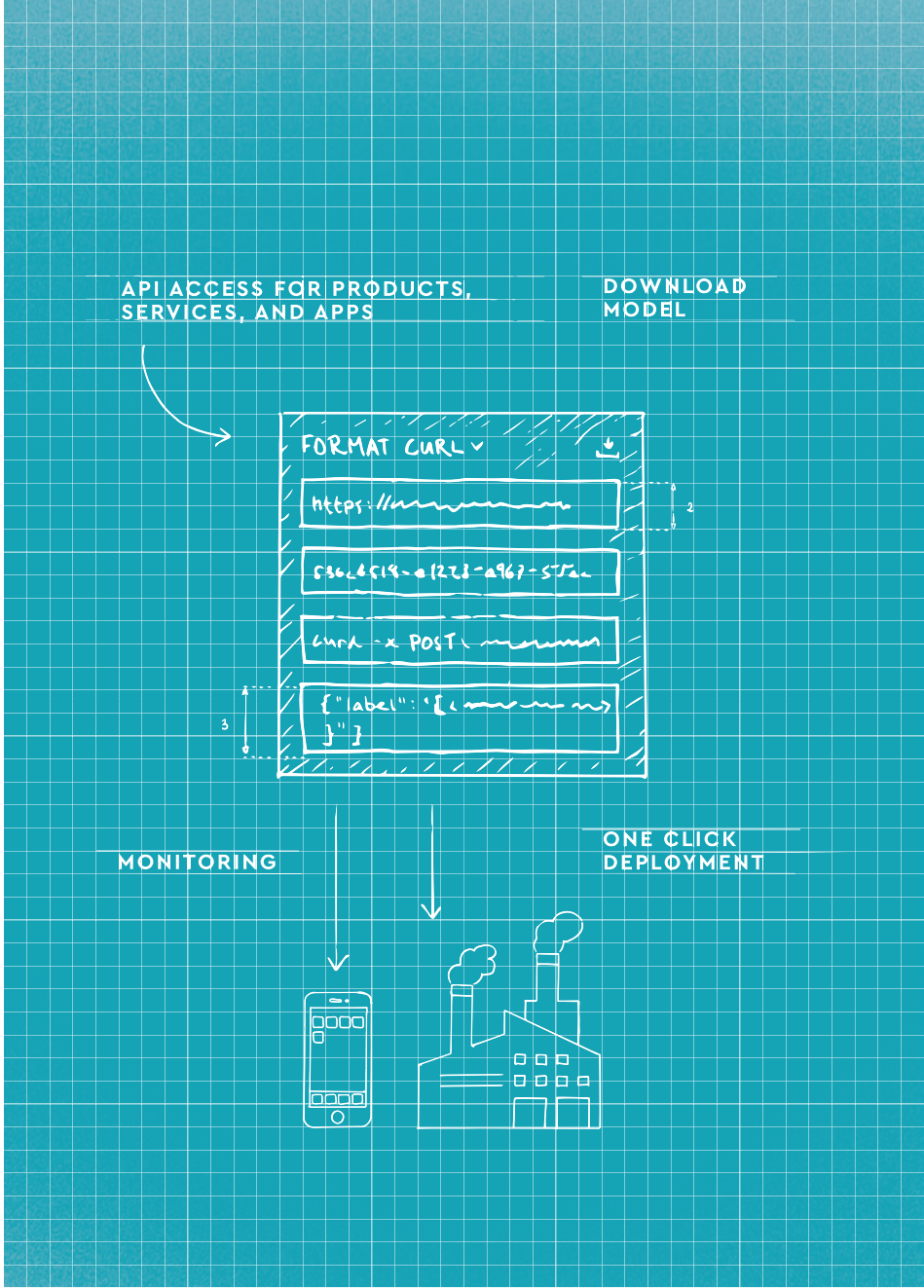
A graphical user interface (GUI) helps us evaluate the results in a structured manner. The GUI makes the AI model less of a black box and helps more people in the organization understand how we reached our goal so that we can make well-founded decisions together.



5. Deploy the AI into real-world use

After you've built, trained, and evaluated your AI model, and are satisfied with its results, you're now eager to put your model to use, so it can start bringing new value to your organization's products or services.

Often this is the step that becomes a stumbling block due to its complexity when all you'd like at this point is to put the model to work. An API allowing your AI model to talk to your organization's products, services, and other applications, is a structured, fast and well-tested solution. The model also needs to be continuously served and updated. You'll also want to monitor performance, and retrain it at regular intervals to reflect changes in the problem domain (market changes, data structure shifts, etc). Ideally, such updates should be automated. API:s and other flexible ways of connecting to a structured, team-focused environment is ultimately what enables that kind of adaptive model.



From handcraft to tooling, it's nothing new

To understand the power of tools in information technology, look no further than the arrival of the internet. In 1992, only 10 websites existed on the world wide web. The pages took months to build, and only small sects of academia were actually utilizing them. The websites in this early-'90s era were for official organizations like the National Center for Supercomputing Applications and the French National Institute for Nuclear and Particle Physics.

Fast forward 20 years, the number of websites on the internet has grown to more than one billion. The Internet's influence on the average citizen's daily life in 1992 was negligible, but today it gives us unimaginable access to information, a new digital economy and has fundamentally changed our way of living.

The accelerating entrance of the Internet into our lives was partly thanks to the constant improvement of technological tools, making it easier to build

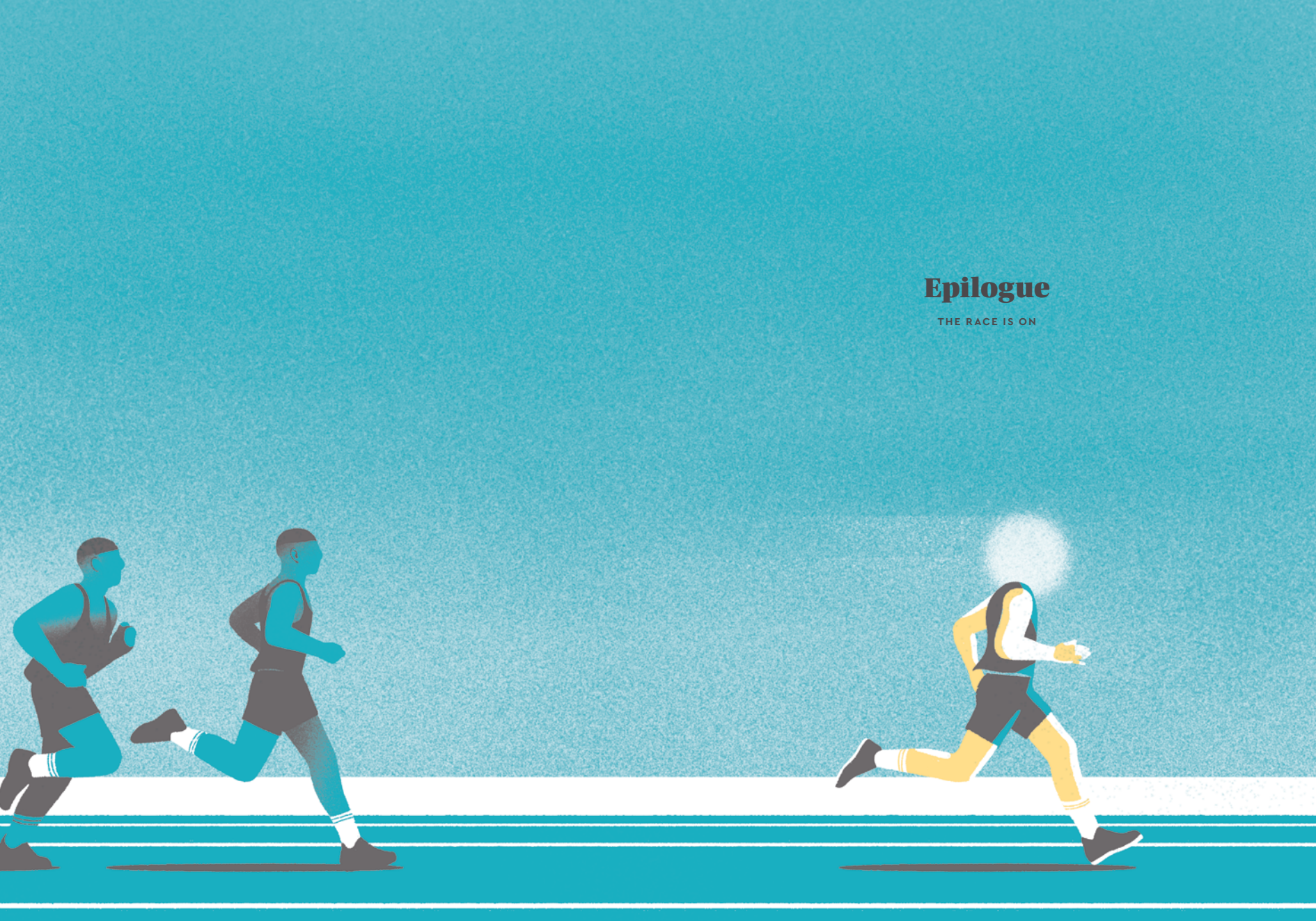
websites. With the tools we have today, children can make their own webpage in under an hour, a process that 20 years ago took high-level computer scientists months to achieve.

The same learning curve will be experienced in AI in the 21st century. And the curve will truly ramp into the stratosphere when we have better tools for working with the technology, from having a comprehensive overview of all the AI projects within an organization to enjoying one-click deployment of self-optimizing models.

Working with AI today has similarities to working with the internet in 1992. Today you must learn a vast number of new programming languages, and possess a collegiate-level mastery of mathematics and statistics to keep up. As such, there are only a handful of large corporations that actually employ AI in real-world usage today. And until proper tooling is in place, the benefits of Artificial intelligence will not be available to everyone. It's time for AI platforms.

Epilogue

THE RACE IS ON



EPILOGUE

WHEN PELTARION CO-FOUNDER Måns Erlandson and myself started working together in AI in the late 90's, we were convinced that AI in the form of neural networks was the right thing to work on. There had to be a better way to solve complex problems without resorting to guessing a set of rules and hard coding them in software - as is done with traditional programming. We were convinced that AI was that way.

Yet we had not anticipated the speed of the breakthroughs leading up to this point – where AI is finally able to change the world. But here we are, and there's no stopping. AI is on everyone's agenda. Organizations are realizing that by becoming AI-first, they can transform and improve their business to a whole new level. It's important to recognize that becoming AI-first is not primarily a technical challenge. Nor should it be an add-on to your conventional way of doing business.

After reading this book, I hope you agree that AI is setting a new standard for solving problems and opens unique competitive advantages.

I believe that welcoming AI into your boardroom and management meetings is the first step towards benefiting from it. Get to know it. Talk about it. Learn the fundamentals and what AI can do for your organization. It's all about ensuring access to knowledge, data and tools.

One way to go about it is to hire consultants to do it for you. Another approach is to build an R&D department and assign its staff to help you reap the benefits of AI. However, like every other important aspect of improving your business – like sustainability or digitalization – there has to be understanding at the very core of your organization. After all, you wouldn't outsource the use of electricity to external consultants or limit it to one specific department.

To become AI operational, you'll need to be able to experiment and deploy AI models fast and

analyze or review them in relation to their effect on your primary business and decision-making. You'll need technology where you can be in control of your data and collaborate on challenges and business problems. This technology has to stay maintainable and reliable over time to survive rapidly evolving hardware and software capabilities.

It's no secret that global tech companies are investing a lot in their own AI capabilities. But not every company or organization can start an R&D department staffed with AI experts. Nor may they have the money to call consultants every time AI expertise is required.

I believe that business and society will benefit most if AI technology is made useable and affordable for all – not only the big and powerful. We are now at a point in time where this is becoming possible, marking the dawn of AI for everyone. This is a good thing. As AI is a major paradigm shift that will affect everyone and as we want it to advance

human-kind, the control of, discussion about, and the understanding of it cannot be limited to a few global tech companies.

I hope you have enjoyed reading this book and that it will give you the essential pointers of how to start your journey to operationalize AI in your business.

LUKA CRNKOVIC-FRIIS

FOUNDER & CEO OF PELTARION

GLOSSARY OF ARTIFICIAL INTELLIGENCE

ALGORITHM

A set of specific, programmed instructions used to solve a problem or accomplish a task.

ARTIFICIAL GENERAL INTELLIGENCE (AGI)

A theoretical AI benchmark for intelligence comparable to the human mind in all areas, also referred to as 'strong AI'.

ARTIFICIAL INTELLIGENCE

Technology allowing computers to solve tasks requiring cognitive intelligence.

ARTIFICIAL NARROW INTELLIGENCE (ANI)

AI systems capable only of solving specific tasks (i.e. all AI to date), also referred to as 'weak AI'.

ARTIFICIAL NEURAL NETWORK

A computer system inspired by the structure of the biological brain. The basis of the current AI boom.

DATA MINING

The process by which patterns are discovered and extracted from large sets of data.

DEEP LEARNING

A preeminent subfield of machine learning that uses multiple processing layers (see: artificial neural network) to solve problems.

GRAPHICS PROCESSING UNIT (GPU)

Hardware that excels at parallel computing, making it ideal for processing AI models.

LAYER

Deep neural networks consist of layers. Every layer of processors handles a specific task and the output of one layer becomes the input to the next layer in the network.

MACHINE LEARNING (ML)

The umbrella term for an AI genre in which computers incrementally improve their ability to solve problems as they receive more data.

NATURAL LANGUAGE PROCESSING (NLP)

A branch of AI technology that lets computers understand and respond to spoken human languages.

REINFORCEMENT LEARNING

A strategy for machine learning in which computers improve their problem solving by trial and error, rewarding successes and punishing errors after long sequences of actions.

SUPERVISED LEARNING

A strategy for machine learning in which the model is trained by data pre-labeled with specific values and potential outcomes.

TRAIN A MODEL

The process of teaching an AI system using data while continuously monitoring its performance.

TURING TEST

A test developed by mathematician Alan Turing in 1950 as a standard to identify when a machine has achieved artificial intelligence.

UNSUPERVISED LEARNING

A strategy for machine learning in which the model is trained by unlabeled data that the model itself categorizes, groups and clusters into patterns.

Colophon

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